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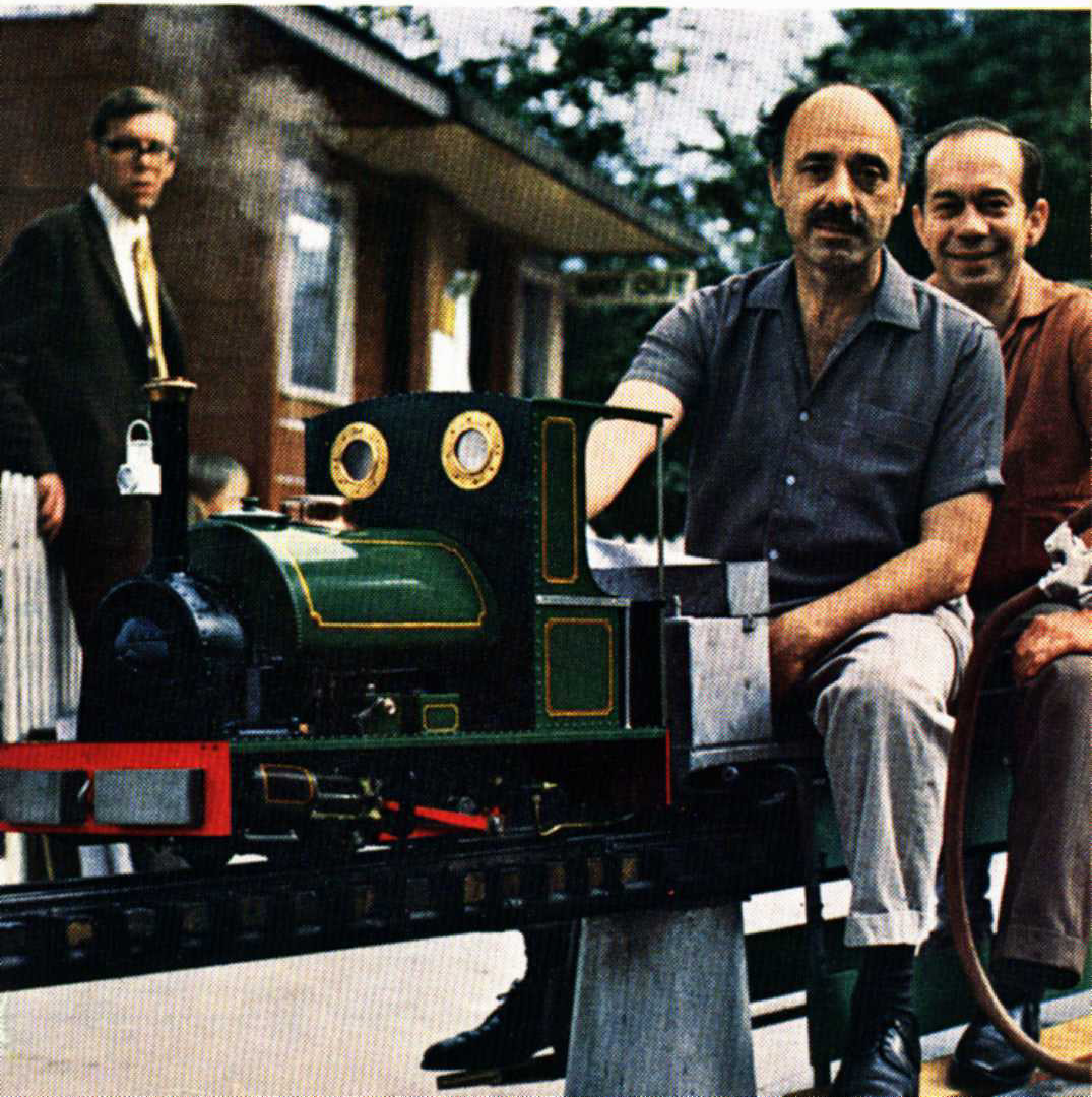
Model Engineer



Model Engineer

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COVER PICTURE

Passing the station on the Chingford track. Colour picture by D. E. Lawrence.

NEXT ISSUE

Awards at the Model Engineer Exhibition. Making locomotive vacuum brake pipes.

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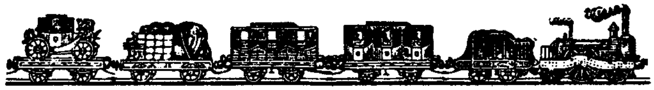

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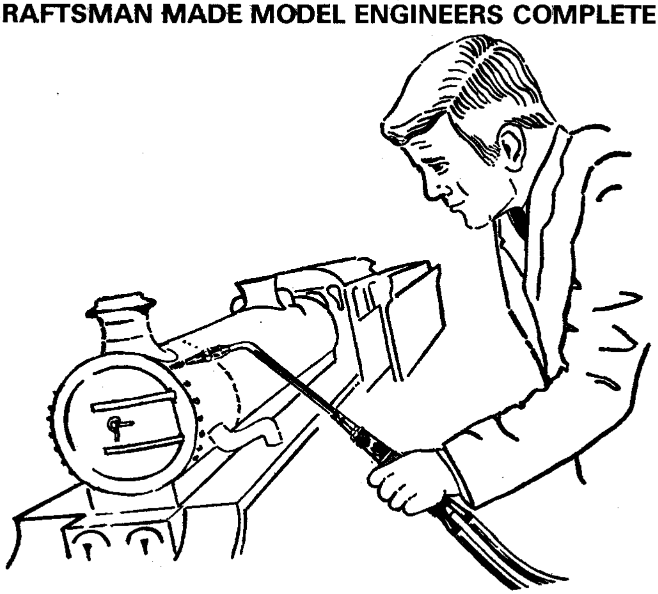

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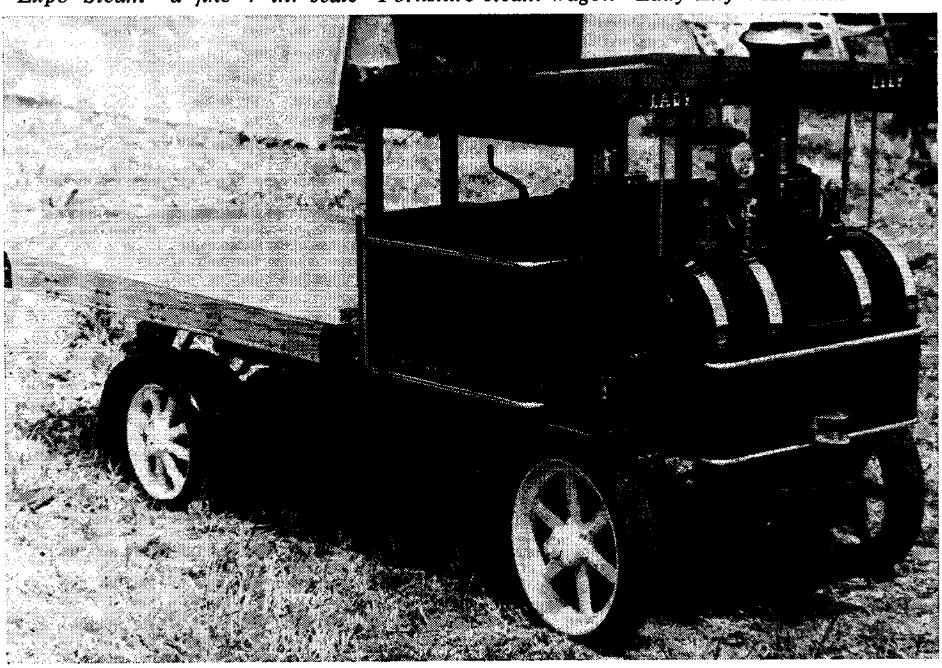


Seen at the 1973 "Expo Steam" a fine 4 in. scale Yorkshire steam wagon "Lady Lily". An unusual three tonner built by K. E. Stokes of Longford Coventry: Photograph by Peter Wilkes.

SMOKE RINGS

A Commentary by the Editor

Models in Natal

There has always been plenty of model engineering activity in South Africa, and Natal is no exception, as can be seen from the photographs reproduced here. These models were all made by reader R. Rochell and are:— a 5 in. gauge 4-6-0 *Springbok,* completed in 1970, a 1½ in. scale Allchin traction engine to Bill Hughes' drawings, a 2 in. scale free-lance traction engine scaled up from the *Minnie* drawings, and a steam launch "Africa Queen" powered by a Double-ten engine with reversing gear operated by a steam cylinder. The boiler is fired by bottled gas.

The "Urwick" machine tool

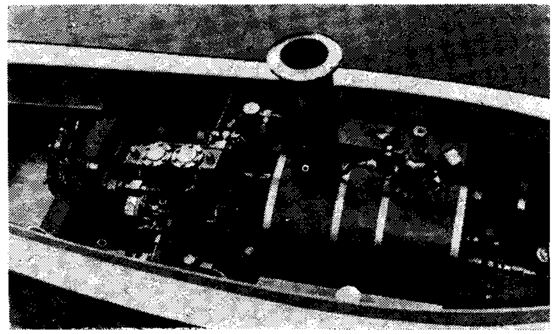
I am sure that many readers must have been interested in Mr. W. D. Urwick's ingenious machine tool, described in our last issue. The question that is being asked is why is it that none of our small lathe manufacturers have taken up the design and put it into production? I imagine that the answer is the probable high cost of the machine.

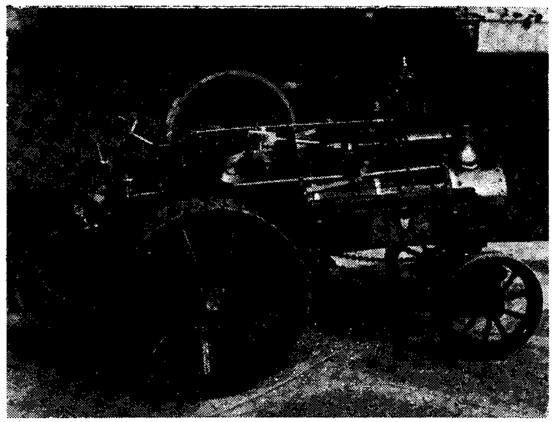
There have been several attempts in the past to put on the market a lathe with milling facilities. The "Bormilathe" was one of them, manufactured some years ago by Murad Developments of Aylesbury and later of Queenborough, Sheppey. There was another similar "two-in-one" machine made in Switzerland; unfortunately I have forgotten its name but I expect some of our readers will recall it. It was rather an expensive machine however.

Unless this type of universal machine tool can be manufactured at not more than 25-30 per cent higher cost than a straight lathe, it loses its attraction I believe. This is because two separate machines, provided one has the space for them, are always preferable to one universal machine, however ingenious.

I.M.L.E.C. 1974

The International Model Locomotive Efficiency Competition this year will be held on Sunday, July 7th, and it will be on the new Bristol track, by kind permission of the Bristol Society of Model & Experimental Engineers. Further details will be announced as soon as possible, but I should make it clear that entries cannot be accepted just yet, until a further announcement has been made in "M.E."





MASTIFF PETROL ENGINE

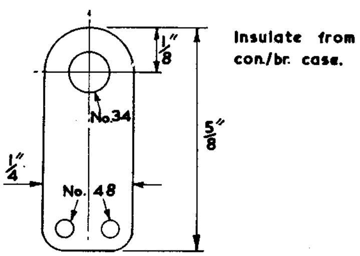
Part XXIII

By L. C. Mason

Continued from page 13

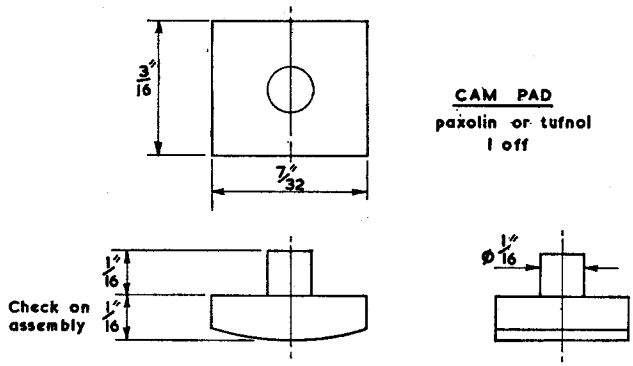
THERE ARE FOUR little fixed items to go in the contact breaker case — a bearing bush for the shaft, the pivot pin for the moving arm, a spring stop pin and the column for the fixed contact. These are all simple bits turned up according to the drawings, and they can be made in any order and fitted in position. The shaft bush is a light press fit in the hole through the boss, fitted with the flange inside. The only point worth noting about any of these is that it might be worthwhile to make the little brass bush for the contact arm before turning its pin, then you can ensure that the pin is a nice fit in the bush. Make the length of the plain part of the pin so that when the top retaining nut is run down firmly against the shoulder, the bush is still free to turn with just enough end play to feel.

The contact points I used were supplied by our useful friend Whiston, and come as 4 BA x ½ in. hex. head steel screws, having a 5/32 in. dia. x 3/64 in. thick tungsten contact on the head. 4 BA is a bit big for the space they have to go in, but if you chuck them carefully by the hex head, you can gently turn the stem down for re-threading 6 BA. When you have one re-threaded 6 BA, chuck it in a 6 BA tapped bush and file the hex. head down to 6 BA size, using the filing rest. The stem turning part sounds a bit dicey, but if you



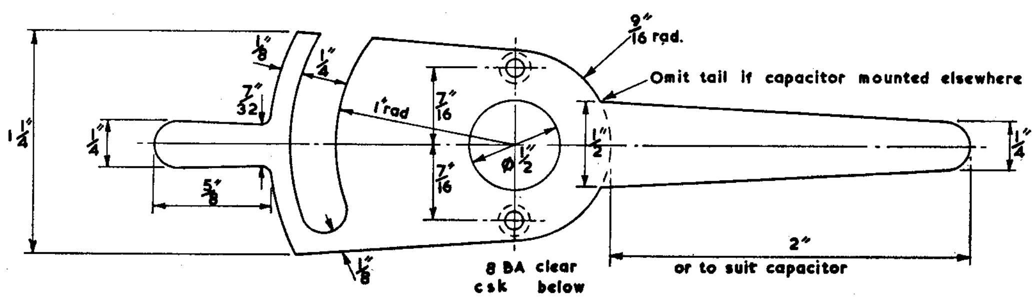
FIXED CONTACT CONNECTOR TAG

24 SWG brass 1 off



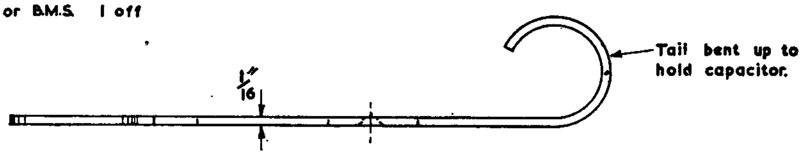
CAM PAD

paxolin or tufnol 1 off

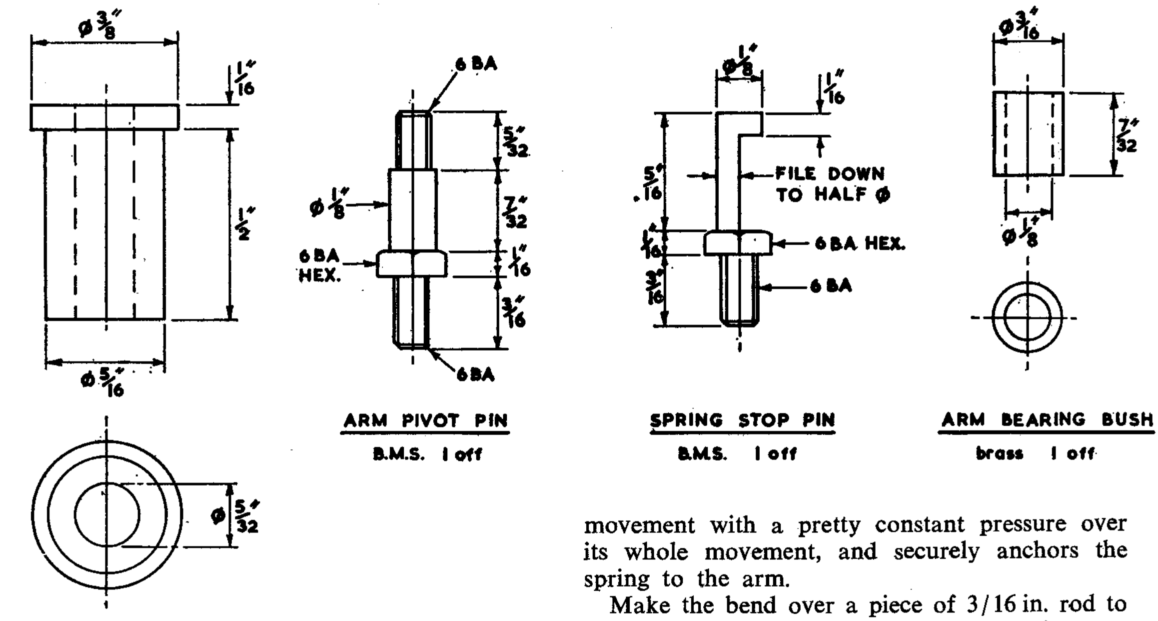


CONTACT BREAKER BASE PLATE

dural or B.M.S. 1 off



CONTACT BREAKER COMPONENTS



DRIVE SHAFT BUSH
G.M. 1 off

ARM PIVOT PIN
B.M.S. 1 off

SPRING STOP PIN
B.M.S. 1 off

ARM BEARING BUSH
brass 1 off

go very gingerly it goes all right. I have done a number like this now, and have taken several pairs down to 8 BA successfully. If one SHOULD go wrong on you, don't discard it, but turn the remains of the thread down to a 1/16 in. dia. x 1/16 in. long stub, then this can be used for the moving contact in the end of the arm. The contact for the arm, incidentally, does not need the hexagon shape behind the contact itself. When you have the stem turned down, re-chuck it by the stem and turn the hex. head round, down to the diameter of the tungsten pad. Do not attempt to turn down the tungsten part for two reasons; you will damage any tool you try it with, as tungsten is extremely hard, and we can do with the full area of the contact to keep the electrical resistance at the contacts as low as possible.

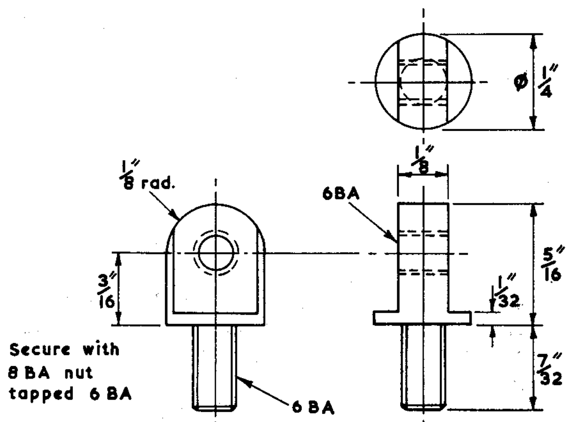
The arm for the moving contact is a bent-up strip of 20 S.W.G. mild steel, 3/16 in. wide. It is in fact more of a bell-crank shape, having a bent-over tip at the non-contact end which is nipped on to the end of the spring and soft soldered to it. This tip is narrowed down to some 3/32 in. wide, making for ease of bending and soldering. I confess I saw this shape of arm in the description of a petrol engine in M.E. a good while ago now, and immediately thought what a good piece of design it was. It is simple, it makes for a long spring in a compact space giving a nice lively movement with a pretty constant pressure over its whole movement, and securely anchors the spring to the arm.

Make the bend over a piece of 3/16 in. rod to a close fit round the bush, leaving the strip over-long until after the bending, then the whole for securing the contact can be located from the bush centre. Tin the opposite tip on what will be the inside of the bend over the spring before bending that, then the spring will be well held when it is soldered. The contact is secured to the arm by soldering the stalk on the outside, the joint being smoothed up to a neat flattish dome. The bush is also soft soldered into the bend in the arm, locating it so that there is the odd 1/16 in. of bush protruding either side of the width of the arm.

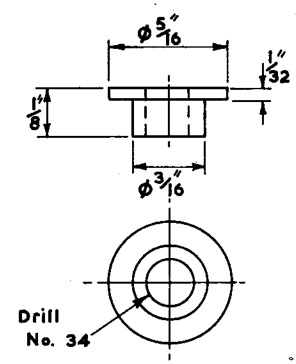
The spring is a piece of clock spring about 1½ in. long overall, and is 3/16 in. wide x .015 in. thick; I do not know if this is a standard size, but no doubt something very near would serve as well. Bend it so that it well clears the case, and the free end stands about ⅜ in. clear of the arm when relaxed. The spring end is pressed close to the arm to fit the arm in position and slipped inside the stop pin, so that it puts some pressure on the contacts when they are closed.

The pad bearing on the cam is a fiddly little job from a scrap of paxolin. A small piece can be gripped in the four-jaw and the little pip turned on that positions the pad on the arm. Then rough file the pad to shape, leaving it full thick, and stick it to the arm with Araldite, putting a small blob over the end of the pip on the outside of the arm. When it is set, finish shaping it up to spring width. Leave adjusting the thickness until after the cam is made, then the thickness can be arranged to give about 20 thou gap on the contacts when the fixed one is positioned to let them meet quite flat in the closed position.

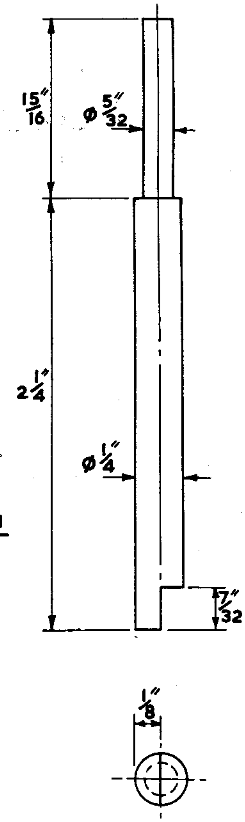
The cam is turned from ½ in. round silver steel, using a piece about 1 in. long. Turn the round boss first and drill in somewhat deeper than the finished cam thickness 5/32 in. For forming the actual four cam noses, you can take the easy way and file four regular flats with the filing rest, making the length of the flats slightly more than the curved parts so that the contacts are "made" for slightly longer than they are broken. I did mine slightly more elaborately and machined flattish curves instead of flats, offsetting the piece in the four positions in the four-jaw. However, the late E.T. Westbury always specified flats, so they are probably just as efficient. Drill and tap the boss for a 6 BA grub screw. This must be a hex. socket screw and not a plain slotted type, as you cannot bring a screwdriver to bear



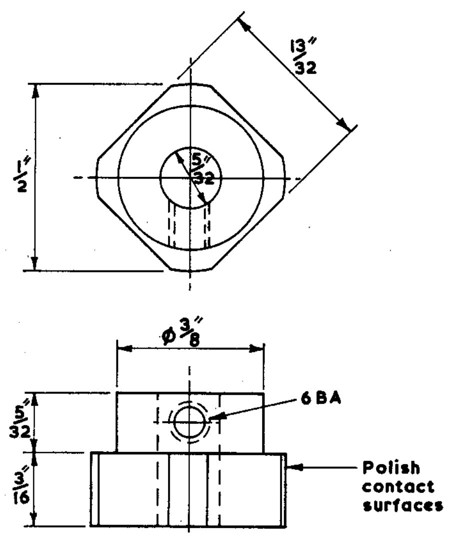
FIXED CONTACT COLUMN
brass 1 off



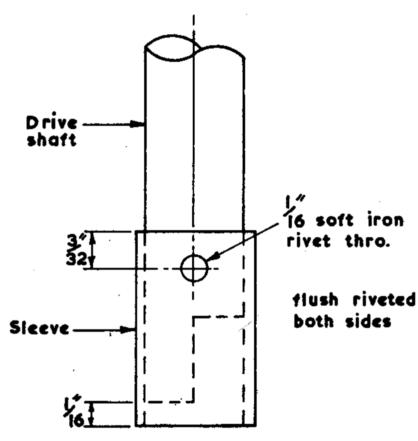
COLUMN INSULATING BUSH
paxolin or similar
1 off



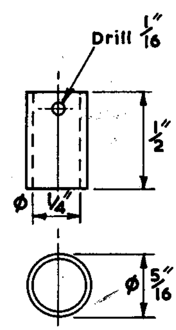
DRIVE SHAFT
B.M.S. 1 off



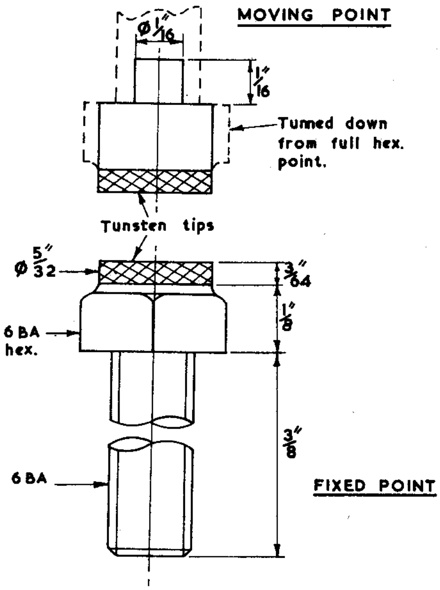
CAM
silver steel 1 off



DRIVE SHAFT LOWER END
COUPLING

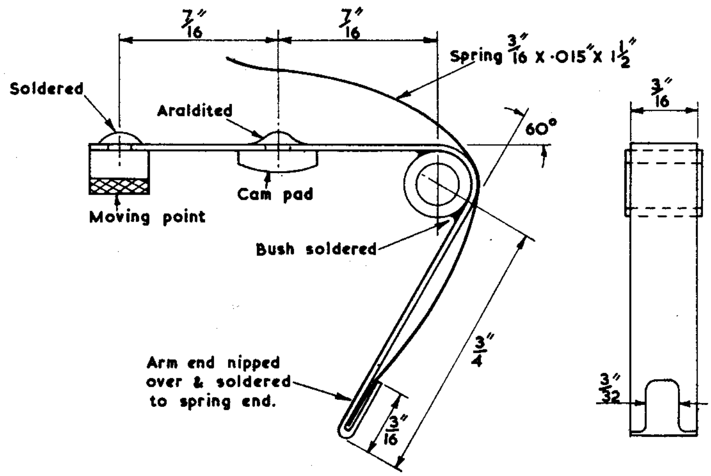


COUPLING
SLEEVE
B.M.S. 1 off



CONT. BR. POINTS

B.M.S. 1 each off

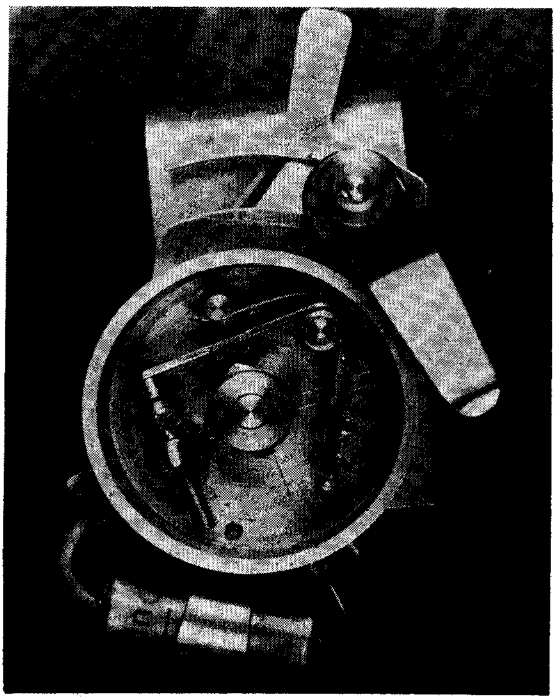


CONTACT ARM

20 S.W.G. B.M.S. 1 off

unless you drill a hole in the side of the body for it. This would be quite in order for a "land-based" engine, but it might be better not to if the engine

Looking down on the contact breaker, mounted on the detached timing case.



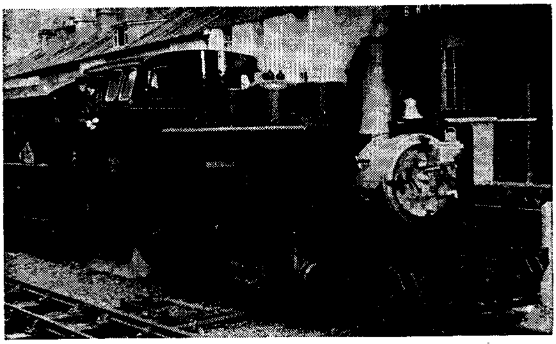
is to be used in a boat. You will probably have to shorten the short leg of the Allen key to get at it comfortably. The cam need not be hardened.

The drive shaft is from ¼ in. mild steel rod as per drawings. Turn the small upper end first and cut the piece full long, then you can adjust the final length to fit the oil pump end of the shaft nicely. The sleeve that encloses the halved joint can be turned and drilled from a stub of 5/16 in. rod, while the pin securing it can be the shank of a 3/32 in. iron rivet, tapped down into a small countersink both sides of the sleeve. Don't file a flat on the shaft for the cam grub screw yet, as the ignition timing will be finally set by the position of the cam on the shaft.

The retaining plate attached to the bottom of the body is a plain filing job from 1/16 in. or 16 S.W.G. dural plate—or mild steel if you prefer. Having drilled the centre hole and the two No. 43 countersunk for the attaching screws, spot through these on to the underside of the body and drill and tap 8 BA. Turn the body to position these so that they do not interfere with anything inside; one under the tail of the arm and the other under the arm contact is as good as anywhere.

In connection with this plate, note that there is a slight modification required on the top of the timing case for this. The hole for the clip column was shown on the drawings as 2 BA. When the engine was being built an improved arrangement was worked out for this, which needs a ¼ in. BSF hole in the timing case instead of 2 BA. So all that is required is to drill this out No. 5 for 5/16 in. deep and tap it ¼ in. BSF. The column will bottom at the bottom of the larger thread and any remaining 2 BA portion will do no harm.

Continued on page 99



MOUNTAINEER

A narrow-gauge 2-6-2 tank locomotive for 3½in gauge

by Don Young

Continued from page 18

CONTINUING with the cross-heads, the taper pin hole will be drilled later on, though a No. 38 pilot hole could be provided now. The two 6BA tapped holes, for the drop arm, will also come later. These latter holes make the crossheads handed, so be warned.

For such a simple piece part, the inner and outer side plates took an awfully long time to sort out drawing-wise. Originally I had one detail drawing for both types, until I tried to explain which holes were plain and which were countersunk on each plate, on each side of the engine, the accompanying notes became so complex that the whole idea was discarded; it read like a legal document! Anyhow, the photographs will help explain the reason for the positions of the countersinks; at the front end the combination lever is the culprit, moving back the coupling rod causes lack of clearance for, say, a hexagon headed bolt. In their final form the drawing details for the side plates are self explanatory, I hope!

The last parts required are the slippers, from ½ in. x ¼ in., machined gunmetal or bronze bar. You will probably have to start with a 2 in. length of ⅝ in. square bar, slit it down the middle, and machine the two halves to size. The bottom slipper requires the addition of the two steps, to be a tight fit in the top of the crosshead body.

Before we assemble the pieces of the crosshead the slide bars must be tackled. The slide bars detailed are machined from ¾ in. x 5/16 in. steel bar, but milling the two flanks down to give a width of .499 in. in way of the crosshead can be a little tricky. Those builders wishing to opt out of this operation can simply use ½ in. x 5/16 in. commercial bar and fix with one 4BA bolt only to the rear cylinder cover. Leave the countersunk holes at the back end of the slide bar for a while.

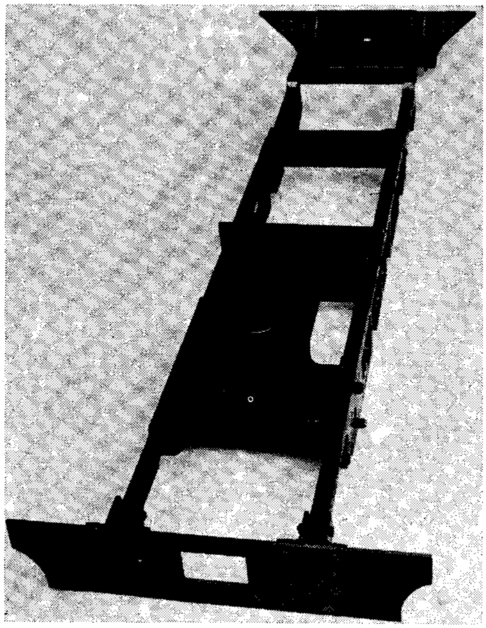
Assemble the pieces of the crosshead around the slide bar, clamp them firmly together and drill through the No. 30 holes; fasten with 5BA commercial countersunk screws, or make up some fancy ones. The crosshead will doubtless be very tight on the slide bar at this stage, ease the side fit by gently filing one face of the slide bar; for up and down clearance ease the top slipper. Just loosening and retightening the screws will almost certainly suffice to achieve the latter.

Assemble the crosshead on the piston rod and mill the top face of the rear cylinder cover, as described several times in the recent past, until the slide bar fits over the surface. Spot through the slide bar, drill and tap the cover spigot 4BA. The crosshead pin is a simple turning operation; choose material, probably silver steel, that is a tight fit in the 5/16 in. reamed hole in the crosshead body. The circular nut, 11/32 in. o.d. x 3/16 in. thick and tapped 2BA, is to emulate the grease cups on the full size engine.

Erect the connecting rod, slide bar and crosshead, coupling the latter to the piston rod. Take the cylinder end clearances or 'bumps', as previously described for earlier engines, then drill for and fit the 5/32 in. taper pin through crosshead and piston rod; do not drive the taper pin too tightly as yet.

We now come to what I consider is the piece de resistance of the whole design, full size if not in miniature:- the motion plates. They are such a prominent feature that to try and simplify them, as I did with the first ill-fated attempt, was to destroy the whole character of the engine. At the rough stage I pencilled in a note that my hope was that a supplier would come up trumps with suitable castings, as I could foresee no other satisfactory alternative method to make them, or rather no other way that would be less than sheer misery. As recent advertisements in *Model Engineer* show, Messrs. Reeves did come to our aid, through their patternmaking department, in the form of David Piddington, experienced a little difficulty in the process, to put it mildly! It was with great relief that I was able to machine up the first sample casting, as shown in the drawing, page 18; it proved more than satisfactory.

Start by generally cleaning up the castings with



Another view of Mountaineer frames made by Ted Benn.

files and emery cloth, a task which took me less than five minutes, then assess the machining allowances for each of the faces. Apply marking off fluid, the red colour is best for gunmetal in my humble opinion, and carefully mark out to drawing. Yours truly anticipated the pattern-maker more or less correctly, in assuming that the front face would be a flat one, leaving us to machine the various steps and recess; in fact some metal was removed at the casting stage, to save builders needless expense.

Grip in the machine vice, on the vertical-slide, and mill the bottom edge of the long frame fixing lug down to the scribed line. Turn the casting, to bring the front face towards the chuck and mill right across the front face. Trim off the inner edge of the lug as the third datum face. Now, mill the .19 in. deep step to 1½ in. length, as shown, to suit the motion plate stay. Move on 1.15 in. and mill out the slide bar bracket recess to .25 in. depth, using a piece of ½ in. square bar to gauge the width of the slot. Finally, mill the outer portion down by ⅛ in.

At the same set-up, mill the slot for the radius rod; it can be dealt with just as easily with files. Mark off and drill the four No. 27 holes in the portion remaining at the original thickness, these will be used as extra fastenings for the intermediate tank stay later on; much later on!

Turn the top edge of the casting towards the chuck and mill across, to leave the required overall lug width of 1 1/16 in.; move the carriage back .033 in., the large graduated wheel at the end of the leadscrew will come in very handy here, and mill across the face of the weighshaft half bearing.

The real reason for specifying a separate bearing cap for the weighshaft is to make an already complex casting not impossibly so. It is also to prototype and will allow us to fit the weighshaft in a more civilised manner. Bearing caps are available as pretty little castings, requiring very little machining. Chuck in the 4-jaw and machine both the side faces to an overall width of 5/16 in., to suit the motion plate, then face across the base. Back to the machine vice, on the vertical-slide, to face off the two tiny bosses for the fixing bolts and to drill them No. 43. Offer up to the motion plate, spot through the No. 43 holes, drill and tap the motion plate 8BA.

The holes for the expansion link bearings are dimensioned from the faces of the casting abutting against the motion plate stay, solely because these two faces determine the positions of the motion plates relative to one another. In practice, it may prove difficult to ream these holes with the frame fixing lug facing towards the chuck, my own reamer was too short to pass through both bearings before the lug fouled the chuck. My solution was to transfer the datum to the outer front portion, in way of the expansion link lugs, which meant that this face had to be accurately machined, and identical for both motion plates. The 1.44 in. dimension then became operative, together with the .28 in. one from the bottom edge; by adjusting the vertical and cross-slides, the weighshaft centre was arrived at in straightforward fashion. Drill and ream, or bore, for the actual weighshaft material, an 8 5/16 in. length of ⅜ in. steel rod.

The expansion link bushes should cause no problems; the stepped bush is pressed home from the outside, the plain bush being pressed home flush with the inner edge of the inner lug. Re-ream the bushes after pressing home.

Offer the motion plates up to the motion plate stay and clamp in position. Try the weighshaft material in place, checking for tightness and squareness, then drill through the six No. 27 holes in each plate; secure with 4BA bolts and nuts.

The slide bar brackets are milled out of the ½ in. square material used as the gauge when milling the slots in each motion plate. Mark off and drill the two No. 34 holes, as shown, clamp to the motion plate, then clamp the slide bar to the bottom leg of the angle. Check that the crosshead moves freely before spotting through the slide bar bracket and drilling and tapping the motion plate 6BA.

There is only limited clearance between the back of the crosshead and the slide bar bracket; 1/32 in. if all goes well, so it is probably a better idea to drill the No. 27 hole in the slide bar bracket first and then drill the slide bar from it; the reverse to what has been specified on the drawing details.

We must tidy up the motion plate. As suspected, it has proved impossible to cast in the lightening hole in the expansion link outer lug; never mind, it is a simple matter to drill first and then finish file to outline. That completes another large portion of *Mountaineer,* we are making very good progress; the next item to be tackled will be the valve gear.

The Valve Gear

Perhaps yours truly has attempted to show too much detail at one go on what is supposed to be the valve gear assembly; my apologies for this. The simple reason was to enable me to check all the limited clearances of the coupling and connecting rods, and to scheme out the lubricator drive as full size; Boston Lodge insisted that I included this latter feature, one that they are justifiably proud of. More of that anon, let me concentrate on the valve gear first.

Valve gear design is based on the No. 1 Rail Motor, having virtually identical characteristics; it makes a change to be able to base the gear on previous practice, instead of breaking new ground every time. The design stage was completed in less than one evening, which is probably why the drawing blossomed out to show other details in gay profusion.

There is one unusual feature to be mentioned before we get down to construction, and I bet alert readers have already spotted what at first sight might seem a serious error. When the lever is dropped into fore gear, the die block is at the top of the expansion link. This feature had been incorporated, without my being fully aware of it, before John de Bank and Arthur Grimmett returned from North Wales with the startling news. Imagine my surprise when the G.A. was hurriedly checked and found correct! Martin Evans' eagle eye also spotted this feature when the G.A. drawing was sent up to Hemel Hempstead for publication. It will be interesting to find out in service just how this arrangement affects wear of the various valve gear pins. Without further ado, let us commence construction.

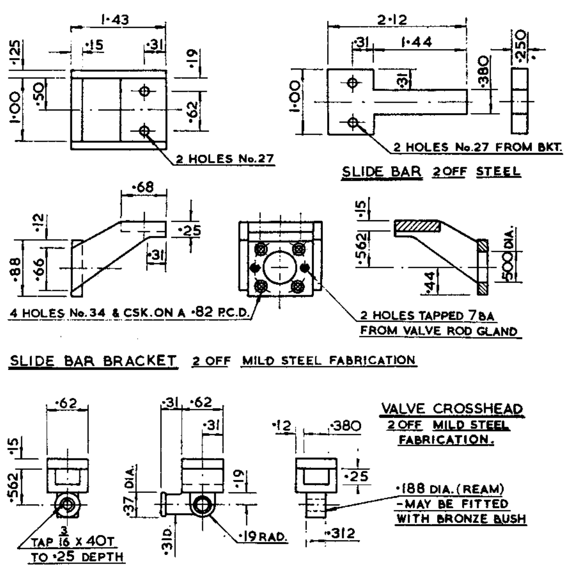
One item long outstanding from the cylinders is the slide bar bracket for the valve crosshead; let us repair this deficiency immediately. On the full size *Mountaineer,* ours are looking very far from miniature by now, this bracket was cast integral with the steamchest. I think it is fair to say that the art of producing intricate castings was more fully exploited in the U.S.A. than anywhere else, until at the end of the steam era, the complete chassis could be one large steel casting. *Mountaineer* herself has quite a few of these beautiful castings, as witness to the pattern-makers' and moulders' skill. However it was considered prudent, for economic reasons (the best!), not to fully emulate same.

A glance at the photograph of the L.H. cylinder will show that the bracket has been broken, probably in the same accident that caused the other damage. To restore its strength, the large inverted channel 'strongback' has been fitted. It is very much doubted if any builder will go to the trouble of producing his own casting, breaking it in the exact spot, and then fitting the strong-back! On with the fabricated replica.

For the steamchest facing, mark out on a piece of 5/32 in. or 4 mm. thick mild steel plate; saw roughly to outline and finish to size by milling, turning, or simply filing to line. Repeat the process for the slide bar facings.

Find the centre of the steamchest facing by the 'X' method, centre pop deeply, and chuck in the 4-jaw with the pop mark running true. Bore out to ½ in. dia., a tight push fit over the spigot on the steamchest. With a knife-edged tool, scribe a circle on a full 13/16 in. p.c.d.; mark off and drill the four No. 34 holes shown, following up by countersinking for 6 BA screws. Mark off and drill the two No. 27 holes in the slide bar facing.

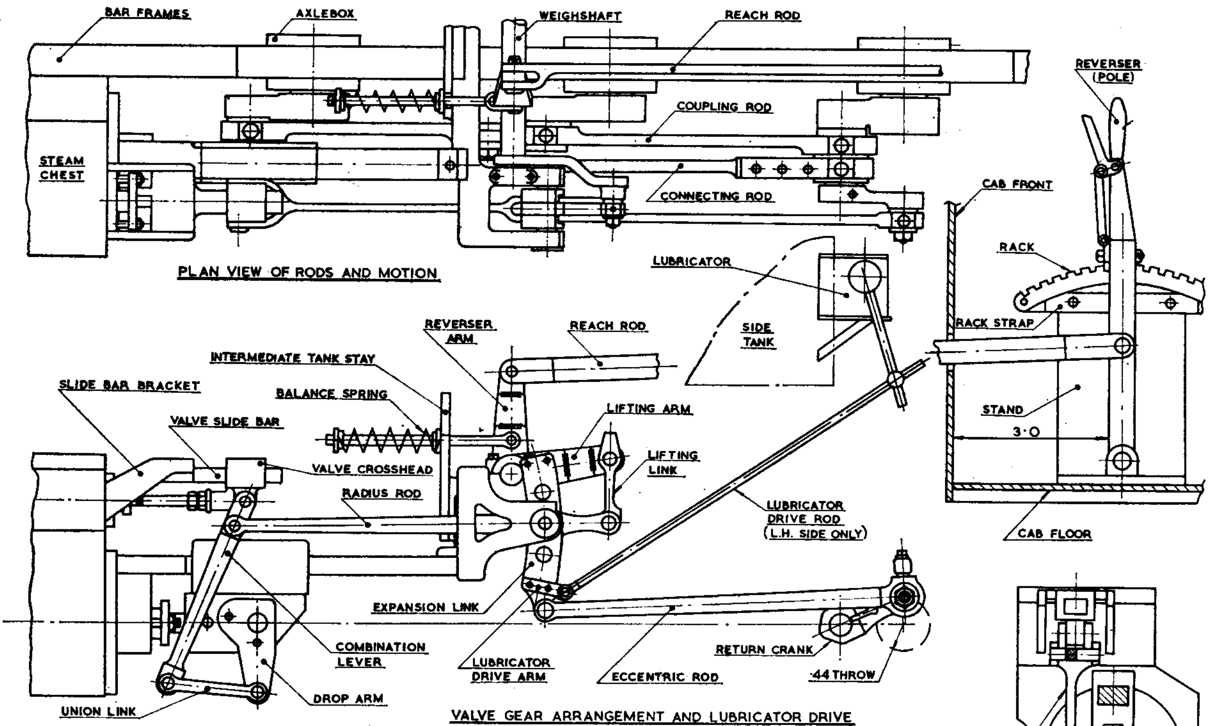
We now require a simple building jig, a 2 in. length of 1½ in. x 1½ in. x 3/16 in. square root



SLIDE BAR 2 OFF STEEL

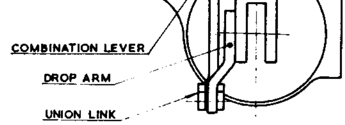
SLIDE BAR BRACKET 2 OFF MILD STEEL FABRICATION

VALVE CROSSHEAD 2 OFF MILD STEEL FABRICATION.



PLAN VIEW OF RODS AND MOTION

VALVE GEAR ARRANGEMENT AND LUBRICATOR DRIVE



SECTION THRO' MOTION

and corner bright steel angle. From the dimensions shown on the detail drawing, mark off and drill the angle so that both facings can be bolted on in their correct position. The No. 27 holes will, of course, be used to affix the slide bar facing; the steamchest facing can best be located by two of the No. 34 holes.

Coat the jig, very liberally, with marking out fluid, so the spelter will not adhere to the jig whilst brazing. Before we reach this stage the two side members must be made, to place, as a pair. Braze up and clean.

Fit the bracket over the steamchest spigot and set the slide bar facing horizontal; spot through the No. 34 holes, drill the steamchest No. 43 and tap 6 BA. Next, slide home the valve rod gland. Spot through, drill the bracket No. 47, continuing into the steamchest if you prefer, and tap 7 BA. Studs are made up from 3/32 in. stainless steel rod, finishing off with commercial brass nuts, if you can get them!

The valve crosshead is detailed as a mild steel fabrication, although on reflection a gunmetal casting would be much preferable, both for construction, and in service. Chuck the casting in the 4-jaw, with the boss running true; face, centre and drill down to 5/16 in. depth at No. 22 before tapping 3/16 in. x 40T. Tidy up the rest of the boss with files and emery cloth, then clean up the two sides of the casting, by filing. Grip in the machine vice and mill across the top, to give the required 9/16 in. height from the centre of the boss. If you screw a short length of 3/16 in. rod into the boss you will be able to check this dimension accurately. Now, mill the recess to suit a piece of ⅜ in. x ¼ in. b.m.s. bar. Turn the casting through 180 deg. and mill the flanks of the spigot for the combination lever; finish by drilling and reaming 3/16 in. dia. for the valve gear pin. The 'lid' is a simple exercise and can either be brazed, using a minimum of spelter, or fixed to the crosshead with six 10BA screws.

As a mild steel fabrication, the crosshead is made in three pieces. The lower, boss portion is machined from ⅜ in. square bar, the central sliding portion is from ⅝ in. x ⅜ in. b.m.s. and the 'lid' as before. A word about the bronze bush, as this is specified as an alternative in many other positions within the valve gear. Ream the piece part ¼ in. dia.; make the bush from 5/16 in. dia. bronze, reducing the diameter to .252 in., or even .253 in., before drilling and reaming the bore.

To be continued

QUORN

TOOL AND CUTTER GRINDER

by D. H. Chaddock, C.B.E.

Part II *From page 22*

THE BASE CASTINGS can be quite easily mounted on the saddle of the lathe and the cored holes bored to size by a boring bar between centres. This method also has the advantage that by using the cross-slide to traverse the work from one hole to the next not only will the two holes be exactly parallel but the centre distance between them can be made closely the same for the right and left hand castings. Here it is worth commenting on the fact that although the centre distance is shown as 3.500 in., indicating that it should be worked to as closely as possible, the actual distance is relatively unimportant, all that matters is that both ends should be the same. If therefore before boring the first hole and locking the cross-slide in position the feed screw is carefully turned right-handed and the micrometer index set to zero, the second hole can be accurately positioned by turning the feed screw the requisite number of turns — 35 in the case of a 10 t.p.i. screw — and finishing up again turning right-handed until the micrometer index is again at zero. By this method all backlash is eliminated and one can freely go from one hole to the other and back again. This is convenient with a boring bar between centres because setting the cutter bit to bore a given diameter is always a bit of a fiddle and a little bit uncertain until a trial cut has been taken. So both holes can be rough bored in turn with the same boring bar setting.

The rear hole, which is the less critical, can then be opened out until it is a neat sliding fit for the front bar and this setting immediately used to bring the front hole to size. Thereafter a slight tap on the cutter will give the necessary oversize to bore the rear hole with clearance. Moving the work between cuts and putting it back afterwards sounds all wrong, but if one accepts the fact that work can be accurately positioned by the use of feed-screws, if it can be set right the first time it can be re-set equally accurately any number of times thereafter. There is no magic in the first setting. Any of the subsequent settings will be as equally accurate — or inaccurate — but the greatest care need only be exercised on the final setting when the cuts are light. Of course the centre distance will not be 3.500 in. to N.P.L. standards, but as already explained that does not matter if both ends are alike.

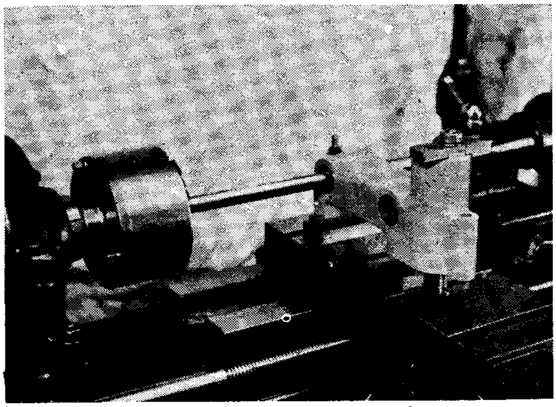
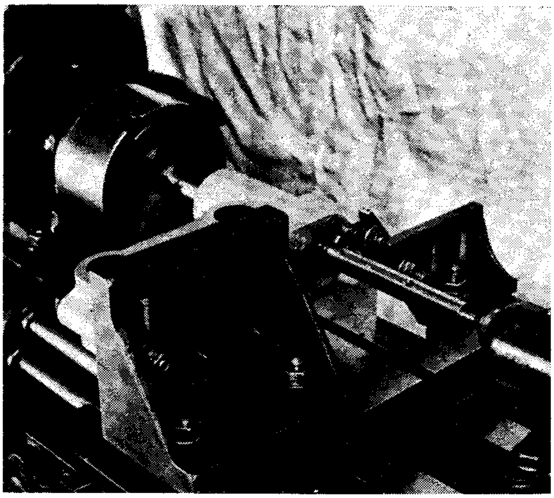


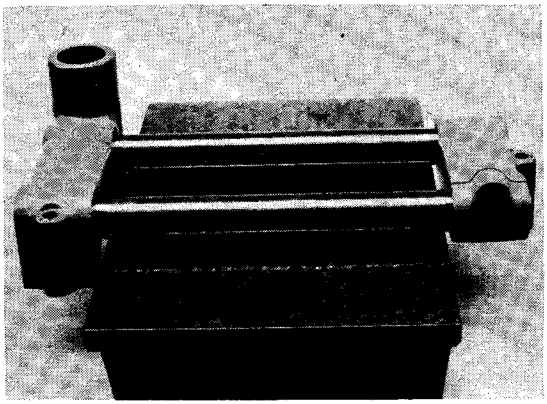
Fig. 5. Base casting bolted to cross-slide.

The castings need little preparation prior to setting up. The under surface should be dressed with a file until the casting sits fair and without rocking on a flat surface. It is convenient too at this stage to drill the holes for the holding-down bolts, which are not critical, as they come in handy for bolting the casting to the saddle — as in Fig. 5. The holes at the back should be a clearance fit for the fixed bar which is going to be "Loctited" into them. The clearance can be checked by inserting a .003 in. feeler along with the test bar. The front holes should be as neat a fit as possible for the front bar which must slide in them without play. If anything it is better to leave them on the tight side because they can always be lapped out afterwords. This will almost certainly be necessary with the right-hand base casting the hole in which may tend to close up after the casting is split for the clamp screw.

The 1¼ in. dia. hole for the vertical column can be bored in exactly the same way with the casting bolted to angle plates on the cross-slide. Because the writer does not own an angle plate big enough to span the length of the casting, nor if he did would he be prepared to bore a hole in it big enough to clear the boring bar, he used two angle plates to support each end of the casting. Although the set-up shown in Fig. 6 looks a bid dodgy it worked perfectly. This hole too should be bored a clearance fit for the vertical column. The other operations, drilling, tapping, sawing etc. are conventional and need no comment although as is standard amateur practice the 4 BA drilled and tapped holes are most conveniently spotted off the mating components.

Here it is to be explained that in this design all dimensions are Imperial and threads BSW,





Left: Fig. 6. The set-up for boring the 1¼ in. hole. Above: Fig. 7. Using the surface plate to ensure parallelism while the Loctite sets.

BSF, or BA. Owners of suitable screwing tackle can replace them with UN or SI but if this is done the coarse series should be used for threads tapped into cast iron, not the fine.

The front and rear bars should now be tried in both end castings together. The front bar should be a close fit but free to move, the back bar should have appreciable clearance so that the front bar can find its own alignment. If all is well, remove the back bar and thoroughly clean its ends and the holes in which it fits, either with hot strong detergent or preferably with the special cleansing fluid supplied by the makers of Loctite. Don't touch the ends or the holes after they have been cleaned before coating them with Loctite. Reassemble and lay the two bars across a surface plate as in Fig. 7 and leave it thus until the Loctite has hardened. The object of this manoeuvre is to bring the two bars absolutely into the same plane even if there was some residual error in boring the holes in the end castings. After the Loctite has set, it ought to be possible to hold four pieces of cigarette paper between the bars and the surface plate — the toolmaker's traditional test for truth. "Loctiting" the vertical column must be done separately but needs no special precaution. If the end of the column is faced truly square and the job stands upon a surface plate it cannot be other than upright.

Before doing this however a decision must be taken as to whether it is to be screwed or not — once it is in it will never come out again. Those therefore who are opting for a plain column can skip the next section — others read on. Firstly how can you cut a 1 in. pitch thread on a lathe if it is not shown in the screwcutting table? The answer is easy — if it has an 8 t.p.i. lead screw and will cut 64 t.p.i. it will also cut 1 in. pitch. Just put the change wheels on backwards so that the leadscrew is running 8 times faster than the

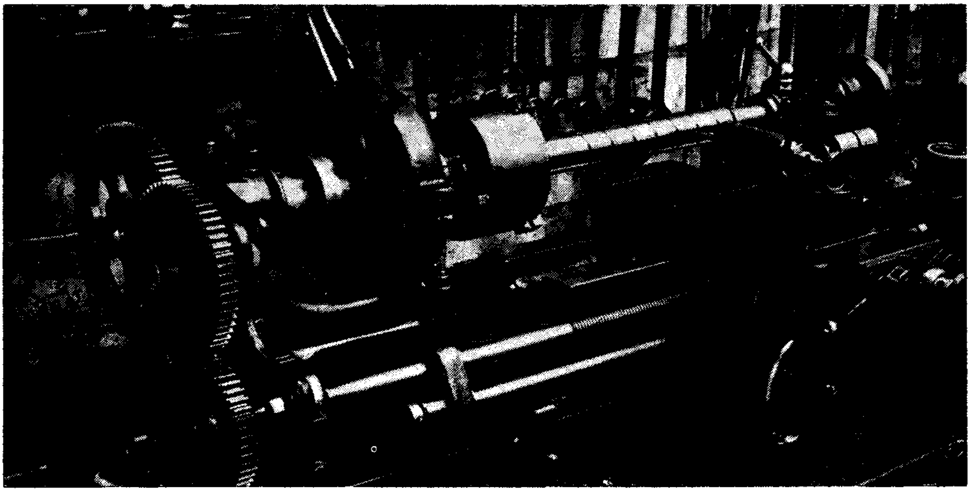


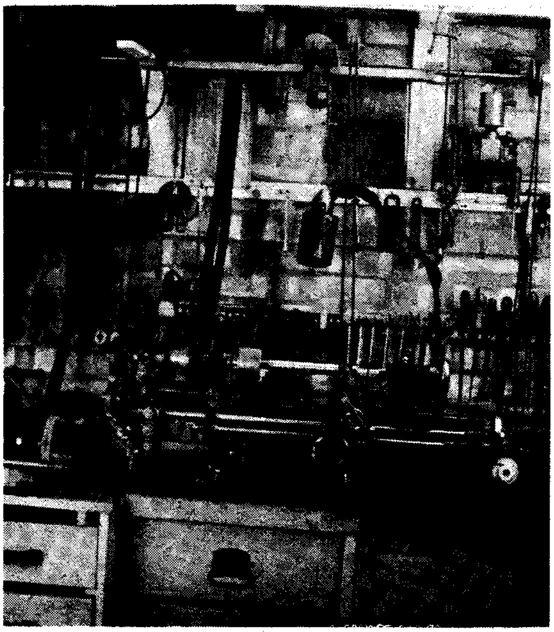
Fig. 8. The set-up used for cutting the quick-start thread in the column.

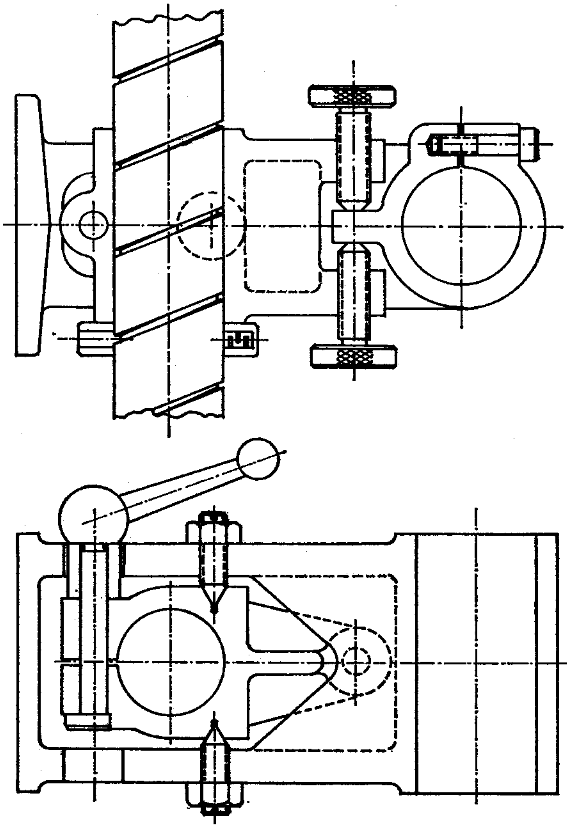
mandrel. The train the writer used was 80/20. 60/30 with a 50 T idler between the 60 T and the 30 T wheels. But there is no magic in 1 in. pitch, anything between ½ in. and 1 in. will do and it does not matter if it is in fractions. So just put the largest wheels you have on as drivers and the smallest on as driven gears. Lucky owners of lathes with Norton boxes are not so lucky here — the best the Norton box can do is 1 : 1 and they will have to borrow or improvise some transposing gears. If I owned such a lathe I should fit a 45-50 T bicycle sprocket to the lathe mandrel and a home-made 6 T sprocket to the input shaft of the Norton box. Not ideal perhaps but with chains one can get away with a lot and it would work.

Geared this way the lathe cannot of course be driven from the mandrel even with the back gear in. It must be driven from the leadscrew and although this can be done by hand the feed is rather coarse. One turn of the leadscrew hand-wheel will rotate the work ⅛th of a turn and produce a length of cut of ½ in. on a 1¼ in. dia. bar. Since this is equivalent to a feedscrew of 2 t.p.i. it is rather coarse for a 3/32 in. end mill. For this and similar work the writer has found it well worth while to rig up a worm drive to the leadscrew and many years ago he cut a 14 D.P. worm which meshes with any or all of the lathe change wheels. An additional 50 T wheel was put on the leadscrew stud and the worm engaged with it as shown in Fig. 8.

Having got so far it seemed logical to provide

Fig. 9. The final set-up for cutting the quick-start thread.





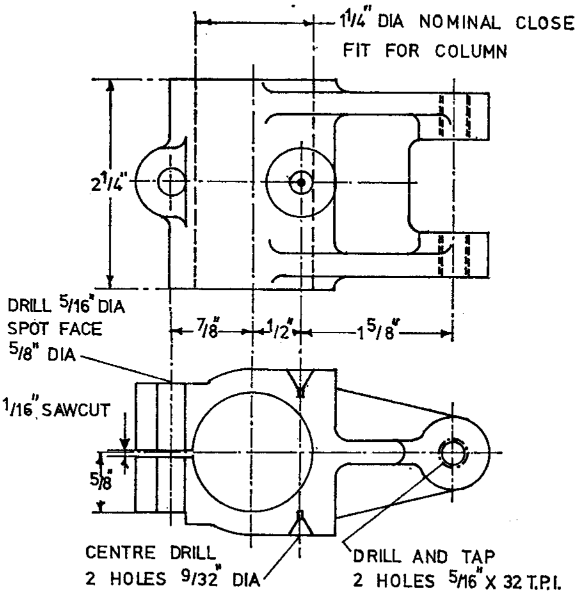
WHEELHEAD ASSEMBLY

FIG. 10

a power feed since this is much kinder to the cutters and produces better work. Now the recommended depth of cut for a slot drill is ½ of the cutter diameter, which for a 3/32 in. dia. cutter is 0.047 in. and so two passes would be required to produce a slot 3/32 in. deep. Also the recommended speed and feed for a cutter of this size in mild steel is 4278 r.p.m. and 1¼ in. per minute respectively. It was not convenient to drive the cutter at this speed, in fact it was run at 1940 r.p.m. but there is no harm in this provided that the rate of feed is reduced in proportion so that the depth of cut per tooth remains constant. This therefore demanded a feed speed of about ½ in. per minute, that is the work should revolve once in 8 minutes and the total cutting time for each pass of 6½ turns should take about 52 minutes — a clear case for automatic feed! Incidentally this simple calculation shows how wrong one could be in guessing the right feed and then attempting to apply it by hand. One or two trials with rough wooden pulleys and lots of plastic belt showed that this could indeed be achieved and the final set-up shown in Fig. 9 worked extremely well. After everything was set up it was only necessary to stand by for nearly an hour dabbing on cutting oil while the lathe solemnly completed each pass. Why not automate the oil feed? Well there has to be a limit somewhere!

The milling spindle used in this operation is one that the writer made many years ago and has been used in innumerable milling, drilling and grinding operations. It is very similar to the quill which in due course will be described for use with the QUORN tool and cutter grinder itself. So if you have not a suitable spindle make this up next and discover for yourself what a difference a precision spindle running in pre-loaded bearings can make to seemingly difficult milling operations. I have described this operation at some length to show that with a little ingenuity and some simple figuring to get the numbers right, a seemingly impossible job is not only within the compass of an amateur's workshop but can add considerable interest to his work.

To return however to the main machine, the next group of castings to be machined could well be the wheelhead assembly (Fig. 10) particularly if, as has already been suggested, it is to be used to machine the spiral keyway in the vertical column. The wheel-collar, Fig. 11, will swing in a 3½ in. lathe so that it can be held in a four-jaw chuck, with one jaw reversed, to machine the 1¼ in. bore to a neat sliding fit on the vertical



WHEEL HEAD COLLAR 1 OFF C.I.
FIG. II.

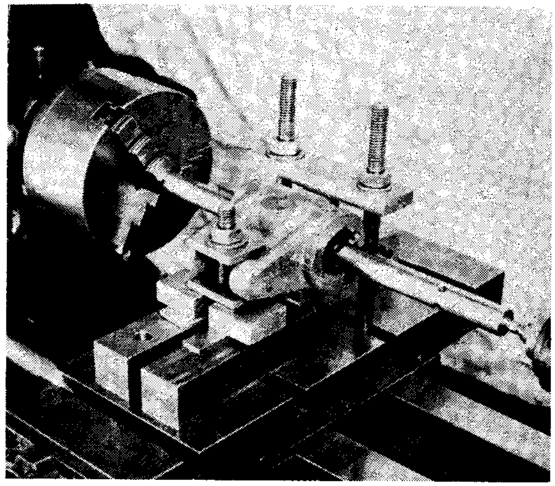
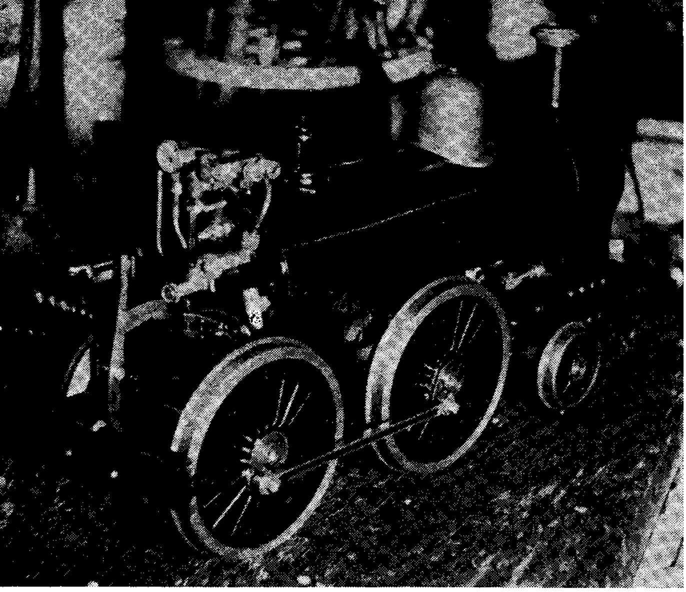


Fig. 12: Machining the wheel-head collar.

column. At this setting one end can be faced but the other end must be faced by mounting the casting on a stub mandrel or on the vertical column itself. Incidentally all these "2nd Ops" of which there a number are very much facilitated if they are deferred until after the castings have been cross drilled for the clamping bolts and split. With a jury bolt through the cross hole they can be firmly and truly clamped to an appropriate bar used as a mandrel between centres. Alternatively the casting can be machined on the lathe saddle as in Fig. 12. In this case both ends can be machined at the same setting by a facing cutter mounted on the boring bar. Cross drilling, tapping and slitting, preferably with a circular saw in lathe or milling machine for neatness, but a hacksaw cut would do, are conventional. Some care needs to be exercised however in planting the 9/32 in. dia. centre holes in which the pivot screws of the wheelhead bracket engage. Unless they are exactly the same height each side the axis of the grinding spindle will be canted and the faces of wheels mounted on it not truly at right angles to the bed bars. Some latitude for adjustment exists in the final assembly, which will be described in due course, but even at this stage it is well to get the work as accurate as possible. Jig drilling would be ideal, using the same jig to drill each side in turn, but hardly worth while for "one off". However if the casting is packed up on the lathe saddle or mounted on a vertical-slide and brought to centre height both sides can be drilled in turn from the chuck without altering the height setting. As a check, clamp a ¼ in. dia. steel ball in each centre hole and test its height with a D.T.I. from a surface plate (cheers from Derek Beck!).

To be continued



Vancouver Island "Jumbo"

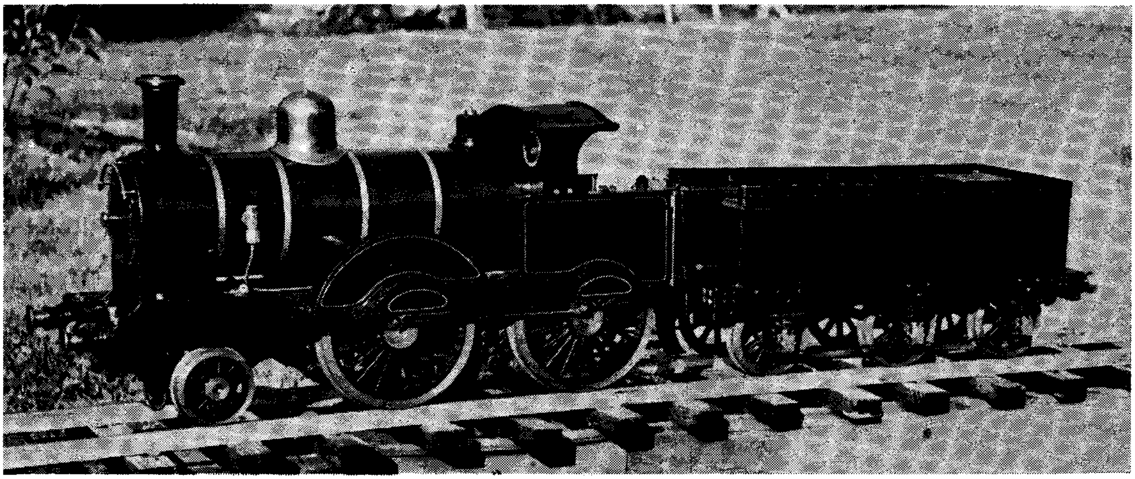
by Vernon Dawson

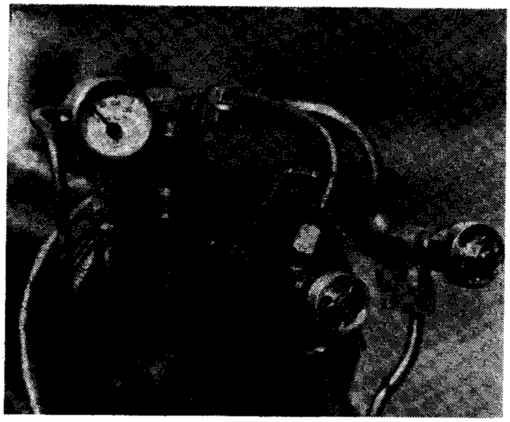
photographs by E. W. Hanning

GREETINGS from the most westerly society of model makers in the Commonwealth — the Vancouver Island Model Engineers. British Columbia is the most westerly province of Canada and Vancouver Island lies west of the city of Vancouver, where there is a very active society, hence the claim that the V.I.M.E. is the most westerly of them all. The provincial capital city of Victoria, B.C., where our group has its headquarters, is farther west than the cities on the U.S. West coast, hence unless there is a society in the Hawaiian Islands, we could well be the most westerly group in the world.

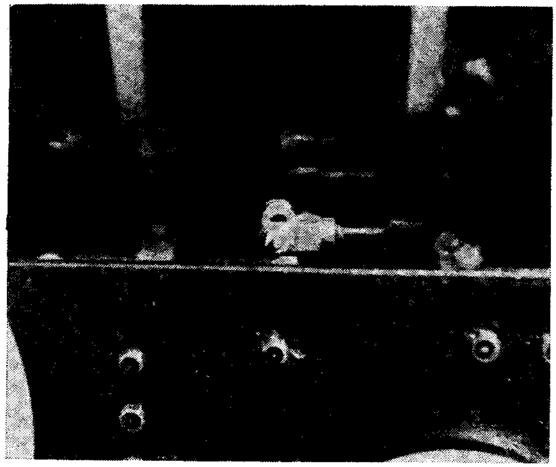
When it comes to longevity, of course, the situation is very different and we become appropriately humble, for our group is only about one year old. The majority of our members are "live steamers" and there are a dozen or so locomotives planned or under construction in 3½, 5 and 7½ inch gauges. British prototypes thus far are predominant — *Tich*, "Hall", "Britannia", *Springbok* and *Rob Roy*. This may at first be found somewhat surprising and, in fact, caused an embarrassing moment during a recent exhibition of our members' work when one spectator plaintively enquired — "Where are the Canadian engines"? Luckily honour was satisfied when we were able to point to a very fine little gauge "O" high pressure C.P.R. "Pacific" that he had overlooked among the more massive exhibits and he went away happy when it was also gently explained that most builders require proven designs, castings and other materials and that for these Britain is the most prolific and economical source.

One of our keenest and most active members, Maurice Foord, has recently completed a 3½ in. gauge passenger hauler and an account of this may well serve to inspire others to take the initial plunge, for it shows that where there is a will, the way will be found. Maurice does not remember when he was not fascinated by steam power and his real inoculation took place one summer afternoon many years ago at the village of Shirley, near Croydon in Surrey. There a friend of the family had a passenger-hauling track in





Above: Backhead fittings.
Right: Valve gear rocker.



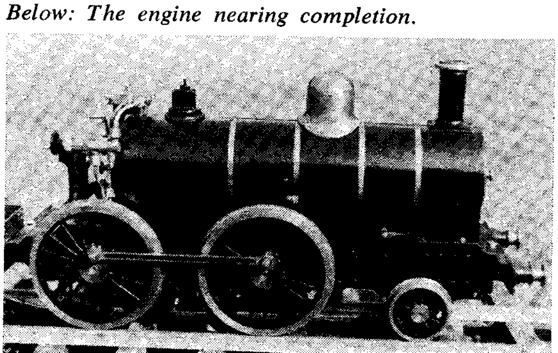
his garden and a happy afternoon was spent lapping it behind a real "puffer". This really cast the die; thereafter there was never any doubt that somehow and somewhere Maurice would build his own passenger puller.

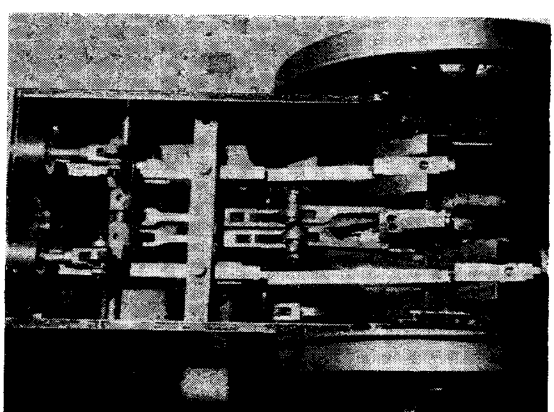
The scene now shifts several thousands of miles west in direction and several years later in time to Victoria, where we find Maurice established as a family man and living in a home with a garden large enough for a continuous track. Always an avid reader of "M.E.", he was about five years ago re-reading some back issues (1966) when lo and behold there were the "words and music" by LBSC for a Webb 2-4-0 especially suitable for beginners. The decision was made—this was "it". Subsequent receipt of the "M.E." drawings and Messrs. Reeves' catalogue merely whetted the appetite to begin.

Here we should pause to note that Maurice at this stage was in his own words an "absolute novice". He had no training in lathe-work (and indeed, no lathe) and possessed only a set of the usual hand tools. The main thing, though, was to get started and when it was discovered that there were no local suppliers of bright mild framing steel he bought some hot-rolled, cleaned it off, squared it up and started to saw out the locomotive frames. Diligent attendance at the local night school courses for three winters provided the necessary machine shop training, a 10 in. Atlas lathe with a vertical-slide for milling was acquired in 1969, a drill press in 1971, and it was a green light all the way (with the usual service slacks, of course).

Erection of the frames was trouble-free and machining of the wheel and inside cylinder block castings was without heart-stopping incident. Even the crank-axle, with its webs and four eccentrics for the Allan straight link valve gear, though much feared and on this account more than once postponed, was built up carefully as prescribed and gave no undue trouble. A standard LBSC single cylinder lubricator was made up and fitted behind the buffer beam, feeding oil from the bottom of the block, up between the cylinders and into the valve chest. Since the loco was meant to be a much-used "runner" and not a glass cased exhibit, it was decided to omit superfluous and delicate details.

Right: The valve gear.
Below: The engine nearing completion.





The Boiler

Next came the boiler. The "words and music" called for $3\frac{1}{2}$ in. copper tubing, which was found to be unobtainable locally. So Maurice obtained a suitable piece of 4 in. tubing, cut a longitudinal strip out of it, re-rolled the remainder to the correct size, used the strip to double rivet the seam and brazed up the whole thing with his small oxy-acetylene outfit. The rest of the job was found to be a matter only of carefully following instructions. Boiler feed is by a Reeves injector, with a tender hand pump as a stand-by. The injector has been found most reliable in service. The boiler was tested hydraulically to 170 p.s.i. by hooking up the hand pump (Maurice was surprised to obtain this pressure from a pump with a single 0 ring for packing) and then under steam to 100 lb. (normal working pressure is 85 lb.). The boiler passed both tests with nary a single weep and both chassis and boiler were now passed into the sheet metal and paint shops.

The boiler was clad with asbestos paper and finished with rolled galvansheet steel, the latter being pickled in vinegar to etch the surface for painting. The prime coat and two finishing coats of enamel were applied by spraying from aerosol containers. Boiler bands are narrow strips of brass bolted together underneath the boiler (Maurice found that this job was a real four-hander and it will not surprise the reader to learn that a little husband-wife co-operation was required).

Sheet Metalwork

Sheet metalwork on the chassis was next on the list and Maurice does concede that it was a "bit tricky" to get the correct curvatures on the running boards. He also decided to re-design the cab to permit easy removal, which in turn will make it easier to remove the splasher and running board assembly whenever this becomes necessary. After spray-painting, the sheeting was lined by pressing on 1/32 in. wide adhesive tape, which was given a finishing brush of clear varnish.

The tender frames also had to be made up from hot-rolled instead of the prescribed bright mild steel. It was also found that there was no suitable sheet brass available locally for making the water tank, so a piece of 4 in. tubing was slit, annealed, rolled flat and that was the end of that problem.

Mabel was now ready for track trials. Initial attempts to raise steam on anthracite were not successful, so local soft coal was used instead. This burned well but too quickly. Finally, the secret of firing was discovered—local coal to get the initial hot fire and then anthracite for the longer lasting fire when reeling off the laps. Experiment also revealed that a slightly smaller blast nozzle improved the fire for continuous running on the fuel available. Another minor problem occurred with the boiler feed. The strainer in the tender tank had been made up as prescribed, which meant that the vertical cylindrical strainer ended about half way up from the bottom of the tank. The injector worked perfectly as long as the water level in the tank was above the top of the strainer, but began to "act up" as soon as the top of the strainer was exposed to air. Maurice thinks there are two likely explanations for this — the size of the wire mesh may be critical (he used what was available) or the injector may find it easier to "suck air" rather than water through any small mesh filter wire. In any event, the remedy was simple—substitute a shallow drum-shaped strainer for the original vertical cylindrical type—and there is now no problem in feeding almost all the water in the tank.

In conclusion, performance has exceeded expectations by a good margin. The Teflon used for packing the piston rods and valve stems has stood up well in service. The engine runs well, steams freely and can be linked up in the approved manner when under way. On steel rails it has managed to haul four medium-sized adults up a $1\frac{1}{2}$ per cent grade but on its home road of aluminium rails it is a little more skittish and inclined to slip at starting. Maurice hopes that this account of one beginner's successful attempt will encourage other aspirants who may be hesitating on the brink to master their diffidence and do likewise. He has already chosen his next job —a $3\frac{1}{2}$ in. gauge 0-8-0 Canadian National Railways switcher *Caribou* as designed by Martin Evans for "M.E.".

BOOK REVIEW

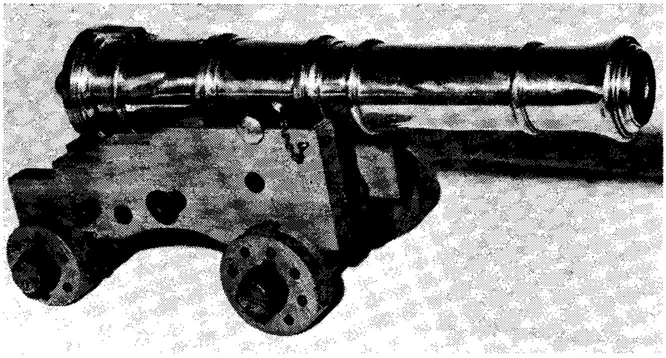
"My Seventy Years with Traction Engines"

By Charles E. Hooker

Published by The Oakwood Press. 45 pp. Price 75p. The author started working on traction engines as long ago as 1895, and in 1907 had his first motor car. This little book tells something of the trials and tribulations of a traction engine driver in the early days when roads were merely mud in winter and dust in summer.

Mr. Hooker was apprenticed to Frederick Clark & Son, general engineers, Elwick Iron Works, Ashford, Kent. His father started in business with engines for ploughing, threshing, road haulage, etc., and at one time had 17 assorted engines and rollers. With his brother Edward, the author took over the business in 1928, when the manufacture of new steam traction engines had almost ceased.

R.M.E.



CAPTAIN COOK'S CANNON

by L. Ridgers

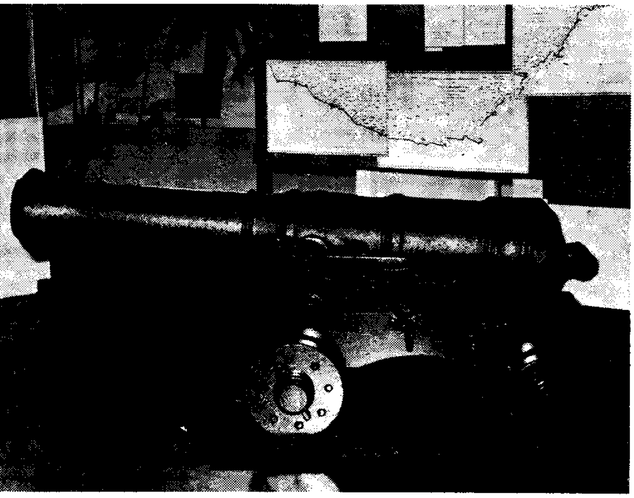
of Tasmania

LATE IN THE EVENING of 11th June, 1770, His Majesty's barque *Endeavour* ran aground on a coral rock in the Great Barrier Reef off the North Eastern coast of Australia. The *Endeavour*, commanded by Captain James Cook, was on its voyage of discovery of the Eastern coast of Australia after the attempt to observe the transit of Venus at Tahiti in 1769.

Cook's official log betrays only a little of the predicament in which the grounding of his vessel must have placed him and his company, thousands of miles from assistance and off an unknown coast. He recorded, in a matter of fact manner, the attempts to heave the ship off the reef with various anchors and, in order to lighten the ship, the progressive heaving overboard of empty casks, the boatswain's and carpenter's condemned stores and the stone and iron ballast from the hold. He finally ordered the six carriage guns carried on the deck of the *Endeavour* to be thrown overboard.

Fortunately, with the action taken and the rising tide the *Endeavour* floated free and after repairs were effected by careening the ship, the *Endeavour* returned safely to England in July, 1771.

The original cannon. The picture above shows the model.



In 1969, almost 200 years later, an American expedition to the Great Barrier Reef was successful in recovering the guns from Captain Cook's ship, despite being hidden by coral encrustation up to 4 ft. thick in places. Although the wooden carriages had entirely disappeared, the barrels of the six guns were found to be in a remarkably good state of preservation after their long immersion, having been protected by the coral formation.

The guns recovered, having a bore of 3 in., would have fired a 4 lb. ball. They were 6 ft. in length and their weight, in hundredweights, quarters and pounds was chiselled near the breech. A Royal Cypher "G R 2" was cast on a raised portion of the barrel near the trunnions. Various moulding bands on the barrel were still intact and except for some small corroded patches, the barrels must look as they did in 1770. Two of the guns were found to be loaded when recovered.

Samples of the iron tie bolts, eye bolts and cap squares for holding down the trunnions were also recovered and drawings made from these, together with the help of a document entitled "A Treatise of Artillery" by John Muller enabled the construction of authentic carriages for the guns by the staff of the Department of Shipping and Transport in Australia.

A gun with its reconstructed carriage was presented by the Australian Government to the Philadelphia Academy of Natural Sciences which had backed the expedition to recover the relics, while others were presented to museums in Australia, New Zealand and the National Maritime Museum, Greenwich.

In 1970, one of the recovered guns was sent around various Australian cities for exhibition as part of the 200th Anniversary celebrations of Captain Cook's discovery of Eastern Australia and in due course it was displayed at the Tasmanian Museum and Art Gallery, Hobart.

The gun appealed to me by virtue of its authenticity and pleasing shape, so much so in fact that I determined to make a model of it. Making model cannons has been included in the projects undertaken in my workshop for many years but the lack of accurate plans has hindered the production of authentic models. With the construction of a pair of Russian fort guns to the design of "Little Eatonian" in M.E. and a field gun of the Napoleonic period designed by Mr. Stair, some of my earlier cannons now appear unsatisfying, and for future models, scale plans will be used where possible.

Construction

The construction of model cannon is quite interesting and the completed article forms a useful ornament. Added to this are the virtues of not being too difficult to make and not taking a long time, making a change for some other projects which may take years to complete.

Although some plans for old time ships' guns of similar type to those recovered are available, I considered it worthwhile to prepare a drawing in view of the good state of preservation of the barrel and particularly as it had been carried by the famous explorer, Captain Cook.

After receiving permission from the Museum Authorities several visits were made to the gun to sketch and dimension the various parts. Contours of the various mouldings were also obtained. From these, drawings of the gun were made by Mr. W. S. Moore of Hobart.

A start was made by making a pattern with adequate machining allowances and a casting in gunmetal obtained, although the original gun was in cast iron. Gunmetal was used as the finished model was to be used as an ornament. A good chucking piece was formed on the pattern and this enabled the casting to be gripped in the chuck for drilling the bore. A small plug with a centre hole drilled in it was then placed in the bore for the tailstock centre to bear in while the barrel was being turned. If this precaution is not taken, the pressure of the centre forms an ugly sharply tapered end to the bore.

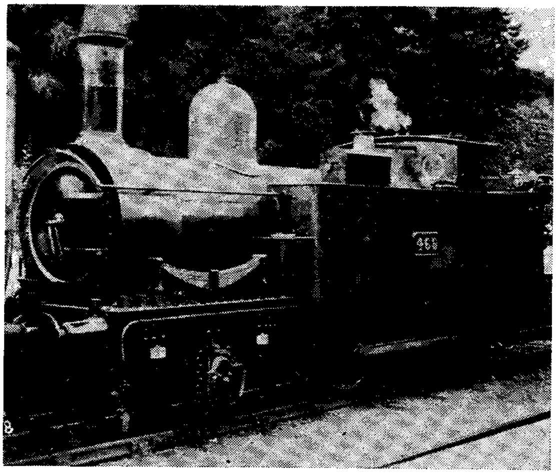
The mouldings, ball and the flared muzzle were formed by hand turning tools. Small form tools to turn the half round beadings were also used. As the barrel was too long to swing on the faceplate of my lathe, holes for the trunnions were bored by clamping the barrel on the cross-slide and the trunnions, made from the same material as the barrel, pressed in. This method is only satisfactory if the gun is not to be fired. Integrally cast trunnions are essential if the gun is to be fired, but these interfere with the machining and necessitate a fairly tricky end milling job with a milling spindle on the cross-slide and finishing with a file.

The built-up portion for the touch hole was filed up and sweated on. Araldite would perhaps have been better, as the solder and marks made by the heat and flux were hard to remove. The engraving of the figures showing the weight of the barrel and the broad arrow mark were made by small chisels and a graver, but as I could not think of any practical way within my skills, no attempt was made to reproduce the Royal Cypher.

Tasmanian myrtle was used for the carriage. This is a close-grained timber, reddish brown in colour. The carriage was glued together with PVA adhesive. All the iron work on the original was reproduced. Form tools were used to form the tie bolt heads that would have been riveted on the original cannon and advantage was taken of Araldite to secure the bolts. To produce the cottered fastenings holding the axles to the cheeks of the carriage, slots were filed in the ends of pieces of mild steel rod about 5/32 in. diameter. By placing the slotted end of the pieces of steel into bored holes in the axles and gluing them into position at the appropriate depth with a washer added, slots for the tapered cotter pieces were easily made. This idea is not original, but was seen some years ago in M.E.

The ring bolts, cap squares and eye bolts were built up with steel and silver solder. Wheels were made of two pieces of wood, glued together at right angles and turned in the lathe. A form tool was also used for the heads of the rivets holding the pieces together.

On the original gun exhibited at the Museum the carriage was painted red and the ironwork black. As this would appear rather gaudy in small size, the model carriage was painted with clear matt plastic and the ironwork black Humbrol matt. This dull finish contrasts with the polished gunmetal of the barrel. A periodical polish with Brasso soon restores the barrel when it tarnishes.



METRO

A new locomotive for 5 in. gauge based on the Great Western Railway "Small Metro" class

by Martin Evans

Part IV *continued from page 28*

A SIMPLE JIG will be required for drilling the driving and coupled wheels; a length of mild steel about 1 in. x $\frac{3}{8}$ in. will do nicely. Drill and ream this at one end $\frac{3}{16}$ in. dia. for the crankpin hole, and at the other, at 1 in. throw, press in a short length of silver steel an exact fit in the wheel boss. The outer end of the jig can be clamped to the wheel with a toolmakers' clamp while the drilling is being done. Afterwards, the wheels can be opened out and reamed $\frac{1}{4}$ in. ready for the crankpins.

The crankpins can be made from $\frac{5}{16}$ in dia. silver steel, or from mild steel case-hardened. They are made a press fit in the wheels, though as there is no outside valve gear this time, there will be no need to pin them to prevent rotation. If case-hardening is adopted, put an old nut on the threads to prevent damage from the flame. One of the trailing crankpins has no thread; it is left with a plain shank $\frac{3}{16}$ in. diameter, to carry a short crank to operate the mechanical lubricator, which can be located in the cab as on *Boxhill*.

We will require one plain axle. This can be made from $\frac{5}{8}$ in. dia. ground mild steel or silver steel. As most builders will not have a lathe big enough to allow the axle material to pass through the mandrel, the axle can either be turned down from larger diameter material between centres, or it can be turned using the three-jaw chuck and a fixed steady. I prefer the second method as the $\frac{5}{8}$ in. material can be used. Set up a length in the three-jaw and arrange the steady to support the outer end. Make sure that the steady is dead in line first, by fixing a D.T.I. to the saddle and traversing this from one end of the axle to the other. Also make sure that the three-jaw is holding the left-hand end quite true; if not, the paper packing dodge can be used. Check with D.T.I. once more. Now turn down one end to a press fit for the wheel, putting a very slight taper on the first $\frac{3}{16}$ in. or so, and trying on the appropriate wheel until the desired fit is obtained. Generally speaking, it should be possible to wring the wheel on by hand about half way. Put the usual centre in, then reverse the axle and turn the other end.

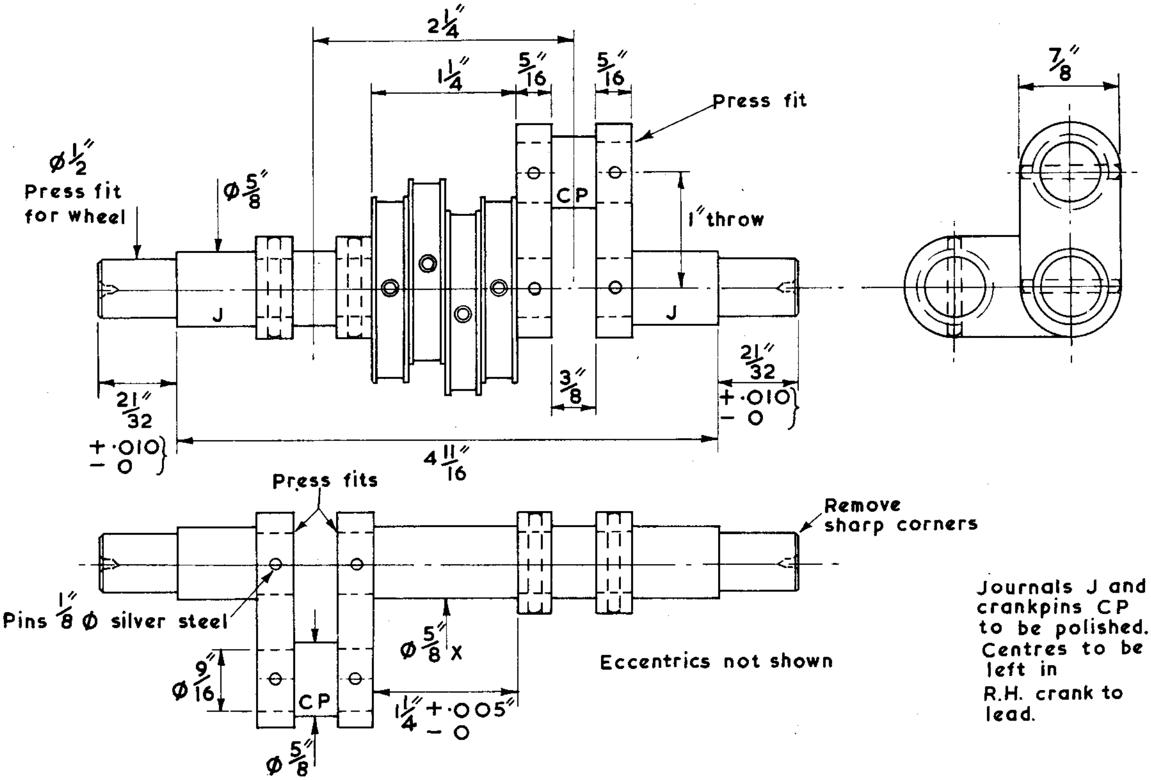
Crank-axle

There are many ways of making a two-throw crank. I much prefer to have the eccentrics free on the axle, so that they can be adjusted as required when valve setting. Skilled turners may prefer to turn the whole thing out of the solid, but the difficulty of marking out the four eccentrics accurately enough will deter most people.

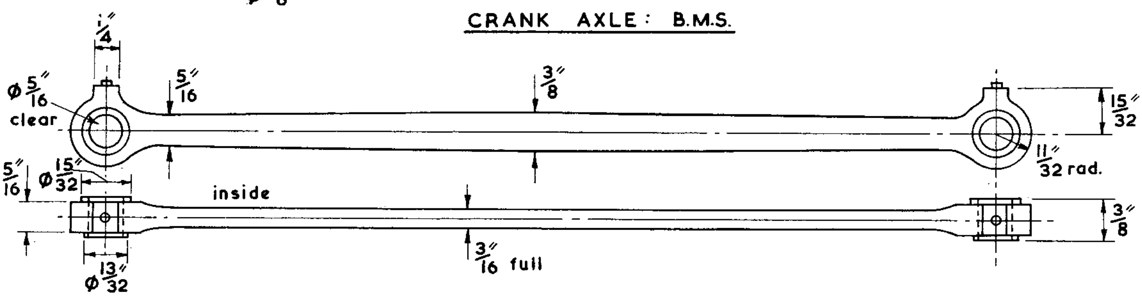
Another method of making crank-axles is by brazing. But the danger of distortion is too great to allow me to recommend this.

The two methods which I favour are the built-up press-fit assembly and a similar method using Loctite in place of press fits. In either case, it is advisable to pin all the webs to both axle and crankpins.

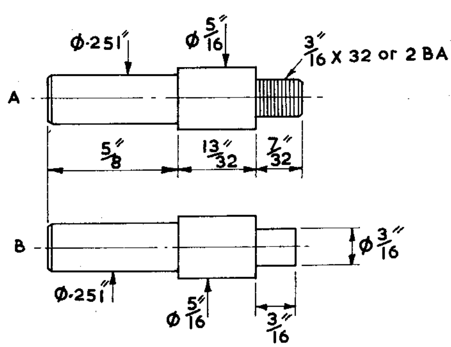
In making crank-axles by the built-up process, it is most important to ensure that the four webs are all exactly the same length, centre-to-centre, the throw in this case being 1 in. The best way to make sure of this is to bore them all together in the lathe. Start by cutting out the webs from $\frac{7}{8}$ in. x $\frac{5}{16}$ in. bright steel or the nearest wider. Thoroughly clean up both sides of each web and sweat them all together with soft solder. They can then be lightly marked out on one side, and the two holes for axle and crankpins deeply centred. If the webs are to be held in the four-jaw chuck for boring, great care must be taken to ensure



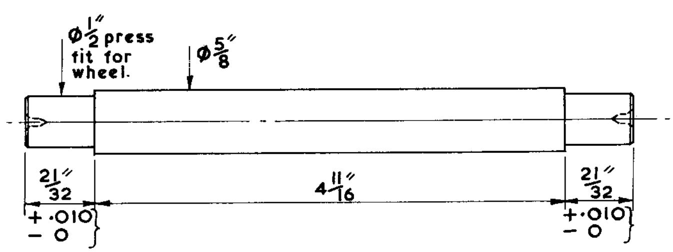
CRANK AXLE: B.M.S.



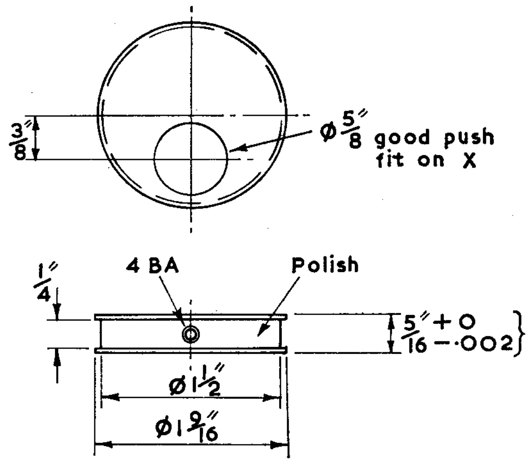
COUPLING RODS: 2 off B.M.S. bushes cast gunmetal



CRANKPINS: 3 off A 1 off B silver steel.



TRAILING AXLE: B.M.S.



ECCENTRICS: 4 off B.M.S.

that they are held truly. Drill the first hole right through ½ in. dia., bore out to 0.559 in. dia., then ream 9/16 in.

Now shift the bank of webs until the second centre runs true. Check once again that the bank is true in all planes. The second hole is now drilled, bored and reamed as before.

Another method of ensuring that the webs are bored truly is to use a small Vee-block clamped to the faceplate. When the second hole is to be bored, the Vee-block is shifted bodily on the faceplate.

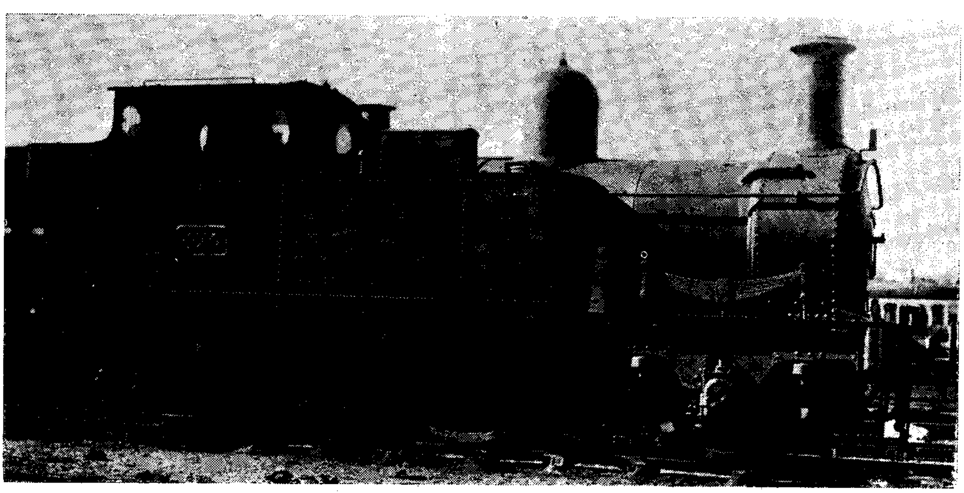
There is a third method for boring the webs. The bank is clamped under the toolholder with the axle/crankpin centres at lathe centre height. When the first hole has been finished, the cross-slide is simply advanced 1 in., measuring this from the graduated dial. A boring head would be useful here; but I should warn builders who may wish to adopt this method that it is essential to make sure that the web bank is clamped absolutely truly in all planes—not easy as many lathe top-slide surfaces are far from true and smooth!

Referring to this third method, the reamer should not be held in the three-jaw unless this happens to be quite true on this particular diameter; support its rear end on a centre in the lathe headstock. Enter the "lead" of the reamer into the webs, and complete the job by moving the saddle bodily towards the headstock, the reamer being prevented from turning by the usual carrier.

The four webs can now be melted apart. To remove all traces of the solder used to hold them together, rub them carefully on fine grade emery cloth laid on something flat such as a piece of plate glass. Remove the sharp edges around the holes on each side of the webs with a scraper. Then mark out the radiused ends of the webs, but do not shape these yet as the flat sides of the webs are a help in arranging them at 90 deg.

The next items are the two crankpins. For these we require two pieces of 11/16 in. dia. or the nearest larger bright mild steel about 1 1/16 in. long. Face both ends in the lathe and reduce to exactly 1 in. long. Chuck again and reduce the amount protruding to 0.626 in. dia. Polish this down to exactly ⅝ in. dia. and then turn the last 5/16 in. down to exactly 0.565 in. dia. Slightly taper the extreme end with a dead smooth flat file and try one of the webs on for size. Reverse the job in the chuck (or use a collet if available) holding the crankpin by the smaller diameter. Check with D.T.I. for truth—most important! Turn the other end down in a similar manner.

Next, turn the centre part of the axle to exactly 1⅞ in. long, but before doing this, check the width



"Small Metro" tank No. 470 as fitted with enclosed cab and number plate at rear of side tank.

across the two pairs of crankpins with the micrometer and adjust if necessary. Turn the ends of this as described for the crankpins. The end parts of the axle should be turned to $1\frac{11}{16}$ in. long plus 10 thou., to allow the axle to protrude slightly through the wheel boss.

Turn the wheel-seats between centres, or use the three-jaw with the precautions mentioned previously, with tailstock support. Try the wheels on individually for size, in case of any slight variation.

The eccentrics

The eccentrics are double flanged, which helps to reduce friction between adjacent straps. For these you will need $1\frac{5}{8}$ in. dia. b.m.s. Chuck sufficient bar to make all four eccentrics, allowing ample for parting off and cleaning up the faces. Centre the outer end and support the bar with the tailstock. Carefully turn down to $1\frac{9}{16}$ in. dia. and mount up a stout parting tool. This should have plenty of top rake, not much front clearance, and the cutting face ground square. Use slow speed and plenty of cutting oil and you should get a good finish for the grooves.

Mark out the axle centre a full $\frac{3}{8}$ in. from the bar centre, which will be seen from the turning marks. The bar can now be held in the four-jaw, with the axle centre running true, and the drilling and boring carried out. As it is most important that the eccentrics should be a good push fit on the axle, it is unlikely that a reamer would do here, as so many reamers tend to cut slightly oversize; so finish off by boring, taking great care over the last few cuts, the tool being kept really sharp.

Re-set the bar in the three-jaw, using the tailstock for support, and part off the four eccentrics, leaving a few thou. on each side of each eccentric for finish turning. Use the D.T.I. again to ensure that the bar is held truly.

There are several ways for finishing the sides of the eccentrics to size. One method is to treat them in the same way as wheels. A casting or thick steel blank rather larger in diameter than the eccentrics is chucked in the three-jaw, and a short stub of silver steel is screwed tightly in, this being $\frac{11}{16}$ in. or the nearest larger diameter. The stub should be very slightly less than $\frac{5}{16}$ in. long. Now turn this down very carefully, and put a *very slight* taper on it until the eccentrics can just be wrung on by hand pressure only. The finished cut can then be taken on one side, the eccentric reversed and the other side completed. In case anyone has trouble in getting the eccentrics off again, it is not a bad idea to drill a couple of holes, about $\frac{5}{16}$ in. dia. will do nicely, through the casting, each side of the screwed part of the stub mandrel. Then a long brass rod about $\frac{1}{4}$ in. dia. can be introduced through the mandrel, inserted through one of these holes from the back, and the rod given a series of light taps with a hammer. Do not remove the casting itself on any account, as it will not go back truly.

Tap the eccentrics 4 BA for Allen type grub screws and we are then ready for assembly. Press each of the crankpins into one of the webs, using the lathe to start with, then transferring to the vice. To get the second web correctly lined up with the first, put a length of $\frac{9}{16}$ in. silver steel (or a piece of b.m.s. turned to exactly that diameter) through the two. Jam a piece of $\frac{3}{8}$ in. thick steel bar between each pair of webs and press home the end pieces of axle.

Before assembling the centre part of the axle, check its length between flanges and compare this with the thickness of the four eccentrics placed together, to make sure that the eccentrics won't be tight between the two inner webs after assembly. Press home the centre piece into one of the assemblies, keeping the $\frac{3}{8}$ in. bar in place to prevent distortion. Thread the eccentrics on, and place the other assembly in its correct position, ready for the final squeeze, with the R.H. crank leading.

To set the cranks at 90 deg., lay the whole assembly on the surface plate, with the R.H. webs lying flat on a strip of steel of suitable thickness. The L.H. webs can then be checked with a try-square. Start the final pressing operation in the lathe, check once again on the surface plate, then finish in the vice.

Pinning the parts

The next operation is to pin all the crankpins and webs, using $\frac{1}{8}$ in. dia. silver steel. Many builders have trouble here; they manage to squeeze the pins in about half way, then they find that the pins will not go in any further, they either bend or swell up! I solved this little problem by trying some sample pins in an odd scrap of steel as used for the webs. The "trial" piece was drilled No. 31 in several places and pins were then forced in, using the vice. Depending on how the No. 31 drill cuts, I generally find that the pins have to be reduced in diameter very slightly, and as only a very tiny amount has to be taken off, emery cloth only is used, the centre of the pin being reduced rather more than the ends.

Having got all the pins the desired size, turn up some silver-steel bushes, making these in various lengths from $\frac{3}{4}$ in. down to $\frac{1}{8}$ in., in $\frac{1}{8}$ in. steps. They can be about $\frac{1}{4}$ in. dia. and are drilled No. 30. To press in a pin, select the longest bush, slip the pin inside it, start the pin in the crank-axle, and press home until the vice jaws contact the bush. Slip off the ¾ in. bush and substitute the next shorter. Press the pin in a further ⅛ in. Carry on in this way until the pin is right home, then there won't be any bent pins.

To complete the crank-axle, round off the ends of the webs, as shown.

A First Affaire with a Lathe

Part XV

By Derek Beck

Continued from page 38

In a photograph accompanying the first article on my drilling attachment a lumpy bracket appeared beside it. This is shown in use in Fig. 77. It converts the top-slide into a vertical one and allows the drilling attachment to be used for drilling or milling above or below centre height.

If you have a Myford vertical-slide you may be able to clamp the attachment to that—if you can find a convenient place to mount the motor. But with a vertical-slide it would be much better to make a new mounting for the barrel.

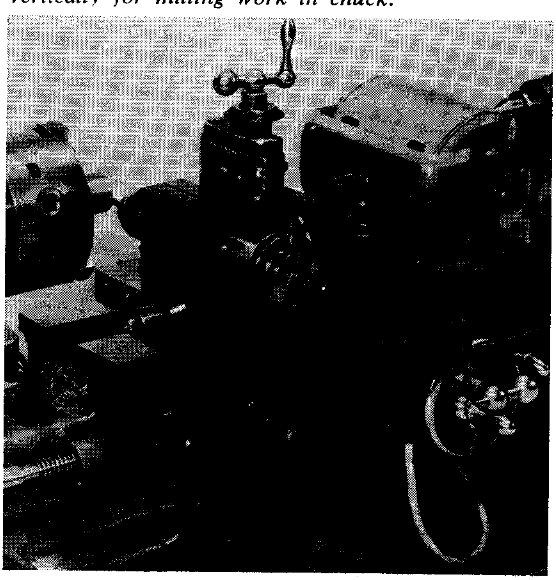
Ungainly though it is, this bracket has proved very useful. It was easy to make, mounts the motor at the right pulley centres and gives the spindle of the drilling attachment a reasonable travel below centre. Clamped as shown in the photograph, the top-slide has to overhang the boring table and, to get the spindle in its lowest position, must overhang the saddle as well. This, and the sizes of steel bar and flat I could get hold of, dictated the shape of the thing.

The dimensions are given in Fig. 78. The plate is made large enough to allow the top-slide to be swung through a reasonable angle whilst still getting support. The top-slide pivot is kept as low as is consistent with the base clearing the saddle when tilted. The size of the bolting-down block does not matter. It should not be much less either way than the one shown but can be larger. The motor mounting plate is stood off from it by spacers to make the pulley centres fit a standard belt.

This is an amazingly simple gadget to make. The only things that really matter are that the ½ in. dia. pivot should be firm in the plate and a good shake-free fit in the top-slide base and that the surface to which the top-slide is bolted should be flat and vertical. I turned the ends and milled two of the long faces of the block at right angles to each other on a vertical milling machine (at my evening class workshop) and then ground the other two faces parallel to them on a surface grinder. Then having got the front plate reasonably flat and free from rock when tested on a surface plate I ground both sides of that.

However the job can be done at least as accurately on the Myford. Clamp the block on its side on the boring table with a bar across the top, setting the base parallel with the edge of the table and projecting about an eighth of an inch beyond it. (Use a length of square silver steel and your finger tips for this alignment.) Machine the base with a fly-cutter. Drill the holes for the two clamping bolts with the block against the tailstock drill pad letting it turn through about 90 deg. each time you withdraw the drill to average out any error. Clamp it with its own bolts on the boring table, aligned as before and machine the vertical face with the fly-cutter. Get the front plate as flat as you can, (no rocking on a surface plate or a sheet of plate glass) mark out and drill the holes and tap the two ¼ in. BSF ones. If it is really flat it could now be screwed to the block and have the outer face machined with the fly-cutter. But since the rear face is used for aligning the fitting with the edge

Fig. 77. Top-slide and drilling attachment mounted vertically for milling work in chuck.



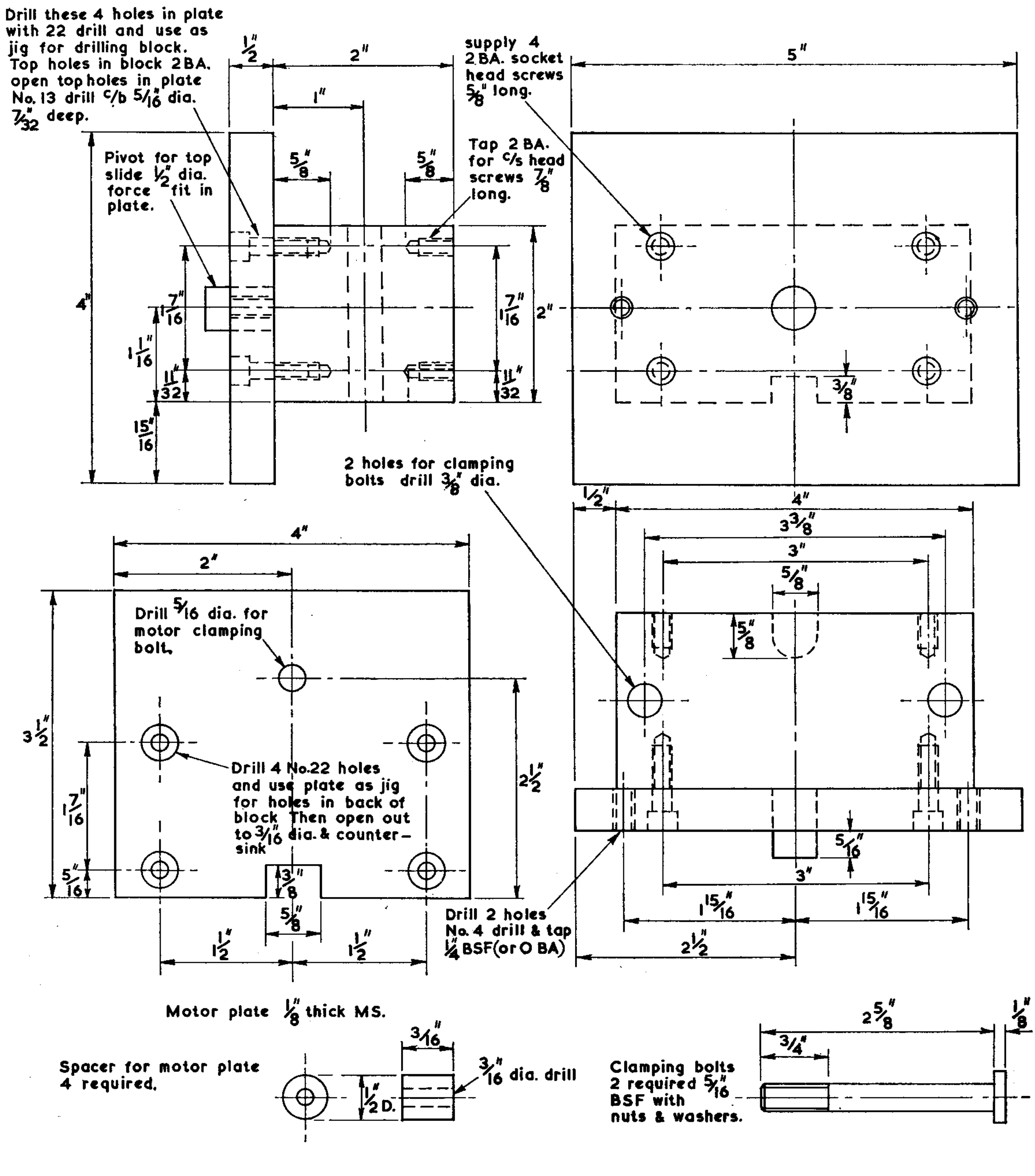


Fig. 78 VERTICAL MOUNTING FOR TOPSLIDE

of the boring table it is as well to machine it. If you do this drill the central hole 7/16 in. dia. instead of ½ in. Clamp the plate to the faceplate with two ¼ in. BSF set-screws from the back centring the hole on a 7/16 in. stub in a wooden plug in the bore of the faceplate. (I have a No. 2 Morse taper with a 3/8 in. dia. parallel nose for this purpose. It is, in fact, the first taper I made which came out too short to be used with the tailstock drill chuck. It gives you accurate centring in no time at all.) Take a skim across the plate until it just cleans up and bore the hole to a force fit for a piece of ½ in. dia. silver steel rod.

Attach the plate to the block, bolt the block

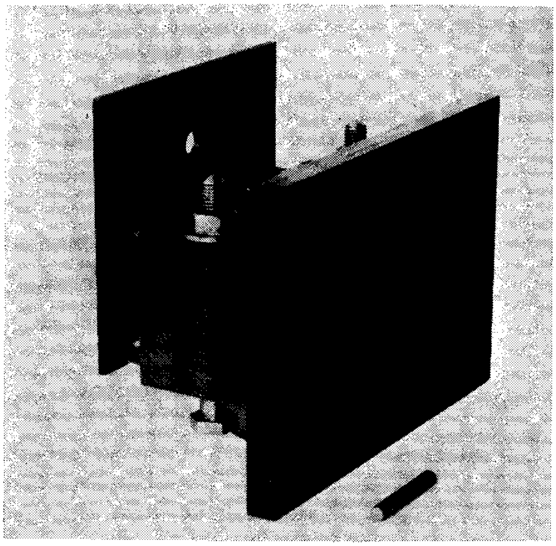


Fig. 79: Bracket for mounting the top-slide vertically.

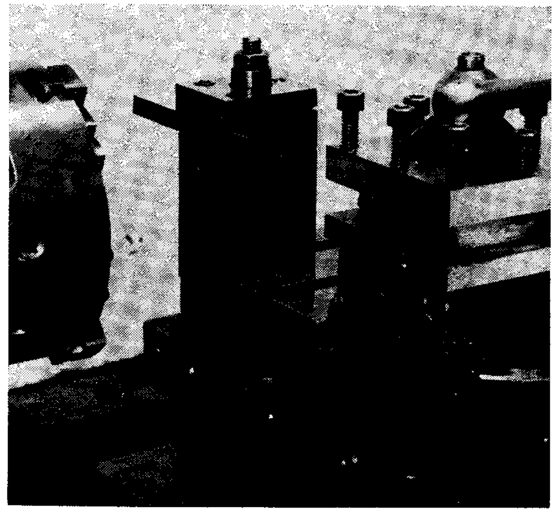


Fig. 80: Rear toolpost in position on standard cross-slide.

to the boring table with about 1/8 in. of packing under it, tap the plate with a mallet to align its rear face with the edge of the table and machine the front face with a fly-cutter. Drive in the ½ in. dia. peg that centres the top-slide. You are now in business to do quite a lot of end-milling.

The length of the spacers you will need between the back of the block and the motor mounting-plate depends on the motor and, of course, the belt. The dimension given in the drawings is appropriate to a 2¼ in. centre height motor and a 19½ in. belt—presumably a nominal 18 in. If you want to drop the spindle of the drilling attachment below the centre height of the lathe the mounting block must clear the saddle. Align the mounting by pushing the front plate back against a length of ½ in. dia. silver steel held against the edge of the boring table.

To be able to set the top-slide travel truly vertical without a lot of fiddling about I have a 3/16 in. dia. dowel in a reamed hole through top-slide and bracket. A certain amount of care is needed in setting the top-slide vertical before drilling and reaming this hole. The easiest way is to clamp a precision square to the lathe bed, mount the clock gauge on the top-slide (which is lightly bolted to the bracket) and run it up and down against the edge of the square tapping the top-slide to and fro until the clock gauge shows no movement over the full travel of the slide. Then clamp up tight and drill. Make a little 3/16 in. dia. plug with a knurled (or larger) head, to fit into this hole when the top-slide is in its normal position; otherwise it gets full of tiny chips some of which will sooner or later work their way between boring table and top-slide and cause damage to both when the top-slide bolts are tightened.

A rear tool-post

All the books and everyone who uses a lathe will tell you that parting-off is far easier with the tool mounted on a tool-post at the back of the cross-slide. They will tell you, also, that this is because the cutting load is then downwards and is taken by the massive headstock casting instead of the bearing caps.

About the effect they are right; about the explanation I have doubts to which I will return. But, whatever the reason, the difference is truly astonishing. With the simplest of rear tool-posts I now part-off without even thinking about it and on brass and dural up to about ½ in. dia., without changing the lathe speed. I ought to have got around to making one long before. One face of the tool-post must be truly square with the base and must set itself automatically at exactly 90 deg. to the lathe axis when bolted on; and that, I thought, would involve complicated and accurate milling which, in the early days, I regarded as beyond my skill. In fact, you can make a useful tool-post with nothing more than a fairly large 4-jaw chuck.

It is the simplest I could think of. Fig 81 and 82. A square block with a hole through the middle and a plate screwed to the front that serves both to support the parting-off blade and align the tool-post with the edge of the boring table. The blade is clamped by a loose plate on top. I started it one weekend and had finished it before I bought a parting-off blade and found that

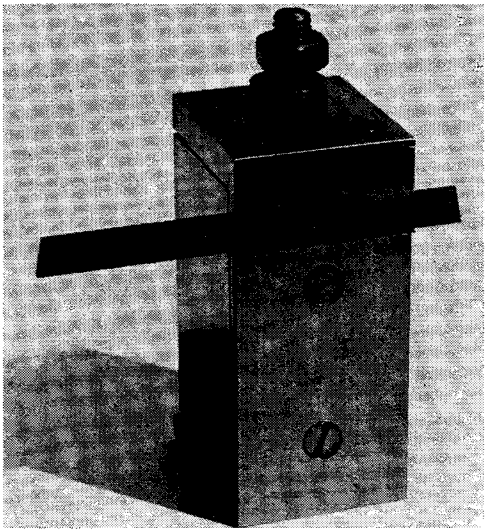


Fig 81: The rear toolpost.

they are not parallel-sided. The blade therefore is unsupported sideways at the top and has to be set by eye. This is the only serious defect I have found in the design. Ways of remedying it will be discussed later. But this crude post works so well that I doubt whether I'll make myself a better one.

Take a piece of 1½ in. square b.m.s. bar about 2¾ in. long and set it running true in the 4-jaw. Set the end near the chuck true first and then the outer one, tapping gently until it runs dead true. If you do the seting with a clock gauge, you can run the plunger along each face in turn to make quite sure they are parallel to the centre line of the lathe. Then, if your 4-jaw is a fairly heavy one capable of holding the bar firmly, face the end and drill the central hole. That completes the post itself. My 4-jaw is a little 2½ in. job and certainly would not have held against an interrupted cut on the corners at an overhang of more than 2 in. I therefore faced a small area in the centre of the end—using a very light cut indeed—and then, equally gently, drilled a centre with a 3/16 in. Slocombe. I ran the point of the tailstock centre into this, checked that I hadn't pushed the bar out of true (I hadn't) and faced the whole of the end, going in as close to the centre as I could, and then drilled the hole through the middle, starting with a very stubby 3/16 in. dia. drill (lest, with the feeble hold of the chuck, the combination of a long drill and long overhang should jack-knife) and working up to 7/16 in. in stages. Then I turned the job round, drove in a short length of rod, turned down to 7/16 in. and centred the hole to provide a seating for the tail-stock centre, and faced the bar to length. Strictly speaking no further machining was needed.

The tool-post is clamped to the boring table by a standard 3/8 in. BSF bolt, 3 in. long, that has had its head faced back until it just slips into the T-slots. I used it to bolt the block to the boring table with the front face projecting slightly beyond the edge and set this face square to the axis of the bed (by traversing it past the clock gauge held in the 3-jaw) and skimmed it flat with a fly-cutter. This is not really necessary if the facing of the end is accurate and the bar itself quite straight. However, with a vague feeling that it might sometime be useful to have a block with faces accurately at right angles to each other I went further and did the lot. I turned the block on the bolt and set the machined face (No. 1) parallel to the lathe centre line (by traversing it past the clock gauge supported from the chuck) and machined face No. 2, then turned the block a further 90 deg., set face No. 1 square to the axis of the bed (with the clock gauge held in the tail-stock), and machined face No. 3; finally I turned the block once more, set face No. 2 square with the axis (with the clock gauge in the tail-stock) and machined face No. 4. The only gain from all this extra work so far is that the post looks quite nice. (The joke is that, owing to the error in the cross-slide movement discovered later, the faces are probably less accurately at right angles than they were before being machined.)

The projecting lower end of the piece of 1/8 in. × 1½ in. strip screwed to the front of the block aligns the face of the toolpost with the edge of the boring table. The top supports the blade and must, of course, be horizontal and exactly at centre height. At the time I couldn't think of a way of getting this right automatically by machining and so I filed it to a mark scribed with a scriber held in the 3-jaw. It finished a bit low and needs a strip of shim under the blade. But, as I now see, getting it exactly right by machining presents no difficulty, provided there is only a little metal to come off. The job can be done with an ordinary knife tool held in the 4-jaw with its point exactly at centre height or with a special tool filed up from an odd end of 3/8 in. dia. silver steel held in the 3-jaw. You simply plane the top of the ledge by moving it past the tool with the cross-slide traverse, feeding the job forward a few thou between each cut with the lead screw. The headstock spindle must be locked of course. The clamp made for the indexing attachment does this very well.

The top plate was made L-shaped so that by reversing it a larger blade could be held. I have not needed to use one so far and I doubt whether the machining involved is worth while; a flat

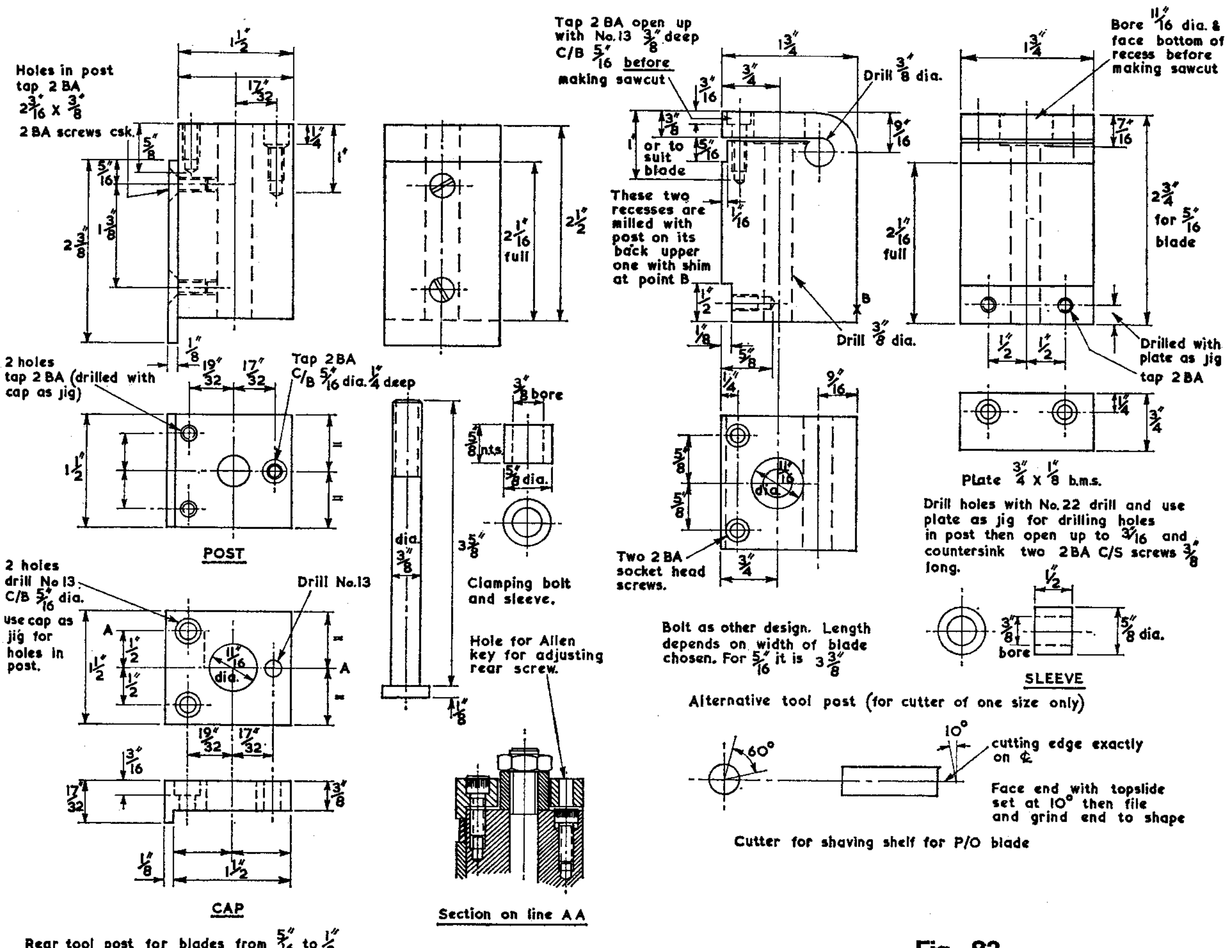


Fig. 82

plate would do provided the block is made about 3/32 in. shorter.

Parting-off blades are hollow ground and narrower at the top than on the cutting face so as to provide side clearance in the cut. When setting a tool in the tool-post the taper must be the same on both sides which means that the inner side is clear of the block at the top. I set mine by eye and it seems to work but I cannot say I feel completely happy about it: and it is a nuisance having to take the tool-post off to check the setting (because it's hard to see in position) every time one pulls the blade forward a little or pushes it back. I have attached a piece of shim to the top of the block and bent it over the edge and when I have time I shall shape the edge of the clamping plate to hold the top of the blade against it.

Obviously it would be much better to have the face of the block above the step sloping forward at the correct angle and the top plate so arranged as to clamp the blade against the face. (You could of course buy a holder for the blade and mount that in the rear tool-post but this seems to me a clumsy way out.) You cannot mill the slope on the face above the step with the post in its working position on the boring table because it is wholly above centre height. To machine it in with the block in any other position means losing the advantage of automatically getting the face exactly parallel to the traverse of the cross-slide. If the front and back faces of the block are machined parallel as mine were, one could bolt the block down on its back, packed up at the bottom end with a small piece of shim, and machine the cut with a side and face milling cutter.

However, if one is going to machine the slot at the correct angle the design in Fig. 82 (left) loses much of its simple charm. One might as well make the more sophisticated tool-post shown on the right in Fig. 82. Here the back is machined flat and used as the reference surface for the two recesses in the front. These are machined with a circular side and face milling cutter on a mandrel held in the 3-jaw and supported on the tailstock centre. The block is on its back packed up to the correct height on the boring table; parallel to the top for the recess at the bottom and inclined (by a piece of shim steel under the rear face near the bottom end) for the one that takes the tool. The distance from the base of the block to the lower edge of this groove is left a few thou oversize and planed to centre height later with a tool held in the chuck. The job is really quite straightforward, given a circular milling cutter. Milling the two grooves together ensures that the tool will be parallel to the cross-slide travel and planing the bottom of the seating afterwards ensures that it shall be horizontal. This tool-post would undoubtedly simplify adjustment of the blade and one day I may make one.

Even though my tool-post can be clapped on in a matter of seconds, putting it on and taking it off every time one parts-off is irksome. One wants to leave it in place. Unfortunately on the short boring table of the ML7 it doesn't leave much room for such things as drill chucks and die-holders between the turret and the parting blade. On the long boring table it can be left in place.

The long boring table

The long boring table has only one slot more than the short one but this makes a quite disproportionate difference to its usefulness, particularly because the pivot for the ML7 top-slide makes part of the boring table more or less unusable unless it is taken out. And to do that you have to take the boring table off the saddle.

I have recently bought one of these tables, and a long feed screw to match and already I have found it very well worth its cost. Besides allowing one to keep the rear tool-post in position and providing a lot more room for milling, it greatly increases the scope of the top-slide drilling attachment. I can now withdraw the chuck far enough from most jobs to be able to change drills, whereas previously I had to move the saddle or the top-slide clear of the job, change the drill and then get the spindle back to exactly the same longitudinal position. Anyone buying a new ML7 would be well advised to get the long boring table from the start. It seems an awful pity to have a perfectly good boring table and feed screw doing nothing as I have. Perhaps I can turn it into a vertical-slide, or maybe it'll come in handy on the drill press.

Rear-mounted tool

Why does the rear mounted parting tool work so much better? I have already said that the reason usually given—that the cutting load is downward on the main bulk of the headstock casting instead of upwards against the bearing caps—does not seem to me very convincing. For one thing the difference is the same on lathes, such as the Myford Super 7, that do not have bearing caps. For another, one has to remember that a downward force on the front headstock bearing implies an upward one on the cross-slide ways and the shears of the bed. On the Myford ML7 or Super 7 this means that the cutting load instead of being transferred as compression, flat surface to flat surface all the way, is transferred from cross-slide to the saddle through the gib strip and gib screws and from saddle through four $\frac{1}{4}$ in. dia. bolts and two short cantilevers to the undersides of the shears. Surely any gain in rigidity at the headstock must be lost here.

It seems to me much more likely that the difference is in the stability of the oil film in the front headstock bearing. (The rear bearing is loaded by the cutting force in the opposite direction to the front one—downward in normal turning, upward when parting-off with the rear tool-post.)

Presumably the headstock bearings are designed for film lubrication. That is to say, there is a clearance between the bearing and journal and the position the shaft takes up when rotating depends upon the distribution of the oil film in this clearance. The centre of the shaft will, therefore, not coincide with the centre of the bearing. Oil is pumped (by the rotation of the shaft) into the area under the load and it is the higher oil pressure here that keeps bearing and shaft from rubbing. The escape of oil from this area is restricted by the close approach of shaft to bearing on the exit side. The high pressure area is necessarily opposite to the load and so the point of closest approach is determined by the direction of loading. If the direction changes this point moves round the bearing to a new position which means, of course, that the centre line of the shaft shifts slightly.

Fig 83a shows the front headstock bearing when the spindle is rotating but no cut is being taken. The load is the weight of the spindle pulleys, chuck and job (or rather the part of this load taken by front bearing.) Since there is very little friction the upward pull of the belt is small and can be neglected. The high pressure area is therefore immediately below the shaft and the point of closest aproach is towards the back of the lathe, say at p1. The curve below the bearing repre-

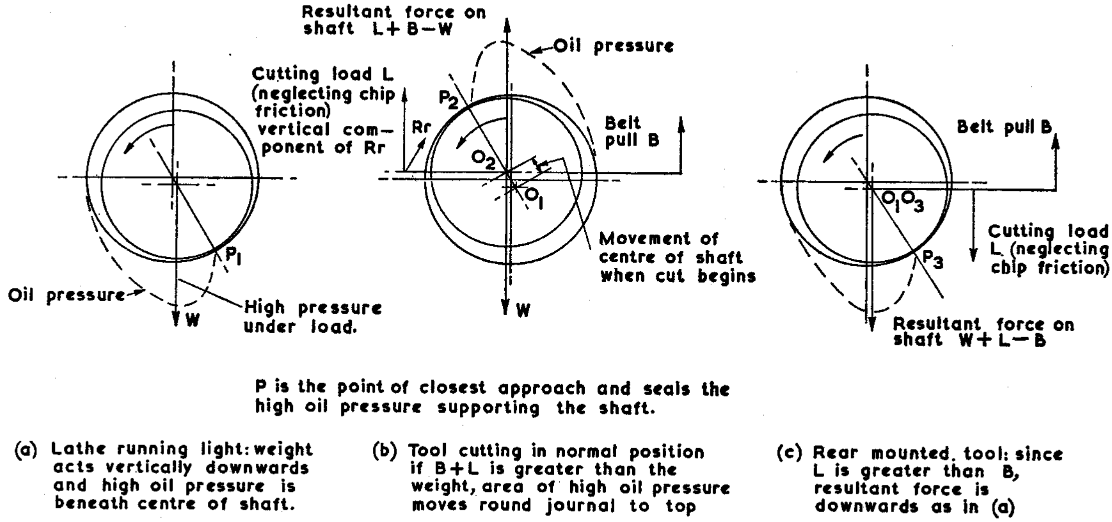


Fig. 83

sents the pressure at each point within the load area to some arbitrary scale.

Now note what happens when we start a flat-topped tool cutting in the normal position. If for the moment we neglect the friction between the chip and the tool, the cutting load will be vertically upward. (This will be momentarily true at the very beginning of the cut before a chip has formed.) The belt pull required to provide torque for the cut also acts upwards and if these two forces are greater than the weight of the assembly the high pressure area will move round towards the top of the shaft. Because of the friction between tool and chip the actual reaction of the cut on the job is in the direction R. The combination of R and the belt pull results in the centre of the high pressure area moving from the bottom, round the back of the bearing, to some point such as L2. The point of closest approach has moved to p2 (and the gap may be smaller to sustain the increased load) and the centre of the shaft from O1 to O2. Any increase in the cutting load tends to make the pressure area and the point of closest approach move round the bearing in an anti-clockwise direction (when seen from the tailstock); any reduction to make it move clockwise. And with a fluctuating load the centre of the headstock spindle may oscillate between two such points as O1 and O2.

With the tool mounted on the rear tool-post, the initial cutting force (i.e. before taking friction into account) is directed vertically downward. It thus opposes the increase in the upward pull of the belt and assists gravity. The pressure area remains roughly in the same place. Even taking friction into acount, so that the resultant force on the work is in the direction R1, the movement of the pressure area is small; it shifts slightly forward. Consequently fluctuation in the cutting force produces little or no movement of the centre of the headstock spindle.

If this is the explanation, one might expect to get a better finish with a rear-mounted top-slide and the tool cutting downward or with the rotation of the lathe reversed and the tool cutting downward with the top-slide in its usual position. I have tried both, (if you try the second do the job between centres. With the lathe running at 600 rpm the chuck comes off very fast once it starts to unscrew.) Neither made any noticable improvement to the finish. It is also interesting to note that with the tool in the usual position there should be less movement of the pressure area with cutting load when the drive is beneath the headstock (as on a treadle lathe) than when above it. To have this movement of the centre of the headstock spindle in mind when things go mysteriously wrong is, I find, quite helpful.

BORING ATTACHMENT

SIR,—When I purchased a second hand Myford M.L.7 lathe some time ago, it was delivered with an extra fitting which was identified as a table for boring full size connecting rods.

This is a very substantial well-made fitting but as I am unlikely to do any full size work, I would be interested to know if any readers have found a model engineering operation for which the tool can be adapted.

Compton, Nr. Guildford. C. M. TRENT

A Model Mill Engine

Anthony Beaumont

THE LONG-POPULAR SET of machined parts was my first 'real' engine, purchased neatly boxed for 30/-. My equipment then extended to a few woodworking tools and a worn file or two ex a car tool kit. Therefore I anticipated no difficulty in assembling the engine and the catalogue statement 'small files are required for fitting' seemed fully covered. However, some of the 3/32 in. Whitworth studs wouldn't screw home and were broken by my forthcoming methods (I had never heard of a tap in connection with screw threads).

Stuart Turner put right the damage and the engine worked for many years, passing to a young relative; back to me and I disposed of it in parts to an enthusiast in the U.S.A. together with the original 500 boiler.

This ⅝ in. x 1¼ in. engine, while obviously excellent value for its price, has several design weaknesses—notably the closely-spaced solid cast-in main bearings, non-adjustable unbushed crankhead bearing and small diameter crosshead pin.

Two years ago, Stuarts kindly supplied a rough cast G.M. cylinder set and box-bed for the engine, together with a print of their works' drawing including machining details. This was a special order and unmachined castings are not normally available. I hoped to build a considerably-modified design but to follow the basic dimensions of box-bed, cylinder and motion.

I built out the box-bed with a slab of alloy to extend the main bearing spacing by ½ in. The solid bearings were cut away and seatings for alloy housings were milled including the upper surface of my alloy 'cast' block. At the same lathe set up, the cast hexagonal dummy box-bed 'nuts' were milled away for later substitution of dummy 7 BA studs and nuts on raised facings. The seatings for the governor stand and crankhead lubricator were also milled at the same time. (The lower slide-bar bearings were already machined in the casting as supplied).

The alloy main bearing housings are suitably disguised with 7 BA studs and caps, but are bored and shouldered to a press-fit for ¼ in. bore ballraces covered by thin brass discs with 12BA C/S screws. I made a special double screw cramp to pull the ballraces and housings to the precise locations on the ¼ in. dia. stainless steel crankshaft after the crank disc had been permanently fitted. This is a b.m.s. disc pressed on to a small shoulder and finish—turned *in situ*.

The crankpin is hard stainless steel pressed in and lightly riveted. The outer flange on the pin is turned integral with the pin itself.

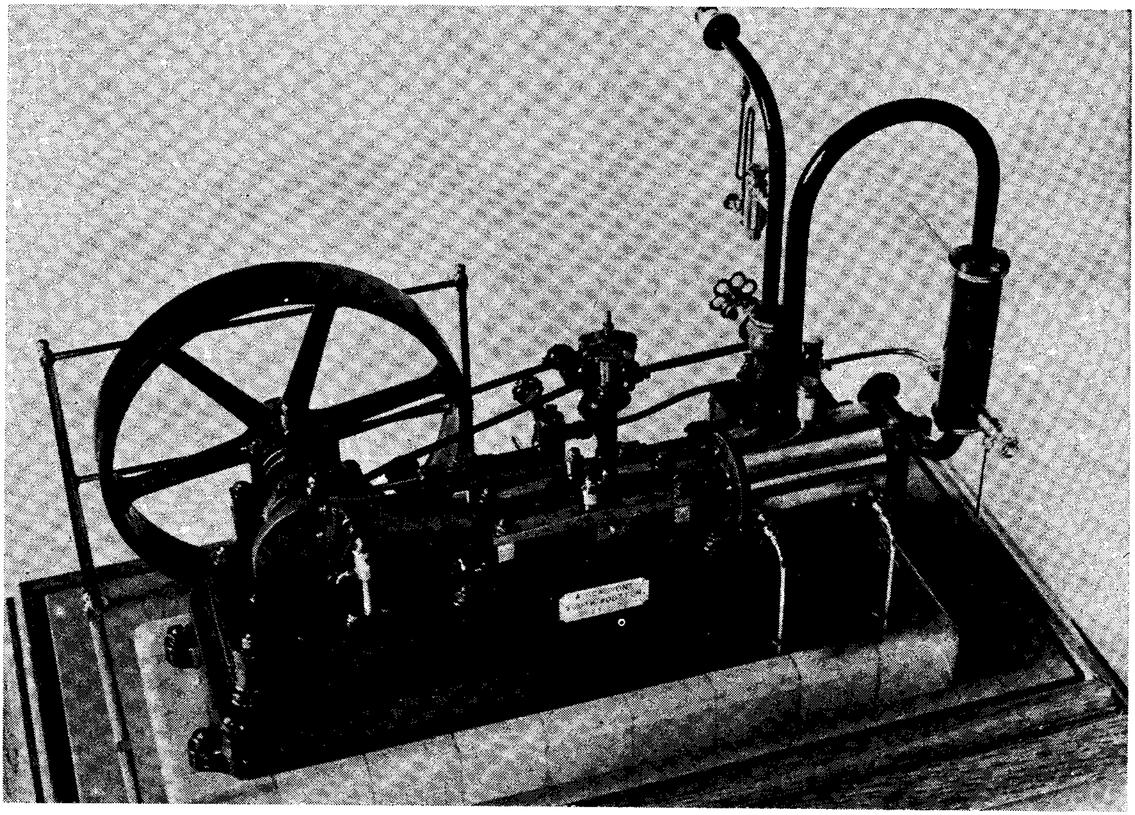
The 4⅜ in. dia. flywheel is rather larger than the original design and more in keeping with stationary engine proportions in small industrial examples. My casting came from a boxful of wheels acquired over the years. The central webs between the spokes were filed away because flat plain rims are usually correct for full-size practice. The rim is crowned for belt drive, the spokes much reduced in section and a 3/32 in. keyway planed in the lathe. The wheel bore is very slightly tapered to suit the .0015 in. taper on the outer one inch of the crankshaft, thence the flywheel is a firm friction fit on the shaft, dead true and the key merely completes the appearance.

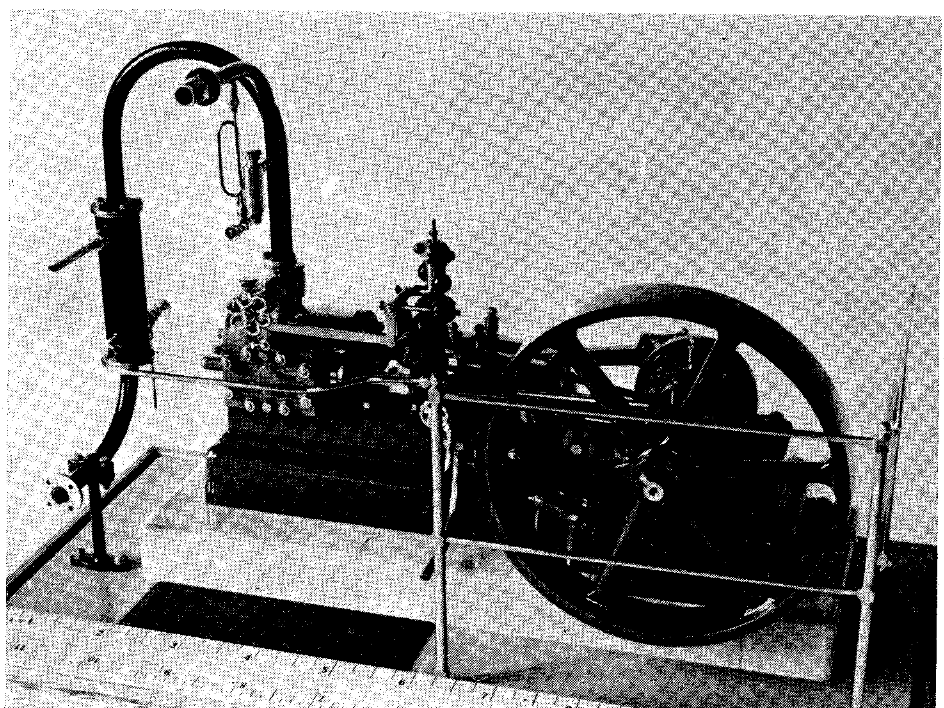
The cylinder base required milling because the flanges protrude below the machined surface. I left on rather more metal than shown in the drawing to allow a slightly higher piston rod centre line and thus a deeper crosshead in which a ⅛ in. dia. pin could be fitted. Three 4 BA hex bolts secure the cylinder to the bed from underneath where their seatings were spot-faced. A little tolerance in the base holes allowed some 'play' in the cylinder alignment to centre the motion between the cast slide bar supports.

When the 5/32 in. dia. piston rod had been fitted together with a milled steel crosshead, I did a little hand-scraping of the cylinder base to get the crosshead to slide evenly along the cast guide surfaces.

The slidebars are b.m.s. and filed to a double-taper profile with parallel flats for the 8 BA nuts and studs. The distance pieces were machined from square b.m.s. bar and polished on the vertical faces.

All the cylinder studs are 8 BA polished and domed, fitted with standard 8 BA polished nuts and washers. Probably 9 BA nuts tapped 8 BA would look better but none were available. The covers have pairs of hex. 10 BA forcing screws. I removed the bosses for the screwed cylinder





Two views of the model mill engine built by Anthony Beaumont, who also took the photographs.

packing glands and made oval studded glands fitted with 10BA nuts. The cylinder lagging is hard stainless steel grained with fine emery cloth and secured by four 12 BA roundhead brass screws. The drain cocks are working with 10 BA tapered plugs and loose brass handles fitted to squared tops. The tapers in the bodies are made with a standard taper pin reamer. This is really too slight a taper but a simple expedient in such small cocks. The drain pipes are 1/16 in. dia. copper fitted in dummy hex brass nuts and unions.

The connecting rod is a tapered rectangular section with a bronze bushed crosshead pin bearing and a 'marine' type split phosphor-bronze crankhead bearing with 8 BA bolts and steel keep-plate. The dummy centrifugal lubricator has a banjo collecting ring centred from the crankpin. The lubricator body has a push-on cap and a 'solid' brass union nut. The extended length of the crankshaft between the bearings accommodates eccentrics for the slide valve and boiler feed pump besides the steel governor drive pulley. This and the governor pulley are flanged and crowned for the ⅛ in. wide x 1/32 in. plastic welded belt. Rubber bands are useless because they jerk round the governor in spasms and also cannot be passed over the assembled bearings.

I made the flat plastic belt section by turning down a 3/16 in. round belt wound in a tight spiral on a ⅜ in. dia. rod. A better idea is to slice through a 1 in. x ⅛ in. section belt with a pair of razor blades clamped 1/32 in. apart, but this latter belt section was not to hand. The ideal tool with which to weld this belting is a low wattage radio soldering iron, applying the belt ends on opposite sides of the bit then butting together quickly.

Returning to the eccentrics; these have split straps as usual but the pump eccentric straps had to be split at 45 deg. to the vertical so that the bolt lugs would clear the base plate. 10 BA bolts are used on the straps and bolting foot of the valve rod.

The pump is fabricated in brass and gunmetal by silver soldering. The stroke is 3/16 in. and bore 5/32 in. with 3/32 in. ball valves and the usual valve-controlled by-pass is fitted to the delivery outlet. The gland has 12 BA studs. A small bolting pad is secured to the main base casting. 'Araldite' is a most useful aid to simulate smooth fillets in fabrication work when a solid cast appearance is required. However the job must be heated to about 100 deg. C. to make the mixed adhesive flow evenly round joints and minimise filing and general finishing.

A feed-water heater is fitted round the ¼ in. dia. exhaust pipe and a miniature screw-down valve drains condensate from the heater drum. This is silver-soldered but the ends carry dummy 10 BA studs and nuts. When making various very small valves etc. it is often an asset to file some of the hexagonal parts from the solid by indexing the lathe mandrel in conjunction with a simple filing rest. Mine is made to attach to the vertical-slide for easy height adjustment and sizing the hexagons (or squares).

The main stop valve is a standard large size design scaled down. The ten studs are 12 BA and an oval packed gland is fitted. This valve bolts directly on top of the governor throttle valve which contains a 3/16 in. dia. 'butterfly' valve held in a 1/16 in. dia. split shaft. Making the disc is easy enough by sawing a 30 deg. angled slice from a 3/16 in. rod, but fixing it in the split shaft when assembled is tedious in such a small size. Again Araldite did the trick. (It will stand steam if necessary).

The Governor

I more or less copied a Stuart No. 9 governor in half size for the small working one on this engine, but the yoke, gearing, counterweight and frame are all 'out of my head'. It is a small one to get to work, the balls being only 7/32 in. dia. on integral pivoted rods 7/16 in. long overall. The governor mitre gears are 100 DP brass from some surplus instrument and should be ratio bevels but this is not immediately obtrusive and the belt drive has a gear-up ratio of 2½:1. A small tension pulley on an adjustable 6 BA screwed stem is attached to the main base behind the flywheel. The adjustable counterweight on the governor lifting yoke arm functions well in the closing of the throttle valve, but is too light to re-open it promptly. A light spring is really necessary but I preferred to be satisfied rather than mar the scale appearance with a spring. The governor parts are b.m.s. case-hardened, either press fits or fitted with 10 BA hardened set screws with square heads.

There is a brassy array of ten lubricators about the engine. The complicated item on the 3/16 in. dia. steam pipe is a copy of the 1880-1900 period hydrostatic lubricator with a working filler and drain valve spindle screwed 10 BA. However the small steam supply 'pipe' is copper wire from a scrap of electric cable. The remaining lubricators work and are used when the engine is run under low air pressure. For that reason I have fitted a lubricator to the top of the cylinder bore which is sometimes done in full size practice when mechanical lubrication is not fitted. Small filler caps (these are 10 BA) can be made steam tight when only finger-tight by turning a small

60 deg. cone above the screw and drilling the mating hole 60 deg. to suit. All the other lubricators are slightly ornamental in shape with spherical push-on lids drilled No. 70.

I made a 'Valspar' gloss mix to obtain a 'soft' olive green for the engine which is painted by hand and varnished. The disc crank, eccentric straps and main stop valve body are red, cylinder mid-grey and steam and exhaust pipes black.

Beech wood is used for the simulated tiled plinth, each being painted a slightly different shade of stone/cream. 'Polyfilla' forms the cement between the tiles. The wood base surround is constructed to take ⅛ in. thick 'perspex' showcase. I make the two wood mouldings required by hand, using gouges and glass paper. It appears that no-one commercially will make mouldings to special order from prepared wood supplied.

My photographs were taken with a modest single lens reflex 35 mm. camera using an extension ring behind the 3 element lens. The exposures were 2-3 seconds at f16 in normal room daylight. It would be an advantage to have a camera with 'movements' so that verticals appear vertical in the photograph when angled views are taken. However I hopefully assume that readers will realise that the errors of parallelism are photographic and not engineering ones.

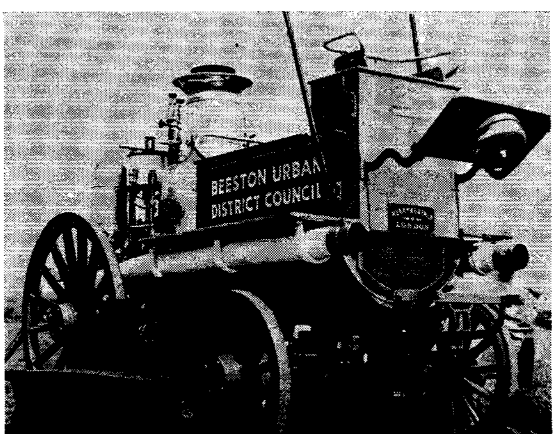
This little engine turns over steadily at 70-80 r.p.m. on a few pounds of air pressure. I have not steamed it because of the fairly high finish and ornamental value in its pristine condition. My card in the showcase describes the model as a 1 in. to 1 ft. scale of a 40 BHP Industrial engine. It could well be a corn mill engine, but certainly not a cotton mill engine which the catalogue has always implied.

A Merryweather Gem

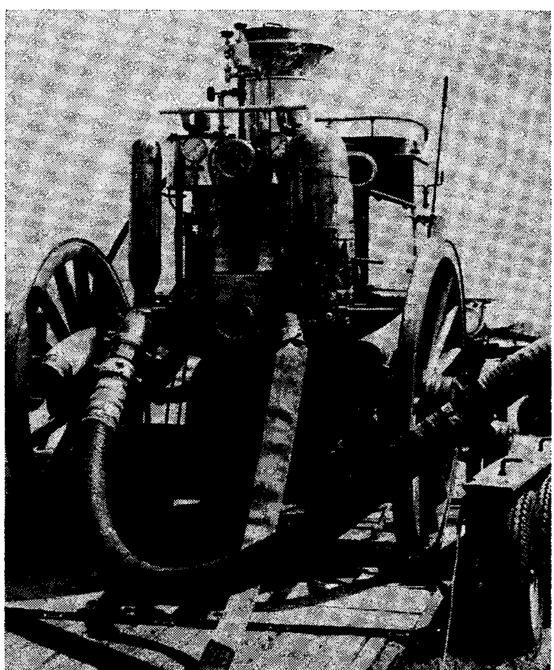
by Peter Wilkes

A POPULAR ENTRANT at Midland steam meetings is an interesting 1907 Merryweather horse-drawn fire engine, No. 2691. It fully deserves all the praise that is lavished on it for, as a steam engine, it is so different from the other machines that surround it at meetings.

The problem with the "Greenwich Gem" fire pump was to design a machine that could steam quickly and continuously, but have a weight within the pulling capabilities of horses. To overcome this a special semi-flash boiler from 5/16 in. steel plate was made. It was fitted with 116 straight cross tubes and 36 copper 'J' shaped tubes. This, coupled with the fact that a circular grate of some 5¾ sq. ft. was provided, gave a total heating surface of 120 sq. ft., enabling steam to be generated, if warm water were used, in some three minutes. From cold, a longer time of 12 minutes had to be allowed. A triumph for both design and construction.



The engine is the Merryweather twin cylinder, with steam cylinder at the top and the water pump cylinder at the bottom. Two copper reservoir cylinders play an important part in the operation of the engine. The smaller one acts as an equal-



The 1908 Merryweather horse-drawn steam fire engine.

izer for suction, enabling the pump to draw water in at a steady rate. The large one on the opposite side of the machine acts in a similar function for the output from the hose. Here pressure is equalized, giving a steady flow of water for the fire being tacked.

New to Beeston Urban District Council in 1908, at a cost of £318, the machine made a name for itself in the story of local fire fighting when it successfully attended the explosion at the Ordnance Depot at Chilwell in July 1918. Today it stands as a tribute to its makers, for it is the only example of its kind that exists in original condition.

JEYNES' CORNER

E. H. Jeynes on the oil crisis

EVEN BEFORE the outbreak of hostilities in the Middle East, there had been disturbing rumours about the World's supplies of oil, which have become the very lifeblood of commerce; whether these rumours had been started deliberately by the oil barons to increase the price of oil, is questionable; but there is no question at all that oil supplies will eventually dry up, possibly not in our time, as there are still some untapped sources to be developed. In any case oil has become of great political significance throughout the world; although many of the countries having an abundance of it have practically no use to which they could effectually put it, so depend entirely upon sales abroad.

With demands for power steadily growing, a great shortage of oil, even temporarily in this country, would have far reaching effects. Many well informed persons have decried the rapid extinction of steam traction on the railways, and although diesel traction can be regarded as merely a transient period between steam and electric traction, a sudden cessation of oil supplies would be a major disaster. The ruthless cutting up of the water tanks along the line was rather stupid, although there are only a few steam locomotives which could be brought out of preservation and put on main line service. I have always thought the haste with which the steam locomotive was withdrawn was indecent, as so many had years of work left in them.

Over the years, the Electricity Boards eliminated many of the smaller steam generating stations as being uneconomic, although many of them were previously owned by Municipalities, and had combined the generation of electricity with the destruction of town refuse, which relieved the rates substantially. Now the modernisation schemes being carried out by the Municipalities include central heating, gas, electricity, oil and solid fuel, the latter three lagging behind in this area at any rate. This has resulted in the amount of combustible refuse being trebled, as the housewife now has to put in the bin the refuse she previously burned on the coal fire.

Nottingham has installed refuse destructors to supply piped hot water, taking advantage of the cheap fuel. This is a step in the right direction, as a large proportion of all collected refuse is combustible. Of course the boilers of a super power station are unsuitable for burning refuse, but Lancashire boilers will deal with this kind of fuel with quite a small admixture of low grade coal, provided there is a good stack draught and Meldrum furnaces in use. Malvern Electricity Works had Lancashire boilers and disposed of all the combustible refuse; the bottles, jars, etc., were collected and went as scrap glass. Ferrous and non-ferrous metals were removed by rough screening, while tins were collected and flattened by steam roller, and baled for sale. This did away with the usual noisome rubbish tip, at the same time relieving the rates.

If there is a real shortage of oil, I think it possible that the small suction gas plant will play a large part in combating the evil. Many of the small oil engines on farms and lighting plants far from the supply networks could be converted, by lowering the compression to run on gas, which by the way could be produced from vegetable waste, sawdust, and possibly animal manure. Where an oil engine has been used to pump water from a brook, it might be possible to replace is with a hydraulic ram, with a corresponding reduction in running costs. It may be of some interest to know that Blakes of Accrington still make rams.

In other cases in flat country, a scientifically designed wind motor could be used to generate low power requirements. I believe Messrs. Lucas experimented some years ago in this direction, with a pole mounted set. The man with a good stream running through his property, would be among the best placed, as a water wheel could be put in. A friend of mine recently discovered a small derelict waterwheel about 5 feet in diameter, with its associated dynamo and a mixture of belt and chain drive, while on holiday in Weardale; the advent of the supply mains had made it redundant.

It is a foregone conclusion that the depleted coalfields and the greatly reduced labour force could not take the place of oil at short notice, therefore the situation should be under constant review. It is significant that some of the large manufacturers of motor vehicles are taking great interest at present in steam and hot air engines.

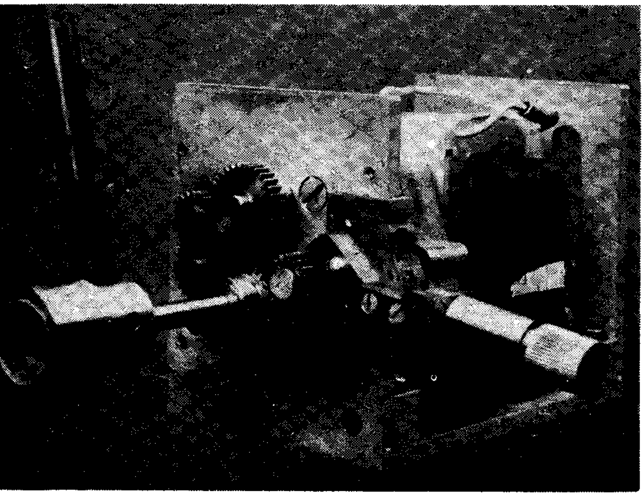
A PORTABLE POWER FEED

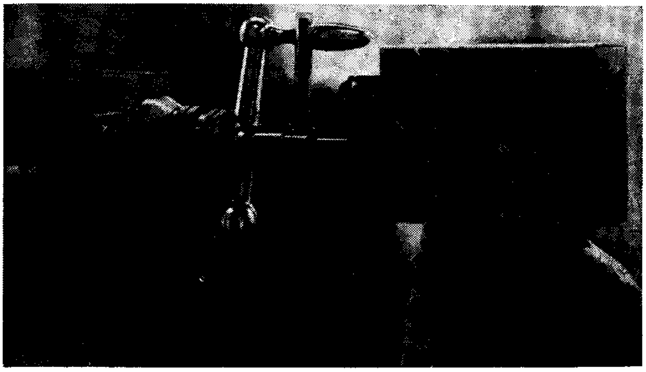
by R. L. Davis

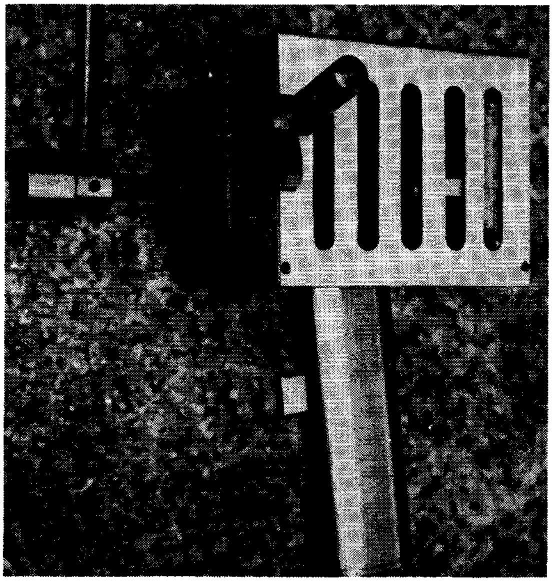
READERS may be interested in a portable power feed for small milling machines I have made. Possibly the idea has not been anticipated.

I adapted this power feed for use on a Centec 2A milling machine. It can be used for longitudinal or cross traverse. I do not doubt but that it can be adapted for other small milling machines.

The 12 r.p.m. 240 volt A.C. motor, purchased on the surplus market, gives a torque of 25-lbs./in. Being non-reversible I constructed the reversing gear as seen below. Most of the body is made of aluminium alloy. At the time of writing a similar motor is still available.







Workshop Equipment and Materials

by "Tubal Cain"

Part II

From page 24

Essential Accessories

I will present these in the order which I think shows the most important ones first; others will differ, but why not? Some items can be made or bought and where the home-made article is likely to be better I will say so, but in such cases you may find them out of order of priority as they may need a device later in the list to make them with.

Workholding

First on the list is the 4-jaw or independent chuck. You can manage without a self-centring chuck but not without this one. The size should be about 1 in. less than the swing (2 x centre-height) of the lathe and for amateur use the "light" pattern is good enough; these are less than ¾ the weight of the standard type. Unfortunately choice is limited these days, but it is worth making a few enquiries with a view to getting a chuck with four steps to the jaws in place of the more usual three. Such chucks can be obtained to screw direct onto the spindle nose, without a backplate adaptor, but I am not sure that these do not wear the nose thread more than the softer iron of the normal backplate does. If you do intend to use a backplate, specify the chuck to be supplied with fixing screws of a thread for which you have a tap, and it is worth obtaining the special backplate from the makers designed for 4-jaw chucks. These carry the greater part of the thread within the chuck itself and so reduce the overhang.

A drill chuck to fit the tailstock comes next. This should be of the key type — so-called "Jacobs" pattern — and have an arbor that fits the tailstock without a sleeve. The common size used is the ½-inch, but many people hold the view that ⅜ in. is as large as should be carried if the tailstock is no larger than No. 1 Morse taper. An alternative to the "Jacobs" is the two-jaw drill chuck, which uses a square key. These, if of good quality, are as accurate as the usual 3-jaw and I think get a better grip on the drill. A minor advantage is that square shank bits can be held in them. If you cannot afford a good drill chuck, then a drill PAD may see you through for a while. This is used by holding the drill in the headstock chuck and supporting the work on the pad. It is a very poor substitute, but better than nothing. The one thing to avoid is the cheap keyless type chuck; there are some precision chucks of this type (The Albrecht is one) but they cost far more than the "Jacobs" type. The cheap ones are useless above ¼ in. capacity. Incidentally, you should not expect ANY drill chuck to have an infinite range — a ½ in. model cannot be expected to hold a drill smaller than 1/16 in. with success.

Now for the 3-jaw self-centring chuck. Many people would put this first on the list, I know, but the point is that you CAN hold any work central in a 4-jaw, but only round or hex. work in a 3-jaw. The size should be a little less than the swing of the lathe over the saddle, which means a four-inch for a 3½ in. lathe. The correct type is the "Geared Scroll" — those operated with a key; the "Lever Scroll" are useful only for the very lightest work on watchmakers' lathes and the like. These chucks also may be obtained to screw direct onto the mandrel nose, but the remarks on backplates made when looking at the 4-jaw still apply. I would certainly not fit a chuck with a *steel* body direct onto the mandrel.

Now, a 3-jaw chuck is made to a tolerance; about .003 in. for the standard type, so that you must not expect it to hold the work "dead" true. The only one in which this can be done is the 4-jaw independent chuck. Further, the degree of run-out will vary with the diameter being held and according to which socket is used for tightening it. To overcome this the so-called "Griptru" chuck has been introduced. This is one which has the self-centring facility, together with a very limited adjustment of the chuck body relative to the mandrel. You must decide for yourself whether this is worth the extra cost — about 25 per cent. My own choice is the third alternative — the "Super-precision" chuck. This has a scroll which is precision ground. It is far more accurate, costs about the same as the "Griptru" type, and has the added merit of being dynamically balanced for use at very high speeds. I have also a very old (second-hand) 3-jaw which I use for normal work, and this I have fitted and adjusted to the backplate (made deliberately a little slack on the chuck spigot) to bring it as true as possible. If I want to set something to "dead" true I use the 4-jaw; for repetition of jobs within say a thou or so I use the "precision" 3-jaw; and for normal jobs, where the work is not going to be taken out and put back into the chuck again. "The 'old un". The accuracy of a 3-jaw — or at least the maintenance of its design tolerance — depends far more on how carefully it is used than anything else, but that is another story.

Carriers

You will need these for work between centres —and how rare this seems to be these days! They can be made, but it is hardly worth while, and one each, ½ in. and 1 in. capacity would be cheap enough. Mine are made of brass, which marks the work less than iron.

Thread Dial Indicator

This enables you to pick up the correct point at which to engage the leadscrew when screwcutting, and I mark it up as an essential. Screwcutting can be done without it, but it is a very tedious operation.

The Travelling Steady comes into the same category; it is an essential if (e.g.) a new feedscrew is being screwcut, or for turning most slender shafts. Both the last items are supplied as standard equipment on better class lathes.

Four-tool turret

I stick my neck out here and assert that this is by far the most useful form of tool-holder on a general purpose centre-lathe. It enables a reasonable amount of presetting to be carried out (if a rear toolpost is fitted also you have a five-operation tool set-up) but at the same time allows toolchanges to be carried out reasonably quickly. Further, the plan angle of the tool face can be adjusted at will and very quickly; the vertical setting of the tool is exact and permanent; the tools are held very rigidly; and it puts very little strain on the top-slide. The so-called "quickchange" toolpost, in which tools and their holders are interchanged in a turret-block are "Production" tools, where the tools are ground and set in the toolroom and issued to the turner with his job-card. In these circumstances they have the advantage, but not for the model engineer.

The main snag with either form is that "fullsize" (i.e. ⅜ in. or ½ in. square) butt-welded or brazed-tip tools cannot be used in it — not on a small lathe, anyway, but on the rare occasions that they are needed the turret may be removed and the normal toolpost supplied with the machine substituted. The one form of toolholder to be avoided is that in which the tool is tilted to get the point at the correct centreheight. We know that top-rake has a very great effect on tool performance and it seems very odd to arrange the toolholding so that this is varied in order to meet a totally different requirement. If you have a toolpost of this type, you can easily make one of the "block" type (see Sparey's book on the Lathe, Fig. 9) pending being able to afford the 4-tool turret. (Even this can be homemade).

Along with the toolholder a tool-height setting gauge saves a lot of time and keeps your tools cutting well. These can readily be made — I hope to describe one in due course if the Editor can find some space! The Tailstock die-holder is another item which is best home-made. This enables you to cut short screw threads with the die and yet get them true to the axis of the work. Or — fairly true; they are not perfect.

We regret that due to the fuel crisis the blocks to illustrate this article did not arrive in time. The illustrations will appear in our next issue.—Ed.

HOT AIR ENGINES

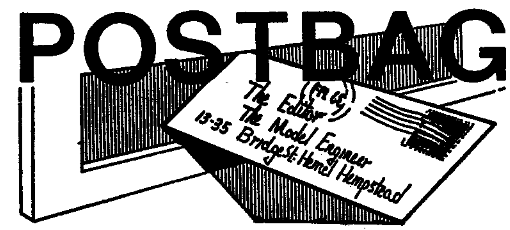
SIR,—Apropos the recent articles and correspondence about hot air engines your readers might like to hear details of an early German toy engine which I have recently added to my collection. It is unusual in that it is a vertical model—most of the miniature engines were built horizontally so as to obviate the cool end of the displacer cylinder getting heated by convection as well as by conduction. In this case a fairly massive casting helps to limit the temperature of the top of the cylinder.

The engine was made in Nuremberg by Georges Carette & Co. about 1890. A number were sold by W. J. Bassett-Lowke and an illustration appears in his early catalogue. It is there described as—'Massive' vertical hot-air engine, best quality and built from well designed castings, all fittings nickel plated with Russian iron base on cast iron stand! There were three models (mine is the smallest) 12 in. high (13/-), 14½ in. high (18/-) and 17½ in. high (24/-).

The design bears a striking resemblance to Robert Stirling's original engine of 1816, a model of which is in the Science Museum at South Kensington. It is also similiar in appearance, but not in operation, to the American engine of A. K. Rider which was patented in the U.K. in 1875. There is an example of this in the Museum of Science and Industry, Birmingham, which also publishes a most valuable survey of the history of the Stirling engine.

After 70 years this little engine still runs with a small methylated spirit lamp but the power generated is minimal.

Moseley. B. W. HARLEY



The Editor welcomes letters for these columns. He will give a Book Voucher for £1.50 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.

Boiler Safety

Sir,—With reference to his letter of 7th December, Mr. E. C. Martin does seem to have a remarkable blind spot in the matter of circumferential stresses in thin tubes as he continues to suggest that they are calculated on the basis of the circumference instead of the diameter as they should be.

With regard to the oil storage tank 4 ft. x 4 ft. x 6 ft. which, he stated, could safely withstand a pressure of 100 lbs./sq. in., I must confess that, at the time I read it, I regarded the statement as bordering on the outrageous—or perhaps it was intended as a joke. But now Mr. Martin tells us that he witnessed an actual test which was allowed, inadvertently, to run up to this pressure. As Mr. Martin says that he saw it, then the case is worthy of a little investigation instead of dismissing it as impossible which has been, I am sure, the attitude of many readers.

Whilst I am not now able to make any reasonably exact calculations without a lot of delving into the work of Timoshenko, which I studied about fifty years ago and have since forgotten, it is still possible to obtain a fair idea of the conditions using only simple arithmetic. If we consider the tank to be 4 ft. x 4 ft. and to have a length much greater than 6 ft. then the constraining effects of the ends can be ignored. Under these conditions the central portion of the tank will tend to assume a cylindrical form with a maximum possible diameter of 5 ft. At this diameter (60 in.) the rupturing load will be one half of 60 x 100 = 3000 pounds per inch length and with material of 12 S.W.G. (say 0.1 in.) the stress would be 30,000 lbs./sq. in. The ultimate tensile strength of the material might be assumed to be 95,000 lbs./sq. in.

Turning now to the axial load caused by the pressure on the ends; these have an area of 16 x 144 sq. in., so that the total force on the ends is 16 x 144 x 100 = roughly 230,000 pounds. This is resisted by the four sides having a total length of 4 x 4 x 12 = 192 in. So the load per inch is 1200 lbs. and the stress 12,000 lbs./sq. in. When this is combined with the circumferential stress at right angles the total compound stress works out at 32,000 lbs./sq. in. which is only about one-third of the ultimate strength of the material.

As I have already intimated, the above calculations are a considerable simplification of a very complex subject but the result does indicate that it might be safe to sit on top of the bulging tank; after all, the true stresses are hardly likely to be three times as high as those arrived at by simple reasoning. It must also be remembered that no account has been taken of the welded seams. The lesson is, however, clear; when a statement which cuts across our preconceived ideas is made, we should analyse it as fully as possible before condemning it as absurd, and it might be found that our ideas need revision.

New Milton. Geo. H. Thomas

Memories of Models

Sir,—I suppose *Model Engineer* must please, and has pleased for many years, two distinct types of reader, those who build models and those who from lack of skill, time or even inclination, merely admire them. As I belong to the latter category I have no qualifications to write about the constructional or technical aspects of model making, but your publication has given me pleasure for some thirty or more years, although I would chide you for more often than not, these days, illustrating real, instead of *model* machinery on its welcome front cover.

I should not be writing this if I had not seen the reference by "Chuck" in your issue of 7-20 December to model gas engines. I have wondered for a long time where all the old models of this kind are hiding and why no one has recalled them. When I was a boy such were available both as complete models and as sets of castings. Indeed, I remember how badly I wanted one, which resulted in my unfortunate mother (a 1914/18 war-widow with this one spoilt son) going into a store where these engines were available, Gamages perhaps, and seriously asking the assistant whether it would be possible to operate one in the dining room. He suggested that it would not, to my great annoyance, and the best I was able to substitute was a chemistry set and crude bench. Honest shop assistants were my stumbling-block in those early nineteen-twenties—I recollect persuading my mother to sell her piano and buy a powerful wireless set. The reason she didn't was solely because the man in the piano vendor's said, almost with tears in his eyes "Oh madam, surely you do not wish to dispose of a beautiful piano for one of them new-fangled nonsenses"; or words to that effect. Unskilled in mechanics as I was, this was not quite such a blow as the passing over of the model gas engine, for I did manage to construct two crystal sets, one with sliding coil and the other with rotary studded wave-band selector, and listen in to 2LO on headphones—remember?

I seem to have digressed. What I set out to ask was why we never seem to encounter miniature gas engines in the 1970s? Maybe this is as well, for any that turned up would doubtless find their way into the hands of speculators who would charge the same inflated prices for such relics as do the vendors of the older motor cars. But to pose the question will not, I hope, bring this about.

I am thinking of gas engine models somewhat different from that built by "Chuck". The ones I so coveted as a boy were quite large, horizontal engines, which you ran on domestic coal gas. I do not suppose they represented any particular full-size engine, although obviously models of such have been, and still are, seen at exhibitions. I think some were powerful enough to be used for driving simple workshop tools. The problem of ignition, which drove "Chuck" to the use of glow-plugs with four stroke engines, was overcome in many instances on the engines I am recalling, by using a full-size single-cylinder chain-driven motor-cycle magneto. This was hideously out of scale, but immensely practical. I think the purists rigged up some form of coil and battery ignition. But

I would have been very thrilled to have poked a flexible gas pipe from the gas-fire point in the dining room over the inlet pipe of a model gas engine, put the h.t. lead from its huge magneto onto its miniature (or 18 mm?) plug, and hauled on its flywheel with all the expectancy of youth. . . .

As I have remarked, parental suspicion prevented this and the desire slowly died, deflected perhaps by being taken to Piccadilly, where my mother took me into the Citroën showrooms and awaited the advent of a smooth young salesman. With hopes of selling a car in the post-war slump period, one soon appeared. Alas for his ambitions, we were shopping for a clockwork Citroën, examples of which he had to climb a high step-ladder to reach. To my mother's surprise I did not go for the (75p) four-seater, regarding the less expensive 10/6d. 7.5 h.p. two-seater as the better reproduction. This, as I was well aware, was not model engineering. But it was the best a boy too indolent to attend evening classes in metal working lathe operation and suchlike could aspire to—which may contain a warning to the present generation of would-be model engineers.

It was an exciting age in which to be young, nevertheless. There were the visits to the Christmas shows which the big London stores — Gamages, Harrods, Derry & Toms, etc.—staged, usually with a special attraction, which could be the display of Malcolm Campbell's Land Speed Record car "Bluebird" or the 170 m.p.h. chain-drive, Liberty aero-engined monster "Babs", of Parry Thomas. These racing drivers would attend in person at the Schoolboys' Exhibition and seeing their cars would be the prelude to another spate of model-building, in my case confined to the excellent but "short-cut" Meccano. (Cliptico I couldn't tolerate.)

Such enthusiasm bade me walk to Weybridge for my initial visit to Brooklands one winter day but I never did discover what became of the fine scale model of "Babs" which C. C. Wakefield Ltd. had made, after Parry Thomas had taken the fastest-ever record on their Castrol oil. It did, I am afraid, cause my mother to enter another showroom to ask what price they wanted for a scale model of a Wolseley Ten two-seater that was on show; the fact that such craftsmanship, even in those times, was very costly and that one-off models were not usually for sale, caused her embarrassment and her child another bitter disappointment. Visits to the Science Museum were equally frustrating, because Meccano would not reproduce the quality found there.

Unable to make them, I collected a great deal of data about model cars of all kinds, from these splendid scale models, upwards and downwards. This I divulged in *Model Engineer* during the last war, so there is no need to repeat any of it here. They all belong to a long-ago age, anyway, when you could gaze into the windows of Bassett-Lowke's in High Holborn and feast the eyes on real scale models and wish you were bound for Bonds o' Euston Road to purchase material for the making of such splendid creations. It was also the era of those model gas engines, which now seem to have gone entirely to ground.

Occupation with full-time motoring journalism and the motor racing at never-to-be-forgotten Brooklands Track prevented any model making I might have managed and the only link with models came with Jury Service in Winchester. A fellow Juryman to whom I gave a lift home asked about local traction-engine rallies to which he could take his small son, which led to the announcement that he had a model locomotive and traction engine in his garage which he didn't want. As a relief from listening to legal complexities for a couple of days, I acquired these for a song. One was a simple 2½ in. gauge 0-6-0 tender locomotive, the other the Bassett-Lowke copy of a Burrell. The loco has a duff boiler and the traction engine is unfinished and for some odd reason was never provided with a safety-valve. Which is about the end of the line. . . .

Does anyone, however, still have one of those gas engines, of model size, running on gas from the main and perhaps using a full-size magneto taken from some luckless motor-cycle?

W. Boddy,
Nantmel, Radnor. Editor "Motor Sport"

Efficiency Competitions

SIR,—I have been following, with interest, the progress of the efficiency competitions, and have also taken part in several Club and inter Club events.

On the last occasion, at the new track at Bristol, I was having to throttle back on a number of occasions, in order to prevent the engine from leaving the track, due to the high speeds possible.

This throttling inevitably reduced the overall efficiency figure because at times the drawbar readings were low and even zero.

It occurs to me, therefore, that perhaps we are looking for the wrong thing.

Surely we should be attempting to run our miniature railways as *economically* as possible. Thus, the driver should take advantage of down-grades to preserve fuel for the climb. His judgement of firing and watering would be important to ensure adequate time keeping, etc.

Would it not be possible to introduce simulated runs, whereby a given distance, including a number of stops and starts, must be carried out within a given timetable?

This sort of exercise would put less emphasis on "thrashing the last ounce of speed" from the engine, and put greater requirement upon the skill of the driver.

It would, I think, be much more interesting and be more representative of running a railway than the model efficiency competition as it now stands. It may well, too, give the smaller engine a more even chance of success, thereby stimulating greater interest.

Your comments, and those of fellow model engineers, would be appreciated.
Cheltenham, Glos. R. W. JONES

Micrometers

Sir,—The anger, splendidly voiced by Mr. Kirkwood, that any criticism of the micrometer evokes is fascinating. One cannot help feeling that, in spite of its limitations as a measuring instrument (it cannot, for example, distinguish between a Rouleux triangle and a circle), the micrometer is a cherished emblem. Certainly it is the popular visual shorthand for accuracy. If you tell any commercial designer that you want to illustrate accuracy his first drawing is always a micrometer. So my suggestion that, for the beginner, a D.T.I. might be more useful was a disturbing heresy. (I now own both 0 in.-1 in. and a 1 in. - 2 in. micrometer, but they have not altered my view.)

Mr. Kirkwood has, apparently, been temporarily (at least I hope temporarily) so blinded by rage as to be unable to read what I wrote. He says that a machinist would be unable to make a part "to specification" (by which, I take it, he means to a properly dimensioned drawing) without a micrometer. Of course he couldn't. I said the same in my original article and in my letters. But the model engineer is not a machinist. And even for the machinist a micrometer is not enough. If he relied on miked sizes when fitting the plunger of a diesel fuel-injection pump to the cylinder, or for the slots in some U.H.F. cavity resonators, he would find himself in trouble. For accuracy we need something that measures more (roundness, for example) and more accurately than a micrometer. The model engineer recognises this when he abandons his micrometer and laps the bore of a cylinder and then laps the piston to it; judging the fit by feel. (He is doing exactly what the manufacturer of fuel-injection pumps does.)

My point was that, because he makes the whole thing, the model engineer can always work like this, whereas the machinist can't. When one dimensions a drawing to go down to the machine shop one chooses the widest tolerances that, in the worst case, will result in a useable combination of parts. For example, in dimensioning a journal and its bearing one selects tolerances for journal and bore such that if, on assembly, a high-limit journal happens to meet a low-limit bore it will at least go in with room for a boundary oil film; and if a low-limit journal meets a high-limit bore the fit will not be too slack. (I'm disregarding, for the moment, such devices as selective assembly because they are not relevant since they do not affect the dimensioning.) All this is totally alien to the model engineer and rightly so.

A glance through the drawings in the M.E. shows a total absence of limits. A bore will be dimensioned: "Ream $\frac{3}{8}$ in. dia." and the journal simply: "$\frac{3}{8}$ in. dia." The descriptive text then takes over: "Turn the journal a close running fit in the bush." Provided the model maker has the tools and the experience to interpret that instruction he will probably get a better fit than some of those based on commercial tolerances. And he does not use his micrometer to get it.

The question, as I have said before, is whether you are compelled, as is a machinist making only a part of the whole, to work in public thou's, or can, by making the whole, work in private ones. In the second case micrometer dimensions are less relevant than actual fits.

Anyway when most model engineers talk of micrometers they mean *outside* micrometers—(I am quite sure that Tubal Cain was not thinking of an inside micrometer when he wrote the letter, my reply to which so provoked Mr. Kirkwood.) They rarely own either internal mikes or Starrett gauges for transferring internal dimensions to outside ones. Hence they are driven to such expedients as miking a stub-end turned to fit a hole, on which Mr. Kirkwood, more liberally equipped by his employers, pours scorn. (Incidentally this tip was passed on to me by a well-known model engineer whose beautiful locomotives proclaim him no slouch in matters of accurate machining.)

In case I have misinterpreted Mr. Kirkwood's "to specification" it is worth noting that the patent laws of most countries take it for granted that a skilled artisan can work without dimensions. The British Patent Office defines acceptable drawings as containing enough information to enable a skilled artisan to make a model of the invention. Very few patent drawings carry any dimensions at all — let alone tolerances.

Finally let me repeat; I am not crabbing the mike. It's a marvellously useful tool for measuring thicknesses, diameters and so on. But the amateur is usually free, like the artisan envisaged by the Patent Office, to work directly in terms of fits, usually does so, and is in fact compelled to do so when he can measure only one part (e.g. a shaft not a bore). The beginner can learn to do the same without much difficulty and he can do that without a mike. There are other things, such as setting a job to run true or parallel to the movement of a slide, which my experience suggests he finds more difficult and which a D.T.I. enormously simplifies. It seems to me that if his budget won't allow him both, he will, in the early stages, get better value from the D.T.I.

London, N.W.5. Derek Beck

Boiler Safety

SIR,—The second letter from Mr. Throp about boiler safety is both more reasonable and more informative than his first which bruised the sensitivities of many highly competent modellers. My reply tried to put the forces affecting boiler safety in a way related to common knowledge and experience, and point out that history shows that the risks are very small if the materials supplied by the model trade, and specified dimensionally by contributors to the Model Engineer, are used. Does anybody, apart from Mr. Throp, dispute that this is true?

If this is generally agreed, then the fact that nine out of ten models to be seen at any club track feature published boiler designs made of materials supplied by the model trade, completely refutes Mr. Throp's implication that dubious design and suspect materials abound.

It takes a great deal of perseverance and conscientious work to start and finish a model loco, and the man who has the guts to see the job through is, by nature, a lot more responsible about the materials he uses than Mr. Throp seems to believe. Certainly we tend to be magpies when it comes to useful pieces of metal, but this does not imply stupidity about boiler materials. If Mr. Throp feels insulted by the word "pontifications" one apologises, but his feeling is typical of that engendered in others by his letter.

It may well be asked why the Editor prints emotive letters that contain inaccuracies, such as those of Mr. Throp and myself. As a regular reader of the M.E., Postbag is, to me, one of the most stimulating features of the magazine because of the editorial policy of Mr. Evans. He insists on the highest standard of accuracy and authenticity in all features and articles to the extent that the Model Engineer has become a work of reference on its subject, but allows free expression of opinion in the correspondence columns whether the facts are right or wrong. This provides a forum whereby the joint views and ideas of the readers can produce progress in the hobby, and stimulates thought on the more controversial aspects of design. In having the temerity to contribute to Postbag myself, my purpose is to provoke comment about some subject, or conclusion, that has intrigued me while playing trains, in the hope that someone with specialist knowledge will reply with confirmation, or an explanation of which I was ignorant. The assumption is that many others who have been curious about the same matter will find the resulting correspondence interesting and informative.

It is therefore disappointing to eagerly open a new issue only to find yet another hoary old chestnut about boiler safety, when there remains so much yet to do to make the model steam loco as effective as the prototypes we model. Am I wrong? A voice in the wilderness? Is there, in fact, a majority of readers interested mainly in making rules for each other to follow, or are we a progressive, enquiring, outward looking fraternity and worthy of the task that time has given us, almost alone, of carrying on the development of the steam locomotive? Many wives, in particular, would like to know!

The example given by Mr. Throp of the engine that burst its boiler at Blackgates proves, to my mind, the main point in my letter about boiler testing. If that boiler, with the butt joint, had been inspected after construction by an experienced builder it would not have been mounted on a chassis, let alone reached a club track. But it is quite conceivable that it could have passed a hydraulic test, and then failed with the thermal flexing of steaming. Such behaviour would be typical of a brittle butt joint. A builder could, of course, lie and claim that such a seam had an internal lap strip, but, who, in all seriousness, would take such a chance with his own life after the danger had been explained? Surely this example of a butted seam proves the need for more communication about boiler making, rather than being a potent plea for more hydraulic tests. It is also a good case for general adoption of the zig-zag seam used by Alec Farmer, and other top boiler makers, that is always visible for close examination.

As for the wheels flying in all directions, this must have greatly added to the fun, but even full boiler pressure applied to the projected area of a wheel rim and spokes could not shift a properly fitted wheel. It must have been a most unusual example of model making, and very short of frame stretchers! Certainly not built to a published design.

Thame, Oxon. E. C. MARTIN

SIR,—I read in the current issue of "Model Engineer" the 'Postbag' contribution by Mr. Arnold Throp whose comments I heartily endorse without reservation.

I am alarmed and surprised however to read in Mr. R. Rivett's article his description of remedial repairs to a leaking boiler. "Rollocks" and not "Potatoes" would have been my comment to the G.W. driver's solution to the problem.

I have seen used over the years white of egg, oatmeal, and "Radwell", all effective hole sealants, all totally unacceptable and unsafe remedies in my book.

I must state that I have had considerable experience with land steam boilers (as opposed to marine boilers) and whilst the "Potato" remedies were employed on occasions in full-size practice, this should in no way be confused with what should be acceptable in model engineering practice. I have never seen a full-size steam boiler with silver soldered or brazed joints.

The sooner expert opinion such as that given by Mr. Throp is heeded and the off-the-cuff "seal it with anything" attitude is dispelled, the safer will be the operation of an increasing number of model steam boilers.

My main concern at the moment is not the practice and building of copper, silver soldered boilers (for which sufficient codes relating to building and testing exist) but steel boilers. Boilers constructed from steel, stainless and otherwise, are much more likely to be badly constructed by the amateur than the copper equivalent and can be subjected to internal corrosion to the point of failure under pressure without the facility for internal inspection.

Let us have a concerted effort to provide adequate codes for building and testing of steel boilers, of which there must be an increasing number as the cost of copper increases.

Sale, Cheshire. P. WM. TOMLINSON
C. Eng. A.M.Inst.F. F.I.H.U.E.

Sir,—Sorry and all that, but Mr. Martin still has it wrong. Not the circumference, but the DIAMETER is the operative dimension for the stress in a tube carrying internal pressure. Stress is given by: Unit pressure x Diameter divided by twice the thickness. (The length makes no difference at all.)

As to the famous oil tank, great oaks from little acorns grow! Raising the thickness from 14 S.W.G. to 12 S.W.G. increases the strength of a flat plate by more than double, and probably even more when the edges are welded into a box! All the same, I do hope Mr. Martin will persuade his friend to use water—then he won't have to run away again! Even at 50 lb./sq. in. it is JUST NOT SAFE.

Finally, the end-temperature of the contents of an exploded steam boiler is around 212°F—quite hot enough to give a bad burn. I absolutely agree that a sense of proportion is necessary. I have handled all sorts of explosives, from big boilers to nitroglycerine, perfectly safely. But this safety can spring only from an appreciation of the dangers involved, so that the correct degree of care can be taken. Not too much, I agree; but not too little, I insist.

Kendal. Tubal Cain

"MASTIFF"

Continued from page 63

There now comes the question of the capacitor, and a word or two about this might be useful. If you use the popular Runbaken ignition coil, a matching capacitor can be supplied for use with it. This has an external clip, drilled for attachment with a single screw. If this is used, the tail of the plate can be curtailed, leaving just a drilled lug for the attachment. Failing this, a radio type component can be used, as in the example shown. The proper value for this is .1 mfd., 250 v. working. The voltage developed in the coil primary circuit can reach quite a high value, and if you install a capacitor of 6 or 12 v. working with the idea that this matches the voltage of the ignition battery used, it will have a very short life. It will either break down or go open circuit. So the size of the one you eventually use will determine the dimensions of the tail for the clip on the baseplate.

To be continued.

Mountaineer

Continued from page 67

Chamfer the extreme end just sufficiently to enter, then press home; these small bushes must be a very tight push fit otherwise they soon become slack; finish by reaming the bush bore again.

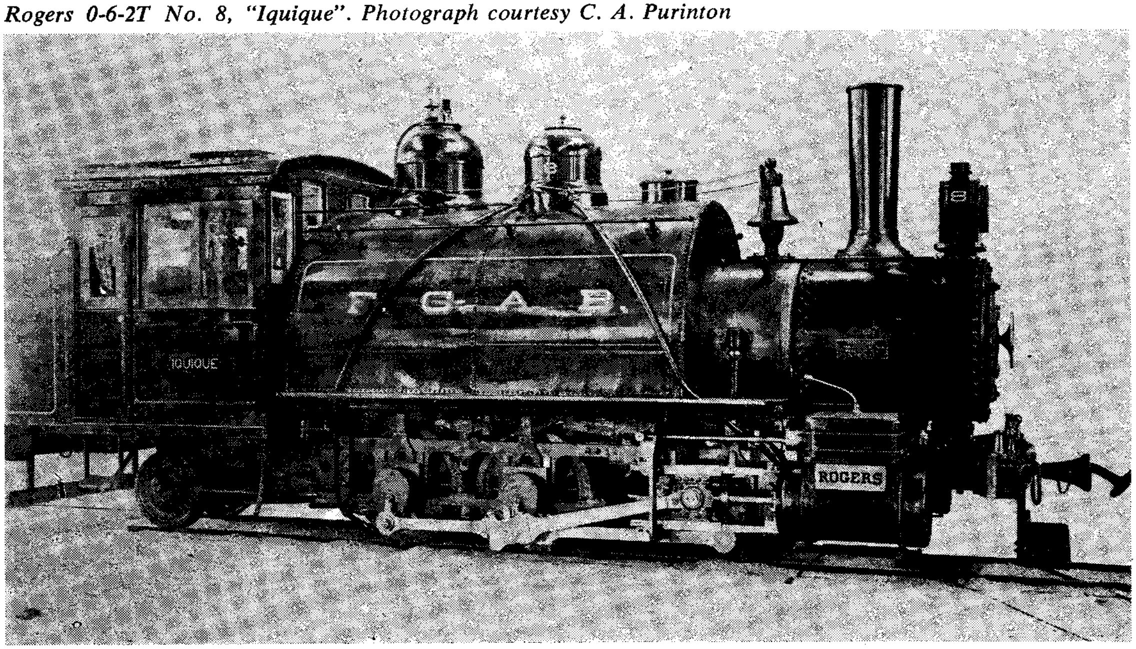
The valve slide bar calls for little comment, after the main ones that we have so recently tackled. Fit the valve crosshead to its spindle, then fit the slide bar; clamp in place and check for tightness. If the valve spindle is being forced downwards, machine either the slide bar, or the facing on the bracket, to alleviate this. Too far the other way and a shim will restore the status quo. That completes another little portion of *Mountaineer.*

Let us partake of a short break for yours truly to mention that *Mountaineer* has already brought me a greater volume of mail than for any other design that I have had the fortune to have published in *Model Engineer;* she has also brought me not a little embarrassment. For many readers have spotted my special love of things Narrow-gauge and I am being bombarded with suggestions for locomotives to follow *Mountaineer,* many of them in the American idiom. The products of the Baldwin Locomotive Works seem popular in many countries, not least in Australia, where some 2-6-2T's are still hard at work on the Puffing Billy Railway. Taking one letter at random, Frank H. Moore Jr. of the Pennsylvania Live Steamers thinks that Narrow-gauge locomotives are 'funny little monsters' and extols the proportions of locomotives for gauges between 3 ft. and 3 ft. 6 in. To back his claim, Frank sent me a drawing of a Baldwin 0-4-0T for the Diamond Rock Sand Co. at 3 ft. gauge, and very pretty she looks too.

All this leads me to make two points. The first is that a return to standard gauge will have to be made after *Mountaineer* has run her course, though the next engine will again be for 3½ in. gauge. The second point is that for nearly all those American designs that have been submitted to me, and there have been plenty, the general design parameters, and *Mountaineer* castings, can be utilised quite simply and effectively. Take as an example the lovely little Rogers 0-6-2T No. 8 *Iquique,* the photograph being from the huge collection of Charles A. Purinton. In many respects this is a sawn off *Mountaineer* with saddle instead of side tanks. There is only one basic difference, Stephenson's link gear is fitted instead of Walschaerts; the gear described for the modified *Maid of Kent* would be ideal here. So with just a little imagination it is possible to produce a whole host of American Narrow-gauge engines.

The cab as fitted to *Iquique* is a veritable palace and readers may be surprised to learn that Alco built a single engine in 1918 generally to the design as for *Mountaineer,* but having a cab almost identical to the Rogers design. This odd locomotive was for the Mines de Liuhoko to the order of Mitsui & Company.

Rogers 0-6-2T No. 8, "Iquique". Photograph courtesy C. A. Purinton



CLUB NEWS

News from Wigan

The Secretary reports that 1973 was a most successful year, with good attendances at all the meetings, particularly at the "bits & pieces" meetings. One member must be singled out—Bill Harrison is building a 5 in. gauge *Firefly* 2-6-2T. Nothing special about that perhaps, until we are told that he is doing this on an Emco Unimat lathe!

Secretary:— K. D. McDonald, 30 Brunswick Street, St. Helens, Lancs.

Pennsylvania Live Steamers

The new track of the Pennsylvania Live Steamers at Rahns, Pa., U.S.A., is now in operation, the first run on the new multi-gauge loop being made by Bob and Rick Dougherty behind the 0-4-0 tank built by their father, followed by a second trip with Kitty as passenger. An hour later, President Bill Scott inaugurated operation on the $3\frac{1}{2}$ in. gauge track with his 2-4-0.

The Annual General Meeting was held on January 13th at the Harvest House Restaurant, King of Prussia.

Secretary:— Robert G. Thomas, 216 Sunrise Lane, Philadelphia, Pa. 19118.

Bournemouth & Dist. S.M.E.

At the recent A.G.M., Sir Donald Bailey, O.B.E., retired after having served as the Society's President for many years. Mr. D. E. Lawrence has been elected in his place. Mr. E. W. Pearce's 15 year stint as Secretary came to an end and Mr. R. Atkins is the new Secretary, although Mr. Pearce will continue as Asst. Sec. to ease the transition to the new officer. A new Treasurer has also been elected; he is Mr. Harry Lee.

The Society has a comprehensive programme of activities for this year and hoped to invite other societies to visit their track before very long. Mr. Atkins' address is:— 47 Pauntley Road, Highcliffe, Christchurch, Hants.

Extension at Leyland

The Leyland, Preston & Dist. S.W.E. are currently extending their $3\frac{1}{2}$ in. and 5 in. gauge track in Worden Park, Leyland. Construction will be as before—steel rail on hardwood sleepers mounted on glass-fibre posts. Multiple steaming bays are also to be built.

Secretary:— Mr. A. Howarth, 15 Lyndale Avenue, Lostock Hall, Preston, Lancs.

Toronto Society

W. F. Choat was elected President of the Toronto Society at its October meeting. Eric Clark continues as Secretary, his address is: 30 Ronald Avenue, Toronto 46E 4M6.

CLUB DIARY

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

January 18 Stockport & District S.M.E.E. Talk by Mr. D. Hoyle on traction engines. 8 p.m.

January 18 East Sussex M.E. Anecdotes of Early Hastings Transport by Barry Funnell, at Mercatoria. 7.30 p.m.

January 18 Romford M.E.C. Annual General Meeting, Ardleigh House Community Association, 42 Ardleigh Green Road, Hornchurch, Essex. 8 p.m.

January 18 Rochdale S.M.E.E. General Meeting, Lea Hall. 8 p.m.

January 21 Leicester S.M.E. "Locomotive Valve Gears" by D. J. Lewin, Royce Institute, Crane Street, Leics. 7.30 p.m.

January 23 Harrow & Wembley S.M.E. Auction, B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.

January 24 Sutton M.E.C. Guitar making by G. H. Love, Clubhouse off Chatham Close, Sutton, Surrey. 8 p.m.

January 25 Merchant Navy Locomotive Preservation Soc. "The 1948 Locomotive Exchanges" Talk by Mr. A. E. Hooker, The "Pillbox", Westminster Bridge Road, SE1, (opposite Waterloo signal box). 7.30 p.m.

January 25 Colchester S.M.E.E. Annual General Meeting, Clubhouse Old Allottments, Lexden. 7.30 p.m.

January 26 S.M.E.E. A.G.M. — Caxton Hall. 2.30 p.m.

January 28 Stafford & District M.E.S. Annual General Meeting, New Inn, Broad Eye. 7.30 p.m.

January 28 Clyde Shiplovers' and Model Makers' Society "The Year on the River" by Michael Campbell, Y.M.C.A. Club, 100 Bothwell Street, Glasgow C.1. 7.30 p.m.

January 31 Sutton M.E.C. A collection of steam loco slides by K. Nichols, Clubhouse off Chatham Close, Sutton, Surrey. 8 p.m.

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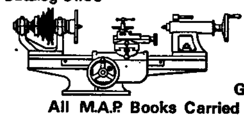

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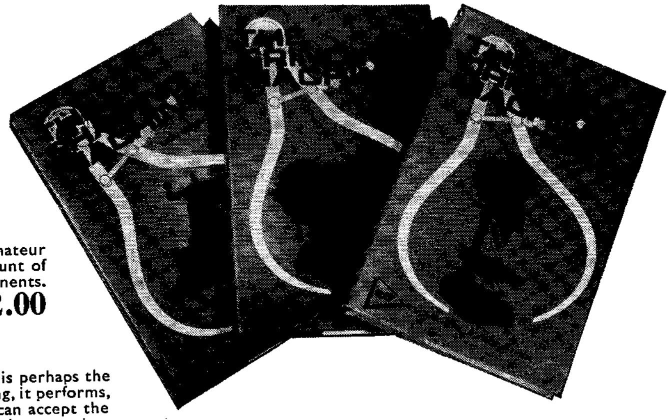

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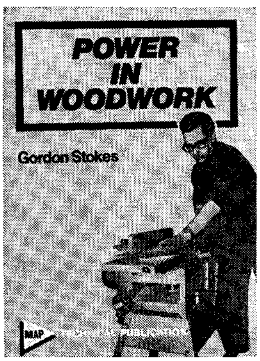

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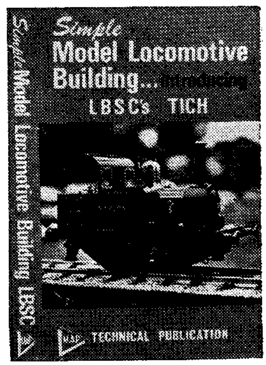

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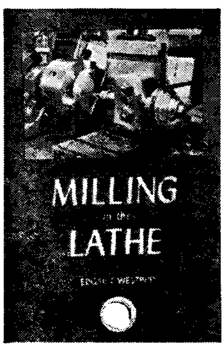

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