15-31 MAY 1970 First and Third Friday Volume 136 Number 3393 3/-
(USA & Canada—70 Cents)

Model Engineer

MAP HOBBY MAGAZINE

Model Engineer

MAP

Founded 1898

Incorporating Mechanics and English Mechanics and Ships and Ship Models

Volume 136 **Number 3393**

May 15 1970

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Second-class postage rates paid at New York, U.S.A. Registered at the G.P.O. for transmission by Canadian Post. American enquiries regarding news stand sales and advertising should be sent to: MODEL ENGINEER, Eastern News Distributors Inc.,155 West 15th Street, New York, N.Y. 10011.

MODEL & ALLIED PUBLICATIONS LTD

COVER PICTURE

A sight only seen at Rallies nowadays—threshing by steam. Colour photograph by A. C. Muttitt of Bungay, Suffolk.

NEXT ISSUE

The internal resistance of the steam locomotive : Building $7\frac{1}{4}$ in. gauge rolling stock : Completion of the County Carlow *series.*

Subscription 82s. (U.S.A. and Canada $10) post free, index included.

Editorial and Advertisement Offices:

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Hemel Hempstead, Herts.
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SMOKE RINGS

A Commentary by the Editor

Power-boat regattas

According to a report in the Belmont Advertiser, a request by a model power-boat club for permission to hold regattas on Burgh Heath Pond has been refused by Banstead (Surrey) Council. At a meeting of the Council's Committee, Councillor Gerald Knight said that if they acceded to the request—made by Hounslow & District Model Power-boat Club—" it would create a dangerous precedent." The Council would be unable to refuse similar requests by other organisations, he said. " In the end, you will have regattas every Sunday and people milling around in large numbers," said Coun. Knight.

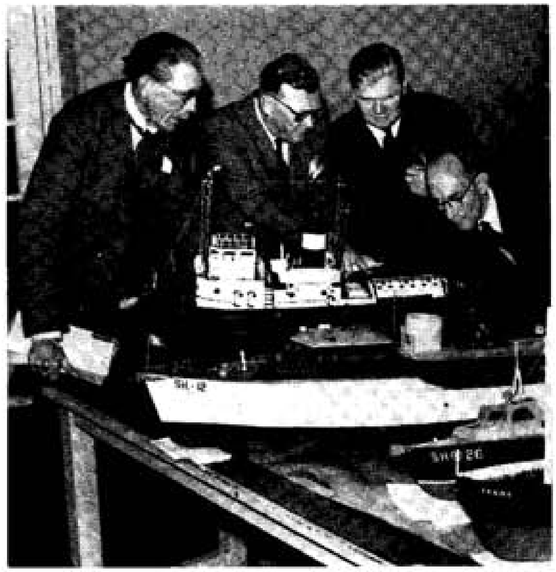
What an astonishing attitude ! No doubt Coun. Knight would prefer to see the younger people of the Banstead district breaking carriage windows, smashing telephone boxes or beating up old ladies, rather than watching or indulging in the " dangerous " pastime of operating model power-boats !

Great Western tenders

Our contributor Don Young refers to the number of spokes in the tender wheels of Great Western Railway locomotives. I think it quite possible that one or two of the standard tenders did have 10 spoke wheels, but the great majority undoubtedly had wheels with 12 spokes, and the official drawings show 12. While it is true that the tender of the *Great Bear* had wheels with 10 spokes, it must be borne in mind that this tender was a " one-off " job with bogies, and the wheels were much smaller than those fitted to the standard six-wheel tenders, in fact they were probably locomotive bogie wheels.

Metric system

I am surprised at the lengths some of the advocates of the Metric system will go, to put their views over. For instance, it has been reported in " The Engineer " and also in the Journal of the Junior Institution of Engineers that one of the advantages of going Metric—to a well-known manufacturer of ball bearings—is that it will be possible to reduce the number of types of ball races produced from 280 Imperial sizes to only 30 Metric sizes. What absolute nonsense ! It would be a poor firm of ball bearing manufacturers which could only offer their customers 30 different sizes ! It would be interesting to know which company this report refers to.



20 years ago at an exhibition of models of the Vickers-Armstrongs M.E.S.: the late J. N. Maskelyne, Messrs. G. H. Thomas, Edgar T. Westbury and A. W. Martin.

The late Lawrence Bateman

Duncan Heriot, of Toronto, Canada, writes—" The career of one of Canada's most prolific and able model engineers has come to an end with the death, at the age of 62, of Lawrence G. Bateman of Toronto.

Continued on page 483.

The first steam trials of Ann and Gordon Hatherill's narrow-gauge locomotive: Gordon at the regulator.

MODEL MARINE PROPELLERS

Practical Aspects of Design and Construction

Part II

EDGAR T. WESTBURY

Continued from page 447

IT HAS OFTEN been suggested that propellers of constant pitch could be produced by the methods normally applied to screwcutting or thread milling. As shown in Fig. 6, the basic shape of a propeller may be represented as a slice cut from a multi-start thread, with a number of "starts" corresponding to the required number of blades. In this diagram, the thread is only cut to part depth; to complete the shaping of the blades, it would need to be cut much deeper, and to a thread form corresponding to the edge contour of the blades. While this method of making propellers is practicable, it is tedious and very wasteful of metal; so far as I know, it is not employed in normal practice, though it might be worth consideration for patternmaking in wood or other solid material, using high-speed routers on a spiral milling machine (or equivalent appliance). I recently saw an excellent example of deep helical-milling, which was performed on a simple lathe with improvised lead screw drive, with the aid of home-made cutters, comparable with the methods used for turning so called "Jacobean" chair and table legs.

One of the greatest obstacles to acquiring a practical understanding of propeller design is the lack of really accurate and concise terminology. In common with many other branches of engineering, the terms employed in specifications are haphazard, vague and even ambiguous. I have tried to clear things up by simplifying the terms used and eliminating possible causes of misunderstanding. Where the terms used in standard text books and other technical literature are clear and definite I have used them, but in other cases I have had no scruples in modifying them or inventing terms of my own.

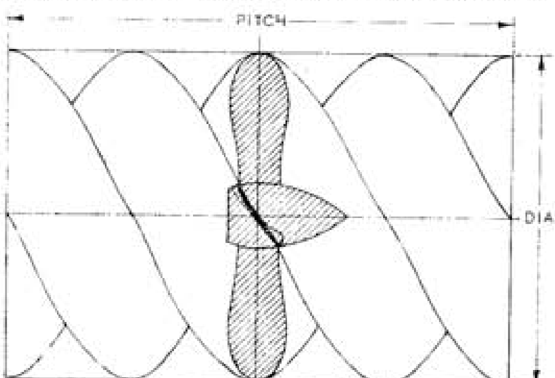


FIG. 6.
FOUR-BLADED PROPELLER COMPARED WITH FOUR-START THREAD

Screw propeller theory

It is perhaps rather unfortunate that the word "screw" is almost universally employed to describe axial-thrust propellers, because it often gives a fallacious impression of their true action. The idea that propeller action is much the same as that of a bolt running through a solid nut, or a wood screw penetrating timber, is often perpetuated, even in technical literature. To quote Sothern's *Verbal Notes and Sketches*, "The water in which the propeller is immersed . . . represents the nut, so that when the bolt or propeller shaft is revolved

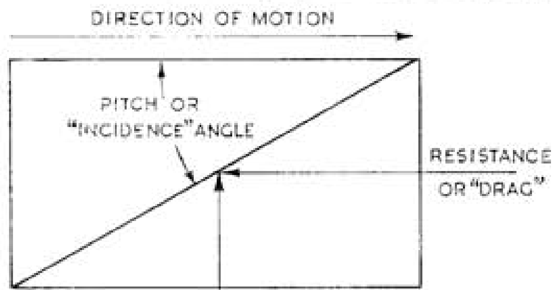


FIG. 7.
FORCES ACTING ON MOVING INCLINED PLANE

the screw or propeller advances in the nut which is represented by the water in which the propeller works. As, however, the water constitutes a yielding nut and gives way a certain amount to the blades, the actual advance of the propeller and ship is less than one pitch of the screw for one complete revolution of the shaft; this difference of advance is known as the slip."

Several other text books give their own versions of propeller theory but I have never considered them adequate; it is difficult to envisage a nut which is constantly stripping and renewing its thread as this idea seems to suggest. Hobbs did not attempt to explain basic propeller theory, but made some vague references to "rotational momentum" and the "vortex theory" without discussing what these terms mean.

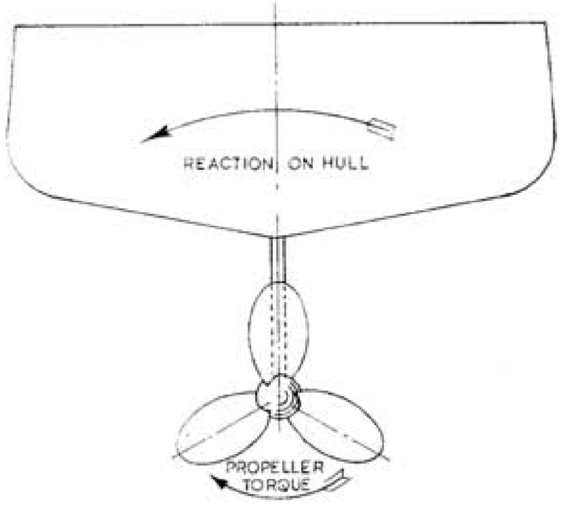


FIG. 8. EFFECT OF TORQUE REACTION

The only theory which *completely* covers the action of the marine propeller is that in which the individual blades are regarded as rotating inclined planes or hydrofoils having characteristics of lift and drag, similar (but not identical) to those of propellers working in air. The major difference between air and water propellers is that due to the density and viscosity of the media in which they work. But analogies, useful as they are, have their limitations, and must be treated with caution. The important thing is to know how far they apply, and at what point to discard them.

It has been noted by a number of readers that, in my articles on various subjects, I make only very sparing use of mathematics, formulae or intricate calculations; this policy has often been criticised in the past. I freely admit that I am not an expert manipulator of figures, and that this may be a handicap in certain circumstances. But in order to employ usefully any method of calculation, or even the omniscient modern computer, the facts which form the basis of the problem must be absolutely correct. In other words, it is necessary to ask the right questions to get the right answers; and therein lies the difficulty of applying an exact science to inexact problems, when one does not often know what the questions are !

At the other extreme, there are those who, like the (proverbial) precocious schoolboy, object to "all this ruddy theory," believing it to be rigidly connected to abstract calculation, and only too often at variance with actual practice. But no engineer can afford to ignore theory which, after all, is simply human intelligence or reasoning power applied to deduction and inference in the pursuit of truth. To attain real progress theory and practice must work hand in hand; if they *appear* to disagree, one or the other (possibly both) must be wrong! A great deal of time and effort is wasted in all branches of engineering in chasing fallacious theories, or in repeating past errors in practical design or working principles.

Torque reaction (TR)

There is much confusion of thought about the nature of this, and its effect on both propeller efficiency and the behaviour of boats. In any rotating object which works against load, torque is necessarily exerted, and by the physical rule that "action and reaction are equal and opposite," it follows that a force in the opposite direction to the rotation of a propeller is applied to the structure of the power source, and through it, to the boat hull. In other words, the torque load exerted by the propeller against water resistance produces a reaction tending to overturn the boat in the other direction. This effect is inevitable and inescapable in all single-screw propelled boats, but it can be cancelled out by using two (or other even number of) propellers of exactly the same size and pitch, running at the same speed in opposite directions of rotation.

In full-size ships, twin or quadruple screws are often used to improve navigation and steering control; sometimes a third screw acts as an "odd man out," but even so, torque reaction is greatly reduced, compared with that of a single screw. The amount of torque produced by the application of a specified amount of actual horse-power will depend mainly on the size of the propeller in relation to r.p.m. Thus, large, slow running propellers will produce greater torque reaction than small ones running at high speed, *in relation to power input*;

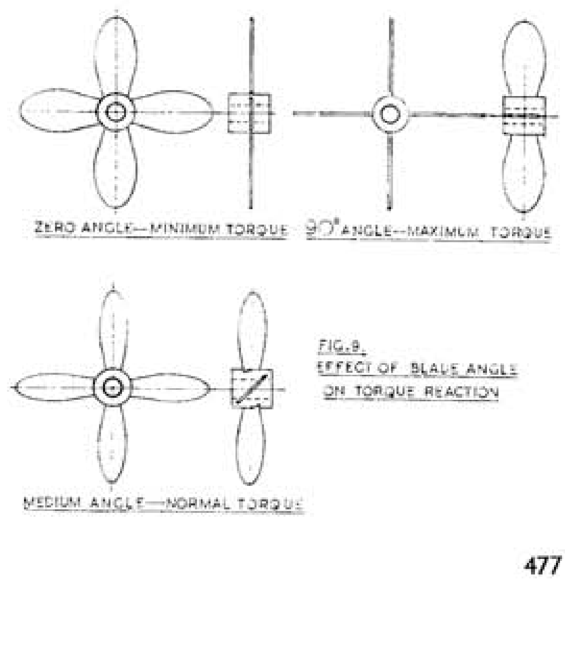


FIG. 9. EFFECT OF BLADE ANGLE ON TORQUE REACTION

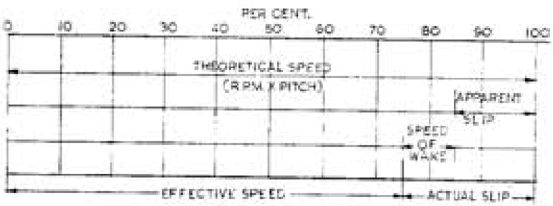


FIG. 10 DIAGRAM ILLUSTRATING PROPELLER SLIP

and in either case, the effect on steering or equilibrium of the hull design is in the same direction.

Propeller design will affect torque reaction in relation to power and speed; a badly designed or incorrectly pitched propeller will cause unnecessary reaction. To illustrate this, consider a propeller with flat blades, set at zero pitch. This will have the minimum resistance to rotation, depending on the thickness or streamlining of the blades, but it will not produce any propulsive effect. Now set the blades at right angles (i.e. 90 deg. pitch angle); it will then have maximum resistance to rotation, producing heavy torque reaction, but still no propulsive effect. Somewhere between these two positions, a pitch angle can be found, which will give a relatively small rotational resistance or "drag," combined with the maximum propulsive effect, or "lift"—to borrow aerofoil terms. The effect of torque reaction on the steering of the hull can to some extent be corrected by rudder setting, but only if the speed is constant; and listing to either port or starboard which it produces will make the hull more vulnerable to either wind or water currents.

Slip

This is the difference between the theoretical speed of the vessel as calculated from the pitch and r.p.m. of the propeller, and the speed actually attained when running in or on water. It involves two factors: the "apparent" slip, which is the loss caused by the failure of the propeller to act as a "solid" screw, and the speed of the water which is projected backwards against the forward motion of the hull. The diagram, Fig. 9, is adapted from *Marine Engineering Knowledge*; it will be seen that with Macgibbon's apparent slip at 15 per cent, and wake speed at a further 10 per cent, the actual slip is 25 per cent. For a theoretical speed of 10 m.p.h., therefore, the actual speed of the vessel would be $7\frac{1}{2}$ m.p.h. For a proper assessment of slip, it would be necessary to make careful tests of a prototype model, with instruments to measure essential speed factors; this is normally done in full-size practice, but calls for facilities not usually available to amateur model builders. It is described here, however, to give a clear idea of what slip really means, not to state or suggest a definite figure for any particular power installation.

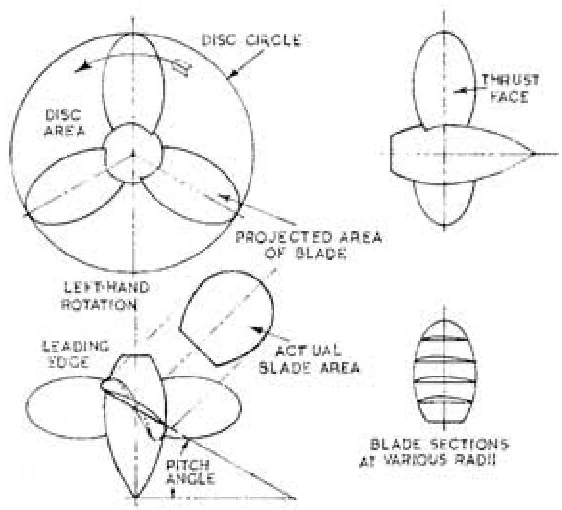


FIG. 11 FEATURES OF PROPELLER DESIGN

Cavitation (CV)

This is a much discussed but little understood phenomenon, which has a very detrimental effect on the performance of propellers. In Sothern's book already quoted, it was stated that it means "the failure of the water supply or 'feed' to the propeller, due generally to excessive blade velocity; in other words, the blade speed exceeds the rate of water flow to the blades, therefore, . . . cavities form at the forward side of the blades." It is, therefore, most serious in high speed propellers, and accounts for the reluctance of marine engineers to run them faster than necessary; but when high speed engines, including turbines, were introduced, a great deal of experimental work had to be carried out in order to enable propellers to be run efficiently at high speeds. The research work of Sir C. A. Parsons, before the end of the 19th century (as recorded in my book on Turbines), is particularly notable in this respect.

The effect of cavitation in all cases is to cause a serious loss of propeller efficiency, but in full-size craft it can also result in erosion of propeller blades. With deeply immersed propellers, the high degree of vacuum produced results in "low temperature boiling" with the formation of vapour bubbles which locally bombard the propeller blades, and produce much the same destructive effect as a continuous sand blast. In models, the propeller is immersed only a few inches, at most, and high vacuum cannot be produced; instead, air is drawn into the propeller stream. This may have much the same effect on propeller efficiency as true cavitation, but it is *not* the same thing. It can be prevented to some extent by provision in the design of the hull, or by fitting "anti-cavitation" plates over the propeller, but it will not remove the predisposing conditions which encourage cavitation.

COUNTY CARLOW

Part XXIV

A 3½ in. gauge G.W.R. 4-4-0 locomotive described by Don Young

Continued from page 431

CONTINUING with the tender beams for *County Carlow*, drill the beam angle No. 30, tap the frames and erect both beams and frames. Check for flatness and squareness, then drill through and tap the front beam securing angles, 5 BA. The frame stretchers can be castings, or bent up from 1 in. × ⅛ in. steel flat. Fit them in place, making sure that the top edge is not proud of the top of the frames. At this point the 4 in. lengths of ½ in. brass angle, shown over the middle axle, can be riveted on. This gives additional support to the tank soleplate.

Axleboxes are as *Ivy Hall's*, with the fancy cover cast on. Clean up the sides of the cast stick with a file, then clamp in the machine vice, on the vertical-slide. Mill the back of the boxes to give an overall thickness of about 23/32 in. Turn the boxes over, so that this machined face is on the bottom vice jaw. Mill both side faces to ¾ in. overall width, keeping the cast-on cover central, or it will look odd. Next, mill out the slots, on each face, to 3/32 in. depth. Finally, reduce the back flange to 11/16 in. width, a tight fit in the frames. Cut the stick into individual boxes and either mill or face them to length. Mark off the journal centres as accurately as possible and drill these ¼ in. dia. to ⅜ in. point depth. An oil hole, say No. 55, is required, as shown, to complete each box.

Horns will probably be available, cast in a stick. These can be gripped in the machine vice for milling the two faces to fit frames and box; although I would file these square: it is much quicker. Saw into individual horns and drill the rivet holes No. 41. Fit a box in one of the horn slots and clamp a pair of horns to same. Spot through the horns, drill the frames, countersinking them on the inside, then rivet in place. Ease the axlebox, if it is at all tight, radiusing the flanges at the same time. It remains to ease the back flange, which was tight in the frames, when the box must slide freely.

Hornstays come next; start by milling or filing the slots, to fit snugly around the frame projections. Drill No. 41 holes in the middle of these slots; then saw off to length, finishing the ends square. Spot through the stays on to the frames, drill these No. 41 and secure with 7 BA bolts.

On to the wheels, which are perfectly straightforward; no crank pins or quartering to worry about! Axles can be machined easiest as follows. Chuck a 5 3/16 in. length of ⅜ in. dia. steel bar in the three-jaw with the end just protruding. Face across then centre No. 3 to a bare 3/16 in. countersink diameter. Grip the axle by its other end and bring the tailstock centre into use. Turn down the end ½ in. to about 0.005 in. less than ¼ in. dia., then reduce the next ½ in. to a press fit in the wheel. Turn the axle round and repeat the procedure for the other journal and wheel seat. Even with a badly worn chuck the wheels will run almost perfectly true. Any error won't notice, and it does not matter one iota if the middle portion of the axle is slightly out.

Chuck a 1 in. length of ½ in. dia. brass bar. Face, centre and drill right through to 11/32 in. dia. Use this collar to either press, or drive, the wheels on to their axles. Now try wheeling the tender. If there is any tightness, remove the offending axle and reduce the journal diameter by an extra few thou.

To conclude the proceedings, let us tackle the springing. Working leaf springs are not really suitable on this tender, because the top leaf would have to include an eye at each end. There is no disgrace in fitting cast ones; the coil springs will work better anyhow.

No doubt our suppliers will have some beautiful castings available by now, which will require very little machining. Clean up the spring buckle sides, grip in the machine vice, on the vertical-slide. It is almost a permanent attachment just lately. Mill across the bottom of the buckle, centre, drill 3/16 in. dia. to within 1/16 in. of the top of the buckle and "D" bit. Tidy up the two eyes, mark off and drill through No. 41. The spring plungers can be machined from ½ in. dia. stainless or brass bar.

Face, centre, drill $\frac{3}{16}$ in. dia. to $\frac{1}{2}$ in. depth and "D-bit" but to $\frac{5}{16}$ in. depth. Turn down for $\frac{3}{16}$ in. length to $\frac{5}{16}$ in. dia., a sliding fit in the buckle, before parting off to 21/32 in. overall. 22 s.w.g. compression springs should just about be right. Start with them approximately 1 in. long. The spring links are a nice saw and file job, from steel flat. Make one and use as a drill jig and filing template for the rest. The spring hangers can either be cut from $\frac{3}{8}$ in. × $\frac{3}{8}$ in. × $\frac{1}{8}$ in. steel angle or machined from $\frac{3}{8}$ in. square bar. There is little to choose between the two methods. Secure to the frames with $\frac{1}{8}$ in. snaphead rivets. The spring pins are a trifle fiddly. Start by chucking a length of $\frac{3}{16}$ in. dia. steel rod in the three-jaw. Face, centre and drill No. 41 for, say, 1 in. depth. Part off $\frac{3}{16}$ in. slices, deepening the No. 41 hole as you proceed. Cut twelve $\frac{7}{8}$ in. lengths from $\frac{1}{8}$ in. steel rod and screw one end 5 BA for $\frac{3}{16}$ in. length. Scallop the other end to suit the top portion, just made. Lay on a sheet of asbestos millboard and braze up. That leaves only the shock absorbers, which aren't, being turned up from $\frac{1}{2}$ in. dia. steel or brass bar. On big sister, these were hollow and contained a thick rubber washer. It would be a waste of time fitting this refinement to our tenders.

For assembling all the pieces, a good look at the general arrangement drawing will be of assistance. The same goes for fitting the horns and hornstays. Feed the spring pins down through their hangers, add the shock absorbers, then a nut and locknut. Fit the spring plunger, with its coil spring, into the spring casting and drop on to the top of a box. Countersunk rivets, 3/32 in. dia. and initially about $\frac{1}{2}$ in. long, make excellent spring link pins. There is a spring link at either side of each eye. Slide the rivet through, check the clearances, then hammer the rivet end over, nice and tight.

Future Plans

Now that *County Carlow* is drawing towards a satisfactory (I hope) conclusion, perhaps this is a good time to mention some "forthcoming attractions." Some few months ago I asked our worthy Editor if some articles on Doncaster Plant Works would be acceptable. The answer being in the affirmative, yours truly sat down to pen a few notes on the subject, an understatement if ever there was one! Previous comments on full-size workshop practice seem to have provided some interest, judging by the "Postbag" columns. Obtaining the relevant official Works photographs is taking a little while to organise, but the wheels are in motion. The hold up is because all the negatives from Doncaster have to go into the "enemy camp" at Derby for prints to be made. The photographs at least should be worth waiting for.

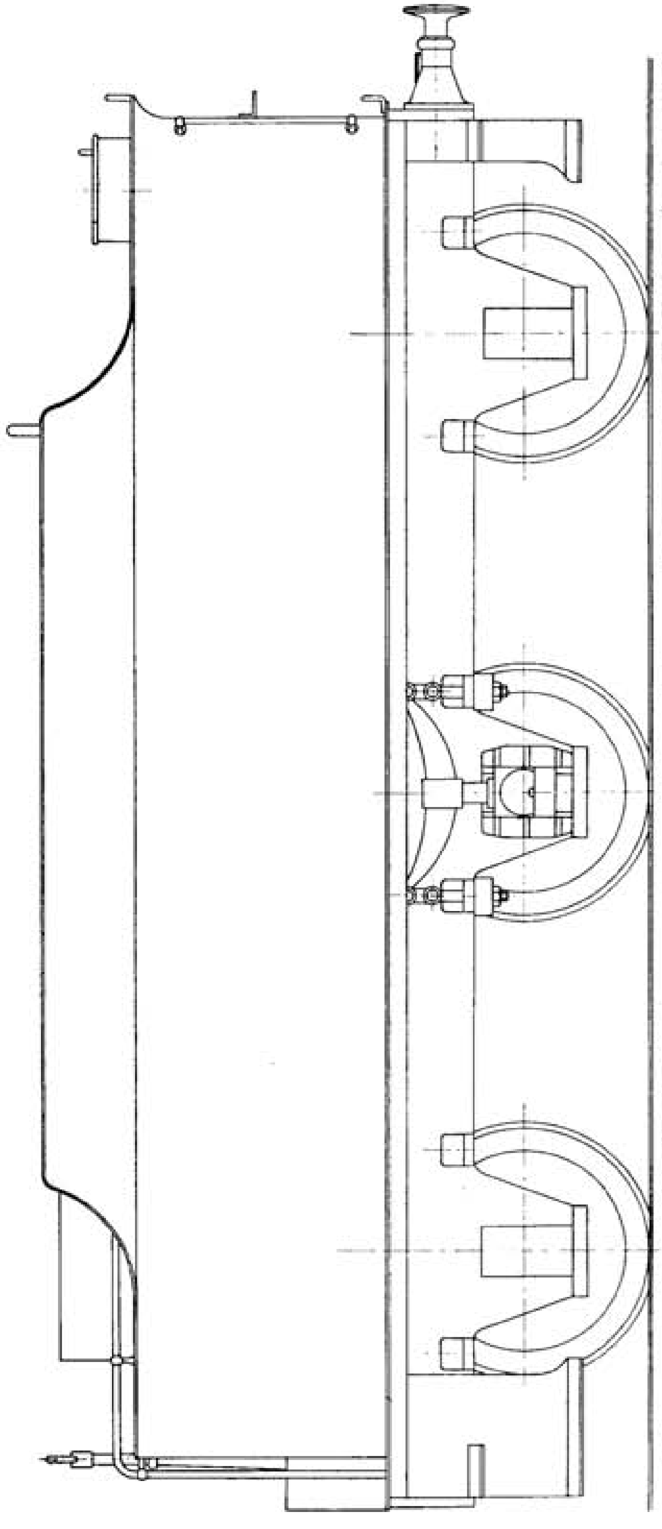
The $2\frac{1}{2}$ in. gauge engine can now be revealed; she will be a Southern *King Arthur*. The Editor has been of great assistance to me with this design, supplying a host of detail photographs. At his suggestion, both the Urie and Maunsell variants are covered. Let us hope that castings will be forthcoming from our suppliers, to help ensure the success of this locomotive. Drawing her up brought back happy memories of days spent on the maintenance of full-size sister at Eastleigh.

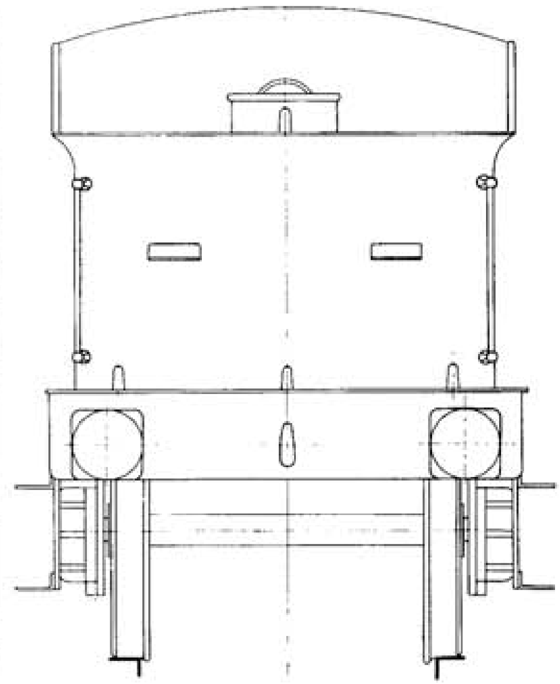
After my expedition into the realms of $3\frac{1}{2}$ in. and $2\frac{1}{2}$ in. gauges, the suggestion of an A.2 Peppercorn "Pacific" was put forward; but this was probably a bit too ambitious. The final choice was, a G.C.R. "Atlantic." This Robinson design was, to me, one of the most beautiful engines built anywhere in the world. So, having settled on the locomotive, steps are being taken to amass as much information on her as possible, starting from "Atlantic Era."

If there is any time left after that, I hope to finish off my K.1/1, before starting on a No. 1 Rail Motor. To this list will have to be added the "Atlantic."

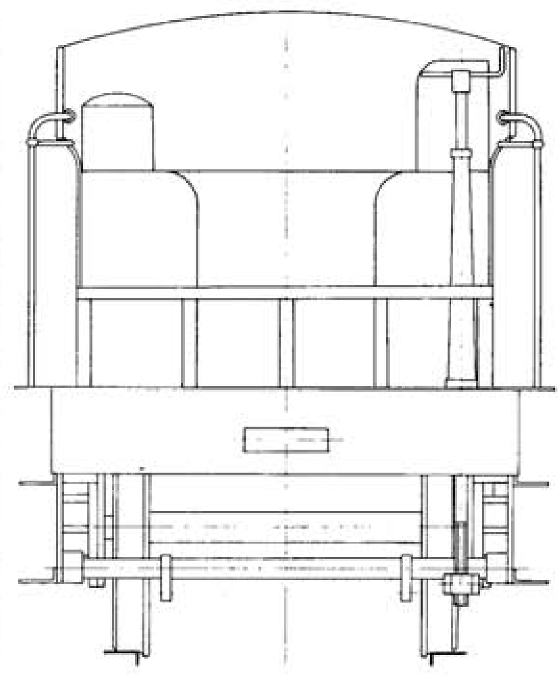
Peak day for my "mailing department" is invariably Tuesdays. Most builders seem to retire to their workshops for the weekend, emerging sometime on Sunday, to hurriedly jot down their tales of joy, or woe! It is easy to pick out these letters, from the "excited" handwriting on the envelope. Such a letter arrived this morning. I quote the first paragraph verbatim: I've just had *County Carlow* running on air and she goes like a bomb! She ticks over (without load) on 10 p.s.i., and on 80 p.s.i. I cannot stop the wheels by pressing a piece of wood against the flanges.

Well done, Colin Archer, you made my day. Incidentally, Colin told me at the outset of the series that he intended to keep up with the script. He will not be far behind, having already tackled the tender frames. All that remains is to substitute steam for air and a passenger truck for that piece of wood. There were two areas where problems cropped up: the usual "fouls." The first was the sloping front portion of the R.H. wheel box, which was too close to the wheel flange, a minus clearance in fact. This is a real "tight spot," so I suggest that the solution lies in milling a clearance in the sloping plate. Colin has secured a temporary clearance by swaging, but I have a feeling that the boiler will not sit correctly, when erected. Another and perhaps better solution, would be to make this sloping piece from much thinner material, say, 1/32 in. thick. Its function is only ornamental anyhow.





COUNTY CARLOW'S TENDER



The second foul occurred on the smokebox saddle, the cross-plates under the exhaust passages came out too close to some of the cylinder fixing bolt heads. Colin's solution was to omit the lower cross-plates altogether. It is possible to position these pieces clear of the bolt heads, though tightening them up calls for a little patience ! All in all, these cross-plates can quite readily be omitted, without affecting the stiffness of the frames. I had my first look at our local *County Carlow*, being built by Stan Slade, on Sunday. If I have managed to focus the camera correctly, along with all the other technicalities, then maybe a photograph of her will be published. It was pleasing to note the extreme robustness of her construction, and Stan is making a real good job of her.

Tender brakes can almost be classed as a de-luxe extra, but if we model our driving practice on full-size, the brake forms an important part of the ritual. Before leaving the footplate, the tender brakes should be screwed hard down and the drain cocks left open. Many shed runaways have resulted from ignoring this simple procedure. Our brakes will not be completely effective, though they will provide more than a modicum of restraint.

There are several ways in which we can tackle construction; the hand brake is as good a place as any to start. The brake spindle is a 6½ in. length of ⅛ in. dia. rod, stainless steel is not amiss here. Square off the ends and screw 5 BA for 1 in. length. Chuck a length of 5/16 in. brass rod, face, centre and drill No. 31 for 3/16 in. depth. Start parting off a 3/32 in. collar, but only reduce to about 7/32 in. dia. With a file, produce the half-round contour shown, and finish parting off. Press the collar 13/16 in. on to the plain end of the spindle and braze it on. Rechuck the spindle and remove any excess brazing spelter. Chuck a length of 3/16 in. brass rod: face, centre and drill No. 31 for ⅜ in. depth, before parting off a ¼ in. length. Press this on to the plain end of the spindle. Cross drill right through at No. 56, about 1/16 in. from the top edge and press in a 1⅜ in. length of 18 s.w.g. steel wire. Bend up the longer end, as shown, and neatly round off the ends.

Next we need the column, from ⅜ in. A/F hexagon brass rod. Chuck in the three-jaw, face, centre and drill No. 30 for about 1½ in. depth. Turn down ⅛ in. at this end to 5/16 in. dia. and screw 32 t, a tight fit in the front beam. Part off to 2 29/32 in. overall. Chuck a 5/16 in. × 32 t adaptor in the three-jaw and fit the embryo column to it. Centre the outer end and bring the tailstock centre into use. Turn the outer taper profile as shown. I would rough this out with a round-nose tool and finish with files and emery cloth. It is not worth setting the top-slide over, as the angle does not work out in round figures. Leave a 3/32 in. thick " nut " at ⅜ in. A/F for tightening. Finally, drill No. 30 from this end, to meet the other hole. Assemble the spindle into the column, make up the little collar for the bottom end, cross drill No. 56 and pin with an odd end of 18 s.w.g. wire. For those who have difficulty in pressing in these small pins, there are spring tensioning pins widely available, rolled up from spring steel strip. I have recently come by a selection of 1 mm. dia. pins of varying lengths, and very useful they are proving. Not surprisingly really, as I have been using them profusely in my " other " job, for the last ten years. Funny how none ever got into the workshop earlier !

Before we move on to the brakeshaft, we require the means to support it, namely the steps. After the engine steps, these are straightforward, there being no cut-outs. The rear steps can best be made at the same time, then all can be erected, temporarily at least. For the brake shaft, saw a 5 7/16 in. length of ¼ in. dia. steel rod. Face and turn down for ¼ in. length at each end, to 3/16 in. dia. Make up the two pull rod levers—the one shown on the left of the drawing—and one of the longer ones for the hand brake nut. Position them as shown on the drawing and braze up.

The brake nut is turned from ¼ in. dia. bronze, or brass rod. Chuck in the three-jaw, face and turn down for a full 3/32 in. length to ⅛ in. dia. Part off to 29/64 in. overall. Reverse in the chuck and turn down a full 3/32 in. length to ⅛ in. dia. Cross drill the centre portion No. 40 and tap 5 BA. Fit to the brake shaft and make up the outer trunnion support in place. Fix this to the brake arm with an 8 BA bolt, there is just room to get it in. Brake shaft trunnions can best be made from ¾ in. dia. brass bar. They are in an area where there could be a lot of excess water flying about, such as when the tender is uncoupled. Made from steel, the trunnions will soon seize up. Chuck in the three-jaw, face, centre and drill 3/16 in. dia. to ⅜ in. depth. Turn down for 5/32 in. length to ⅜ in. dia., before parting off at ¼ in. overall. Rechuck and with a knife edge tool, mark on the bolt pitch circle at 9/16 in. dia. Mark off and drill the No. 44 fixing holes, then saw off the excess flange, which would otherwise protrude below the steps. Erect the brake shaft in the position shown, engage the brake nut and try the hand brake. Adjust the shaft position, or elongate the lever slots, if necessary, to get full travel on the screwed spindle. Remove the steps, with the trunnions still clamped to them. Drill through the No. 44 fixing holes and secure with 8 BA bolts. Take a short break and " knock up " the valances, these are fitted outside the steps, the extra 8 BA screws will assist in keeping the front steps reasonably rigid.

Brake hanger pins are a simple turning job, screw them to the insides of the frames. The brake hangers are somewhat fancy shaped, from $\frac{5}{16}$ in. × $\frac{1}{8}$ in. steel flat. Make up one and use as a drill jig and filing template for the remainder. The end radii can be milled, just like the motion rod ends. Fit brake shoes to the hangers, remembering to give them just a little angular play. Make up the brake beams as shown, then erect the beams and hangers. Clamp the middle and rear sets of shoes hard against the wheels and measure off the pull rod centres. Make up a pair of pull rods, from $\frac{1}{16}$ in. steel flat, and then try them in place. The rods must clear the inside faces of the wheels. Make up spacers to fit between the pull rods and brake hangers, on the trailing set. Leave the intermediate beam until the additional pull rods are fitted; our next job.

Remove the clamps from the trailing shoes and transfer to the leading pair. Again measure the pull rod centres, make and fit them. Now the intermediate spacers can be made up. Set the brake nut about $\frac{3}{16}$ in. from the top of the brake spindle threaded portion and with the shoes still "hard on," measure for and make the leading pull rods. Use $\frac{1}{8}$ in. snaphead rivets for the pins, to couple to the brake shaft, then drill for and fit 3/64 in. split pins to all the rod ends. That takes care of the brake gear and it only remains to make the drawbar before we move on to the tender body. This has been shown on the massive side, to make sure engine and tender never part company unintentionally. When the ends have been finished, again milled as for the valve gear parts, open out the pin holes to 17/64 in. dia., to allow some "rise and fall." Talking of engines and tenders parting company, it is a good idea to make up a couple of plates, shaped like the outer trunnion for the brake nut, to stop the drawbar pins from lifting. The engine one can be permanently fitted, the tender pin retaining plate being made to swivel, when splitting the engine and tender.

Tender body

I usually favour the inclusion of the tender well, adding that little extra realism, as well as providing a suitable bulkhead at the front end for the necessary pipe fittings. However, following G.W.R. construction exactly would have over-cramped the emergency hand pump. So the well was dispensed with and some of the coal space annexed. A question of swings and roundabouts. The final result still provides some intricate platework, the side tanks being retained. For ultra simplicity the latter could be omitted, the floor of the coal space being extended to the tender sides.

Getting right down to the job, the first item is the soleplate. This will involve quite a bit of sawing, from 16 s.w.g. brass sheet, to include the front wings. Actually, these form the top step on the tender. They could be silver soldered on, but this usually leads to horrible distortions on this size of plate, which are difficult to remove. That's putting it mildly ! After all the good work put into the engine, there is often the tendency to skimp the tender, this is quite natural.

To be continued.

SMOKE RINGS

Continued from page 475.

"Mr Bateman was born in Surbiton and first worked for the General Electric Company, obtaining his degree in electrical engineering in 1931 at the Northampton Institute. He emigrated to Canada in 1932 and began a career in the design and production of X-ray equipment with the Burke Electric Co. of Toronto.

"Lawrence joined the Toronto S.M.E. in 1934 and became one of the most prominent members. In 1938, he joined the firm of Delamere & Williams, as a design engineer in the manufacture of automatic packaging machinery, and later became a Director of this company. His first model of steam machinery was completed in 1943—a Maudsley table engine. His models of many different types of steam engine will be well-known to readers. His workshop grew from a small lathe on the kitchen table to a magnificent combination of workshop, drawing office and study, overlooking the Humber River.

"Apart from model engineering, Mr Bateman had a keen interest in sports car racing and rallying; for many years he was Vice-President of the Canadian Automobile Sports Club. He was also an enthusiastic traveller, and apart from visits to Europe, had travelled in Mexico, Brazil, Peru, Guatamala, Yucatan, Uganda, Kenya and Ethiopia.

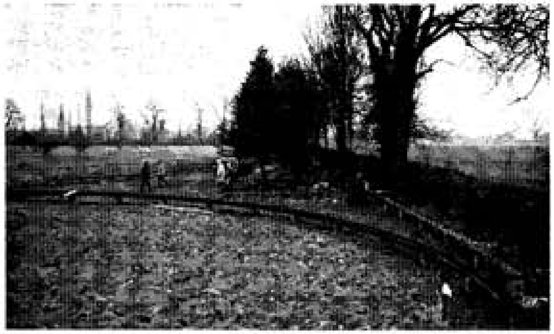
"At his death, Lawrence was a member of a number of organisations including the Professional Engineers Association of Ontario, the Royal Ontario Museum, the Royal Canadian Institute, the Newcomen Society and many other associations."

Blenheim Open Day

The Witney & West Oxfordshire S.M.E. will be holding their Annual Rally at Blenheim on Saturday, May 23. Tickets for entrance to the grounds can be obtained from R. C. H. Chilton, 41 Waverley Avenue, Kidlington, Oxford.

Extensions at Colney Heath

by G. M. Cashmore



THE NORTH LONDON Society of Model Engineers decided early in 1969 to extend their track to about double its present length.

The photographs show the work which has been in progress during the winter months. Two teams have been working from each end to join up at the bottom high level curve.

When finished, the total length of the railway will be 2,450 ft. The track will run through attractive scenery and include some challenging gradients.

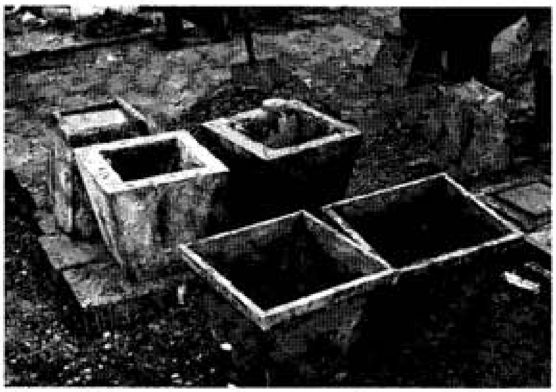
On Sunday mornings an average of 20 members turn up to give a hand and all materials are available to finish the job. It is not going to be possible to run on the extension this coming summer but by the end of 1970 the job of joining the new to the old will be completed and it is hoped by the spring of 1971 all will be ready, including the signalling.

The ends of the original track, no longer required, will be extended and joined up to make a smaller layout within the main track for beginners and those who wish to run $2\frac{1}{2}$ in. gauge locomotives.

Above: View from tunnel mouth looking towards extension.

Right: Plinth and concrete block assembly for the high-level portion

Below: Loaded with supplies a train approaches. the railhead.



Above: Moulds and core-boxes are used for casting plinths for the high-level portion.
Below: Loading a train to supply plinths and concrete to the railhead.

Winding and Hauling Engines

Part II. Continued from page 386.

by W. J. Hughes

LIKE OTHER MAKERS, Ransomes Sims and Jefferies built self-contained winding engines, and these were fitted with double cylinders and disc cranks. There were two main classes, Types RA and RB, similar in general design but the latter was cheaper in first cost.

The type RA is shown in Fig. 11; it had double drums, both of which were loose on the shaft and provided with separate clutches and brakes. The twin cylinders were designed for a working pressure of 100 p.s.i., and lagged with wood covered by sheet steel. A central regulator lever controlled the starting valve, from which steam passed through twin below-floor inlet pipes. The exhaust branches also passed below the floor.

Two central clutch levers are seen, with foot-pedals below to control the brakes, held by kick-off ratchets. Four outer cast-iron girders and one central one were bolted together to form the main frames.

The side flanges and barrels of the drums were fabricated from mild steel, but mounted on cast-iron centres bushed with gunmetal. Cast steel was used for the clutches and jaws, the latter being bolted to the drum centres. The actual braking was by posts fore and aft of the brake drums. Each post carried a friction material-lined shoe, and was pivoted at the bottom and linked at the top to its opposite number, coupled to the brake lever in such a manner as to pull both shoes on or to release them, simultaneously.

Trunk guides were used on the motion, and bolted to the main side frames. Reversing was by common link motion. The crankshaft ran in two large bearings, and the drum-shaft in three; both were of the best mild steel. For the reduction gears the pinions were cast steel but the spur wheels were cast-iron. All gearing was fully shrouded.

The chain-driven depth indicators shown were not standard, but could be fitted as an extra.

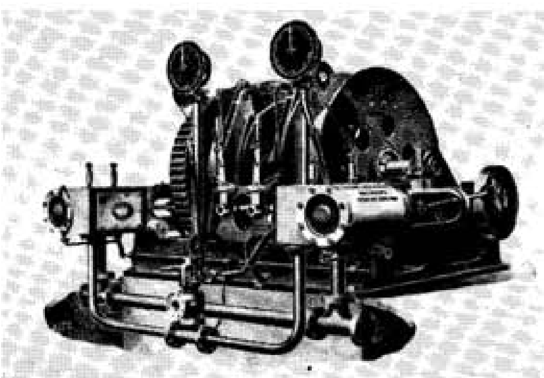
In the cheaper version, Type RB, the chief difference was that one drum was fast on the shaft and only one could be clutched to it separately. For many installations this was quite adequate. On this type too only two bearings were fitted for the drum-shaft. Otherwise the design and appearance were identical with the Type RA.

Four sizes of each were available, and the attached table gives the leading dimensions. It was recommended that the engines be steamed by locomotive type boilers, which, of course, Ransomes could supply from among the wide range they built.

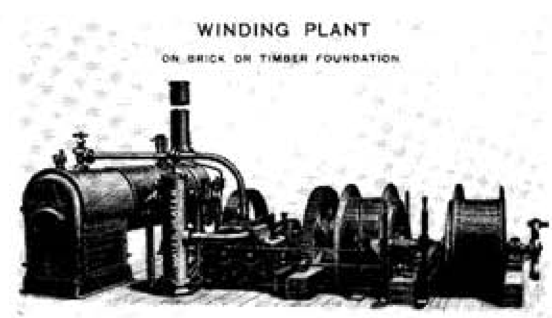
Marshall winding gear

In a catalogue issued by Marshalls of Gainsborough, probably in the nineties, there are two illustrations of winding plant, this time complete with separate locomotive boilers. Another Marshall feature was that the engine itself was also a separate double-cylinder unit, instead of being built in a unit with the winding gear.

Both these sets of plant (Figs. 12 and 13) are stated to be designed to meet the requirements of the South African or other gold mines. The drums have steel flanges, and can be lagged with either steel or oak to take the wear of the ropes. Each drum can be clutched separately to the drum-shaft, and each can be braked independently.



Left: Fig. 11. Below: Fig. 12.



Leading Particulars of Ransomes' Winding Engines, Types RA and RB				
Cylinder bore and stroke, in.	8 X 16	9 X 16	10 X 18	11 X 18
Diameter of drums	3 ft. 6 in.	3 ft. 6 in.	4 ft. 0 in.	4 ft. 0 in.
Width of drums, each	1 ft. 0 in.	1 ft. 0 in.	1 ft. 1 in.	1 ft. 1 in.
Rope speed, ft. per min.	300	300	300	300
Approximate vertical lift, cwt.	31	39	50	62
Approximate weight, Type RA, cwt.	150	155	173	180
Approximate weight, Type RB, cwt.	135	140	163	170
Maximum circumference of Best Improved Plough Steel Rope recommended	2¼ in.	2½ in.	2¾ in.	3⅛ in.
Approximate maximum depth to which these winding Engines will work	1,000 ft.	1,000 ft.	1,000 ft.	1,000 ft.

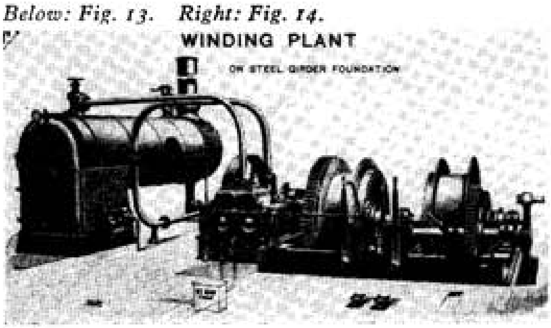
Whereas the plant shown in Fig. 12 is shown on brick foundations (or it could be mounted on heavy timbers), that in Fig. 13 is on a steel girder framing, to which the engine is bolted. Thus lining-up of the gearing is facilitated, together with the shaft bearings.

The crank on the end of the drum-shaft in Fig. 12 is of course to work a lift pump to keep the mine drained. An improved version is seen in Fig. 13, where the pumping crank is on a separate shaft so that it can be worked by the engine independently of the drums at will. In each case the crank has two arms, so that the pin can be inserted at a different radius to vary the stroke of the pump.

In Fig. 12 a vertical feed pump is fitted at the smokebox end of the boiler: in Fig. 13 a horizontal one is near the firebox side. The feedwater heater shown in Fig. 12 could also be fitted to the other plant.

Unfortunately I am not able to give the leading dimensions of the Marshall winding gears, as that particular page is missing from the catalogue, but if the handles of the levers are about 3 ft. 6 in. from the floor, the drums would appear to be approximately similar in size to the Ransome's.

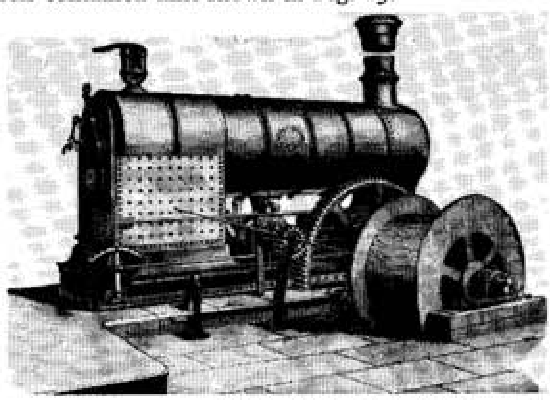
Below: Fig. 13. Right: Fig. 14.

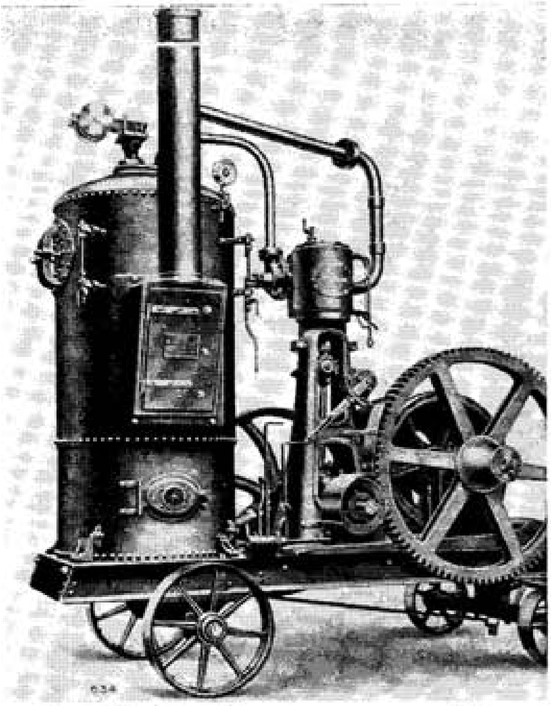


On another page is shown a simple winding gear, with a single small drum driven by direct gearing from an undertype engine (Fig. 14). It is possible to discern two big ends, so the engine would be either a double-cylinder or a compound, most probably the former. A wheel-type throttle control is close to the reversing lever and the foot-lever works a band brake. The purpose of the slender sloping control-rod is not clear: it does not appear stout enough to control a clutch, and in any event it seems to have a choice of four notches in the bracket on which it rests. Doubtless there is some simple solution staring one in the face, if only one could think of it !

Paxman's "Improved" Winding and Hauling Gear

Davey, Paxman and Co. Ltd. of Colchester, like Marshalls, were in their day famous for all kinds and types of steam engine, from the tiny horizontal or vertical to the lordly mill engine. Naturally winding and hauling machinery were included, and one of the first examples from their catalogue is the self-contained unit shown in Fig. 15.



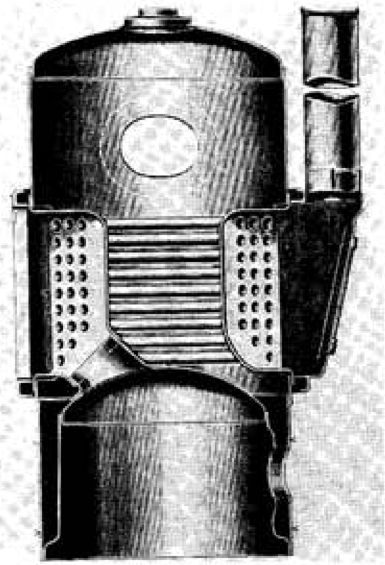


Left: Fig. 15.

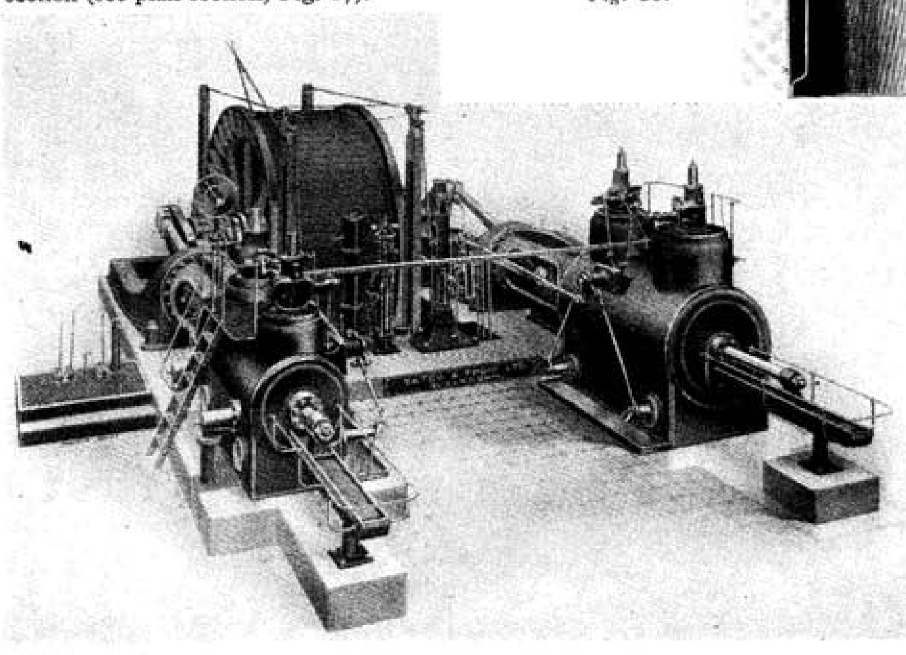
The boiler is of the Paxman patent " Essex " type, which they made in all sizes from 2 to 30 nominal horse-power, and claimed to be " decidedly the best (vertical boiler) ever introduced " (Fig. 16). From the firebox a straight flue takes the products of combustion to a chamber at the left, of triangular section (see plan section, Fig. 17).

A similar chamber is on the right, and the two chambers are joined by curved tubes passing through the water-space, giving a large amount of heating surface. The left-hand chamber is fitted with an access door, and that on the right is enlarged to form a smokebox, with door and uptake. The curve of the tubes is of greater radius than that of the boiler shell to enable them to be put in or withdrawn without trouble.

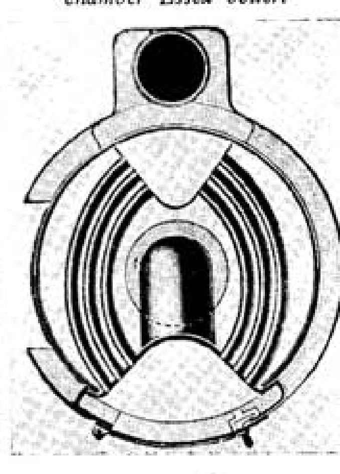
To return to the winding unit, the engine is also a standard small vertical, with Stephenson reversing gear, a curved-spoke flywheel (with the eccentric for the feed pump between it and the main bearing), a bent crank, and a shrouded pinion to drive the drum. A band-brake is fitted to the drum at the near side, worked by a foot-pedal. The regulator



Right: Fig. 16.



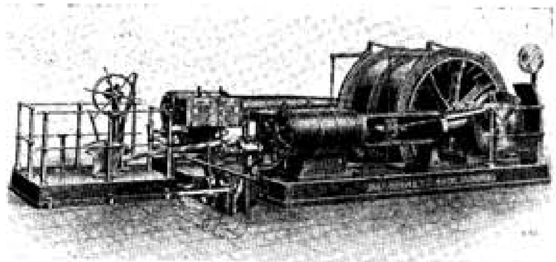
Below left: Fig. 20.



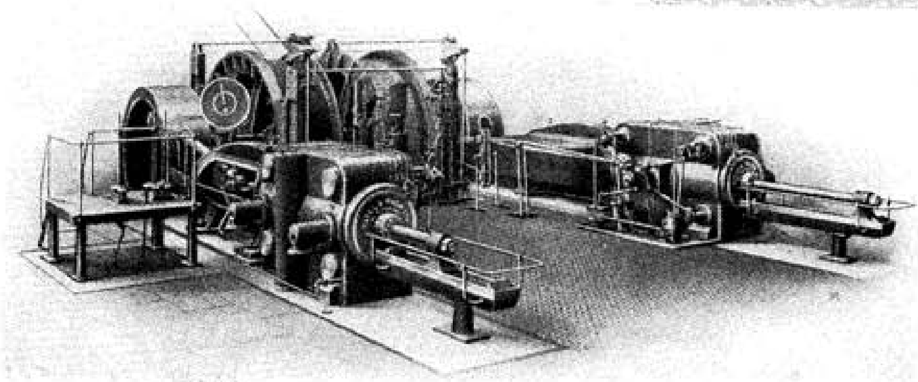
Below: Fig. 17. Section of combustion chamber "Essex" boiler.

is a simple disc type, mounted direct on to the valve chest.

The unit is mounted on a girder bedplate, part of which forms the ashpan, with four wheels built up in portable engine style: that is, spokes formed by bending strip metal, with inner ends cast into the hubs and outer arcs riveted to the outer rims.



Above: Fig. 18.



Left Fig. 19. High-pressure winding engines by Yates and Thorn.

A much larger winding engine is seen in Fig. 18, with long-stroke cylinders and girder frames: that is, each trunk guide is extended forwards and is in one casting with the main bearing and its pedestal. In these engines the stroke was almost twice the bore; for example, an engine of 12½ in. bore had a stroke of 24 in.

The regulator valve, worked by the wheel on the platform, is situated between the branch pipes to the cylinders, each of which has a separate stop valve. Link motion reversing gear is controlled by the taller lever in the quadrant, and the shorter lever is coupled to the drain cocks. As usual, a foot-pedal controls the brakes, which have curved posts—a common feature on larger sizes of winding gear.

Again this catalogue (which is a general one) does not give dimensions, because there was a separate special catalogue of winding and hauling machinery "available on application." But on general proportions this could be the 24 in. stroke engine, which would make the drums about 6 ft. dia. by 18 in. wide.

Yates and Thorn of Blackburn

Some of the finest steam engines in the world were built in Lancashire and Yorkshire, in close proximity to the mills and the mines they were to serve, and not the least of the famous makers was the Blackburn firm of Yates and Thorn.

My Fig. 19 shows a fine pair of high pressure winding engines built by them, coupled to the same shaft which carries two separate drums. Corliss valve gear is fitted, worked by straight link motion Allan gear with a small vertical steam engine to reverse the motion.

A second vertical engine was used to apply the brakes, of straight-post type fitted with curved shoes. On this size of engine a governor was usually fitted: it may be seen in front of the right-hand brake post. It was coupled to the regulator and the braking engine so that, in the event of anything untoward, steam would be shut off and the brakes applied.

General Proportions

Again from general proportions it would seem that these engines would be perhaps 27 in. bore by 54 in. stroke, and the drums possibly 7 ft. dia. by 24 in. wide.

The compound winding engine shown by Fig. 20 is obviously appreciably larger, with cylinders perhaps 33 in. and 48 in. by 60 in. stroke, and a drum 10 ft. dia. by 48 in. wide. It possesses (as one would expect) several features common to the previous engine, including the steam-operated Allan link motion reversing gear, the steam braking gear, and the governor gear.

This time, however, the inlet valves are drop valves, though worked by wrist plates on the same rocker shafts which carry the wrist plates of the Corliss exhaust valves.

To be continued.

IN THE WORKSHOP

Tapping Attachments for the lathe

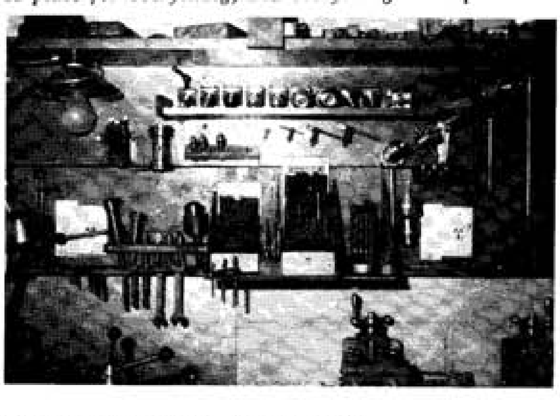
by J. A. Radford

TAPPING in the lathe where the tap is held in the drill chuck in the tailstock and the work is pulled around while held in the headstock chuck is a hazardous procedure in the smaller BA sizes, and is a strenuous and slow procedure in the larger Whitworth and other sizes. While I have not yet broken a tap by these methods, I have been filled with apprehension while tapping down to 12 BA. The difficulty of pulling around the chuck while tapping, say, ½ in. Whit. and at the same time preventing the drill chuck from turning in the taper of the tailstock, with the possibility of scoring the taper, has left a lot to be desired as an efficient workshop practice.

I have, therefore, designed two tapping attachments which take care of all sizes and threads from 12 BA to ½ in. Whit., for use on the two screwing slides of my quick change attachment. They will fit also the normal screwing shanks or die-holder shanks with No. 2 Morse taper; the advantage of the quick change fixture is that the tailstock does not need to be withdrawn to remove the tapping attachment, merely release and lift straight up.

The smaller of the two tappers has two collets, one ⅛ in. and the other 3/16 in. and has a knurled shank for tapping the smallest sizes and a four-pronged star for tapping the larger BA sizes from 5 to 2 and including 5/32 in. and 3/16 in. The larger tapper has three collets, the ¼ in. size takes care of No. 1 and No. 0 BA and 7/32 in. and ¼ in.

A place for everything, and everything in its place.



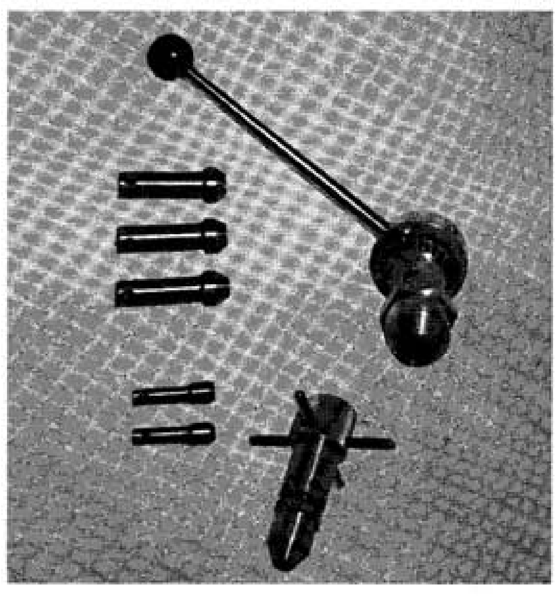
and the 5/16 in. size adjusts to all those taps with shanks above ¼ in. and up to 5/16 in. and the largest collet is ⅜ in. size which will handle taps with shanks from 5/16 in. to ⅜ in. which includes ½ in. taps.

This larger tapper has a single lever which swings to the right to clear the clutch teeth and in the right angled position the clutch teeth are engaged so that the tap can be engaged in the work, the tap advanced and relieved to clear chips, then swung to the right. Further clutch teeth are then engaged so that the tap can be further advanced. The work meanwhile is held stationary in the headstock chuck by engaging the back gear or mandrel lock, and there is no twisting motion on the tailstock as the fixture turns freely on its spigot, thus relieving the tailstock key and keyway of a lot of wear.

All the parts are made of mild steel with the exception of the five collets which are made of oil hardening, non-shrink tool steel and the two phosphor-bronze bushes which fit the shanks of the two die-holders, one being ½ in. and the other ⅝ in.

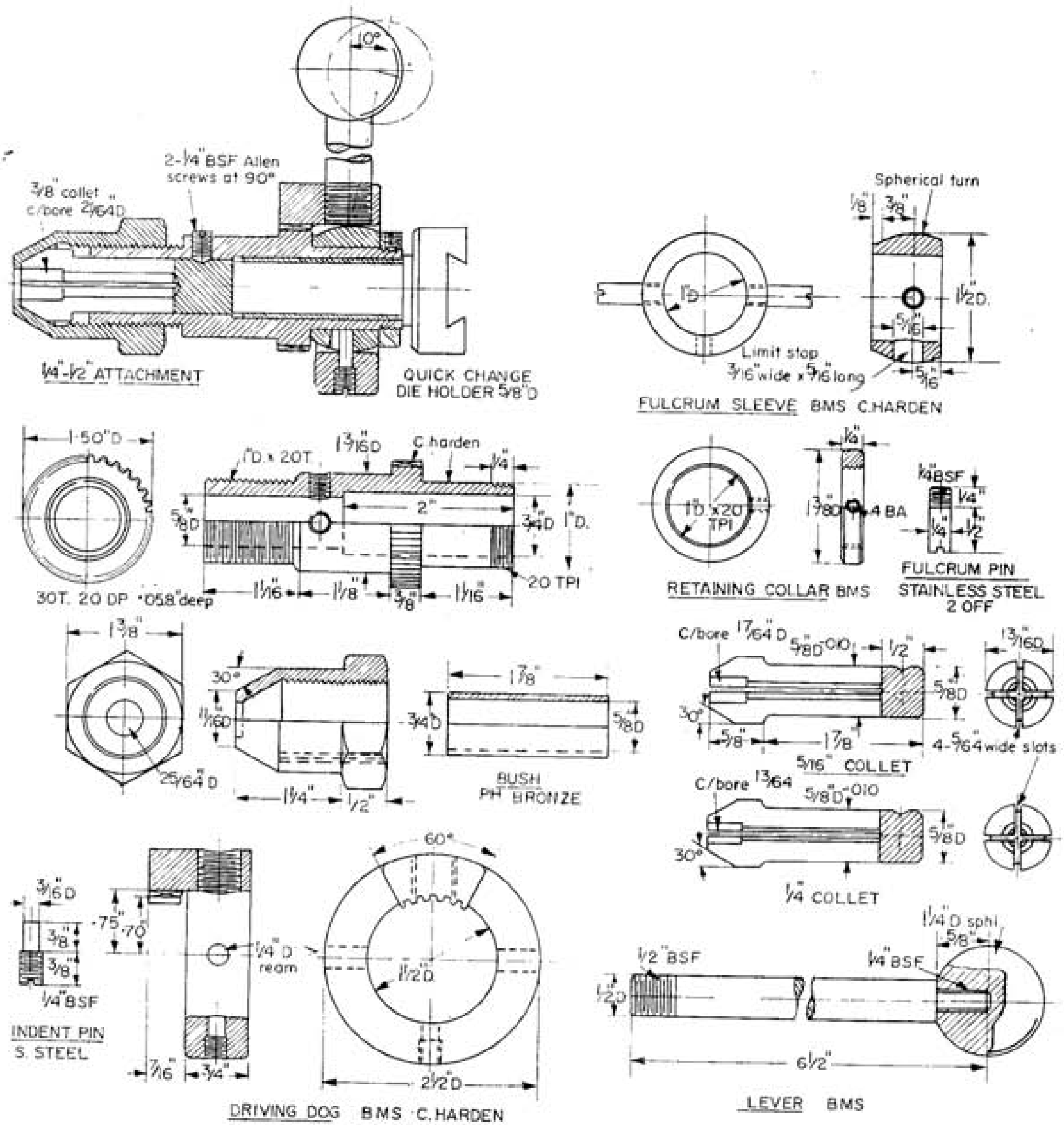
For the main body of the smaller tapper, a piece of 1¼ in. free cutting b.m.s. was cut off and faced each end to 3¼ in. long, centred while held running true in the four-jaw chuck on one end only and drilled 23/64 in. for a depth of 3 in. only, then redrilled to 9/16 in. for a depth of 2 in. and bored to .620 in. and machine reamed to the bottom of the counterbore, namely 2 in. to the end of the reamer. The balance of the hole, still 23/64 in. and 1 in.

The two tappers with five collets.



long was bored to run true and reamed ⅝ in. which was about the maximum length of the reamer.

A freshly turned stub mandrel ⅝ in. dia. to tightly fit the ⅝ in. reamed hole was made ready in the three-jaw chuck and the piece tightly twisted on. The end of the piece was now centred and the part turned to the drawing, namely, down to 1 in. dia. for a length of 2½ in. leaving 1 in. of the full size, which was very lightly skimmed to clean up and then the end was turned and screw cut ⅝ in. × 26 t.p.i. for a length of ¾ in. without undercutting the end of the thread. The dies were now run over the thread to size it. The centred end was drilled 23/64 in. and bored to a depth of ¾ in. only to .380 in. The 1¼ in. end was knurled with a medium knurl. The four holes for the star spokes were marked out with the dividing attachment before removing from the lathe, by means of a square drilling bush under the toolpost and the electric drill. After removing from the mandrel it was transferred to the drilling machine and the four holes drilled into the centre, reamed



7/32 in. dia. and tapped $\frac{1}{4}$ in. BSF, as also was the grub-screw hole a $\frac{1}{4}$ in. from the shoulder.

The phosphor-bronze bush is $1\frac{7}{8}$ in. long and is turned outside to .0015 in. larger than the reamed hole and bored to .501 in. as it will close down this much on pressing in. After removing drilling burrs from the $\frac{1}{2}$ in. reamed hole and fitting the four star spokes, which should remain clear of the reamed hole after tightly screwing in, the bush can be pressed home, which will leave a space for oil at the end of the bush. The bush can now be reamed by holding the piece in the hand with the reamer in the lathe or drilling machine.

I had a piece of $\frac{15}{16}$ in. A/F hexagon steel left over from a previous job, which I used for the tightening nut, but this could be made from round b.m.s. with a flange and tommy bar hole or holes, although I prefer the hexagon steel and spanner. This was drilled right through 9/32 in. and bored to a depth of $\frac{7}{8}$ in. to 37/64 in. and with the top-slide set at 30 deg. the end of the hole was bored until the angle met the full diameter of the hole. The bore was then screw-cut 26 t.p.i. and the plug tap run in to size the hole. Then parting off at $1\frac{3}{16}$ in. long, a screwed stub mandrel was made and the nut screwed on and turned outside to just remove the hexagon leaving $\frac{3}{8}$ in. and the end chamfered to 30 deg. and faced off so that the end dia. was $\frac{1}{2}$ in. and the length was $1\frac{1}{4}$ in.

With the exception of the collets which we will leave until the last and make them all together, this completes the smaller tapper.

The large tapper

The larger tapper main body has to be case hardened on the clutch teeth and also on the 1 in. dia. journal for the fulcrum sleeve, and as this would result in distortion if the piece were completely machined before hardening, we have to adopt the following procedure.

Cut off a piece of $1\frac{1}{2}$ in. b.m.s. to $3\frac{3}{4}$ in. long and get running true to gauge in the four-jaw chuck. Turn to 1 in. for $1\frac{5}{8}$ in. long and from $1\frac{1}{2}$ in. from the end up to the chuck jaws turn to $1\frac{1}{4}$ in. dia. Set up the indexing attachment for 30 divisions and the milling attachment for 20 D.P. and mill 30 teeth to a depth of .058 in. only. This is the dedendum of 20 D.P. and as the 1.50 in. dia. of the steel is the pitch circle diameter of 20 D.P. we will have the bottom half of the teeth of a gear which will form an excellent clutch. Now remove from the lathe and case harden thoroughly, but do not quench out, that is carburise only, the teeth of the clutch and the journal.

Set back in the chuck in the same position, running true to dial and turn $\frac{1}{16}$ in. off the end and turn the previously turned part up to the chuck jaws to $1\frac{3}{16}$ in. This will remove the carburising from these surfaces and the piece can now be heated to bright red and quenched in water. I forgot to say that the 1 in. × 20 t.p.i. on the end of the journal to a length of $\frac{1}{2}$ in. should also be screw-cut before quenching out.

Set back once again in the four-jaw chuck to exactly the same place and to dial gauge again to run true on the journal and clutch teeth and centre the end and drill and bore to .745 in. for 2 in. length and drill and bore to .620 in. for the balance of the length. This can now be machine reamed to $\frac{5}{8}$ in. right through, as the reamer will be long enough and also the outer end of the bore can be reamed $\frac{3}{4}$ in. for the full 2 in. length.

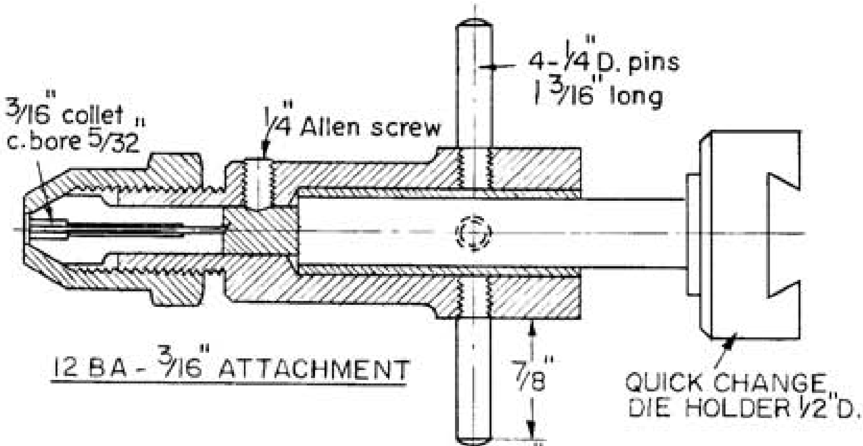
A proper mandrel should now be prepared to fit both the $\frac{3}{4}$ in. and the $\frac{5}{8}$ in. reamed holes to make a good true running job and the piece can now be turned to the drawing and the total length is faced up to $3\frac{3}{8}$ in. and the 1 in. × 20 t.p.i. screw-cut to $1\frac{1}{16}$ in. long. Two $\frac{1}{4}$ in. Allen grub-screws are fitted at 90 deg. at $\frac{1}{4}$ in. from the shoulder to hold the collets.

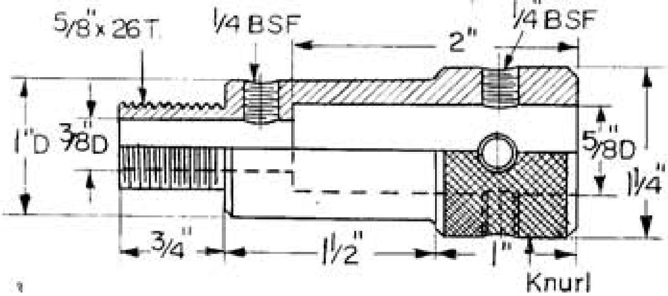
The phosphor-bronze bush is also $1\frac{7}{8}$ in. long, .752 in. o.d. and .626 in. reamed hole. This is pressed in and the reamer run through again as it will close in. This completes the main part of the large tapper and the nut I made from a piece of $1\frac{3}{8}$ in. A/F hexagon steel which I happened to have in the scrap box, but this again could be made from round b.m.s. with a good solid tommy bar to tighten it up. The tommy bar should be $\frac{3}{8}$ in. at least, which is why I prefer the hexagon rod. The piece is drilled right through 13/32 in. and bored to $1\frac{1}{8}$ in. length to $\frac{15}{16}$ in. dia. and screw-cut 20 t.p.i. to a nice fit on the main body, and taper bored 30 deg. the same as the smaller nut.

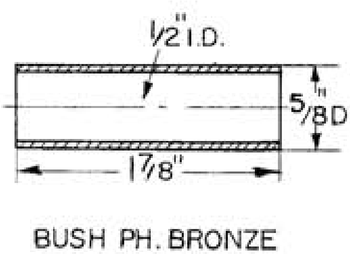
The retaining collar $1\frac{3}{8}$ in. dia. and $\frac{1}{4}$ in. wide can also be bored to $\frac{15}{16}$ in. and also screw-cut 20 t.p.i., to fit its thread on the other end of the body. This part is fitted with a 4 BA Allen grub-screw.

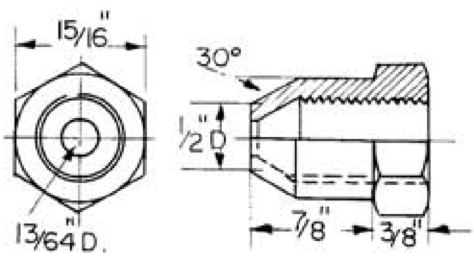
The nut is finished off outside to clean off the hexagon leaving $\frac{1}{2}$ in. hexagon and to a total length of $1\frac{3}{4}$ in. turning off at 30 deg. leaving the end $\frac{11}{16}$ in. dia.

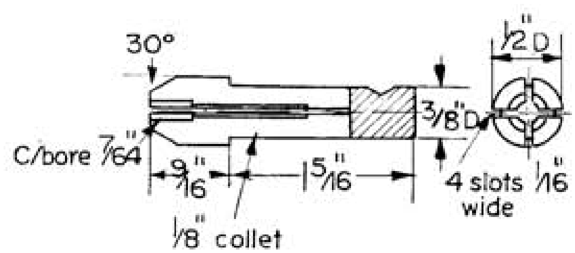
The fulcrum sleeve is of mild steel and is also case hardened all over after finishing. It is bored a free fit on the 1 in. dia. case-hardened journal, and is spherically turned outside to $1\frac{1}{2}$ in. dia. the centre of the spherical turning being set at $\frac{7}{16}$ in. from one end, leaving the opposite end at $1\frac{1}{4}$ in. dia. Two $\frac{1}{4}$ in. BSF holes are tapped across the diameter at $\frac{7}{16}$ in. from the end, bringing the holes to the centre of the spherical turning and at right angles to these two holes another hole $\frac{3}{16}$ in. wide, but elongated to $\frac{5}{16}$ in. long, is drilled and filed up to fit the limit pin and sufficiently long to clear the











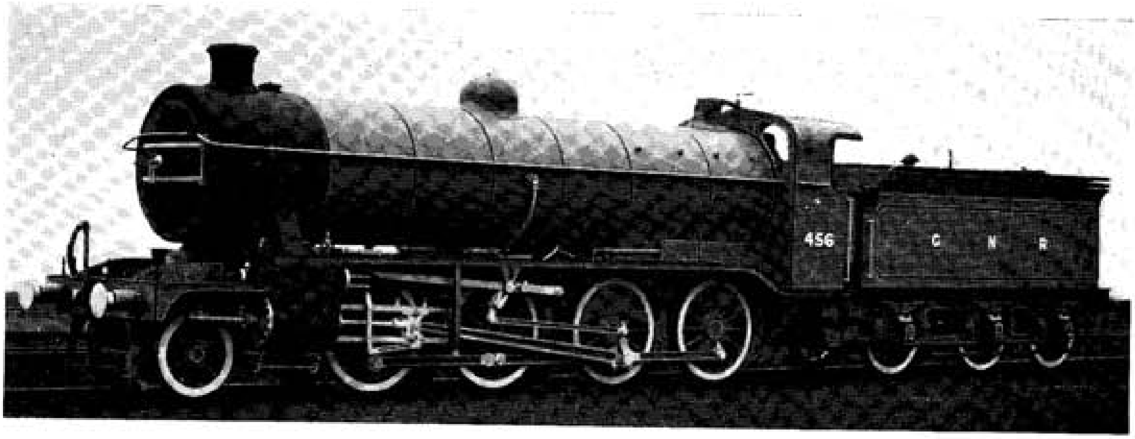
clutch teeth on the driving dog, when this is made and fitted up. Do not therefore harden out until this slot is checked with the driving dog. The two fulcrum pins and the limit pin can be made of silver steel and the fulcrum pins fitted temporarily.

The driving dog, a piece of 2½ in. round b.m.s. 1¼ in. long, is held in the four-jaw chuck to run true, faced off and bored right through to 1.40 in. and then counterbored to 1.505 in. for a length of ⅞ in. Chamfer the outer edge of the hole. Then with an internal pointed tool such as a screw-cutting boring tool, mark a ring inside the hole at ¾ in. from the outer edge. Reverse in the chuck and get running true. Mark two radial lines 60 deg. or one-sixth of the circle with a lathe tool and now proceed to remove with a hacksaw the unwanted metal, sawing along the two radial lines down to your circle marked inside the hole and after marking a circle on the outside of the piece, saw down to remove all but the 60 deg. segment as per drawing.

This segment is now slotted for 30 teeth to a depth of .058 in. using the indexing attachment and the slotting attachment (3 January 1969) with a shaped tool which should leave teeth which will fit closely the mating teeth, but will not quite bottom; this will need to be found by trial and error.

The sawn surfaces can now be dressed up with a smooth file and the two fulcrum pin holes drilled and reamed ¼ in. to fit the fulcrum pins, these are in the centre of the ¾ in. wide part and are truly radial and also the ¼ in. tapped BSF hole for the lever is drilled and tapped on the same line, but at 90 deg. to the other two holes and in the centre of the segment part.

To be continued



"NIGEL GRESLEY"

A 5 in. gauge Great Northern Railway 2-8-0 goods locomotive

Cab and Running Boards

Continued from page 444

by Martin Evans

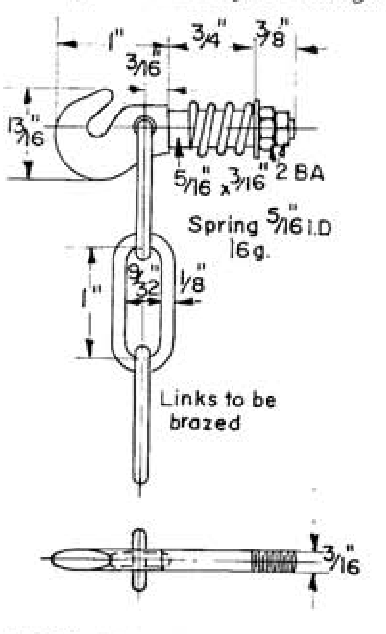
THE RUNNING BOARDS are made up from seven separate pieces, three each side and one section to lie between the frames ahead of the smokebox. In addition, there is a section which we can call the footplate, on which is mounted the usual wooden floor for the enginemen.

Looking at the general arrangement drawing, page 1014, October 18, 1968, the impression is given that the running board is in one piece from the top of the steam chest back to the cab; but in actual fact, a break has to be made at the link bracket, which is the widest part of the engine.

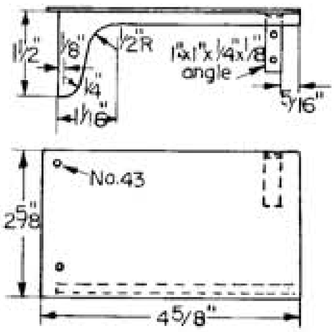
The running boards outside the frames are made from flat hard brass $2\frac{3}{4}$ in. wide $\times \frac{1}{16}$ in. thick. The valance edging or hanging bar is made from $\frac{3}{16}$ in. $\times \frac{3}{16}$ in. $\times \frac{1}{16}$ in. brass angle, except for the "shaped" end at the front buffer beam, which can be cut from $\frac{1}{16}$ in. sheet material. My usual method for securing the angle to the sheet is to drill clearing holes in the angle and tap the running board 8 BA to match; roundhead brass screws are then put in tightly, from underneath, any excess being cut off at the top, and then filed flush. When each section of running board is completed, the angles are sweated over on the inside with ordinary soft solder. However, the section which lies above the cylinder requires a little bracket to hold it to the frames, which is better than trying to screw it down to the steam chest cover—especially as this item is not quite horizontal. This little angle should be silver soldered to the running board, using Easyflo, so this must be done before any soft soldering is carried out.

Slots are required for the lubricator driving arm in the left-hand running board and for the reversing arm in the right-hand side.

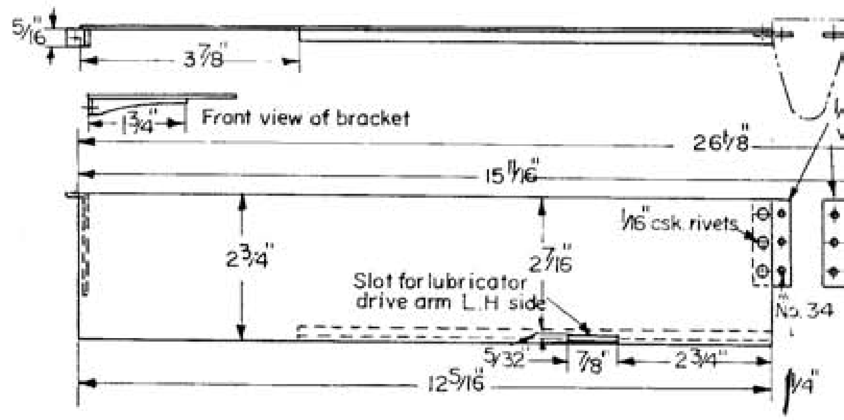
Some builders may have difficulty in bending the



HOOK AND LINKS 2 OFF BMS



FRONT RUNNING BOARD
1/16" BRASS AND 3/16"x3/16" BRASS ANGLE



RUNNING BOARD 1 L

angle at the rear end of the running boards. The radii here are quite easy ones, and if the angle is annealed, and the bending carried out in stages, it should not give any real trouble. An alternative here is to use a short section of $\frac{3}{16}$ in. square brass.

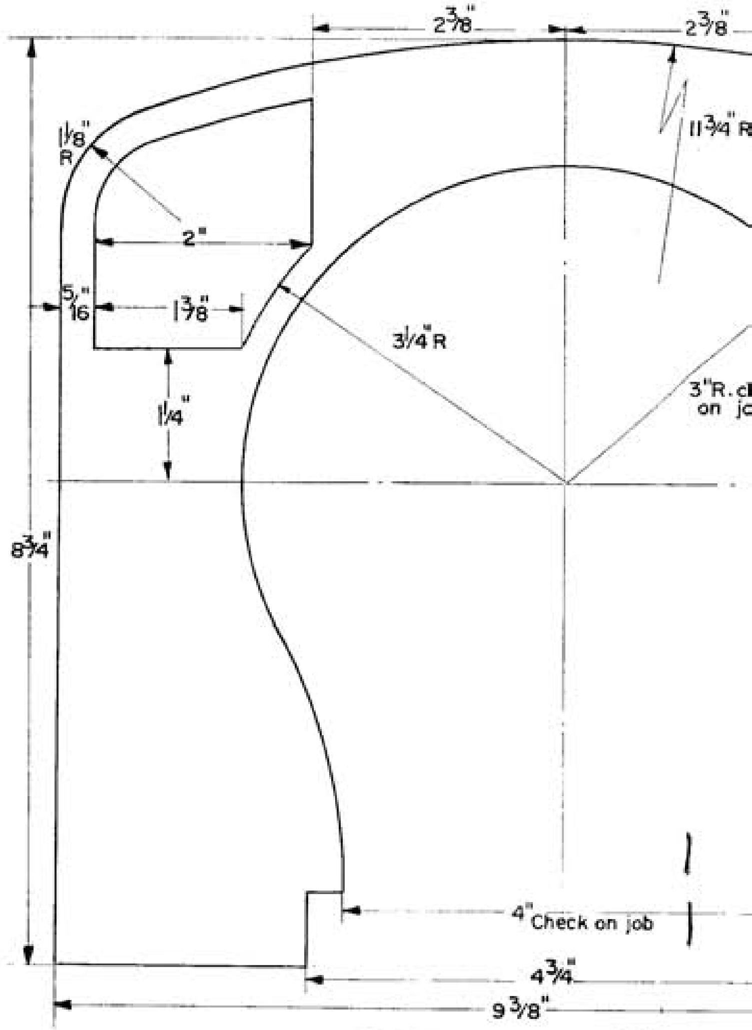
The rear sections of the running board are supported by two short pieces of $1\frac{1}{2}$ in. × 1 in. × $\frac{1}{8}$ in. steel angle, and of course by the $\frac{1}{2}$ in. angle on the drag beam. The former may be flush riveted on, while two or three hexagon-head steel screws can be used for the rear end; 6 BA is heavy enough here.

Before I forget, there was a slight error in the dimensions given in the cab drawing on page 442, May 1 issue. The overall width across the running boards should be $9\frac{7}{8}$ in., not $9\frac{3}{4}$ in.

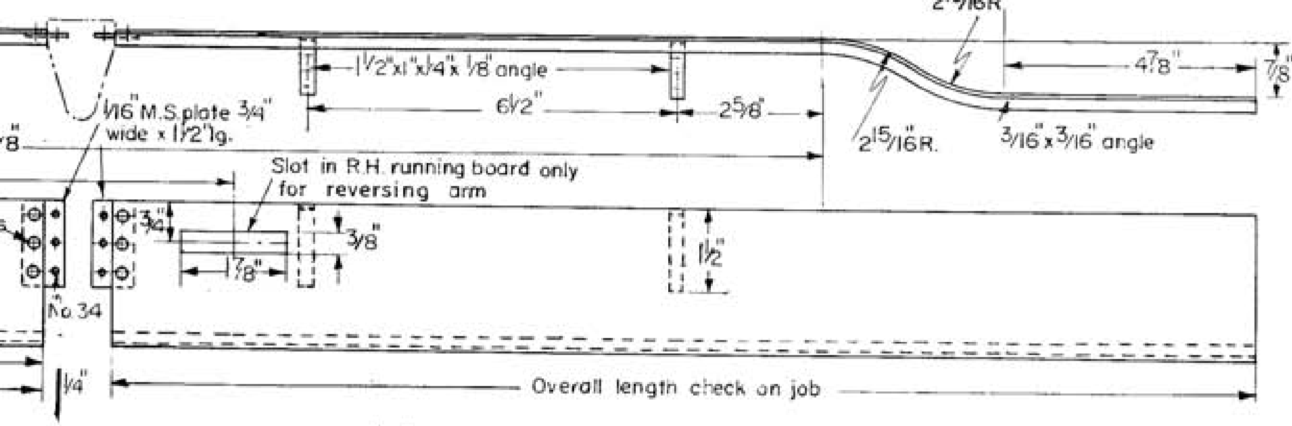
The Cab

There are two distinct ways of tackling the cab. One method is to make the front or spectacle plate first, finishing the radiused corners to size, then attempt to bend the cab sides and roof in one piece, which is not an easy task for anyone unaccustomed to sheet metalwork, though easy enough to the "professional." Another approach is to tackle the bending first, then when the right shape has been achieved, the combined cab sides and roof are laid against the flat sheet to be used for the spectacle plate, and a line scribed all around the inside. I think I shall make mine this way, as it is easier !

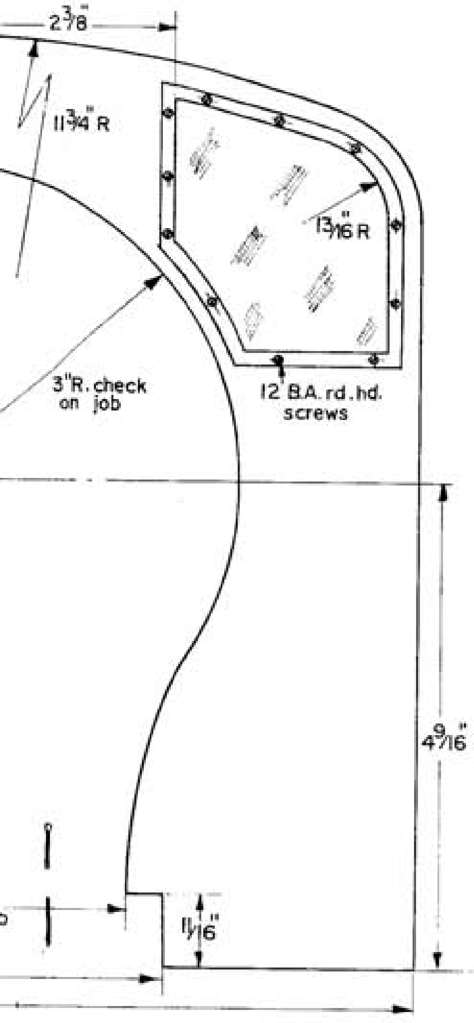
There is of course no reason why the cab sides should not be made combined with one half of the roof, a join being made along the longitudinal centre-line of the roof. But although this would certainly make the bending easier, the joint would show up rather badly, unless disguised by some form of roof vent. Which reminds me, I have been unable to discover whether these engines had any



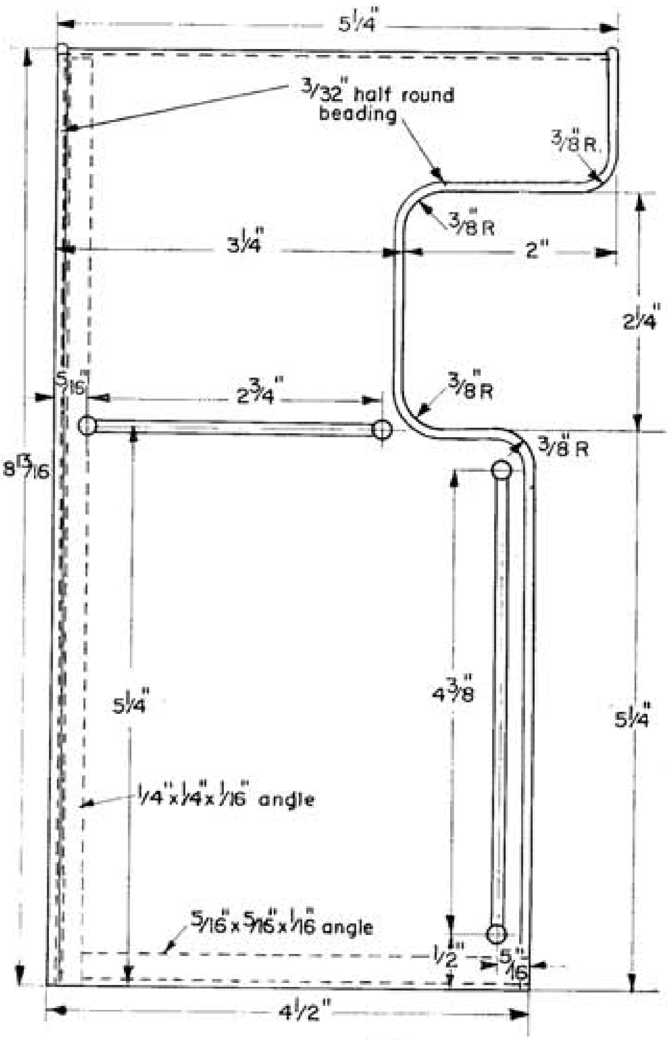
SPECTACLE PLATE 1/16" BRASS



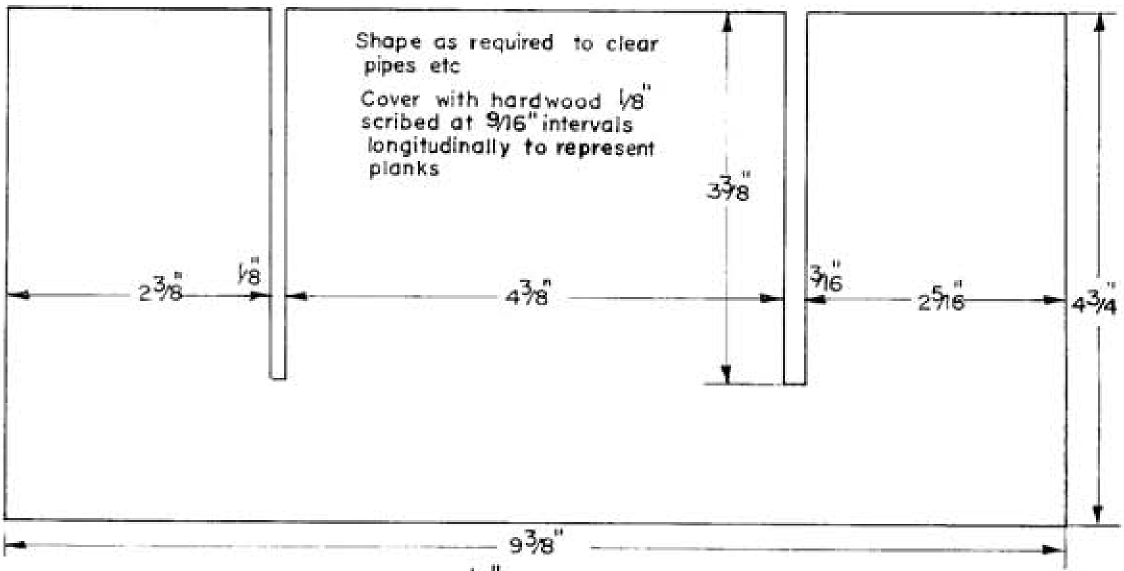
BOARD 1 L.H. 1 R.H. L.H. DRAWN 1/16" BRASS AND 3/16"x3/16" BRASS ANGLE



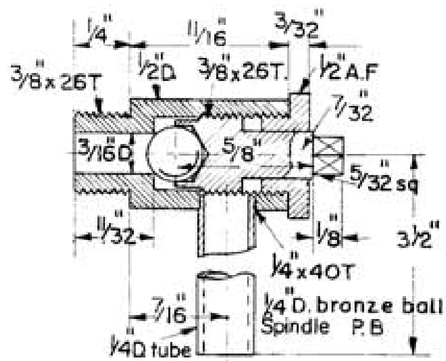
S" BRASS



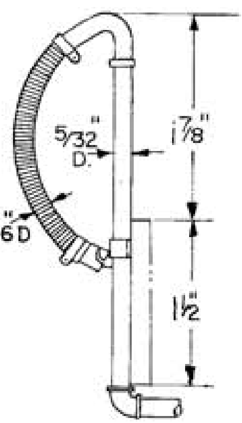
CAB SIDES & ROOF 1/16" BRASS



CAB FLOOR 1/16" BRASS



BLOWDOWN VALVE



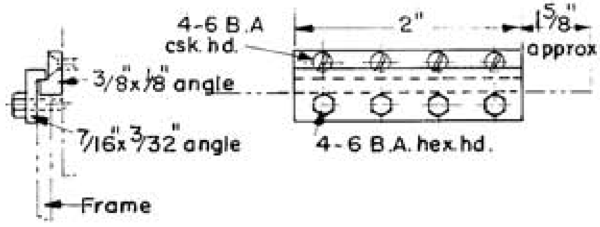
VACUUM BRAKE PIPE

kind of roof ventilator. None of my photographs shows this very clearly. Perhaps one of our readers who was familiar with this class will be able to tell us. As the cab roof is a very short one, by modern standards at least, there is really no need to cut anything away for driving purposes, but a decision on this I can safely leave to the builder's own ideas.

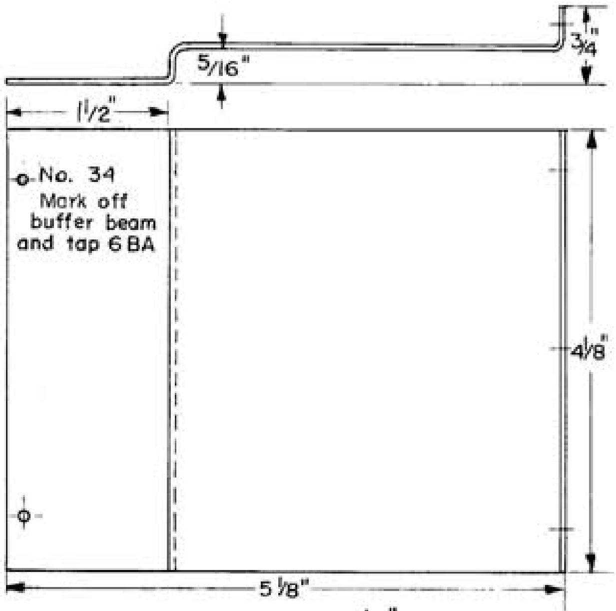
There is a small point worth noting before marking out the spectacle plate. If the lagging is carried right to the end of the firebox, inside the cab, then the cut-out for the firebox will be struck at 3½ in. radius; but if the builder prefers to finish the lagging in front of the spectacle plate, then the required radius of cut-out will be 3 in. exactly.

As for the "spectacles" themselves, my own preference is for glass, rather than perspex. 3/32 in. thick glass in this size is fairly strong, and this is held on to the inside by a thin frame, made from 1/32 in. thick brass sheet, held up to the spectacle plate with 12 BA roundhead brass screws, put into tapped holes in the spectacle plate, and filed off flush on the outside.

I do not think that I have referred to the question of how the boiler is held down at the rear end. The exact height of the boiler above the frames is determined by the saddle and smokebox, so no adjustment is possible at the front, once these have been made and fitted. All that is necessary, then, is to "jack up" the rear end of the firebox until the barrel is exactly horizontal, after which the



BOILER EXPANSION BRACKET



FRONT CENTRE PLATE 1/16" BRASS

four pieces of angle comprising the expansion brackets are made up and fitted. The drawing should make this quite clear. The lower angle—that is the one which is bolted to the frame, should butt up against one of the running board support angles, just clearing the trailing coupled wheel at its rear end.

The steps hardly require any description. They are made from 1/16 in. b.m.s. and are prevented from being pushed out of line by a slanting strip attached to the back and bolted to the frame at a convenient spot. The overall width across the steps should come out at very slightly less than the widest part of the engine, which as mentioned previously, is the expansion link bracket.

The original engines were fitted with three-link couplings at the front end; but I am not certain about the rear end. As they were not designed for fast "fitted" goods trains, I can see no reason for fitting screw couplings. In any case, Gresley was currently building his 5 ft. 8 in. 2-6-0's for coping with the fast goods of the period. Mild steel wire, 1/8 in. dia., is used for the links. A simple bending jig should be made up to ensure that all three links are exactly alike. The top link should be bent up to final shape and then opened out again just sufficiently to enable it to be put through the hole in the hook, closed again and then brazed. In fact all three links must be brazed or silver soldered, otherwise they will very quickly be pulled open in service. To make the job easier, fix the hook on to a suitable piece of steel bar, with a wire hook at the other end looped through the outer link, so as to pull the links out almost taut.

Buffers

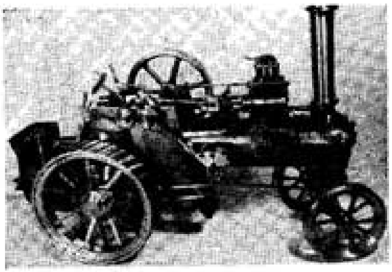
The buffers used by the old Great Northern Railway were of very simple design. Gresley used the Ivatt type on his earlier designs; the more elaborate type with the springs behind the buffer beam came in with the three-cylinder locomotives. They are straightforward turning jobs from free-cutting mild steel. The stocks are turned down to 3/8 in. dia. and threaded 26 t, to take a nut and washer at the back of the buffer beam, while six 6 BA screws—hexagon-head with 8 BA size heads—are put through the flange of the stock into tapped holes in the beam. The spindles are cut from 3/16 in. dia. silver steel threaded 2 BA at each end, and fitted with 2 BA nut and locknut on the back of the buffer beam. The springs are 16 s.w.g. and Messrs. Terry's of Redditch can supply something suitable—which will save us rather a tough job trying to wind our own. A drawing of the buffers and also the footsteps will appear in the next issue.

Returning now to the remainder of the boiler fittings, we need two blow-down valves, and the design of these follows the valves described for *Simplex*, using a loose bronze ball in a housing, instead of the more usual "needle" type spindle. The waste pipe, of 1/4 in. dia. copper, should be annealed, polished, assembled, and then bent to clear the back of the driving wheel, as shown. A special key may be made up to fit the spindle of the blow-down valves, which should be used after every run.

NEW NIGEL GRESLEY DRAWINGS

LO.936 Sheet 6. Brake gear, cylinder drain cocks, smokebox and details.

Sheet 7. Cab fittings, saddle, grate, ashpan, chimney, dome, running boards. Price **8s. 6d.** each.



THE "MODEL ENGINEER" TRACTION ENGINE

Built and described by L. C. Mason

Part XXXIII

Continued from page 447

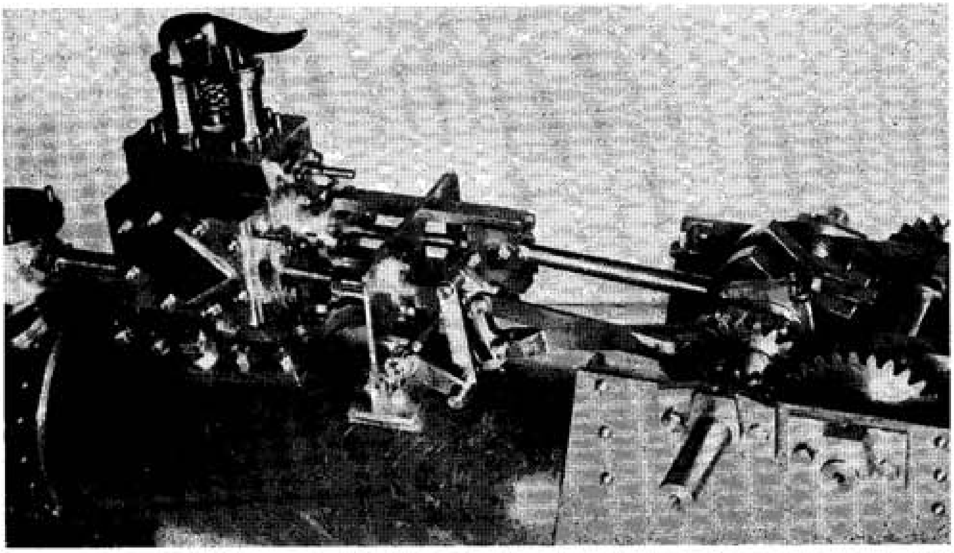
ECCENTRICS for model locomotives are conventionally made up using mild steel sheaves and cast gunmetal straps. This is fine so far as materials are concerned, but where the eccentrics are as conspicuous as they are on a traction engine, gunmetal straps do not look all that true to life. An alternative here, having good wearing properties, is a mild steel strap running on a cast iron sheave. Either type is equally easy to make, and it is up to you which you adopt. Just for the record, I used the mild steel/cast iron version.

First, dig out a stub end of $\frac{5}{8}$ in. dia. rod, or turn down $\frac{1}{2}$ in. or so on something bigger to serve as a gauge for the sheave diameter and the bore of the straps.

The sheaves are quite straightforward to machine, using either $\frac{3}{4}$ in. mild steel rod or cast iron stick. Face a short length in the three-jaw, and make a tiny centre indentation with the small centre drill. With the dividers set to $\frac{1}{8}$ in. radius, mark a circle on the end, using the indent as a centre. Mark in the full $\frac{1}{4}$ in. dia. circle, then when that is checked true to size the $\frac{1}{8}$ in. radius—which is the eccentric throw—must be reasonably true. Mark a centre punch dot somewhere on the circle, exactly on the line.

Both sheaves can be turned together to ensure producing a matched pair. Turn the $\frac{5}{8}$ in. dia. centre portions with the square ended parting tool, leaving enough of the full $\frac{3}{4}$ in. dia. between the grooves for parting off and light finish facing. The $\frac{3}{16}$ in. width of the grooves is too narrow to accept the normal micrometer anvil, so it is a case of careful feeling with the calipers, comparing the turned portions with the gauge piece. When both grooves are to size, transfer the piece to the four-jaw and get the punch dot on the $\frac{1}{4}$ in. end circle running dead true. Go in fairly deeply with the centre drill, drill in about $\frac{3}{4}$ in. deep with letter N or 19/64 drill, and D-bit to $\frac{5}{16}$ in. dia. Back in the three-jaw, part off each sheave separately, facing the outer side of the second one before parting it off. With careful light chucking you can just about hold each sheave to face up the parted side. In the middle of the groove at the point farthest away from the bore, drill through into the bore No. 44 and tap 6 BA. The sheaves will be locked on to the crankshaft by a 6 BA Allen grub-screw, $\frac{1}{4}$ in. long.

Cast straps will already be roughly to shape; for mild steel ones, a short length of $1 \times \frac{3}{16}$ in. b.m.s. bar provides the material. Mark out the shape of one strap on the end and where the split line comes

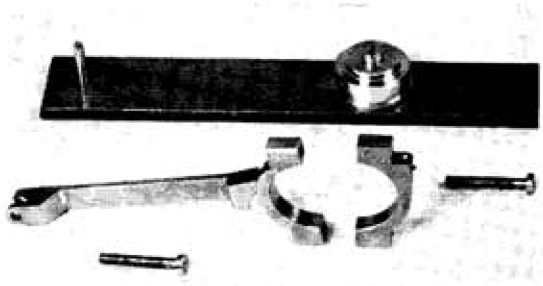


First assembly of the motion—made easier by the temporary omission of the front spectacle plate.

between the two halves, mark in two lines, as far apart as a saw cut will need. This is another case where by far the neatest result comes from making the cut with a slitting saw. File out four corner notches to produce the faces for bolt heads and nuts and mark in the bolt hole centres.

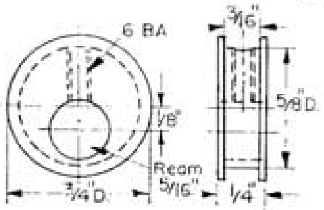
Starting with the smallest centre drill, drill the 3/32 in. bolt holes, going halfway through from each end. If you do it in the lathe, a short dummy centre turned on the end of a stub of ¼ in. rod and held in the tailstock chuck will hold the piece in line up to the drill.

With the holes drilled, saw the piece in half between the marked lines, lightly clean up the cut surfaces and bolt together again. Mark a centre punch dot exactly on the joint line in the middle, chuck truly in the four-jaw with the centre dot running truly, and drill through and bore out to a nice running fit on the gauge piece. Finish file to shape. Clamp under the toolpost or on the vertical-slide to mill the 1/16 in. flat on the lug for the eccentric rod and to drill the lubricating hole.

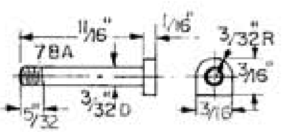


Eccentric rod with assembly jig.

The rods are shaped from strips of ⅜ in. × 1/16 in. mild steel, a full 2⅝ in. long. Start with the forked ends that embrace the expansion link. File up a couple of short blocks of steel 3/16 in. thick by a full ¼ in. wide for silver soldering to the rod end. When you have an appreciable area to be silver soldered to another surface, as in this case, a useful tip is to bump three centre punch dots on one surface. When the pieces are then clamped



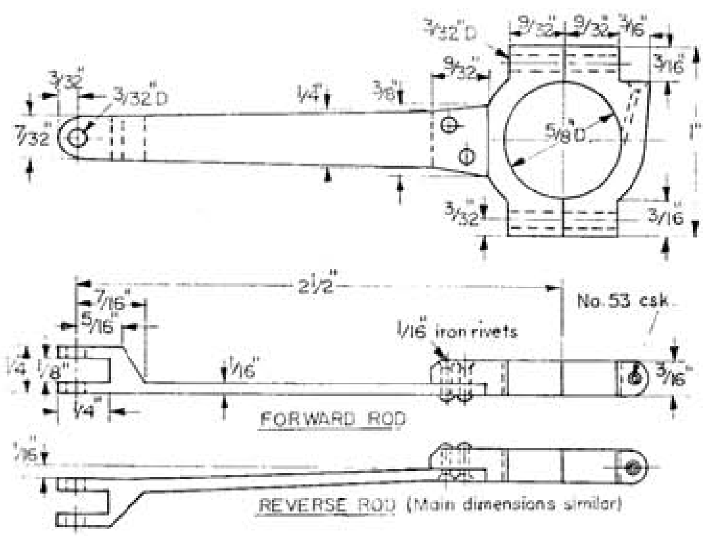
ECCENTRIC SHEAVE 2 OFF
C.I. WITH M.S STRAPS OR
B.M.S WITH G.M. STRAPS



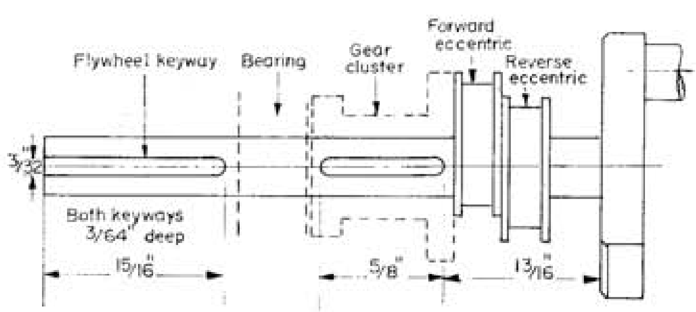
ECCENTRIC STRAP BOLT
4 OFF B.M.S

Die block L = 11/32" 1 off
Eccentric rods L = 11/32" 2 off
Lifting arm L = 3/8" 2 off
Expansion link L = 11/16" 1 off
Weighshaft cr. L = 9/32" 1 off

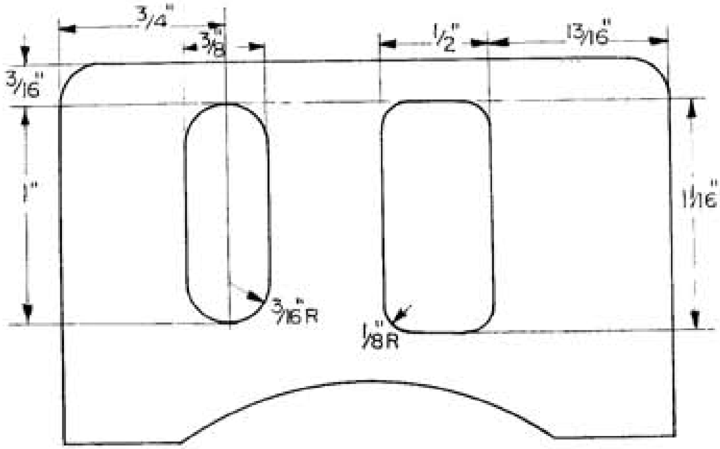
MOTION WORK PINS



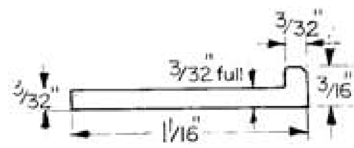
ECCENTRIC ROD



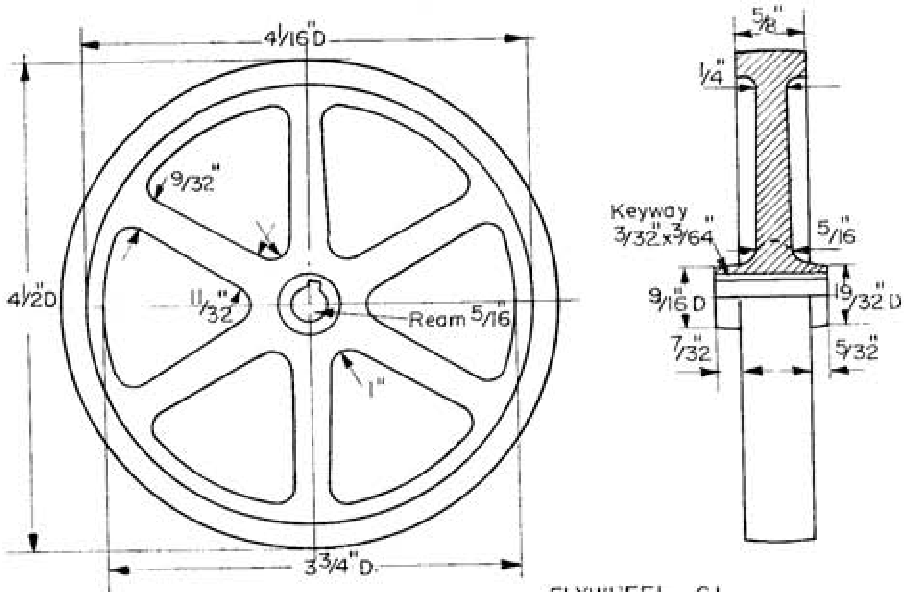
LOCATION OF CRANKSHAFT COMPONENTS



MOTION WORK APERTURES IN FRONT SPECTACLE PLATE



FLYWHEEL KEY
3/32" B M S



FLYWHEEL CI

together for silver soldering the tiny lips of metal thrown up around the punch marks stand the pieces just those few thou apart sufficient to let the solder flow freely between, making a thoroughly sound joint. When the blocks have been silver soldered on and the rod cleaned up, mark the centre of the pin hole and drill squarely 3/32 in.

The rod can now be clamped tightly with a toolmaker's clamp to the side of a lathe tool blank, held in the toolpost in the normal way, for cutting the slot forming the fork—again with the slitting saw. Round off the ends with the little $\frac{1}{8}$ in. packing piece and the $\frac{1}{4}$ in. buttons.

It is highly necessary that both rods should be the same length, and this is easily arranged by adjusting the rod length on a simple jig. On any odd stout strip of metal—say, $\frac{3}{4}$ in. × $\frac{1}{8}$ in.—mark out a couple of points $2\frac{1}{2}$ in. apart. Drill both No. 48 and tap 7 BA. Screw a stub of 3/32 in. rod about $\frac{1}{2}$ in. long into one, and in the other use a 7 BA bolt to screw down a slice parted off the $\frac{5}{8}$ in. dia. gauge—drilled centrally 7 BA clear, of course.

Peg the forked end over the 3/32 in. stub and mark the other end for cutting to length to fit the flat milled on the strap, the strap sitting over the

$\frac{5}{8}$ in. disc. Bend the $\frac{1}{16}$ in. sideways set in the lower rod before adjusting to length, else it will be fractionally short if this is done later. When adjusted to length, rivet the rod end to the strap lug with a couple of $\frac{1}{16}$ in. iron rivets, countersinking the ends and filing flush. Do not bother to use a proper dolly to support the rivet heads, but rest them on a flat surface; this will produce a neat flattened " pan head," taking up little room. Note that the rivet heads come on the outside of the rod in each case. Finally finish file to shape.

If the connecting rod and the completed eccentrics are now fitted up, the eccentrics can be adjusted on the crankshaft so that everything lines up squarely, allowing the shaft to take up its proper position between the bearings. This in turn enables the shaft to be marked exactly where the keyways for the gears and flywheel should come—if you have not already cut them.

Cutting the keyways is a straightforward end-milling job on the vertical-slide, using the 3/32 in. cutter as for the other shafts. The key in the gear cluster is a parallel one, tightly fitted.

A job held over from the early stages could now be completed, and that is cutting the clearance slots in the front spectacle plate for the connecting rod and eccentric rods. The drawing shows the sizes and locations as they come for my plate, but in case you differ slightly, the holes could be cut undersize for a start, and then opened up to provide symmetrical clearances all round the rods.

The flywheel is an iron casting, again straightforward machining. After a rough clean-up, it can go either in the three-jaw or on the faceplate, clipped down over the spokes. If you machine it in the chuck, it is highly unlikely to run truly straight off, but by gripping it with the inside jaws inside the rim you can probably find one place where it runs truer than anywhere else. Little pieces of thick paper or card packing under one or more jaws should soon get it running pretty true.

Held in this way, you can machine the outside of the rim, the outer rim edge, the hub and the bore all at the one setting. It can then be reversed in the chuck, holding it over the outside of the rim, but only halfway into the jaws for facing the other side of the rim and planing the keyway. To be correct, the rim should be slightly " crowned," i.e., the surface is slightly convex for use with a belt on the rim, and this can be done either by filing with the wheel mounted on a true-running mandrel, or by the use of a hand graver. The rim should be very smoothly finished—a sort of " dull polish "—and you can get this effect by using progressively smoother grades of emery cloth while running in the lathe, finishing up with the last application using it oiled.

The flywheel is held on the crankshaft by a gib headed key, which allows of it being withdrawn for removal of the crankshaft. This could be very slightly tapered in depth so that it taps in tightly before the head contacts the end of the wheel hub.

The flywheel is fitted on the crankshaft so that the end of the hub protruding farthest goes next the bearing, standing the rim of the wheel far enough away from the hornplate to clear the steering shaft. The positions of the gear cluster and flywheel on the crankshaft regulate the crankshaft end float.

With all these various components fitting together nicely, the way is now clear for finishing off another little postponed job, and that is drilling the holes in the gear lever bracket for the locking pin. With the crankshaft gear cluster and flywheel in position, you can locate the three positions for the second shaft gears exactly, spotting through the lever for the pin holes in the bracket.

To be continued

RECORD REVIEWS

" North British Engines "
Argo Transacord. Mono EAF 148. 45 r.p.m.

This recording was made in Scotland and includes the sounds of some well-known N.B. and L.N.E.R. locomotive classes. They include C.15 4-4-2 tanks, " Glen," " Scott " and " Director " class 4-4-0's, V.3 2-6-2 tanks, 0-6-0's of class J.36 and a standard Class 5.

" The Railway to Riccarton "
Argo Transacord. Stereo ZTR 126. 33 r.p.m.

A recording, made in 1961, of ex-L.N.E.R. steam locomotives at work on the " Waverley " route, between Steele Road and Riccarton Junction, at Stobs and at Hawick.

Among the locomotives heard are A.3 class " Pacifics," V.2's, B.1 4-6-0's and K.3 " Moguls."

" The Knotty," a Musical Documentary
Argo Transacord. Stereo ZTR 125. 33 r.p.m.

This is a musical documentary about the great days of the railways, and in particular the North Staffordshire Railway—" The Knotty "—from the stage coach era to the railway amalgamation of 1923. It has been adapted from Peter Cheeseman's 1969 production of " The Knotty " for the Victoria Theatre, Stoke-on-Trent, with the cast of the theatre and the voices of railwaymen who worked on the North Staffordshire Railway.

An interesting and unusual record.

" Steam in the Worth Valley "
Argo Transacord. Mono EAF 149. 45 r.p.m.

A recording made recently on the Keighley and Worth Valley Railway. The locomotives heard include " Black Five " No. 45025, J.72 class 0-6-0 tank No. 69023, 0-6-0 saddle tank No. 63 and " U.S.A." class 0-6-0T No. 72.

A Decade of Progress at Guildford

G. F. Asplin reports on the Guildford Model Engineering Society

IN 1959, the 24 members of Guildford M.E.S. were without good club facilities and a permanent live steam track, so they approached the local council to try and obtain a new site with room for a club house and a live steam track.

Their quest was successful, and as shown in the photographs, the pick and shovel brigade were hard at work that year, the foundation stone being laid by the Mayor of Guildford on October 3, 1959, and the shell of the building being completed by the end of that year. During the winter of 1959-60, the sections of the live steam track were assembled in the club house, and track laying was completed during 1960, to provide a track approximately 660 ft. in length.

As originally laid, the steepest rising gradient was 1 in 43, and this proved very difficult for passenger hauling and the operation of small locomotives, which were in a majority. The only 5 in. gauge locomotive available for passenger hauling at that time was the Halton tank *Taurus*.

By 1962, the membership had increased to 40, and there had also been a steady increase in visitors on open days. To ease locomotive operation, it was decided to construct a cutting and reduce the maximum rising gradient to 1 in 65. The pick and shovel men were again busy during the winter of 1962-3, when the cutting was completed and automatic colour light signalling installed. The signals protect the arrival and departure platforms and the swing bridge to the steaming bays. In 1965, a station was built; this serves as a ticket office and a store room for passenger trolleys.

At the same time as the live steam members were improving the outdoor track, the 4 mm. enthusiasts were busy constructing a permanent layout in one half of the club house. This is a circular layout of approximately 14 ft. diameter, and is laid out to provide continuous running.

In 1966, it was decided to make radical changes to the live steam track. A new design of turntable was built to provide easier access to the steaming bays, and the lifting section of the track was replaced by two swing gates, complete with the necessary locking devices. During the winter of 1966-67, the cutting was deepened, and other parts of the track were raised, so that the ruling gradient is now 1 in 100. The gradients make for interesting driving, but are not steep enough to make locomotive operation difficult.

By 1967, the membership had increased to 58, and the amount of room then available in the open part of the club house was insufficient for meetings, film shows, catering on open days, etc. Early in 1968, it was decided to enlarge the club house by building a new kitchen and store room. Plans were drawn up and approved, and during one of the few fine weeks during that very wet year, two members completed the outer structure. Since then, the interior has been completed and the Society now has a large well-equipped kitchen which enables the catering staff to cope with the provision of refreshments for the ever increasing number of visitors.

The Society's summer programme for open days, etc., is to hold them on the third Sunday of June,

The Guildford clubhouse under construction in 1959.

July, August, September. In 1968, the first Model Traction Engine Rally was held in conjunction with the July Open Day. This event was so popular, with both visiting traction engine owners and visitors, that it will become an annual event.

Another regular feature has been a two-day exhibition in September. This year however, due to rising costs in tentage, etc., the exhibition will be held later in the year as an indoor event only. So, at the end of ten years, the Society has a membership of 65, with the likelihood of a steady increase, a well equipped club house, a permanent live steam track, and a 4 mm. layout with track circuiting, stations and all lineside features. The operation of this layout is always a popular feature on Open Days. The number of visitors attending our Open Days has increased in recent years, and the three available 5 in. gauge locomotives, the Halton Tank, a *Maid of Kent* and a *Speedy* are hard worked on these days. 1970 will see a 5 in. gauge "Hall" in steam, which will be an interesting addition.

In 1969, a gauge "O" section was formed, which has an ever increasing number of enthusiasts who are busily constructing a portable layout, the highlight of which is a girder bridge. No doubt, in the near future, gauge "O" live steamers will be in operation; at least one member is building the M.E. *Royal Scot*.

The future will be mainly a period of consolidation, with improvements to track drainage, an addition to the club house to provide accommodation for the gauge "O" layout and other equipment, completion of the steaming bays with compressed air, water and electricity available at each bay, and other detail improvements. With major construction work complete for a time, more time will be available for social activities, a comprehensive summer and winter programme, and for model activities.

Club members are busy finishing *Ajax* the club locomotive, which together with an *Ajax* chassis recently donated will, when finished, provide a useful addition to the live steam stud. Many models are under construction, the majority being locomotives in gauges from "OO" to 5 in. and including a "Schools," *Springboks*, *Speedys*, Stirling "Single," *Maisie* and many others. Other members are constructing such varied models as a traction engine, 4 mm. rolling stock, stationary engines, internal combustion engines and model cars—a really wide selection. ▣

NOTES ON CYLINDER COCKS AND INJECTORS

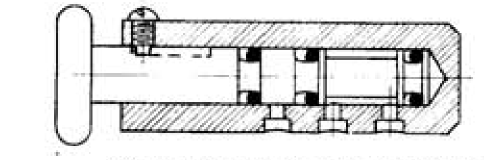
by Jim Ranford

Since the publication of my article on steam operated cylinder cocks in *Model Engineer* in November 1968, several queries have come to hand. Strangely enough these have been in relation to the control valve. I had assumed that previous contributors would have dealt with this adequately and I didn't bother to go deeply into this aspect, except to point out that an exhausting type of valve was necessary.

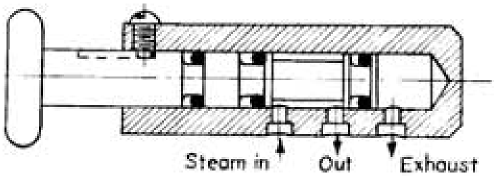
The types that I used on my engines, although doing the job, had a tendency to leak, there being such a small bearing surface between the ports, and were difficult to lap effectively. In an effort to overcome this problem and particularly in view of the possibility of devising a leak-proof system for air brakes, I considered incorporating O rings in a control valve; it occurred to me that a system along the lines of a simplified piston valve might serve the purpose. A prototype was made which proved very satisfactory and, besides being absolutely leak-proof, was considerably easier to make. Whether or not I can claim any originality, as far as I am aware the one I have evolved has not been described in *Model Engineer* before. Its simplicity and ease of manufacture, as well as its leak-proof quality, I consider a great asset and worth bringing to the attention of other enthusiasts who might be contemplating the use of such a device.

The minimum stock size O ring has a bearing on the diameter of the "piston" which is ¼ in. Travel is only important to the extent that the relevant ports are opened or closed in their correct sequence. The method of operation is optional; I used a cam arrangement so that it was in keeping with the cab layout, but a lever would be just as effective and could be left to individual requirements.

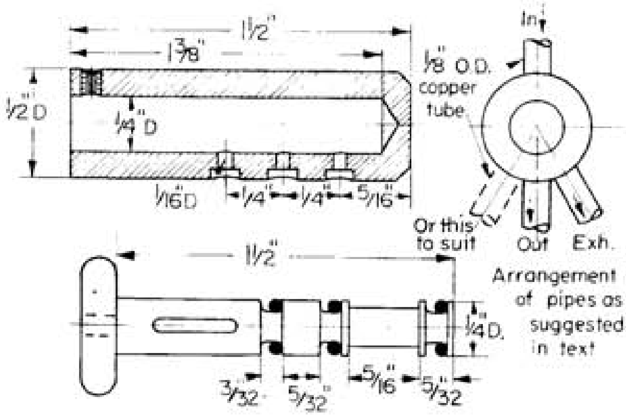
A piece of ½ in. dia. brass with a ¼ in. hole drilled 1⅜ in. deep forms the body. Holes for outlet to cylinder cocks, steam inlet and exhaust are shown in line for clarity but their position on the periphery of the body is optional and can be placed to suit the circumstances encountered in the cab layout or as illustrated in the sketch. The important thing is to have them the right distance apart *longitudinally*. In the instance shown it is ¼ in. pitch but this could be varied so long as the grooves and lands on the piston are made to suit and the amount of travel is adjusted accordingly. The sketches shown illustrate the dimensions used in the one on my engine but one was also made with $\frac{3}{16}$ in. travel which proved quite satisfactory.



CYLINDER COCKS OPEN POSITION



CYLINDER COCKS CLOSED POSITION



The piston or sliding part, for want of a better term, is a simple turning exercise and the grooves are made in accordance with the requirements of the O rings, in this case 3/32 in. wide and .057 in. deep. Pitch is naturally governed by the pitch of the holes, as the illustrations show. A good way to see what happens is to draw on separate pieces of paper a sketch representing the body with its holes at the required pitch and another showing the grooves and O rings. Place these together and slide them in a similar manner to the operation of a slide rule and the whole picture of operation will becomes obvious.

My method of operation is to twist approximately one turn, thus moving the piston, in or out as the case may be, a distance of 1/4 in. This is achieved by a groove formed by milling with the end of a slocombe drill (good tip here) set up in a small toolpost milling attachment. The lathe is set up to cut 4 t.p.i. and the mill is fed into the job by the cross-slide. Operation of the lathe is by hand and from the lead screw as the gearing is more suited for driving in that manner for this particular purpose. I found this a very effective and simple method of forming what is virtually one turn of a very coarse thread. A simpler method of operation would be to mill a straight slot, instead of the foregoing, to engage the end of the set-screw and use the simple push-pull motion used in some electric switches.

Digressing for a moment if I may, and since O rings are the essence of the exercise, I find them one of the greatest innovations for the model engineer in many a long year. I have used them to great advantage, as many others have done, for such things as piston rings, sealing in place of packing glands, seating in clack-valves and even injectors and also to make a more efficient non-return valve for the water pump in my caravan. Food for thought ?

Mounting in the cab can be achieved by a circular clamping arrangement or, as I have done, by support by the pipes only, unorthodox perhaps but evidently quite adequate.

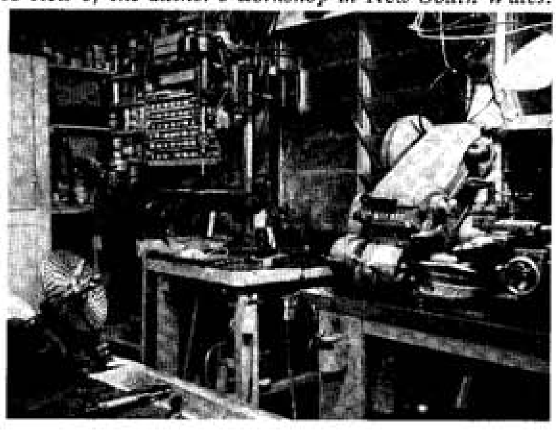
I have not yet had the opportunity to try the idea as, say, a steam or air brake valve but it should work satisfactorily. The only doubt in my mind is whether or not there would be adequate control. Only experiment would determine this and for the time being I must leave this for others to toy with.

Operating injectors

To obtain the best results from an injector due regard should be given to the following points:

1. It is absolutely imperative that there be no air leaks in the water feed line; also place the injector in an accessible position on the engine, not under the footplate where it will get hot.
2. Sharp bends and any other form of restriction in the feed water line must be avoided.
3. Plug type cocks are not recommended, they have a tendency to leak air when slightly worn.

A view of the author's workshop in New South Wales.



4. It is preferable for the water valve to be placed in a sump below the bottom of the tender so that it is always immersed in the water. (This reduces the possibility of air leaks).
5. Always maintain caps on the injector and water unions when not in use to prevent the entry of foreign matter and also incorporate a filter at the control valve.
6. It is advisable to take the injector off the engine when not in use and store it in vinegar and water (say 50-50) to prevent the accumulation of water impurities on vital places in the injector. This is particularly so of some water supplies. If these deposits do gather, a 24 to 48 hour soaking in the dilute vinegar will usually remove them. A pointed match can be used in the cone throats to help. Steam and delivery cones must be removed to do this.

All testing has been carried out with water at 70 deg. F. The performance will vary as this temperature varies: above it will fall off and below it will improve. As the temperature of the water rises or the steam pressure falls, dribbling will occur at the overflow but the injector will still work within certain limits.

To operate: *turn on the water first*, wait a few seconds, say, three or four, then turn on the steam fairly quickly and fully as usually a good flow of steam is required. The few seconds wait is to ensure that water is flowing freely from the overflow. If the injector does not pick up, turn off the steam and try again. If dribbling is evident or water is running from the overflow, adjustment will be necessary by slowly closing the water valve. *This adjustment is invariably required.* If the stage is reached where it is almost closed and spluttering begins, a quick "off on" flick of the water valve will usually seat the ball valve and start the dry feed. The same result can be achieved by pinching the water feed tube quickly between the thumb and forefinger. Both methods induce a water hammer effect which slams the ball valve on to its seat and provides a good seal. So-called flicking the water feed valve is sometimes used on full-size injectors to start them.

As the boiler pressure decreases so the water valve will need adjusting as before by slowly closing to maintain a dry feed. This is only desirable and not essential as the injector will continue to feed despite the dribbling. If this does not stop it, try throttling back the steam; some adjustment can be made this way. If it still persists then the water is too hot or the pressure is too low and no adjustment can be made. This does not necessarily mean, however, that the injector is not feeding.

It is advisable to place a clack valve at the injector as well as the one at the boiler, especially where the delivery line is long. This overcomes the possibility of an air cushion forming in the feed pipe and causing erratic starting.

Once the injector has worked satisfactorily and found to be O.K. it should always maintain the same performance and any failure to do so can usually be attributed to one or more of the following:

1. Ball valve sticking or not seating properly. (This is the most frequent cause of failure after having been out of use for a while and is usually caused by deposits of impurities in the water.)
2. Deposits of impurities on the cones. (The vinegar treatment and the pointed match referred to is the treatment indicated.)
3. Foreign matter in the cone throats; soot, ash, etc. (Usually occurs during running.)
4. Air entering the feed line. (Evidenced by spluttering at the overflow.)
5. Water too hot or pressure too low or too high. (Evidenced by water pouring or squirting from the overflow. Quite often the injector will still be working, but not efficiently.)
6. Injector too hot. (Place on the outside of the engine where air can circulate and help to keep it cool.)

Remember this: air enters the boiler via the clack valves as it cools down and you can bet your bottom dollar that it will draw in some ash or soot, etc., into the injector in the process, so keep those caps on. ▣

BOOK REVIEW

"Engineering Workshop Exercises" (Books 1 and 2). *By C. Chandler and R. Cumber. Forrest Publishing Co., Porlock, Somerset.* **5s. 0d. each.**

These books, which are primarily intended to assist students or apprentices preparing for metalwork examinations, contain exclusively line drawings of the various items, with no explanatory text. A special feature of the drawings is that all dimensions are in metric terms. They represent utility appliances and devices for use in the workshop; most of these are of a familiar type, such as clamps, V-blocks, gauge fittings and calipers, but others are of a more advanced or specialised nature, such as extractors for gears, pulleys and ball or roller races, presses, assembly vices and ratchet spanners.

While all the drawings are clear and accurate, a minor criticism is that in most cases they define only the individual details of the appliances, omitting general arrangements to show how they are assembled. This is no disadvantage in class work which is carried out under supervision, but may present problems to the individual worker. The reliance entirely on drawings or other illustrations, in this and similar publications, is in line with modern tendencies, but one cannot help thinking that such books would be improved by a certain amount of explanatory text about the items and their uses. E.T.W.

SOFT SOLDERS

R. W. Inkster

A RECENT VERY GOOD ARTICLE in *Model Engineer* says, apropos the fitting of locomotive firebox stays, "All these should for preference be run over with best-grade silver solder, but if this is out of the question, use a high-melting point soft solder. On no account use ordinary tinman's or plumber's solder on the stays."

This advice is sound as far as it goes, but leaves so much unsaid that a few words on the subject of soft solders generally may be of interest to readers.

The majority of soft solders are alloys of tin and lead, and can be in any proportion from, almost, pure tin to pure lead, with or without the addition in some cases of a little antimony. The antimony increases the strength and hardness of the solder to some extent, but antimonial solders should not be used where zinc or galvanising are present.

Solder comes in a number of forms, the commonest being Plumber's, in approximately 1 lb. bars, Tinman's in 8-oz. or 4-oz. sticks (Note: the term "Tinman's" refers to the size of the stick rather than the quality), Blowpipe strips, Flux-cored Wire, Solid Wire, and Ingots.

The eutectic tin/lead alloy (i.e. with the lowest melting point) is 62 per cent tin, 38 per cent lead, and this alloy melts and solidifies at virtually the same temperature, 183 deg. C. All other alloys have a greater or lesser melting range, the lower being known as the *solidus* and the higher as the *liquidus*. Between the two the solder is in a pasty or plastic condition. It cannot be too strongly stressed, however, that all tin/lead solders commence to lose strength at temperatures well below the solidus.

Now, here is the nasty bit! *All* tin/lead solders have virtually the same solidus, varying only between 183 deg. C. and 185 deg. C.; the liquidus varies considerably, but for our sort of use only the solidus is of interest.

As for the proportions of tin and lead, there is an ideal solder for every use. For example, plumbers require a wide pasty range and an alloy of around 27 per cent to 30 per cent tin is used (185 deg. C. to 250 deg. C. approximately). This enables lead pipes, cable ends, etc., to be "wiped" efficiently and easily. Such solders are also widely used for "filling" motor car body shells prior to spraying. The epoxy resin fillers are not generally considered a satisfactory substitute for body filling metals, at least in the manufacturing stage.

For general "tin-bashing" a 40/60 to 50/50 alloy is normally quite satisfactory. Note that the alloy is always described by percentages of tin and lead, with the tin first.

For electrical connections and the very fine work often done by model engineers it will be found advantageous to use a 60/40 or 65/35 solder. These are very free-running alloys and a pleasure to use, but the high tin content, of course, causes greater wear on solid copper soldering-iron bits, but not on the modern copper-iron bits. Some solders are made with about 4 per cent copper inclusion to combat this "bronzing," but I am personally not convinced of the protective effect and feel it is somewhat of a gimmick. For really speedy bronzing of an electric iron bit an 80/20 is superb!

A great many soft solders conform to British Standard Specification 219/1959, and an abbreviated version is given below.

Grade	*Tin per cent*	*Melting Range deg.C.*
A	65	183-185
K	60	183-188
B (Sb)	50	185-204
F	50	183-212
M (Sb)	45	185-215
R	45	183-224
C (Sb)	40	185-227
G	40	183-234
D (Sb)	30	185-248
J	30	183-255

(Sb denotes antimonial solder)

The uses of solder in industry are legion—the writer handles up to 90 tons per month!—and part of the solder maker's art is to provide the user with a solder that will do the job satisfactorily, and at the same time as cheaply as possible. With tin at £1,650 per ton at the time of writing, it will be appreciated that even a one or two per cent reduction in the tin content will represent an appreciable saving where large quantities are used. The solder maker can frequently suggest alterations in technique which will enable a lower grade to be used.

So far we have dealt with tin/lead solders only and it is probable that the only soft solders which the model engineer will be able to purchase easily will be somewhere within this range; the only way in which one will differ from another as far as the boiler stays are concerned will be in the ease with which they can be applied—and in the price!

There are, however, in BSS 219 three rather exotic solders for use at higher temperatures, e.g. soldering leads to heavy-duty commutator bars, etc. These are known as 95A, with 95 per cent tin, 5 per cent antimony approx., with a maximum of 0.07 per cent lead, 5S, with 5 per cent tin, 1.5 per cent silver, balance lead, and 1S, similar to 5S but with only about 1 per cent tin. The melting points of these are:

95A	236-243 deg. C.
5S	296-301 deg. C.
1S	309-310 deg. C.

They are rather more difficult to use than tin/lead solders, becuase of the higher temperatures involved, and a more active flux may be required. Also, for obvious reasons, they are very expensive solders, and will not be readily available to the small user. I would imagine that, if there is a demand, the best way of satisfying it would be for clubs to approach a solder manufacturer and purchase, say, a 1-lb. reel of 95A wire, or a small quantity of 5S or 1S in wire or needle-blowpipe form, and re-sell to members. Most solder manufacturers would be happy to supply such amounts.

As this article is about solders rather than soldering, I do not propose to dwell greatly on techniques, as these will vary as widely as do the types of work which model and experimental engineers are called upon to do. I will, therefore, confine myself to reiterating the old advice—clean work, enough heat, suitable materials and a well-tinned iron. If a blowpipe flame is used instead of an iron, the job will be simpler and more elegant if you can organise a reducing flame rather than an oxidising flame. For electrical work or very fine work which will subsequently be painted avoid Bakers Fluid or similar liquid fluxes, and use a reputable activated resin paste flux. Residues of the latter are more easily removed and in any case are less likely to initiate corrosion.

Earlier in this article I mentioned the binary eutectic alloy, 62 per cent tin, 38 per cent lead. By using ternary and quaternary eutectics, etc. (i.e. three, four, etc., metals), and fiddling about with the proportions, some interesting alloys can be obtained. A few examples are as follows, including one exotic binary eutectic.

Wood's Metal, composed of Tin, Bismuth, Lead and Cadmium, melting point 70 deg. C.
Cerrolow 117, Tin, Bismuth, Lead, Cadmium and Indium, melting point 47 deg. C.
Binary Eutectic of Tin and Gallium, melting point 20 deg. C.
Ternary Eutectic of Tin, Gallium and Zinc, melting point 17 deg. C.

Apart from mercury, the last has the lowest melting point of any metal that I know.

Finally, it may surprise many readers to know that an aluminium solder is used by the various Electricity Boards by the ton for tinning aluminium cables, now so widely used on account of lightness and the high price of copper. These solders are a tin-lead-zinc alloy, and their use requires rather peculiar techniques and a special flux; joints so made also require to be sealed off from the air to avoid after-corrosion setting in, so I am afraid that they do not really mean the advent of easily-joined aluminium as a constructional material for model engineers. ▣

CLUB DIARY

Dates should be sent five weeks before the event. Please state venue and time.

May 17 Huddersfield SME. Open day at Highfields, Locomotives and Boats.

May 19 Sutton Coldfield & N. Birmingham M.E.S. Lecture: "British Rail Diesel Locomotives," by Mr Crisp. 286 Brookvale Road, Birmingham 23. 7.30 p m.

May 20 Bristol SMEE. Slides and Films by D. Williams. Unitarian Hall, Lewins Mead, Bristol 1. 7.30 p.m.

May 21 Glasgow SME. Auction night. St. Peter's Primary School, Stewartville Street, Partick, Glasgow. 7.30 p.m.

May 23 Witney & West Oxfordshire SME. Annual open day, Blenheim Park. Tickets for entry to the park are available from Mr R. C. H. Chilton, 41 Waverley Avenue, Kidlington, Oxford.

May 23-25 Whitchurch & District MES. Bank Holiday Exhibition. Club Headquarters, Highfield Road (off Lake Road West), Roath Park, Cardiff. 2-8 p.m. (Sat. & Sun.); 10 a.m.-8 p.m. (Mon.).

May 24 Ardeer Recreation Club. Track open day. Ardeer Recreation Club, Stevenston, Ayrshire.

May 24 Bracknell & District MRS. Public passenger carrying on Jocks Lane track. Jocks Lane, Bracknell, Berkshire. 3-6 p.m.

May 24/25 National Traction Engine Club. Rally at Husbands Bosworth Airfield (Welford Rally). Details from Mrs. P. A. West, 4 Adam and Eve Street, Market Harborough, Leicestershire.

May 24/25 National Traction Engine Club. Rally at Beaulieu. Details from B. Johnson, 24 Sheridan Road, Worthing, Sussex.

May 24/25 National Traction Engine Club. Rally at Burton Constable. Details from J. R. Chichester, Burton Constable Hall, Nr. Hull, Yorkshire.

May 25 Cambridge & District MEC. Public track day at H.Q., Fulbrooke Road, Cambridge.

May 27 Devizes MES. Illustrated talk by Dr Hancock on the Kennet & Avon Canal. Hare and Hounds, Hare and Hounds Street, Devizes, Wilts. 7.30 p.m.

May 30/31 National Traction Engine Club. The Bath Lions Festival Rally. Details from David C. Polson, 105 Penn Hill Road, Weston, Bath.

May 31 Crawley Model Engineers. Track day at Goffs Park, Crawley. 2.30 p.m.

June 2 S. Cheshire Live Steam Society. Talk: Foundry Work. Shavington Social Club, Shavington, Cheshire. 7.45 p.m.

June 2 Sutton Coldfield & N. Birmingham MES. "Other People's Jobs." 286 Brookvale Road, Birmingham 23. 7.30 p.m.

June 3 Bristol SMEE. Club affairs and "Brains Trust.' Unitarian Hall, Lewins Mead, Bristol 1. 7.30 p.m.

June 3 Portsmouth MES. General meeting. Y.M.C.A., Penny Street, Old Portsmouth. 7.30 p.m.

June 5 East Sussex Model Engineers. "Workshop Practice," lecture and demonstration. Mercatoria Hall, Mercatoria, St. Leonards-on-Sea. 7.45 p.m.

June 5 Model Engineers' Society (N. Ireland). Practical demonstration of clock assembly by Mr Robert F. Barfoot, C.M B.H.I. Transport Museum, Witham Street. Belfast. 7.45 p.m.

June 5 Romford MEC. Competition night. Ardleigh House Community Association, Ardleigh Green Road, Hornchurch, Essex. 8 p.m.

June 6 Derwent Valley Railway. Annual Garden Fete and public open day. Rowlands Gill, Co. Durham. 2-6 p.m.

June 6/7 National Traction Engine Club. Rally at Chivenor, Devon. Details from J. G. Burt, 17 Toronto Road, Exeter, Devon

June 7 Bracknell & District MRS. Public passenger carrying at Jocks Lane track. Jocks Lane, Bracknell, Berkshire. 3-6 p.m.

June 7 Crawley Model Engineers. Open day. Visiting locomotives welcomed. 1.30 p m.

June 7 Brighouse & Halifax SMEE. Club visiting day. Ravensprings Park, Cawcliffe Road, Brighouse

June 7 Colchester SMEE. Track day. Clubhouse, Old Allotments, Lexden. 10 a.m.

June 7 Devizes MES. Visit to Crofton Pumping Station. Meet in Devizes Market Place. 2 p.m.

June 7 York City & District SME. Public running day. Track at Moor Lane, Dringhouses, York.

June 12 Brighton & Hove SMLE. Annual general meeting. Elm Grove School, Elm Grove, Brighton. 8 p.m.

June 13 Brighton & Hove SMLE. Annual charity track day (proceeds this year to Centenary Appeal for Research into Children's Diseases). Hove Park.

June 13 SMEE. "Bits and Pieces," Marshall House, 28 Wanless Road, London S.E.24. 2.15 p.m.

June 13/14 National Traction Engine Club. Hungerford Town Hall Restoration Fund Rally. Details from J. L. Newton, Oak Lodge, 8 Salisbury Road, Hungerford, Berkshire.

June 13/14 National Traction Engine Club. Rally at Puttenden Manor, Lingfield, Surrey. Details from Mrs. Y. V. Hanmore, "Woodcote," Wannock Road, Polegate, Sussex.

Repairing a four-jaw chuck

by R. Knee

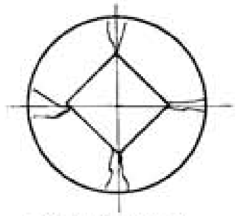


FIG. I

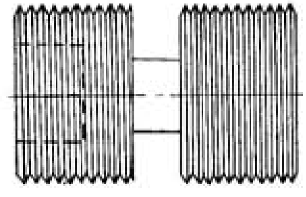


FIG. 2

A FREQUENT FAILURE on four-jaw lathe chucks is the cracking of the jaw adjusting screws, from the corner of the square key holes outward as shown in Fig. 1.

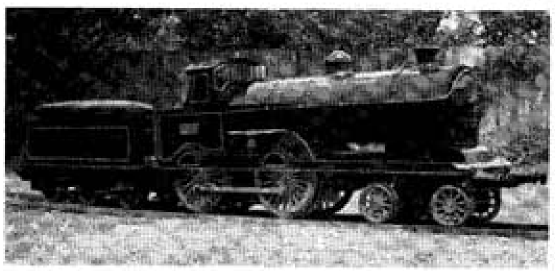
This aggravation besets both amateur and professional turners; regrettably the root cause is trying to snatch the lost ½ thou when "clocking" a job true. Two of my chuck screws were thus afflicted, but still operational, until one night when, with a full evening's programme lined up, I administered the final, fatal twitch which resulted in the key rotating in its once square hole, and two screws spread and immovable. The usual remedies were tried, various penetrating oils and releasing agents having no effect; heat was considered and turned down for obvious reasons. Drilling out was of no avail, high-speed drills refused to touch the tough steel. The makers were approached, and told me, with a candour for which I was grateful, that a repair by themselves would probably amount to at least the price of a new chuck ! They also informed me that the square socketed screws are now considered obsolete, being superseded by hexagon type, as Allen screws.

The ball now being fairly back in my own court, I sought for some form of drilling or boring tool to cut away the offending screws.

About to try brazing a bit of tungsten carbide on to a silver steel rod, my eye lit on a humble ¼ in. masonry drill lying on the bench. I reground the rather bluff cutting edge on my green grit wheel, giving it the usual angle and backing off which one would give a HSS drill for cutting mild steel. The chuck was clamped on the drilling machine table by means of bolts through the body (backplate having previously been removed) to my lathe angle plate which in its turn was bolted to the table. Using bottom speed, after a rather "graunchy" start in the remains of the square holes, I successfully drilled a clean hole through both screws.

As the screws on my chuck are standard ½ in. Whit., a 13/32 in. masonry drill, borrowed from work and ground as previously mentioned, soon reduced the offending screws to a spiral which could be picked out with a scriber. A ½ in. Whit. tap was then passed through to clear some slight bruising of the threads in the body. The modern type hexagonal drive screws were soon made by obtaining four ½ in. Whit. Allen grub-screws, and setting them up in a tapped and split bush in the three-jaw chuck for facing off to appropriate length and turning the driving groove to engage the tongue of the chuck jaw. For these operations tipped tools were found to be necessary. An appropriate key was made by brazing a short piece of Allen key of suitable size into a hole in the end of a piece of ⅜ in. round mild steel, cross drilled and fitted with a ¼ in. dia. handle.

I have refrained from going into dimensional details, as these will of course be determined by individual chucks, but I have found to my surprise that masonry drills come in 1/64 in. sizes, which gives a universal application for this method of repair. ▣



A "George V" in New Zealand

IT WAS JUST OVER two years ago that Mr S. Compton of Palmerston North, New Zealand, obtained drawings of the 7¼ in. gauge *George the Fifth*. In starting this project, Mr Compton was fortunate in obtaining a set of castings imported into New Zealand in the thirties ! It was his first attempt. Some of the drawings were missing, but among them was one of the Greenly-Joy valve gear. He was able to plan the general outline of the locomotive with the aid of a general arrangement that I sent to him at that time. It will be noted that the cab roof is shorter than the original, it being more convenient when driving. (In a letter to me Mr Compton observed that "I don't like cut-away roofs.")

The boiler was supplied with the castings and is riveted mild steel. He fitted a new grate with a

50/50 ratio of bar and gap, but with the fuel he has been using (unspecified) Mr Compton concluded that he could have cut down on the spaces as he found that the boiler steamed better when the bars began to choke with clinker !

At a recent local festival *George the Fifth* was put into service on the track owned by the Wanganui Model and Experimental Engineering Society, to the delight of scores of children. Incidentally, as a sign of the times, Mr Compton has this to say about the modern child:

"Do you know modern children do not know what a steam locomotive is or that not so long ago steam was the prime-mover on rails ? I have to explain every time that it is water I am putting into the tender—not petrol !"

Whilst the cylinders provided plenty of tractive effort, additional dead weight had to be fitted under the footplates to improve adhesion and hauling capacity. No less than 45 lb. were added.

The early historic types of locomotive also interest Mr Compton and he is now contemplating building "Locomotion No. 1" of 1829 to the same gauge. Now that would indeed give the children of North Palmerston something to talk about !

Mr Compton hails from Birmingham where he served his engineering apprenticeship nearly thirty years ago.

E. A. STEEL

READERS' QUERIES

★ 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 send a stamped addressed enevelope with each query and enclose a current query coupon from the last page of this issue.
★ Replies published are extracts from fuller answers sent through the post.
★ Mark envelope "Query," Model Engineer, 13-35 Bridge Street, Hemel Hempstead, Herts.

Lapping process

I would like to ask your advice on how to lap a small cylinder (¾ in. bore); the tool finish which I can attain does not appear to be good enough.

I have searched in M.E. over the last few years and in several textbooks but although I can find plenty of odd hints and tips, I am unable tc find a description of how to proceed. I am proposing a home-made lap of soft material (possibly wood?), but should it be parallel, expanded one end, expanded both ends or in the middle? Also how long should it be and what abrasive is suitable?

What really perplexes me is how the cylinder should be manipulated during lapping to ensure a parallel bore. I assume that one simply measures the diameter at both ends with a tapered plug.—A.J.J.

▲ *This process has been dealt with in many M.E. articles dealing with engine construction, but there are so many aspects of its application, and alternative methods, that it cannot be fully covered within the scope of our Queries Service. For cylinder lapping, we recommend the use of soft metal laps (copper, lead or aluminium), not longer than the bore diameter, and preferably internally tapered and split so that they can be mounted on a taper mandrel and expanded to compensate for wear. For coarse lapping, fine carborundum paste can be used, followed by milder abrasives according to the degree of finish required. Either the lapping mandrel or the cylinder may be run in the lathe, the other part being held in the hand and kept in constant endwise motion to avoid scoring. Unless measurement of the bore to fine dimensional limits is necessary, the "feel" of the lap will be sufficient to ensure that the bore is parallel, and if not, local lapping will correct it. Care and patience are the most important essentials in all lapping operations.*

Burrell traction engine

I have recently undertaken to complete a 1½ in. scale Burrell traction engine for an old friend. I have no experience with traction engines and the drawings give little indication of the piping up required. The drawings and castings are A. J. Every's and about 1945 vintage.

Can you give me some advice on the piping up required and in particular tell me:

a. How the boiler is filled on initial starting?
b. How the water level in the tender tank is known when running?
c. How the sealing of the face joint between the cylinder block and the boiler is made?
d. The flywheel is in bronze. Would this be a normal finish on the belt face—I would have thought this should have been cast-iron.
e. Did this type of engine have mechanical lubricators and could the usual locomotive (ratchet wheel) type be used?
f. How is the steering chain fastened to the shaft carried on the hornplates?

Finally, is there a suitable varnish for finishing off locomotives which can be sprayed on and which will stand boiler temperatures? My locomotive boiler is lagged.—K.R.F.K.

▲ *The pipework from the pump (which I presume is on the hornplate) should be—suction almost vertical into tank, reaching nearly to bottom and fitted with filter; by-pass almost vertical into tank top; feed forward inside hornplate; and to central clack on boiler barrel. Injector feed to clack either on firebox side (hornplate) or to clack central on boiler barrel.*

For initial filling of boiler there should be a screw plug in one of the side flanges of the cylinder saddle. For checking water level in tender tank there should be a bib-cock in the side, about 1 in. above the bottom, or a little less (often fixed in side manhole of tank).

For sealing the joint between cylinder and boiler, try aluminium foil—two or three thicknesses may be necessary. If jointing compound is used, see that it is the non-hardening type.

The flywheel should indeed be cast-iron, and there is no satisfactory looking substitute, though we have seen matt plating used.

A mechanical lubricator was mounted on a bracket on the front end of the cylinder block (which to a traction engine man is that nearest the driver: the end nearest the chimney is the back). It should be comparatively small; much smaller than the usual model locomotive type. You will find details of the Allchin lubricator in M.E. dated April 18, 1957; alternatively if you haven't these copies see Sheet 12 of the Allchin drawings.

The steering chain would usually be secured by a hexagon bolt or set-screw passing through a link of the chain into the barrel: a washer may be needed under the head. Make sure the chain is wrapped the correct way for the engine to steer right as the wheel is rotated anti-clockwise, and vice versa.

We regret that we do not know of a varnish that will withstand high temperature.

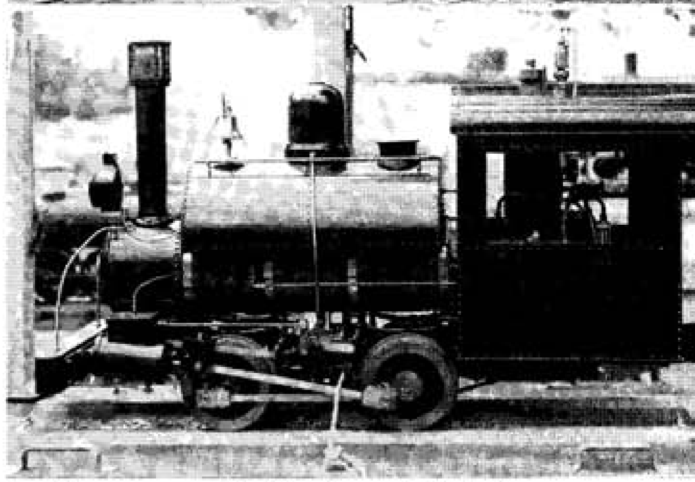
Flash steam plant

I wish to obtain some plans for a flash steam plant which would be able to supply steam to a Stuart-Turner "Sun" engine. This engine is a ⅝ in. bore × ⅝ in. stroke, twin cylinder, single-acting piston valve unit, which would be required to drive a 56 in. tug model. I would also like to obtain some literature on constructing and using these flash steam units.—C.A.M.

▲ *To supply an engine of the size specified, a flash boiler having a two-layer coil of ¼ in. o.d. steel tubing, about 25 to 30 ft. in total length, is recommended. This should be wound on a mandrel about 1½ in. dia., and arranged horizontally in a sheet metal casing internally lagged with asbestos millboard. A cross coil across the exit end of the main coil may be added to provide extra superheat. Firing may be torch type blowlamp or bottled gas burner. Flash plants are essentially experimental, and their details inevitably call for some trial and error. We do not know of any literature at present available on the design or use of these plants, but many articles have been published in M.E. at various times, and in the Handbook "Flash Steam," which is now out of print.*

CLUB NEWS

Top right: Fall meet at Los Angeles. Bill Webb's 7½ in. Pacific in action.



Right: Spring meet. H. K. Porter industrial locomotive built by Bud Whitner.

Bottom left: Spring meet. Doug. Alkire driving his 1 in. scale B.80 class locomotive "George Washington."

Bottom right: Fall meet. Harry Haas' nearly completed 7½ in. gauge Santa Fe 4-6-4

News from Chichester

A change of Secretary has taken place at the Chichester and District Society of Model Engineers. The new official is Mr B. E. Gilbert, of 20 Norwich Road, Chichester. Phone: Chichester 85790.

This Society caters for all interests in model engineering from 10¼ in. gauge live steam locomotives down to small scale miniature railways. It is also fortunate in possessing considerable workshop facilities for the use of members. Current projects in hand include the refurbishing of the 600 ft. multi-gauge track (2½ in., 3½ in. and 5 in. gauges), an extension to the ground-level 10¼ in. gauge track and a new "OO" layout.

It is planned to hold an open weekend on Saturday/Sunday, June 20-21, when it is hoped that both live steam tracks and the "OO" layout will be in operation. There will also be a display of members' work.

The Club premises are open to members four times a week. Tuesday, Thursday and Friday evenings from 7.30 p.m. and Sunday mornings from 10 a.m. Lectures are held regularly at monthly intervals during the Autumn, Winter and Spring. Full information about the Society can be obtained from the Secretary.

Holiday Weekend Exhibition

The Whitchurch (Cardiff) and District M.E.S. is presenting an exhibition of working and static models over the Spring Bank Holiday; this will take place at the Society's Headquarters in Highfield Road (off Lake Road West), Roath Park, Cardiff, and will be open on Saturday and Sunday, May 23 and 24, from 2 p.m. to 8 p.m., and on Monday, May 25, from 10 a.m. to 8 p.m.

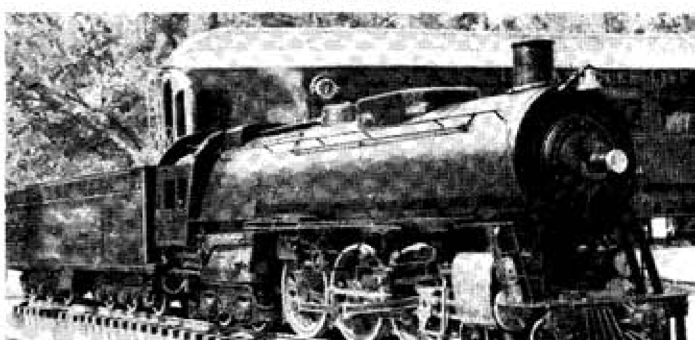
The 3½/5 in. gauge track will be in action throughout the weekend and the much enlarged OO gauge Club layout will be on show for the first time, besides a working 1 in. scale tram layout and many static exhibits.

Admission will be 2s. and 1s.; refreshments will be available. Any enquiries should be addressed to Mr J. T. Jenkins, 89 Celyn Avenue, Lakeside, Cardiff CF2 6EL. Tel.: 755568.

New Committee at Guildford

The Guildford M.E.S. elected a new Executive Committee at the Society's Annual General Meeting in March; Mr F. Bolting of Bow Cottage, Millmead, Guildford, Surrey, was made Hon. Secretary and the new P.R.O. is Mr G. Asplin of 86 Nirk Way, Barnstead, Surrey.

The President reported the completion of a very successful year for the Society, during which there had been a steady increase in membership; and said that work was going well on the construction of the two Club locomotives, one of which it was hoped would be steamed before the end of 1970.



JEYNES' CORNER

E. H. Jeynes talks about the early days of model engineering and describes some of the queries sent in by readers in 1866.

MODELS HAVE BEEN MADE throughout the centuries; many have been of a mechanical nature, including model windmills, and water-wheels; though principally intended for toys, serious attempts have been made to prove, or disprove theories. Many examples of early work have been preserved and recorded since the time of Hero's steam reaction turbine.

It would appear that many of the early engineers made models, either to forward their inventions, or to order, from inventors, or from Seats of Learning. One instance which comes to mind is the fact that James Watt, at the outset of his career, was asked to repair and overhaul an existing model of a Newcomen engine. It could really be said that James Watt owed his success to model engineering. Murdoch built a model road engine, Smeaton constructed model water-wheels, to carry out his efficiency tests; Stringfellow built a steam driven model aeroplane in 1847, which actually flew. In many cases the word "model" may be questioned, for really they were small prototypes but they can certainly be included under the heading of model engineering.

There have been several letters following Mr Steel's short article entitled "Model Engineering 80 years ago," regarding the facilities afforded to the model engineers of the time, in the way of literature, castings, drawings, instructions, etc., also the availability of lathes suitable for model engineering work. Having been engaged on research in a parallel direction, I have taken the opportunity of ascertaining what the position was about a century ago.

The main vehicle conveying the "Know How" was the *English Mechanic*, a weekly penny paper, having Reader's Queries, Letters, etc.; this paper was eventually absorbed by the Percival Marshall group. To give a general idea of the paper, I give a few selections from the Reader's Queries, and advertisement columns in 1866, which show that there was a healthy demand and supply in model engineering, and it will be noticed that most of the advertisers offer catalogues: also that there are "Handy Books" available.

From Reader's Queries, 1866 :

Will any reader kindly inform me how to cut the rectangular ports for a model cylinder ?

I have a small iron locomotive boiler 2 ft. long, 6 in. dia., inside firebox 7 in. sq., and nine ¾ in. tubes. When I get steam nearly up, and put on more coal, the steam drops immediately. Will any kind reader assist me in this difficulty ?

Can any correspondent supply me with a small cylinder 2 or 2½ in. stroke and about 1½ in. ready bored ?

Will any kind reader inform me what size cylinders and boiler it will take to propel a small boat with a screw ? The boat is 36 in. long, 8 in. wide, and 7 in. deep.

From advertisements, 1866 :

Stevens' (original) Model Dockyard, and City Toy Repository. Established 20 years. Catalogue three stamps.

Model Steam Engines. Manufactured by Thomas Lisle, Falcon Works, Wolverhampton. Price lists three stamps.

Machines and Models of every description, wheels and pinions cut to order. Goodwin and Co., Bishopsgate, London.

Model engines, boilers, cranks, pistons, slide-valves, stop-cocks, etc. Descriptive catalogue in five sections. Sections free on receipt of two stamps. J. Bowie.

The Model Dockyard. Originally opened in 1774. A London institution. Capital catalogue of Model Marine, Locomotive, and Stationary engines with or without boilers. Post free 7 pence.

An Editorial comment on this is as follows : "We are in receipt of a capital catalogue published by Mr E. Bell at the Model Dockyard, 31 Fleet Street. This shop originally opened in 1774, and is quite a London institution. It is well known as a depot for models of Marine, Locomotive, and Stationary engines and for the requisites of model shipbuilding. The catalogue is very readable, and somewhat instructive, its teaching plainly expressed. If there be a fault in it, it is that too much space is devoted to land and water locomotion, and when the next edition is published, perhaps Mr Bell will take our single objection into consideration."

Other literature published by this firm was a series of instructive "Hand Books" as follows :

How to make a model ship.
Illustrations, and names of every class of craft afloat.
Contains Rules and Regulations for forming Model Yacht Clubs.
How to make a Steam Boat.
How to make a Model Oscillating Engine.
How to make a Model Horizontal Engine.
How to make a Model Locomotive.
Contains information not to be found in any other work.
All above books published by E. Bell at the Royal Model Dockyard and Model Engineering Establishment, 31 Fleet Street, London, E.C.

Advertisements continued :

Amateur's lathes. Gentlemen who require a turning or screw-cutting lathe would do well to order of R. Pierce, Gt. Suffolk Street. Lathes ready for use from £3 10s.

W. H. Pierce. Lathe and Toolmaker. Union Street, Borough, S.E. Amateur's lathes from 35s.

Lathes and Tools of every description for Amateurs. J. Buck, London.

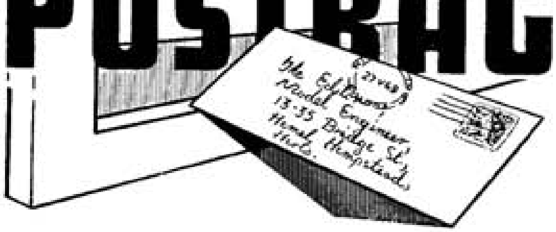
Sets of castings for Planing Machine £3 12s. 6d. Set of Table Lathe Castings 6s. for back-gear and slide-rest included 10s. Slide-rest castings from 2s. upwards. Planing to order. Taylor, Manchester.

At the Newcastle upon Tyne Royal Show in 1864 a model of a stone and ore crushing machine was exhibited by Marsden of Leeds.

In conclusion, I would cite the following interest in Model work a century ago :

At the Metropolitan and Provincial Working Classes Exhibition and Industrial Festival which opened September 3, 1866, a prize of £2 2s. was offered for the best working model of a steam engine, also a prize of £2 2s. for the best model of a grinding mill for flour. ■

POSTBAG



The Editor welcomes letters for these columns. He will give a Book Voucher for thirty shillings for the letter which, in his opinion, is the most interesting published in each issue. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

Diesel electric traction

SIR,—I should like to thank Mr Mount for his appreciative comments on my recent articles. His letter suggests many interesting variations and additions to the control and operation of miniature diesel elecric locomotives and it also raises some queries. Dealing with the latter first I chose series-parallel control without any refinements because it is simple to operate, effective in providing a limited but reasonable number of running speeds and has been well proved in service. With four or six motors one can dispense with resistors and the consequent power loss in them when they are used for intermediate speeds. It is true that this scheme is more usual with "straight" electric rather than diesel electric locomotives.

No results are available of a locomotive powered by the suggested 100 cc version of *Sea-lion* because the engine has not yet been built, but there can be no doubt that a Westbury based design would produce the desired output and performance. The 30 volt. 50 amp. generator to go with that engine was constructed some three years ago and with my original BB battery powered locomotives it was left with the Tyneside S.M.E.E. when I retired to the South, in the hope they would finish the conversion as a club effort. With advancing years I rather jibbed at further manhandling some 3 cwt. of locomotive on my own!

The idea of remote control from the driver's trolley, with the master controller coupled to the locomotive by a multi-core cable and linked to the frictional brakes on the trolley, seems reasonable and is really only a matter of arranging suitable linkage details. The electrical braking which Mr Mount suggests should be included to operate simultaneously with the frictional brakes, and they would be rheostatic and not regenerative. He may like to know that a further article dealing with electric braking is in the "pipeline" for publication later this year.

With the control schemes I have so far described, I would certainly expect to use the throttle to control engine speed, as well as controlling the generator excitation by a rheostat (manually, not by contactors), as additional ways of varying track speed above or below that resulting from motor grouping. I have made reference to this in my earlier article and also in a letter to Postbag in October, 1968.

The provision of running notches, additional to those obtained by the three or four motor groupings, by switching diverter resistors across the motor fields is quite practicable in small scale, but it does mean more contacts and fingers on the drum controller. If contactors are used for speed control, however, only two extra contactors would be needed for two notches of weak field running. My 1962/63 article about the BB locomotive included such diverter resistors as well as rheostatic braking and the resistor units were mounted below the underframe between the bogies to avoid high temperatures within the locomotive body.

Separate excitation of the main generator by an exciter on the same shaft and the use of this to supply also all auxiliary current (for circuit breaker, contactors, pilot lights, etc.), with a car type regulator to ensure constant voltage, are somewhat conflicting conditions because the main generator excitation should vary with speed and load changes whilst the auxiliaries require a constant voltage irrespective of engine or track speed.

In main line practice these two requirements are met by the exciter output being divided, one circuit feeding the auxiliaries via a constant voltage regulator and the other through a sophisticated varying voltage regulator to the main generator field. The generator has in addition a shunt connected self-excited field which is also variable. Such elaborate equipment is rather out of the question for a miniature locomotive and our solution would perhaps be to use the generator field and it should not be impossible to devise a suitable linkage between that rheostat and the engine throttle to produce the desired generator voltage—current characteristics at different track speeds and loads.

The use of a battery to motor the generator to start the engine, the battery being charged by the exciter during normal running, is certainly possible. It would mean that the generator should have a short time rated series field added so that it could act as a starter motor.

All these ideas would be that "further approach to realism" mentioned by Mr Mount and with some ingenuity the extra pieces of equipment could be accommodated in a 5 in. version of a large prototype. I would doubt the possibility in 3½ in. gauge. Some of the details could be worked out fairly easily and presented to readers but with the greater steam interest in M.E. would one be justified in expecting you, Sir, to allocate further valuable space in your pages to the rival interests of a possibly limited number of electric traction enthusiasts, however fascinating those interests may be.

Warminster, Wilts. F. L. DAVIES.

Robinson-type hot air engine

SIR,—I was very interested in Mr Westbury's design for a model of this one time very popular hot air engine, but it seems a pity that he does not embody the regenerator-cum-displacer, which, so far as I know, was a feature of all engines of this type made by Robinson and later by Norris, Henty & Gardiner. It is mentioned in every account I have ever seen of this engine, from the 1880's to the final models of the twentieth century, as a hollow piston, with perforated pressed steel ends, the inside being filled with what is variously described as some "loose non-conducting material," wire, gauze or slats. Probably all three were used at different times, but in each case it is emphasised that the transfer was made through the displacer and not round it; in fact in all the sectional drawings I have seen, a ridge round the top of the displacer seems to prevent any escape that way. Most engines working on the Stirling cycle had some form of regenerator, if they were meant for real work, though of course most of the small toy engines had no such refinement, and would still run. The regenerator was also an invention of Stirling and embodied in his engines to their very considerable advantage.

Mr Westbury mentions Ericsson's hot air engine. There is an example of this as produced commercially in America in the Science Museum. It is of the "Constant pressure" type and has an "open cycle" like the Cayley engine, but with external heating. A very complicated engine with numerous valves, and though I believe a fair number were made in America, I believe the firm making them, though retaining the name, later built many more which were Stirling cycle engines. The big marine engine which Ericsson built was I believe also on the "Caley" cycle but again with external heating. I don't think that Ericsson's hot air experiments were so happy as some of his other ventures.

Shotesham All Saints, Norfolk. GEOFFREY K. KING.

Kitson & Hewitson P.E.

SIR,—Replying to the letter from Messrs. Tyler and Haining (page 202), I am very glad to be absolved of any share in the design of their Slanting Shaft model: it has always been my endeavour to maintain accuracy, both historical and practical, and I have already pointed out that the model falls short on both points, defects which were unnecessary because adequate data of at least two prototypes have been available since 1964. This data was obtained from Kitson's drawings and measurements of an actual engine.

There is a fallacy in comparing the Kitson with the Usher model. The latter, according to C. E. Shackle who once owned it, was associated with Usher himself; in the former instance the *drawings*, not the model, are associated with the builders of the engines.

I did not write in "Steaming" that 12 h.p. cylinders were fitted to engines having *early* 10 h.p. boilers; the insertion of the word *early* in the context suggests a rebuild, whereas these were new engines. Having refreshed my memory from the Kitson records, I can say that the boilers for these engines were about 1 ft. 6 in. longer than the 10 h.p., the front ring being extended beyond the boiler proper to form the smokebox, as on the 14 h.p. I have also found that particulars of the winding forward gear of the twelve 10 h.p. engines had been recorded. All Kitson records which are relevant showed winding forward gear and drums; none showed strakes. Such items are somewhat larger than nuts and bolts!

Halstead, Essex. R. C. STEBBING.

Winding engine

SIR,—Two of your contributors have commented on the method of valve actuation on the winding engine by Mr E. D. Jakins exhibited at this year's Model Engineer Exhibition, and both have assumed that the drop valves have replaced original slide valves.

Whilst not knowing the history of the engine on which Mr Jakins' model is based, I would guess the engine is as designed, for drop valves were quite common on steam winders in the early years of this century and perhaps earlier.

Messrs. Holman Bros. Ltd. of Camborne made several winders using drop valves for both steam admission and exhaust. These valves were worked from double eccentrics on the drum shaft through what was a modified form of "Gooch" gear, the expansion link working on centrally placed fixed bearings. The eccentric rods were proportionally shorter and the valve rods longer than on Mr Jakins' model and drove the rear set of valves, an auxiliary rod between the two sets of valves working the rocking lever for the front valves. The use of the modified "Gooch" gear made for far less weight for the driver to lift when changing direction.

The inlet valves were damped by oil dash-pots and the exhaust valves were assisted by weights as in the model.

All these engines had double drums, one drum being keyed to the shaft and the other held by a dog clutch, this being common metal mining practice to allow for hoisting from different levels and for the deepening of the shaft when necessary. The drums were only 2 ft. wide to suit the small compartments of the Cornish shafts and this was a distinct disadvantage as frequent trouble was experienced in getting the rope to "book" or lay properly in up to four layers.

The Holman engines had balanced, disc cranks and rotary, clock type depth indicators situated immediately behind the drums, the driving position being between the cylinders.

It was the practice in Cornwall each morning to make one's peace with the "whim man" (winding engine driver to the English) and discuss one's personal riding programme in the shaft—this might sometimes entail getting off and/or calling for the cage at up to five levels so that one had to keep in with the "whim" man if one was going to get service. A teapot was invariably stewing on the valve box or alternatively one could get roped in to clutch the engine—a job for two men.

Having ridden on these engines many thousands of times I can vouch for their smoothness of operation and their "nippiness," both in acceleration and in mid-shaft if the driver had had many delays during his shift. At the same time, if there was only a small shaft fault, a good driver would feel it immediately.

The last Holman steam winder was employed at Robinsons shaft at South Crofty from 1906 until some two years ago, when it was replaced by the present electric winder, which I am afraid is far more cheaply operated, in spite of changing the Lancashire boilers to oil firing.

Like most model engineers I have a fairly full programme in my workshop but one day!! a Holman steam winder will be commenced.

Redruth. J. SYMONS.

Compounds and coupling rods

SIR,—In Mr Lennox F. Beach's interesting and welcome letter from the States, in the issue of February 6-19, he thinks I am wrong about coupling rods, but perhaps he has misunderstood what I wrote. He is talking about machine friction only; I was considering the total running resistance of an engine and tender. At 60 m.p.h., machine friction of the motion is only a small fraction of the total. Coupling rod resistance is not a lubrication problem but a matter of interference friction between two sets of wheels coupled together.

If Mr Beach would care to refer to E. L. Ahrons' work "The British Steam Locomotive" he will be able to conclude for himself that the difference in haulage capacity between a single-driver express engine and an otherwise identical coupled engine is about one bogie coach of the period, of 1½ to 2 six-wheelers.

This refers to experience by Stirling on the G.N.R., Holden on the G.E.R. and Leitzmann in Germany.

A British bogie coach of that period weighing 22/24 tons required some 40 d.b.h.p. to haul it on the level at 60 m.p.h.. This represented perhaps 15 per cent of the total resistance of engine and tender at the same speed. This was a general statement; in this particular instance a better figure would be about 14 per cent. In the case of a Webb "Teutonic" with a maximum power output exceeding 800 i.h.p., coupling rods would therefore have absorbed rather less than 5 per cent of the total power developed.

In this connection I might mention that the Editor has on hand, awaiting publication, an article dealing with the subject of engine resistance.

Hayes, Kent. J. N. C. LAW.

River Esk

SIR,—I feel that I must reply to your correspondent Mr W. L. Jennings (March 6) in respect of his letter about the *River Esk* and my alleged statements.

I probably know more about this locomotive than Mr Jennings, and have never at any time said that it was fitted with Lentz valves, nor have I said that Henry Greenly or Paxmans were responsible for the galvanised iron pipe work, but I do know what I saw when I examined the engine in 1964 or '65 and I stand by my statement.

Mr Jennings is right in saying that the piston valves are 3 in. dia., but my recollection of the cylinder bore is $5\frac{5}{8}$ in. not $5\frac{1}{8}$ in.

Mr Jennings forgets that this engine was about 42 years old when I first saw it, and anything could have happened to it in that time. As regards the Poultney system the cylinders, except that the bore was 3 in. only, were identical with the cylinders on the engines (these were removed from the tender frames and returned to Ravensglass), the piston valves and liners were removed and fitted to the new cylinder castings which were cast in our own foundry.

The Poultney Cylinders showed very little signs of wear, and as I have said before, this system never had a chance of succeeding because both front steam passages were stuffed with rag which could only have been stuffed in before the piston valve liners were pressed in.

York. H. CLARKSON.

Conway Valley

SIR,—In a letter to the "North Wales Weekly News," Mr Bowen of Wallasey suggests that steam on the Conway Valley might be a workable proposition.

He believes that the use of steam traction, linking up the popular resorts of Llandudno, Deganwy and Conway at the north end of the present diesel line and the future terminus of the expanding Ffestiniog Narrow Gauge Railway, at Blaenau Ffestiniog, would prove to be a great attraction for tourists and steam enthusiasts alike. I agree, as I am sure will many of your readers.

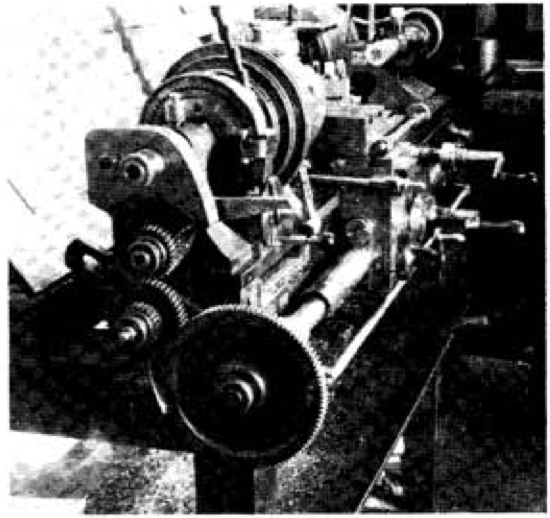
But, the presentation of this scheme to British Rail would, thinks Mr Bowen, require careful planning by interested parties, especially those with specific knowledge or experience, in order to convince them of its viability. If you are interested in the project, please write to: Mr T. C. Bowen, 5 Bedford Road, Wallasey, Cheshire. L 45 5EB.

Deganwy. J. KENNETH JONES.

Home-built lathe

SIR,—Readers of *Model Engineer* may be interested in a lathe of my own construction, finished 20 years ago, having been in constant use ever since.

The design of this lathe was influenced by one I had contact with at the time, i.e. an instrument lathe somewhere about the turn of the century by Thomas Cook & Sons of Yorkshire.



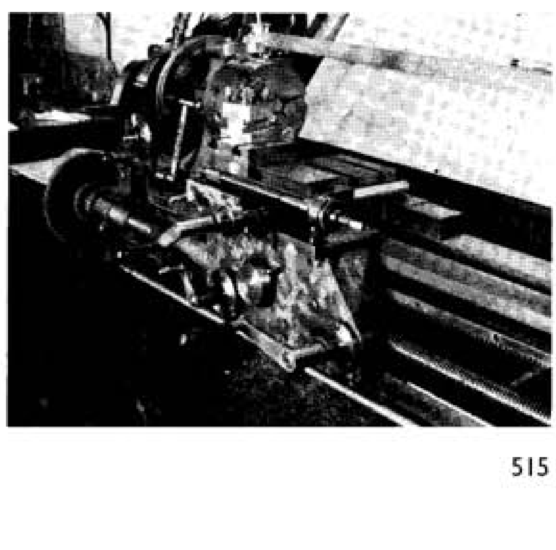
Mr Millen's home-built lathe.

There are parts of the design and construction of my lathe which may be of interest. The only part of this machine not constructed by myself is the bed, this I had cast and machined for me. Interesting features are: fully indexing head, direct and through worm, segmental stops. Tailstock has set over on top instead of on the base which is usual practice. Saddle is flame cut from steel plate with vee's screwed and dowelled into position. Slotted cross-slide is cast-iron. Top-slide of same construction. Leadscrew *square thread,* half nut operation. Stops to saddle and cross-slide. Mounted on wooden stand.

Spindle turned from a scrap lorry half-shaft, this material is very tough but easily machined if speed is kept low, is very freecutting and leaves a good finish. This spindle has been running continuously for 20 years in cast-iron taper bearings, and when inspected recently, there was no sign of wear and the surface had acquired a high polish. These half-shafts can easily be obtained from breakers—mine cost as little as 2s. 6d.

St. Just-in-Penwith, Cornwall. L. K. MILLEN.

Another view of Mr Millen's centre lathe.



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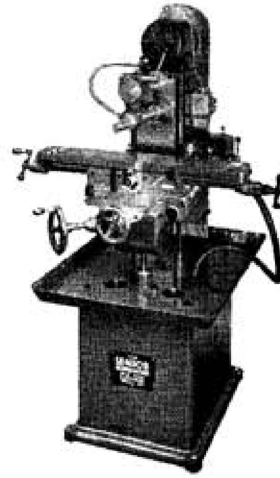

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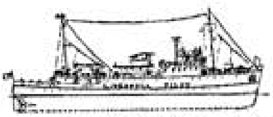

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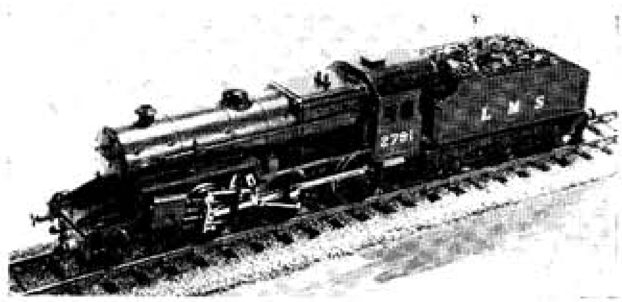

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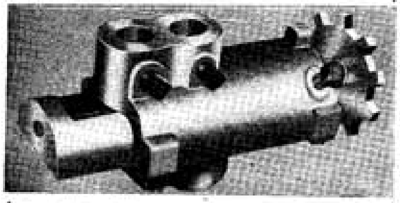

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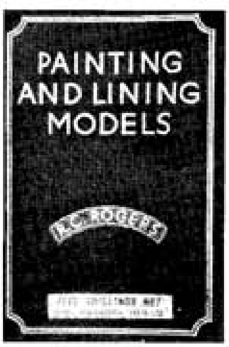

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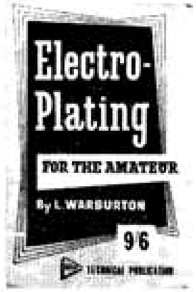

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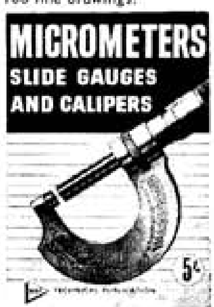

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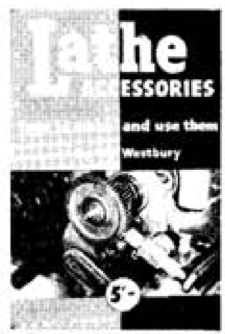

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