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Model Engineer

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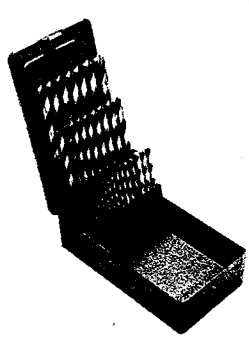

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Volume 143 Number 3573

18 November 1977

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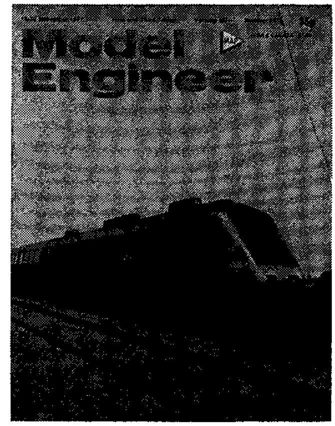

Dramatic shot of an advanced passenger train by Alan Rimmer.

NEXT ISSUE

Time to think about Christmas with a Steam Crane.

The Editor is pleased to consider contributions for publication in "Model Engineer". Manuscripts should be accompanied if possible by illustrations and should also have a stamped addressed envelope for their return if unsuitable. While every care is taken, no responsibility can be accepted for unsolicited manuscripts, photographs, art work, etc.

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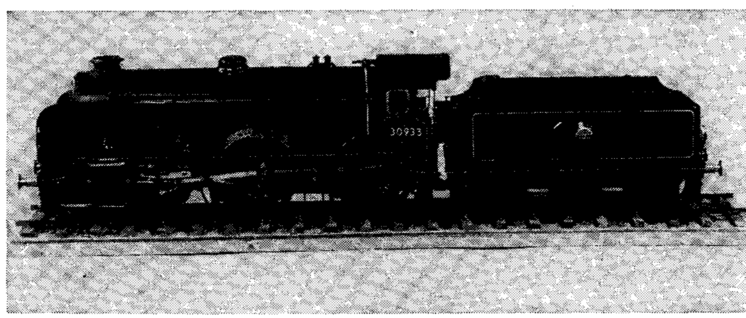
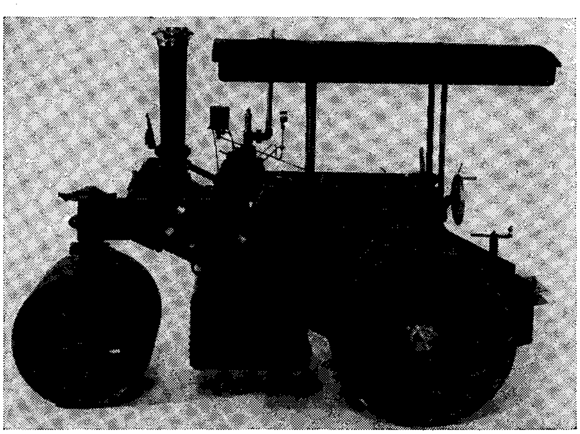
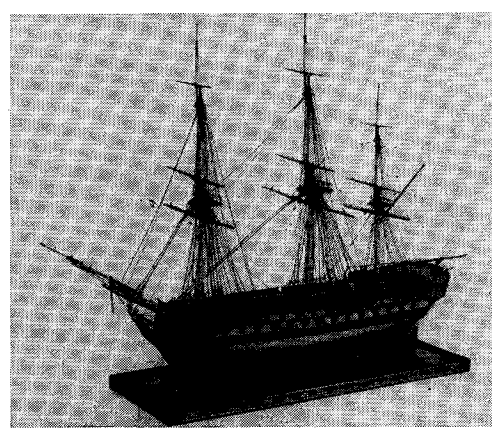


3½ in. gauge model of the British Railways "Schools" class 4-4-0 locomotive and tender No. 30933 "Kings Canterbury", built by F. W. D. Tucker, Greenford, 1952, 10¼ in. by 45 in. (26 cm. by 114.3 cm.)



3 in. scale model of a Wallis and Steevens "Simplicity" road roller, built by L. Whalley, Coventry, in 1973, 25 in. by 35 in. (63.5 cm. by 89 cm.)



Early 19th century boxwood and ebony copper-sheathed fully rigged French prisoner-of-war model of the 96-gun man-of-war "Le Heros", 15 in. by 20 in. (38 cm. by 51 cm.)

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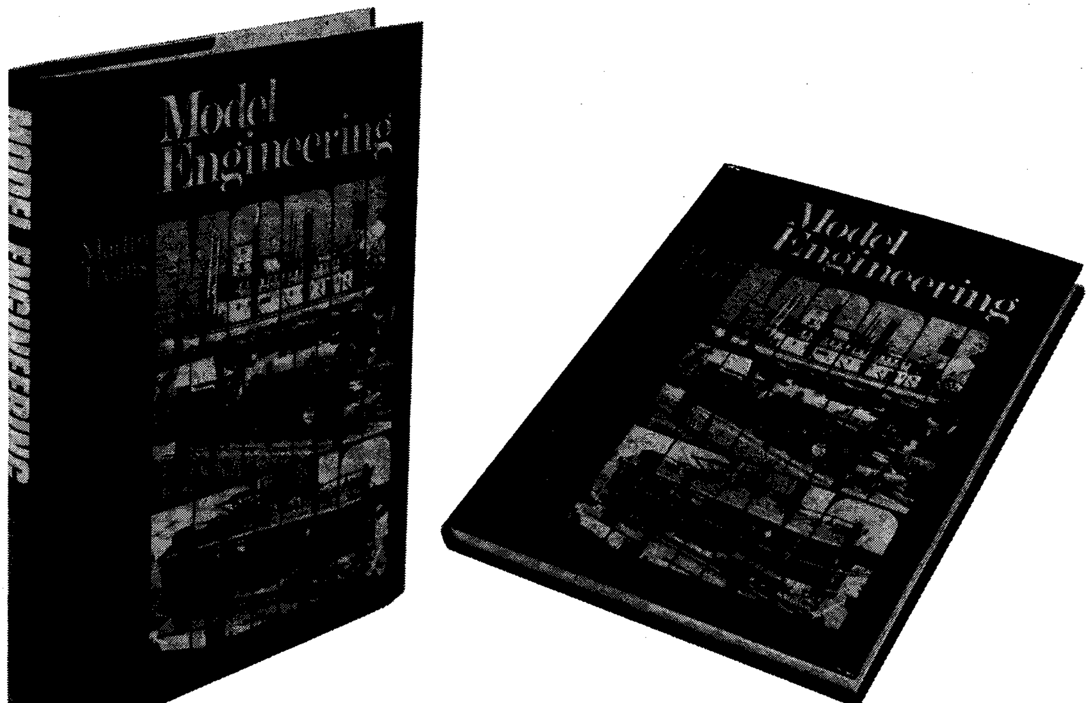

The basic guide to model engineering which will bring long hours of pleasure to all enthusiasts of this fascinating and highly popular activity. No other book has its scope; it covers not only workshop practice but types of models, and activities in clubs, rallies and exhibitions. The text is accompanied by a superb set of technical drawings and photographs of model engineers from all over the world.

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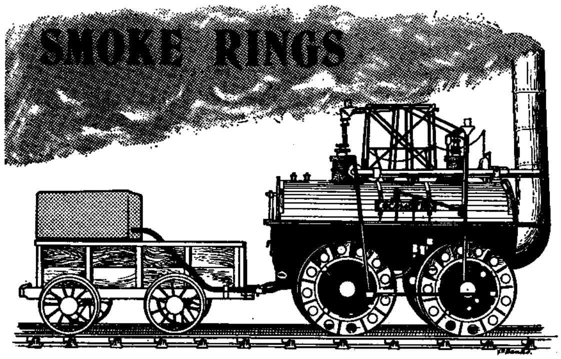


A Commentary by the Editor

Clock watchers

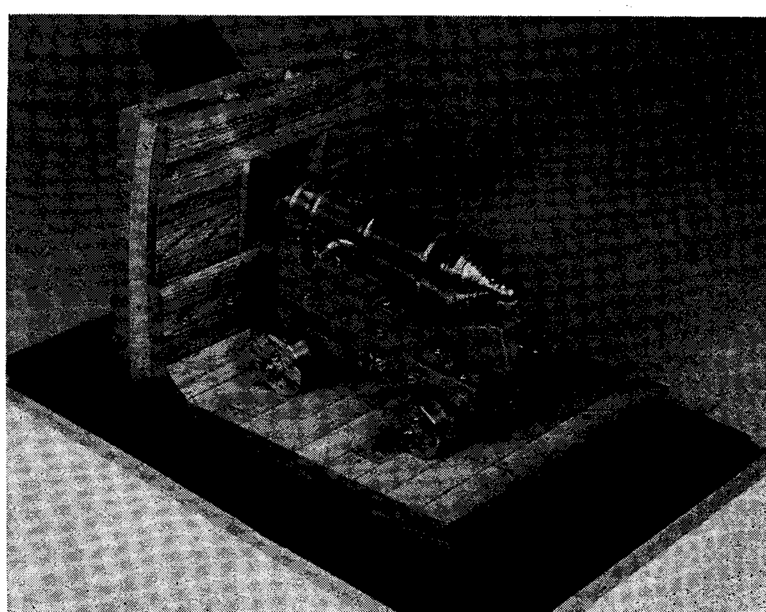
Model engineers with a leaning towards the construction and repair of clocks will be interested to know that a new monthly magazine is to be published shortly by Model & Allied Publications Ltd. The title will be *Clocks* and the cost 75p. The editor is Mr. Henry Massie, former news editor of the *Daily Mail.* Another clock news item is that as a result of several enquiries, *M.E.* hopes that it will shortly be publishing the constructional details of the case for Mr. Claude B. Reeve's weight driven regulator clock which was featured in the magazine back in 1966. Although at the conclusion of the series it was remarked that details of the case would follow, for some reason they did not materialise. Those readers who have had a naked regulator clock on their walls for the past eleven years can now complete the job.

Aircraft poster

The Phoebus Publishing Company has commenced publication of a new series of posters called "Fighting Machines of the World Wars". The first poster, measuring 24 in. x 36 in., shows the JU87 "Stuka" in full cut-away illustration and photographic format. The presentation makes it ideal for the model maker who likes to have authentic constructional details, and hopefully the series will be extended to cover a very wide range of machines.

"Model Engineering"

Martin Evans has aimed at the beginner to model engineering in his latest book which carries that name as its title. Published by Pitman Publishing Ltd., the book explains the types of models, workshop equipment, use of castings, joining methods, and adds useful information about Societies and exhibitions. Also of extreme convenience is a glossary of terms but—and this is something which has been brought to *M.E.*'s attention by our overseas readers—there is no list of common abbreviations such as f.c.m.s. One tends to forget that to the raw beginner and foreign readers these letters mean nothing and there is a mental note that *M.E.* must include a list in the near future. However, the books offers an introduction to model engineering and at £7.95 makes an ideal Christmas present. To regular readers, some of the photographs will have a familiar ring but there are many other fine examples of the model maker's skills and also line illustrations where necessary. A full review will appear shortly.



This fine model of a 24-pounder cannon was made by Mr. Richard F. Cutler of Phoenix, Arizona. Mr. Cutler has promised us more photographs and a detailed description in the near future.

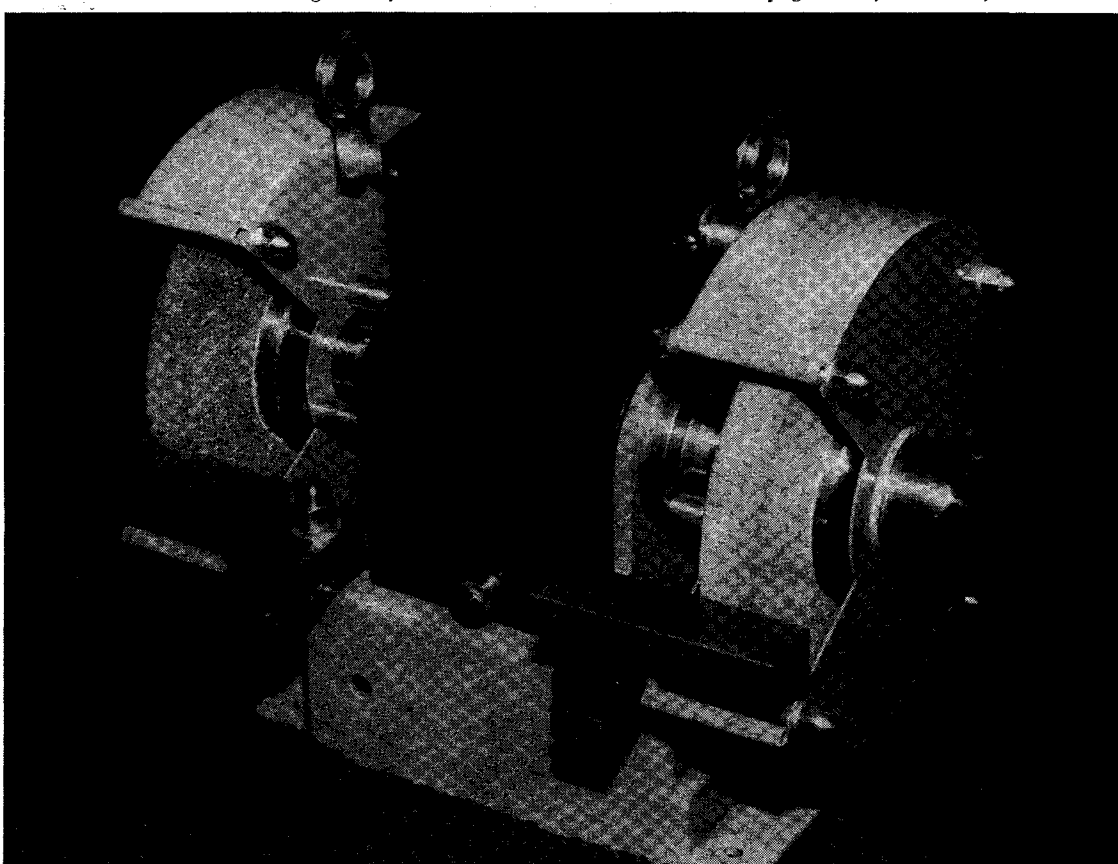
Occupational hazards

If we did not already know that there are inevitable hazards associated with model engineering—even if they are only confined to blisters or cut fingers—there are constant reminders of the perils in using certain adhesives, machinery, materials or methods. Some may be considered to be obvious and dependent upon the common sense of the operator, but others are only brought to our attention as a result of scientific discovery and should not be treated too lightly—asbestos is a good example. The latest comes from the Presbyterian-University Hospital of Pittsburgh, Pa. and refers to the dangers of welding. Our correspondent, Malcolm D. Orr, Director of Cardiothoracic Anesthesiology, draws our attention to a letter from W. J. Fessel to the Editor of the *New England Journal of Medicine* in which the practice of welding in an enclosed space is associated with scleroderma, a disease of skin and internal organs. Of fourteen patients mentioned, five had been welders *and two were ladies whose husbands welded as a hobby*. Just watch that ventilation.

"Invicta"

Since *M.E.* published a picture of *Invicta*—"Canterbury Lamb" to LBSC fans—on the front cover of the 2 September issue, we have heard from Mr. T. Redshaw of Kemsley, Kent, that the old loco is about to be removed to York for extensive renovation. *Model Engineer* has spoken to *Kentish Gazette,* the newspaper which carried the story, and written to the City of Canterbury Public Relations Officer, Mr. P. A. Dewhurst, and Curator of the Royal Museum, Mr. K. G. H. Reedie. *Invicta* is still in Canterbury but will shortly be taken to York for an as yet unknown period. On her return to Canterbury, the old lady will be found space within the museum as her delicate health would deteriorate if she returned to her outdoor site. Finance for the renovation is coming from the Transport Trust with a Government-assisted grant through the Science Museum. The Trust also hopes to raise money locally. *M.E.* has been promised a progress report with photographs, and we hope to publish the full story when *Invicta* returns.

Mr. S. H. Willetts entered this grinder for the last M.E. Exhibition. Turn to page 1301 for more of his work.



ADHESIVES

From page 1214

by R. L. Tingey

LOCTITE CALL THEIR range "Superfast" because the initial curing time is very fast, dependent on the material and ambient temperature. On copper and its alloys the adhesive cures very quickly, on iron and steel quickly, and on aluminium and stainless less quickly. However a combination of phosphor bronze and dural can cure so quickly, using 601, that one has to be pushed into the other, correctly positioned, within seconds. The initial curing time is rather longer for the Rocol products, but they do supply an accelerator which brings the cure to handling times close to those of Loctite.

It is important not to move the bond during the initial curing as the strength of the bond relies on the initial polymerisation period. The time to ultimate strength of products varies, dependent on the type, the material, gap-size and temperature of cure. Most threaded jobs can be used after about 30 minutes with safety, but smooth bonding jobs should be left for the full 12 hours before working.

Gap Filling

The gap filling capability varies quite a lot between types, and, generally, the stronger the adhesive the better the gap-filling capability. Obviously the greater the gap filled the less strong the bond tends to be, but, alternatively, smaller gaps may exclude most of the adhesive, such as with a press-fit where most of the adhesive will be wiped from the mating surfaces, preventing good adhesion.

The same is true, to some extent, of threadlocking, where a thread which is tightly tensioned to its 80 per cent of maximum torque may have all the adhesive squeezed from the load-bearing sides of the thread into the space between the non-load bearing sides, providing large-gap adhesion one side and little adhesion the other, thus less total locking adhesion can be present than with the same thread, no tension applied.

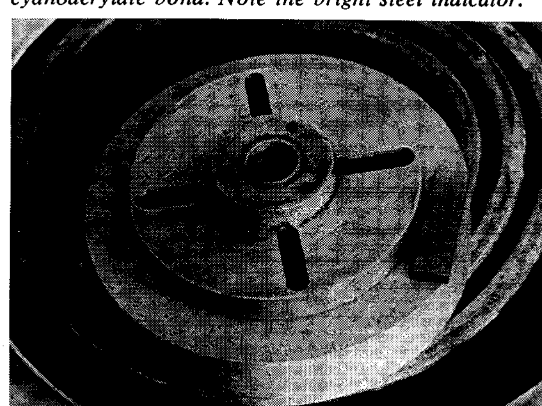
To eliminate the gap-filling problems it is best to ensure that when press-fits or threads to be tightly tensioned are to be adhered, adhesive should be applied to both surfaces, and sharp corners avoided on the female of the joint, to avoid the wiping clean. But large gaps are to be avoided, even with the more viscous products; gaps may be considered as too large if the adhesive runs out after application.

Dispensing Anaerobic Adhesives

The standard bottle size is 10 ml. (or 10 cc.) and consists of a plastic bottle with a removable nozzle and a cap. The dispenser is best stored upright, and in use I have found that the best sequence is to first remove the cap, bottle upright, squeeze out a little air, invert the bottle and squeeze further to eject some of the contents, as required. Return the bottle upright and allow the ingress of air to clear the nozzle of adhesive back into the bottle, then wipe the neck of the nozzle with clean rag before replacing the cap.

The more viscous fluids may need a sharp flick-

Heating the workpiece on a hotplate will liquefy a cyanoacrylate bond. Note the bright steel indicator.



ing action to bring the adhesive to the nozzle even with the bottle inverted.

Never draw dispensed adhesive back into the bottle from the work surface as it will contaminate the contents; contact with metal contaminates. If adhesive sets within the nozzle, remove the nozzle and clear it out with a small broken twist drill, but before replacing it clean it through thoroughly with a chlorinated carbon, such as CTC, and allow the agent to dry out before replacing the nozzle onto the bottle.

The adhesives are quite expensive so they are worth a little care in handling. Rocol dispensers have long thin nozzles which clear easily in use; they are rather better than the Loctite dispensers, which tend to clog up if care is not taken. Remember that the bottles have to have an air space to keep the anaerobic action from taking place, and when purchased bottles will be only half full because of this. Rocol containers have a sealed nozzle when purchased, the Loctite anaerobic containers are unsealed.

Tables and Tests

The results of the various tests are tabulated, with explanations about the tests. Also the various grades from the two manufacturers are compared in broad outline.

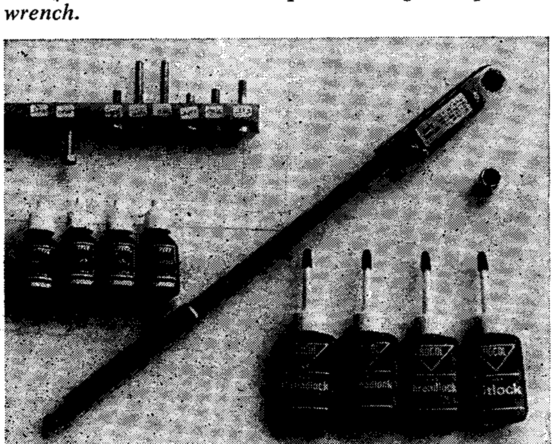
Safety Precautions

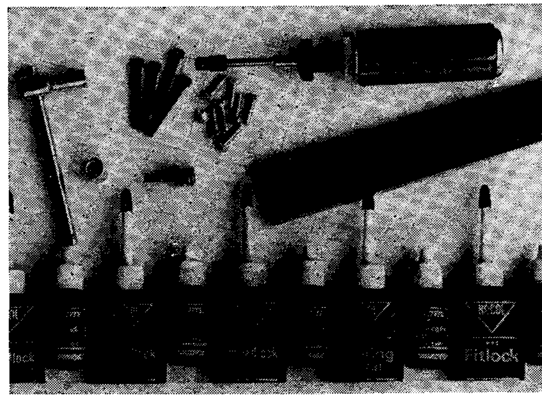
Always wash the hands after using the adhesives. If you have cuts, bruises or abrasions on the hands wear rubber or polythene gloves when handling the adhesives.

Cyanoacrylate Adhesives

These adhesives are made in two grades by Loctite; the IS 415 has high viscosity and good gap-filling properties, the IS 495 is of low viscosity to be used as an extremely thin film, and is suit-

The ¼ in. B.S. Whitworth required a larger torque wrench.





Testing the BA series with a Britool "Turntorq".

able for rubber and plastic. They both bond in seconds in a relative humidity of 40 to 60 per cent, speed of cure is dependent on the material joined, and full strength of bond is attained in three hours.Both the cyanoacrylate adhesives have a high temperature use limited to 80°C, and so are unsuitable for many model engineering purposes, but I have used the IS 415 to great effect as an "invisible chuck" in the workshop.

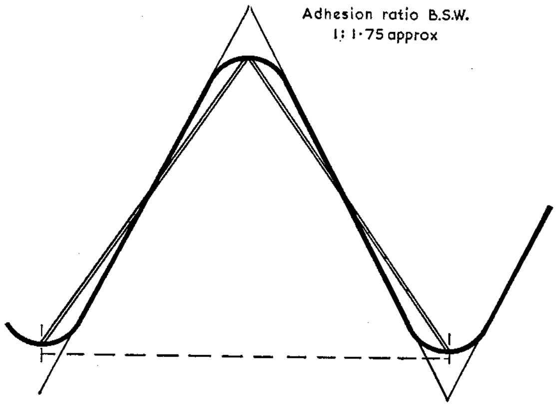
Safety problems with this adhesive type cannot be over-emphasised. It will bond body tissue in seconds, before you can think about it. If a piece of metal with this adhesive on it is picked up the metal will be bonded to the fingers and be difficult to remove.

IS 415 in the Workshop

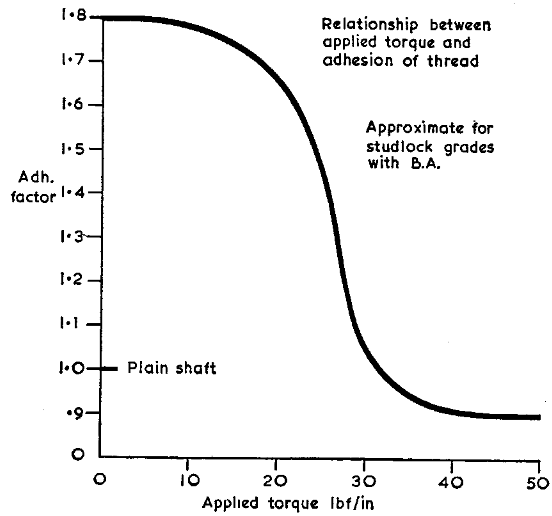
The adhesive has a greater potential in the workshop, as a chucking medium, than has the anaerobic adhesive since it is faster setting. I wished to turn a 4 in. diameter block, 1 in. thick, in the Unimat, but the chuck jaws do not extend this far, and if they did they would bang on the bars even in the increased swing mode.

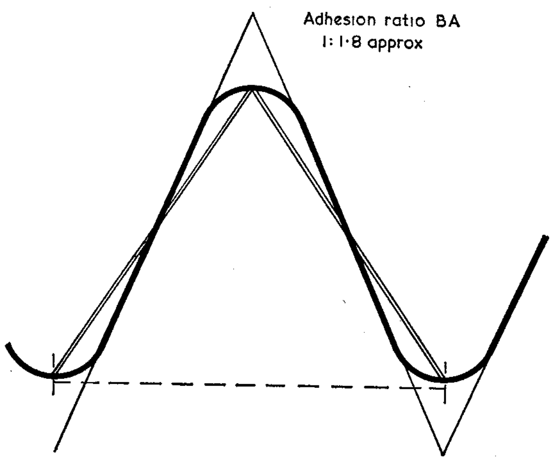
The method is: clean off one surface of the block, and the face-plate, mark the centre of the block and apply IS 415 to the face-plate. With the jaws of the vice opened ready, offer the face-plate surface to the block, visually centring through, and, with a gloved hand, quickly press the two together and lock in the vice. By the time it takes to loosen the vice again the adhesive will have cured sufficiently to be handled, still with the glove, until the surplus "wet" adhesive is wiped off with a piece of rag where it will immediately set within the cloth structure.

Leave the adhesive to cure for at least an hour, or three hours if any problems are likely to be encountered in the turning operation. Machine on the lathe as if held in a chuck, observing the usual safety precautions, and bringing up a centre in the tail-stock if necessary.



B.S.W. Configuration
— — — Unthreaded shank length for adhesion
═══ Mean of threaded surface for adhesion





B.A. Configuration
— — — Unthreaded shank length for adhesion
═══ Mean of threaded surface for adhesion

When complete the workpiece is removed from the backplate by placing it down onto a controlled hotplate and heating up slowly until the bright steel indicator, placed on the work, oxidises to the very first yellow when the cyanoacrylate adhesive will be found to be liquid between the two surfaces, lift apart. Do this in a well-ventilated room and avoid breathing the fumes which may be given off.

As soon as the work and the backplate are slightly cooled the adhesive will harden to a film which can be easily pulled off.

Using this adhesive rather than the anaerobic one is better in two ways. The cure time is quicker with just as strong an adhesion, and the removal is at a lower temperature and does not require a knock to break the bond.

For Best Adhesion

Cyanoacrylate adhesives are water setting and rely on moisture in the atmosphere. In the British Isles the relative humidity will rarely be outside the range of 40 to 60 per cent which provides the ideal curing atmosphere for the adhesives. In conditions of low relative humidity it should be found sufficient to have a kettle boiling in the workshop, to quickly supply the right atmosphere.

For a strong bond, surfaces to be joined should be very clean, and a lightly abraded surface provides good adhesion.

Safety Precautions

Wear gloves when using this adhesive; most chemists sell throwaway polythene gloves, which are ideal for this purpose. Remember not to scratch or rub, particularly the eyes, when wearing contaminated gloves. If the adhesive gets onto the skin do not attempt to wipe it off, but flush it off. Keep a bottle, with a dropper, full of acetone for this purpose.

Keep the adhesives and contaminated material out of the reach of children. Use the adhesive in a well-ventilated workplace.

Epoxy Resin Adhesives

These adhesives consist of two solutions, an adhesive and a hardener, which, when mixed together, set from a sticky substance to a hard resin by forming its own heat of curing. Brands most easily obtained are Bostik and Araldite, and both of these are obtainable in a quick-set version as well as the normal, and they all set more quickly if both heat and pressure are applied. The standard pack consists of two tubes with different colour coding so that the correct cap is replaced on the tube to prevent contamination.

The two solutions are very viscous and are expelled from the tubes in equal amounts to be thoroughly mixed together before being applied to the work. The adhesive will bond to most clean surfaces and can be particularly useful for filling in countersunk screw holes, where subsequent rubbing down and painting can make it undetectable. It is useful for filling quite large gaps and irregularities, and can be used to contour-fill when gasketting for one surface not quite mating with another.

It has excellent high temperature properties up to 250°C, and past this temperature remains firmly adhered while starting to brown and smoke until it finally burns. It can, for example, be used to secure the smokebox onto the front end of a boiler with far less fuss than with other methods, and will only burn if the boiler runs dry of water.

A Quick Setting Method

Used cold the setting of the epoxy resins can vary considerably and they are sensitive to whether the amounts mixed are equal. The Araldite Rapid, particularly, remains sticky if slightly too much hardener is mixed with the adhesive, not really setting at all. The answer, I have found, is to always mix these adhesives hot.

The method to use is to heat a piece of 18 gauge sheet brass on the hot-plate turned low; as soon as water spits when applied remove the brass from the hot-plate and squeeze onto the brass the required amounts of the two solutions, slightly apart so as not to contaminate one tube with the other. The two solutions on the hot brass will flow together and become far less viscous. Mix together well with a matchstick and the solution will be transparent and flowing, pick it up with the match and apply it to the job. The workpiece should be cold and the adhesive applied accurately and quickly; the rapid grade will be half-cured within a few seconds with this technique.

Safety Precautions

These adhesives can cause skin problems, and those prone to skin complaints should wear polythene gloves when handling. The rapid setting resins contain a peroxide which can irritate; a barrier cream applied to the hands before using the adhesives will help remove adhesive as well as protecting the hands.

To be continued

COMPARISON OF ADHESIVES

Rocol		**Loctite Superfast**		
Fitlock	9	Retainer 601	10	High strength retaining of metal surfaces. Fitlock requires an accelerator for treated finishes. Both are ideal for fitting permanent assemblies.
Bearing Lock	5	Bearing Fit 641	6	Medium strength retaining of metal surfaces. Both are ideal for fitting items needing eventual replacement.
Threadlock Studs	8	Studlock 270	7	High strength retaining of threaded surfaces which should not need dismantling.
Threadlock Nuts	2	Nutlock 242	4	Medium strength for locking short lengths of thread which may be disassembled.
Threadlock Screws	1	Screwlock 222	3	Low strength for locking longer lengths of thread which may be disassembled.
Seal Lock	1	Penetrating Adhesive 290	1	Low strength capillary adhesive for locking components already assembled.
Instant Gasket Fluid		Gasket Eliminator 504		Gasket replacing adhesives, medium strength and surface filling.
Fitlock	9	Adhesive 317	<10	High strength surface adhesives for chucking onto backplate for machining.
		Cyanoacrylate Adhesive 415	<10	High strength surface adhesive for securing components for machining. Ultimate strength in 3 hours. Melts at approx. 200°C. Useful for delicate components.

CROSS-SLIDE MICROMETER COLLARS

Part II

by George Thomas

From page 1223

MENTION OF THE SCREWS brings me to (A) again in which it will be seen that something funny has happened to the thrust collar. This is a little modification which I carried out to increase the thrust bearing area by turning back the face of the collar by about 1/32 in. and skimming the top diameter. After thorough degreasing with C.T., a false collar was secured with Loctite. The new thrust face was finally skimmed up to a fine finish and dead square to the axis. This, admittedly, is an alteration to the standard screw but it is unconnected with the design of the micrometer dials and is quite optional—an improvement nevertheless.

The choice of design rests with the reader; my own preference is decidely for (A) but (B) runs it a close second and involves less work and no mods to any existing parts. Although I had no immediate, or even possibly future use for the dial shown in the photos, I must say that it was a most enjoyable exercise in turning from which I derived much satisfaction. Before giving a few constructional details it might be appropriate to mention that, for those who "don't like making tools" but who would like to have better mic. collars on their ML7 or ML7R, Myfords do supply kits comprising screw, handle, friction dial and bearing bracket, which convert a Super-7 standard at a cost (June '77) of about £14. On the other hand, if they care to overcome their prejudices for a short while they might add that amount to the value of their lathes.

I suppose that it should not be necessary to have to state that the most important qualities to strive for in this class of work are concentricity and accurate working to lengths. Those with Griptru chucks should experience no trouble with the former, others might, but all such difficulties can be overcome by careful planning and resort to various subterfuges.

The bosses 4a, 4b, 6 & 8 must have their working O.D.s truly concentric with their threaded bores which should be carefully drilled at the same set-up, first with a drill at about 3/16 in. opening up to the correct tapping size, 5.3 mm. (or No. 4). Tapping will be carried out in the lathe at a later stage after the back end of the bore has been opened up to a full ¼ in. (say letter "F"). Threaded components are screw-cut—even if you do happen to have suitable dies. I have remarked on a previous occasion that I frequently use 26 t.p.i. because I have a useful range of G.T. taps up to ¾ in. so I screw-cut the internal threads almost to completion and then pass a tap through to size them, after which screw-cutting of the mating part can be carried out almost without reference to the "nut". If you have no such taps you might, with advantage, screw-cut 24 t.p.i.—you won't have to watch the dial! With regard to 4a and 4b, transfer the bar before parting-off to a dividing head on a vertical miller (or to a vertical slide on the lathe) and do all the milling with 5/32 in. and ⅛ in. slot drills; return to the lathe and part-off. Reverse in the chuck and face off to leave the flange exactly 7/64 in. thick—clearances between faces is provided in the dimensions of item (2) etc. The spring pockets in (6) and (8) can be handled in a similar manner.

Pressure collars 5a and 5b will present no difficulty. The bores should be a free but close fit on the bosses and the inserted key in 5a made to fit in the ⅛ in. slot without rotational shake. I silver-soldered mine in and faced off that side afterwards, using one of my "backstops" to obtain absolute parallelism. 5b has a 3/32 in. keyway cut in it to fit closely over the pin in 4b. I have not used this pin-in-slot arrangement myself but have included it because it might be easier for some workers; note that a clearance "keyway" will have to be made in the micrometer collar as shown in 3b, otherwise it would be impossible to assemble it.

Graduated dials or collars

These are, after all, what all the fuss is about. *All* dials are turned with the graduated edge outwards and at the same setting they are faced off, bored and any face recesses turned. If there is any knurling to be done it should be completed before any finish turning or boring is carried out. Having turned the item as far as is possible, it is graduated

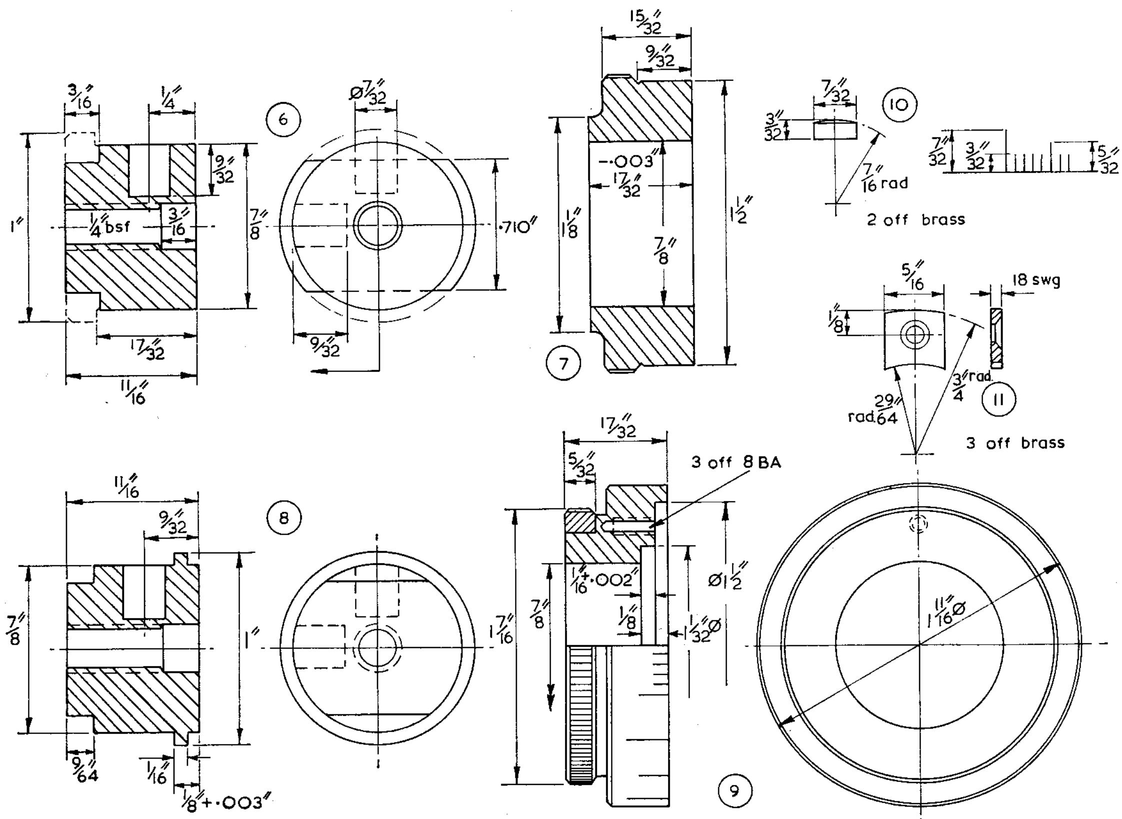


Fig. 2

as will be described towards the end of this article. Some aspects of this have been dealt with in previous articles but I feel that a review of some of the methods ought to be included here if only for completeness.

It will be sufficient if I give a few hints on the making of items (2) and (3a), and the machining of the bearing bracket which is shown at (C) and which will be the final job. The stationary ring (2) is turned from 1¾ in. FCMS and the notes on my workshop sketch read as follows: "turn O.D.; face; drill ½ in.; take out recess to .187 in. deep; bore to 25/32 in.; enter large centre-drill; part-off 9/32 in. full (with tailstock support)". If one works always with a piece of material equal to the length of the finished job plus a bit to hold, one ends up with a collection of useless discs, so I tend to work with a longer piece of material which might stand 3 in. or so from the chuck jaws, the residue from which, after parting-off, is not wasted, *but* some tailstock support is desirable when parting-off large diameter material although it *must* be released before final severance. Next grip it in the recess by opening the drill-jaws and turn the step, making sure that the dimension given as 3/16 in. —.005 in. is, in fact, .005 in. less than the depth of the recess on the other side. The 3/16 in. is not all that important but the —.005 in. is a necessary running clearance. Face off to 9/32 in. o/a.

The marking-off for the two screw holes can be accomplished quite easily by setting a very sharp pointed tool towards the face of the work and adjusting the cross-slide until the tool will scribe a circle 1 1/32 in. dia. Remove from the lathe, mark one centre on the circle with a sharp punch and, with dividers set to .893 in. (57/64 near enough) step off the other centre. Drill tapping size (No. 43) but don't countersink until after the holes have been transferred to the bracket and opened up to No. 33 to clear 6 BA.

The micrometer collar 3a

If you decide to knurl direct on to the collar as at 3b you can turn the 1 11/16 in. dia. down almost to size and then clean up a band to about 1/32 in. to .040 in. larger. This will take the knurling which is preferably straight, medium, but see notes on knurls at the end of the article. After knurling, face off; turn recess to 7/64 in. deep (which must be the same as the width of the flange on 4a). Bore ⅝ in. dia., or bore and ream if you have a ⅝ in. machine reamer. Finish turn the top diameter to exactly the same dimension as item (2) all ready for graduating. Cut in on both sides of the knurling with a 90 degrees vee tool. After graduating (for which, see later) the collar can be parted-off, reversed in the chuck with three pieces of sheet brass interposed between the jaws and the graduated surface and the second side faced, recessed etc. to dimensions. For those who prefer the appearance of the stepped-down knurling (one never knows!) the step is turned to about 1 3/16 in. dia. to suit the knurled ring about 1½ in. dia. which will, eventually, be stuck on with Loctite or Araldite.

We will now move on and assume that all the component parts have been completed. It remains only, in the case of (A), to turn the end of the bearing bracket and transfer the holes for the two screws, but before this we require a small turned component which will assist both operations. Make a centring plug from a piece of ⅞ in. dia. m.s. Turn to an accurate .250 in. dia. for about ½ in. and then reduce for a short distance to 25/32 in. dia., a free fit in the ring (2); part-off leaving the 25/32 in. head a full ⅛ in. thick. Reverse in the chuck, face off head and centre it carefully with a No. 3 centre-drill. The plug is pushed into the bore of the bearing bracket in which it should be a good fit. Now set up the bracket on the faceplate, clamping down with two dogs. Use a wobbler between the centre in the plug and the tailstock and set to run true by tapping the foot of the bracket. Now use the tailstock centre as a support and turn back the end of the bracket in accordance with Fig. 1 (C). The diameter is not important, it is not complete anyway, and can be measured from the O.D. of the head of the plug—it should be about 13/64 in. In order to carry out this operation the top-slide will have to be turned right round to act as a cross-slide. In its standard form it will not turn round to 90 degrees, but I have dealt with this matter in a previous article. Alternatively, I have a suggestion to make which is contained in the concluding paragraph of this article.

Having turned the necessary clearance on the bracket we now use the same plug to locate the ring (2) for transferring the holes. The correct alignment will be obtained by sighting with a rule held across the two holes. A toolmaker's clamp will hold all in place for drilling. Tap the holes in the bracket and open up the holes in (2) to No. 33 and countersink (on the right side!).

To be continued

EASY SAWING ATTACHMENT

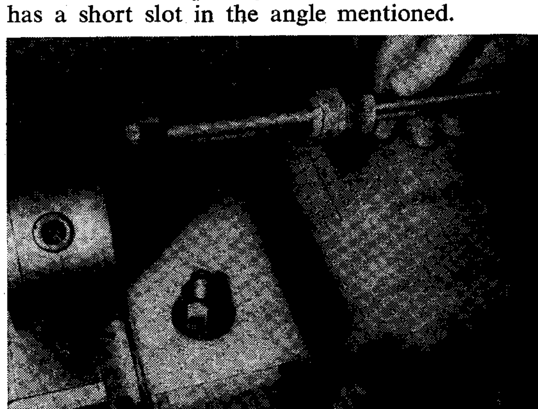
by F. G. Rayer

THE WISH TO SAW a fair number of plastic strips, cleanly and accurately, prompted this attachment for the lathe. It has proved to be of enormous aid for this, and for soft sheet metal. The constructional time was small, and all items except the saw were scrap. No doubt all the dimensions mentioned could be changed.

The spindle is made from a 12 x ⅝ in. pin with a square head (original purpose not known). This is turned true in the lathe, and about ¼ in. removed from the head so that it can be gripped by the 3-jaw chuck (see photo). The head is also drilled for a ¼ in. die bolt so that the spindle can be driven between centres by a pin on the faceplate, if required. The spindle is threaded for about 7 in. from the tailstock end, to suit nuts to hand. A nut is then screwed on very tightly, and machined to leave a 1 in. dia. bush ⅛ in. long for the 1 in. hole of the 2¾ in. saw. (A hardened steel nut would be inappropriate.) A ⅛ in. thick washer is made to follow the saw, on the bush, and is backed by an ordinary washer and nut. This results in exactly true running.

As quick fitting is needed, and no finished work is wider than 3 in., the table fits on the top slide toolholder stud. A piece of hardwood 8 x 3½ x 1¼ in. goes over the stud first, followed by a 6 x 3 x 1 in. piece of angle (to take the fence), then the table, which is 9 x 8 in. sheet, about ⅛ in. thick. The sheet is supported by the stud in line with the saw, and slowly lowered on to the latter, so that it cuts its own slot. The table is just high enough to clear the nuts on the spindle.

The fence runs along the edge of the table, and is merely "borrowed" from the B. & D. wood saw-bench. It is clamped by a bolt and wing nut, and has a short slot in the angle mentioned.



SOME TIME in the early 1940s, I received a call from a fairly large cotton mill in the vicinity, to say that there had been a serious accident to the main engine, and that the mill was closed down as a result.

I was on my way within minutes, and upon arriving in the engine room, was shown the accident. The whole of the condensing plant appeared to be completely wrecked. The engine was known to me, and indeed was one of our own construction. She was a horizontal cross compound of some 800 i.h.p. with Corliss valve gear on both cylinders and a central flywheel fitted with 30 or 40 two-inch diameter cotton driving ropes. She was driving some 2000 Lancashire looms from a line-shaft. I must confess that an engine of such a power driving this number of looms appeared to me to be rather overloaded. I accordingly asked if any recent indicator cards were available for inspection; the answer was no. My next was the standard question: had there been any recent repairs carried out on the condensing plant or indeed, anywhere on the engine; again, the answer was no.

ALAN HAWORTH DESCRIBES HOW HE TACKLED AN AIR-PUMP BREAKDOWN

It was obvious that the first step was a complete strip out in order to ascertain the extent of the damage. This was started immediately. I agreed with the management that night and day working would apply until a repair was effected. It should be remembered that this was war-time, and the armed forces were crying out for textiles of every description.

A typical arrangement of condensing and air/condensate extraction plant for an engine of this type consisted of the following: a vertical jet type condenser chamber was mounted side by side with an air and condensate extraction pump. The pair were mounted on a vacuum-tight rectangular C.I. box with a rubber foot valve (non-return valve) between the two vessels. This particular casting was always known as "the spectacle case", probably due to its appearance. This assembly was set up in such a manner that the centre line of the air pump coincided with the centre line of the L.P. engine, the pump rod being driven from the L.P. crosshead via side levers and bell cranks.

An alternative arrangement much favoured in those days was a combined air pump and condenser placed in tandem behind the L.P. cylinder and driven by an extension of the L.P. piston rod. The size and layout of the engine room largely dictated the choice of arrangement.

As the stripping out proceeded, the reason for the accident became apparent. The cotter securing the air pump crosshead to the top of the pump rod had worked loose, and finally parted company. The safety split pin at the point end of the cotter had sheared off! It is surprising that the attendant had not heard any knocking from this area prior to the breakdown, which would have given him warning to shut down. The full extent of the damage soon became known:

1. The air pump delivery head plate containing the valves had fractured.
2. The air pump bucket was in two pieces.
3. The air pump rod was a write-off.
4. The spectacle box was fractured along its width.
5. Nearly all driving rods and motion were twisted and bent.

The condenser chamber and air pump barrel were intact. Since nearly all these were castings, an early start was out of the question and the management were advised accordingly. Their first question was of course, the usual: "What can be done to expedite matters?" It is always difficult to convince management that condensers and air pumps do not lie on shelves in the works! I had a momentary vision of constructing sheet metal exhaust ducting and running the engine to atmosphere, and as quickly dispelled the idea for one reason or another. I was told to proceed with the repair as quickly as possible.

Application was made to the Ministry of Supply for a works permit to enable the work to proceed and this was granted under the Essential Works Orders. This was a wartime ruling and applied to all general engineering. Details of metals used and their weights, together with estimated number of man hours, had to be sent to the department concerned.

In the meantime a thorough examination of the L.P. engine was made for any damage, and this was found to be in order. All the components of the condensing plant were returned to the works. Since the engine was of our own manufacture, patterns and drawings were existing—a bit of good luck amidst the bad! The patterns and coreboxes were found and checked with the broken castings. They were in order, and were immediately sent to the foundry to prepare the moulds.

With reference to the bent shafts and driving rods, it was the practice in those days to straighten shafts etc. in the lathe. Strangely enough this process was never referred to as straightening, but "stretching" a shaft. I suppose a straightened shaft is to some extent a stretched one. The process was accomplished as follows: a stretching machine was mounted on the lathe bed. This was, in effect, a three point vice, capable of applying a large force through a square thread screw via a windlass. This force was applied to the shaft to be stretched held in centres. The machine was mounted on rollers to enable it to be traversed along the lathe bed, and the shaft was spun periodically between centres to check progress. A skilful turner could straighten a large shaft in a comparatively short time, and I myself have seen a shaft of 4 in. dia. x 20 ft. long straightened to almost perfect truth by this method.

During this time a new air pump rod had been machined, and the delivery rubbers removed from the delivery head plate as these were all re-usable. It should perhaps be mentioned here that the gauge which is made to suit the air pump barrel bore. This diameter also contains a number of water grooves to assist in lubrication, but oil of course, is sparingly used in or around condensing plant. The condensate is, of course, boiler feed and any oil in this feed would cause trouble at the boiler. It was the practice years and years previously to fit brass or bronze rings to the buckets, but the breakages of such rings caused the practice to be discontinued. Besides, no useful purpose was served by the use of these rings. The top face of the bucket was studded to receive the bucket rubbers and guards. The bucket was now securely attached to the pump rod on its taper end with a large nut and split pin.

Next on the agenda came the delivery head plate and its rubbers which is simply a cast iron disc machined all over, fitted with its rubbers and guards. A gland is provided in the centre of the top face for the pump rod to pass between vacuum and atmosphere on its up and down journey. Finally came the spectacle box and its cover with

ON A LARGE MILL ENGINE

design of the delivery head plate varied somewhat. One design had a great many small rubber valves on its surface, but I could see no particular advantage in either one against the other. The rubber foot valve in the spectacle box was next removed to prevent any backflow of condensate into the condenser when struck by the descending pump bucket.

We were now informed by the foundry that the moulds were ready to receive metal, and the small furnace which was reserved for breakdowns was charged and made ready to "blow". It had a capacity of about 3-4 tons, and when it "blew" the metal was poured into the waiting moulds. Everyone's fingers were crossed to ensure that the castings were "good 'uns" which were to remain in the moulds to ensure adequate and even cooling for 24 hours. The time came for "lift out" and the castings appeared to be sound. They were dressed or "fettled" to use the common expression, and sent to the machine shops for "marking out".

Marking out was usually done by the foreman fitter but I think, on this occasion, I did them myself as I was responsible for the whole "shooting match". The first casting to be machined was the air pump bucket, which is essentially a piston, and is turned, faced and boxed to suit the pump rod. The outside diameter is machined to a pin facings to receive the condenser and air pump barrel. The castings were not necessarily finished in the order described, however.

During this time the fitters at the mill had disconnected the exhaust pipe from the L.P. cylinder and the top of the condenser chamber, lifted the condenser and the air pump barrel, and removed the spectacle box. This was usually secured by holding down bolts, and grouted down to the ashlar stones of the foundation. A fair amount of digging and shipping had to be done. The foundation face then had to be cleaned up and prepared to receive the new spectacle box. Next the bell cranks or L.P. rocking levers had to be checked for parallel and truth. These levers were cut from one-inch thick solid boiler plate and attached by side levers to the bottom. These were checked as follows: With the engine on back dead centre, the distance between the bell cranks relative to the centre line of the engine was carefully measured. The engine was hand barred forward to mid-stroke and the measurements taken again. The engine was now hand barred forward to front dead centre and the measuring repeated. If the measurements coincided at all points the rocking levers were parallel. Fortunately on this occasion, they were. Some fitters preferred to use a long pin gauge with

Continued on page 1280

Doctor Derwent Mercer

ON EYEGLASSES AND MAGNIFIERS

IT IS A LITTLE sad to read, as one does occasionally in journals such as this, statements implying that the use of a watchmaker's eyeglass for a long period makes one go "cross-eyed" or "nearly blind". As I have been regularly using eyeglasses since working on aircraft instruments during the war, and have since instructed generations of students in the proper use of optical instruments, I would like to feel it is worthwhile to show that the use of such valuable aids as magnifiers need produce no discomfort or stress. After all, watchmakers and others work for many hours on end while using magnifiers, and these give no trouble whatever if properly used.

For those who wish to know the basis of the statements made, the next section gives a brief account of the optical principles of magnifiers; but those who do not wish to read it may go straight to the section following it, taking the conclusions of the argument on trust.

Simple optics of magnifiers

We consider only the "simple thin lens", an idealised lens whose properties are quite sufficiently accurate for our purpose. Such a lens brings parallel light to a focus at a certain distance behind the lens, known as the focal length, irrespective of the angle at which the beam of parallel rays falls on the lens (Figs. 1 and 2). This is the point, for instance, at which the sun's rays are brought to a focus (actually a very small image of the sun) in order to produce a "burning-glass". It should be particularly noted that a ray going through the centre of the lens (AB or CD in Figs. 1 and 2) goes straight through.

Now in Fig. 3, consider an object placed at the focal point of a lens. Ray PQ is parallel to the lens axis, so that it is refracted to go through the focal point F; ray PS passes straight through the centre of the lens. Clearly, rays QR and ST are parallel; the eye thus judges them as coming from a very large object at a great distance. For such an object, the normal eye (or the eye assisted by correct spectacles) is completely relaxed—think how restful it is to look up from a book at a distant landscape! Looking at such an image causes no strain whatever on the eye.

Now look at Fig. 4, in which the object is closer to the lens than the focal length. Here the situation is quite different. Ray PQR still passes through the focal point, but ray PST diverges from PQR. These rays apparently come from an image shown dotted, and the apparent position of this image may be very close to the eye. This causes a strain on the eye for the following reason: when the eye needs to focus on a nearby object, the eye lens (which is visible as the dark part, or pupil) is "bulged" by the contraction of the "ciliary muscle", a circumferential muscle surrounding it, positioned approximately behind the iris. To focus on a nearby object, therefore, puts this muscle in a state of tension; it relaxes only when the eye looks at a distant object. (The textbooks talk about "infinity", but in practice any object more than about five metres away can be regarded as equivalent to an infinite distance, from the point of view of using the eye.)

Practical means of avoiding eyestrain

The conclusion of the foregoing section is that, to produce no strain on the eye, the magnifier must be positioned so that the object is at its focal point —no closer. The practical interpretation of this is that the magnifier (or eye-plus-eyeglass combination) must be as far away as possible from the object while still maintaining distinct vision. Placing an object too close to the eyeglass is the biggest single factor in causing eyestrain. People often move in too close because of a subjective impression that they must get close to the object in order to see it; it helps to realise that you are not looking *at* the magnifier, but looking *through* it.

Exactly the same goes for the use of, say, a telescope or microscope, especially if it is fitted with cross-wires or a graticule. The procedure is to pull the eyepiece right out, then slowly push it in, keeping the eye relaxed, and stop as soon as the image is seen clearly. It is then, incidentally, a salutary exercise to push the eyepiece right in, hard against its stop, while watching the cross-wires; the eye can be positively felt to "tense-up" as the ciliary muscle bulges and the eye tries to accommodate itself to the image which has suddenly moved much closer.

Other aids to relaxation

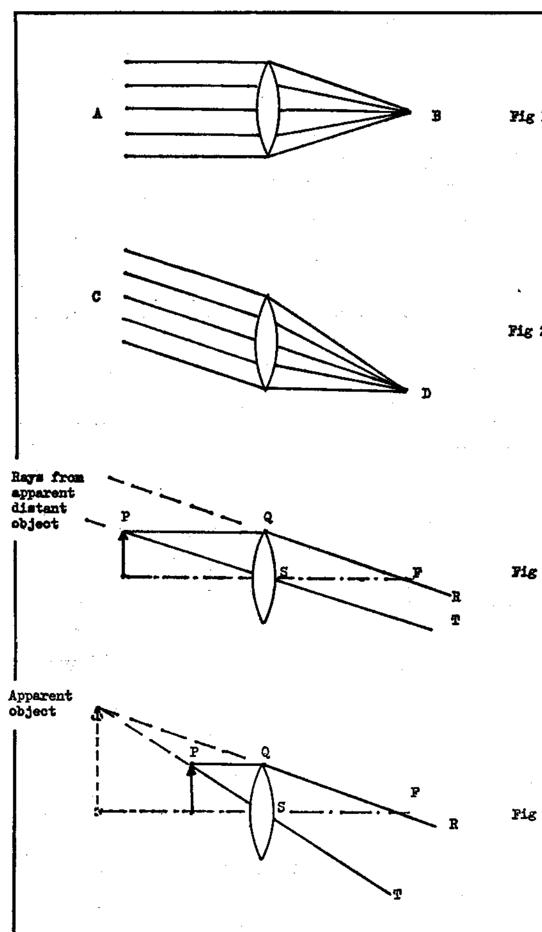
There are several other factors which can aid relaxation, and an important one is to learn to work with both eyes open, thus reducing the muscular tension entailed in screwing up one eye. This may need a little practice, and perhaps needs trying the eyeglass in each eye, in turn, as most people have one eye which is "dominant" and it helps to put the glass in this one.

But it really becomes quite easy after a time; the brain automatically rejects the image from the open eye until you want it—e.g. to pick up something from the bench, when you will find that normal vision returns quite easily. One can in fact without much difficulty combine the two images—as many people need to do when drawing on a piece of paper beside a microscope, while looking through it at the object to be drawn—the brain can superimpose the magnified image and the moving pencil quite easily.

Now to some practical points. Many people cause muscular strain in the attempt to fit a watchmaker's eyeglass or "loupe". There is no need to screw up the eye in order to hold it. The correct method of fitting it is to hold it in position in front of the eye but pointing slightly upwards; then push it up against the fold of skin under the eyebrow. If its lower side is then allowed to fall on to the cheekbone, it will stay in place without any strain. Admittedly this is however difficult for some people, and eyeglasses of different sizes may need to be tried; if holding it in this way is still impossible, a loop of springy wire going round the back of the head can be attached to it, so that it is held against the eye by gentle pressure.

Spectacle wearers are in fact rather better off (quite apart from the fact that they know their now-corrected vision is usually 100 per cent or better!) as there are several types of eyeglass which clip on to the spectacle frame, and can be pushed easily out of the way when not required.

A most important point however with all such glasses is not to get one with too short a focal length. True, it produces greater magnification, but this is bought at the expense of two disadvantages; the object needs to be held very still and in a far more critical position to obtain sharp focus, and a lesser depth of it will be in focus at any one setting. (These two related factors arise from the reduced "depth of field" of the shorter-focus lens.) A focal length of 3 in. will usually be found adequate, and personally I find anything less than this rather trying. The general situation is that on the occasions when you want more magnification you usually want a very great deal more, and a 1 in. glass can be useful for occasional work; but certainly not for routine wearing.



Different forms of magnifiers

Other sorts of aids are binocular eyeglasses or "eyeshades", which have incidentally the advantage of providing some protection for the eyes when machining. However, they must be (and usually are) prismatic, which means that the light rays are slightly bent in the horizontal plane so that the two images as seen by the two eyes appear to come from a very distant object. (If this was not the case, each individual image would appear at a great distance when correctly focused, but the two eyes would be directed to the position of the nearby object; the eyes would tend to squint.) There is the slight disadvantage of having lenses before both eyes, so that the device must be pushed up out of the way in order to regain normal vision.

Large magnifiers—such as a large lens perhaps nearly a foot across, on a stand, under which the two hands can be seen to perform an assembly operation or something similar—can be found very helpful for certain jobs. Some of them have illumination built in. Some types are "aspheric", meaning that the lens is specially shaped to give correct definition right to the edges; a useful improvement. However, whether they are corrected in this way or not, some apparent distortion can occur in all such lenses if objects are twisted around at different angles; this is inevitable, and is not usually a problem.

Conclusion

This about exhausts the list of aids to vision, but the same principles govern all: relax the eyes; hold the object as far away from the lens as practicable. If you get used to doing these simple things, optical instruments and aids will become, instead of a tiring chore, a positive joy to use.

MILL ENGINE BREAKDOWN—continued

the centre-line of the engine scribed on the gauge. This was inserted between the levers at the various points of the stroke.

The various bits and pieces were now ready for delivery at the mill and the fitters would go "all out" night and day to erect them. It was a curious custom on those days that before an engine-fitter would work a "ghoster" (that is, all night), he had to be provided with his "lowance" (allowance). This was an enamel bucket containing about four gallons of "common" ale. It was an accepted, established practice in the trade, and a fitter would flatly refuse to work unless it was provided; the mill management were only too happy to comply. The writer has never seen this practice abused and there were never any instances of insobriety. In any case, the common ale of that time was pretty weak stuff—about 2° per pint. It didn't stay inside you very long when wielding a 14 lb. back-hammer!

The erection proceeded according to plan. The spectacle box was laid down, lined up, packers introduced and grouted in. (Quick-setting cement was used.) This was allowed to settle for 24 hours, then the condenser was dropped onto its facing and bolted up. The exhaust pipe and cold water injection pipe to the jet were then coupled up and the air pump barrel was lowered onto its facing and bolted down. The pump rod and bucket were in turn lowered into the pump barrel, checked for running clearance and alignment. Next the pump crosshead was fitted together with the side guide rods. Previous to this, the delivery head plate had been fitted to the top of the air pump barrel and the gland packed. The vacuum gauge connection on the condenser was re-made, the air vent on the spectacle box opened, and we were ready to run.

A man was posted in the air pump well and the engine was hand barred forward for two complete revs. It was reported from the pump well that everything appeared to be in order, steam had been raised in the boiler and the engine oiled round. The rather dubious honour of opening the stop valve fell to me. It is a curious fact that, in spite of all the years I had had in the game, I could never approach a stop valve handwheel without trepidation after a major breakdown.

I approached the stop valve, having first personally warned each man that the first to drop a spanner would suffer grievous bodily harm! The cylinder drains were open, and I cracked open the stop valve, the engine began to turn, first one rev. and then another. My ears were almost aching in an effort to catch any untoward sound. There was no shout from the air pump well. I let her turn very slowly and walked over to the L.P. crosshead. The side rods were dancing merrily. I next glanced at the vacuum gauge, the needle of which was slowly climbing to the 26 in. mark. Full vacuum would not be obtained until the engine was on full load. I walked back to the stop valve and slowly opened up, with my eyes on the governor. When the governor lifted I held her at that; there was no load on the engine except friction load, perhaps 70-80 i.h.p. I decided to steam her for a couple of hours to prove things one way or another. The management were now in full strength in the engine room; smiles all round. I said that work could be resumed the following morning.

On my way out I saw the notice on the mill gate: "It is requested that all weavers report for work tomorrow morning at 7.30 a.m."

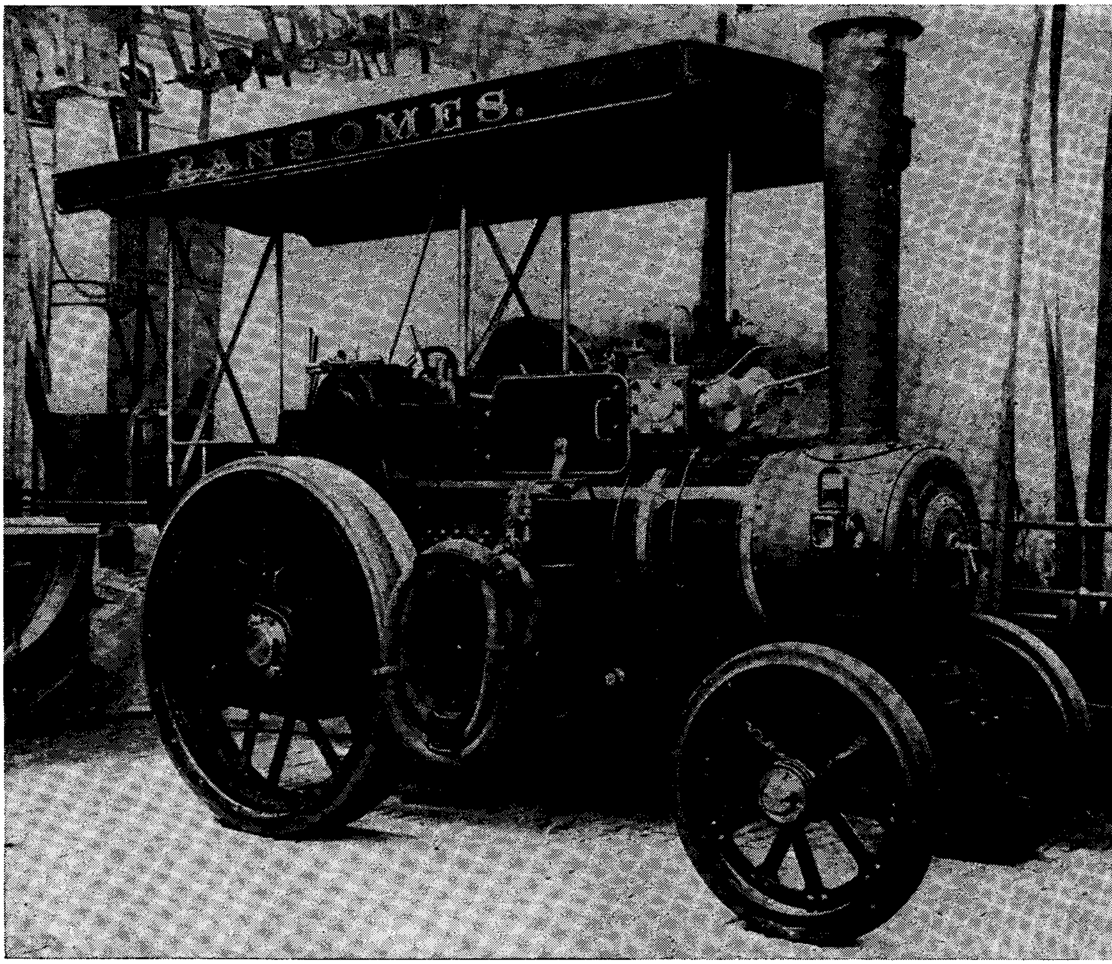


Photo by courtesy of Museum of English Rural Life

Light Compound Steam Tractor

Part Five, featured in the 4 November issue, proved too lengthy for the available space. To avoid upsetting the sequence, John Haining's fans have a bonus in this number.

THE CRANKSHAFT of the full-size tractor has a 4 ft. 1 in. overall length with a keyway on the left-hand end for the flywheel, plus a hole through shaft and keyway for a $\frac{3}{8}$ in. dia. pin to prevent the flywheel working outwards on the shaft.

The right-hand end carries four keyways equi-spaced on centre lines for the sliding fast and slow speed pinions. These are *not* splines cut in an enlarged diameter length of shaft, a fact which is emphasised by a note on the works drawing calling the four keyways to be broached, and the tops of all keys to be left radial—a requirement which will aid the modelmaker who decides to leave this end large in diameter and machine the four upstands from the solid bar.

The crankshaft is a good plain forging $2\frac{1}{2}$ in. dia. all the way along except at the keyed end, where it is increased to $2\frac{5}{8}$ in. dia. and $3\frac{1}{4}$ in. dia. over the radiused keys, and again where the eccentrics are fitted on the outside of each crank, where the diameter becomes $3\frac{1}{4}$ in., as does the length between cranks. The crank webs are drilled for $\frac{1}{2}$ in. bolts securing the balance weights in position, and each balance weight has a rectangular cavity through it to enable a $\frac{5}{8}$ in. stud to project through from the crankweb with a hexagon nut fitting on the stud within the cavity—all of which should have guarded quite adequately against the appalling havoc caused by a balance weight coming adrift while running. No middle main bearing is fitted or necessary in a shaft as robustly proportioned as this; and there is ample room for the eccentrics as both fast and slow speed gears are fitted outside the crankshaft right-hand main bearing, the two pump gears being on the outside of the left-hand main bearing, the driving one between bearing and flywheel boss.

I decided to draw the crankshaft as in full-size practice complete with detachable counterweights but dispensing with the increased diameter between cranks and in way of the eccentrics. A $2\frac{1}{2}$ in. dia. shaft works out at 7/16 in. scale dia., and the webs, $1\frac{3}{4}$ in. wide in full-size, scale .020 in. below 5/16 in. in two-inch scale, so, having an in-built dislike of crankshafts which bend under load I decided to opt for a $\frac{1}{2}$ in. dia. shaft with $\frac{3}{8}$ in. wide webs — slightly over scale width — but hardly noticeable and certainly more robust. Although I have shown detachable counterweights the webs may be cut from solid if desired. The construction of the shaft follows usual practice, with the $\frac{1}{2}$ in. dia. bar a light drive fit in the webs and Loctite applied through the previously drilled pin holes in each web; the centre section between the webs must be sawn out, but I have found it advantageous to let the shaft stand for a few days to allow it to settle before sawing out redundant lengths. My method of cutting the four keyways is to remove the lathe topslide and mount on the cross-slide a short length of channel with two vee blocks attached. The base of the channel is slotted to attach to the cross-slide facing the headstock of the lathe. Mark out the centrelines of the four keyways and clamp the crankshaft into the channel vee blocks, which should be wide enough and square enough to each other to prevent any distortion of the shaft. With a 5/32 in. milling cutter held in the lathe chuck, mill the shaft with four equi-spaced keyways 5/32 in. wide by 3/32 in. deep. Prior to the introduction of modern adhesives I would have secured the keys in position by either pinning or drilling and tapping the shaft for No. 6 BA countersunk head steel screws, but am going to have a go at using Loctite in this instance. Cutting the keyways and fitting standard steel keys 5/32 in. square by the method I have described places great reliance on making sure that each keyway is exactly the correct depth, otherwise we end up by having to file or grind the top face of individual keys to obtain uniformity in height. I am making no attempt to leave the top faces of the keys radial as in full-size practice as they are partially hidden by the sliding pinions and totally obscured by the gear guard. A simple gauge shaped

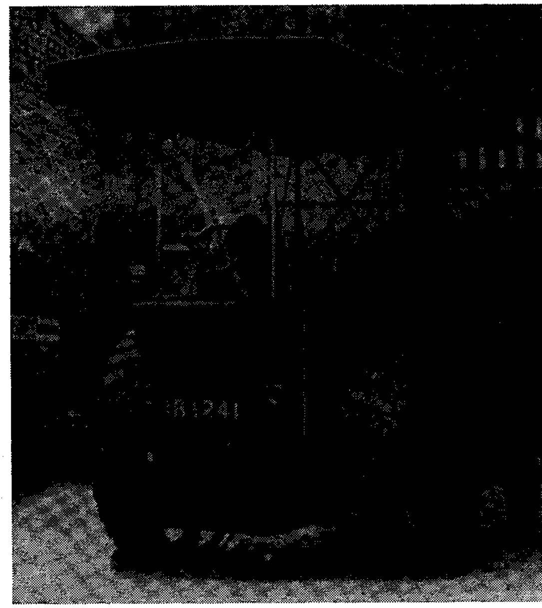


Photo by courtesy of Museum of English Rural Life

to slide over the assembled keys on the shaft might not be a bad idea.

The flywheel is keyed to the shaft, with a pin through as I have already described, so there should be no problem there. As was the usual practice with light steam tractors, the flywheel is solid, not spoked, and without even a slight dishing towards the centre. Agricultural engines were turned out almost universally with spoked flywheels, a considerable advantage if it became necessary to use a rope around the rim to pull a stiff belt over the rim, but the flywheel of the little Ransomes engine lacks even the three or four slotted holes close to the inside of the rim cast in some solid flywheels to facilitate using a cord for this purpose, although there are three equi-spaced small holes which I suppose might be used.

The Ransomes, like other light steam tractors of the period, was designed as a spring-mounted engine principally for road haulage work, and conformed to the practice of most makers in having a solid flywheel and hiding as far as possible both reciprocating and rotating parts behind and beneath sheet metal covers to avoid nuisance to other road users—particularly horses.

As a three-shaft engine the flywheel rotates forward when the engine is travelling forward, unlike a four-shaft engine, and the links will therefore be down for forward and up for reverse gear. Although the valve motion is reproduced to scale, there is a point on the model which will be noticed: on the full-size engine the link is comparatively short whereas on the small version the link appears rather disproportionally longer. This is unavoidable because the valve travel is relatively longer on the model than on the full-size engine, necessitating a longer link being used, and consequently longer lifting links etc. The valve gear is all straightforward, and follows closely that of the Aveling & Porter roller, differing from the latter in that there is plenty of room to get at everything, between the hornplates. Returning again to the crankshaft, the cranks are of course set at 90 degrees to each other in plan view, the L.P. (left-hand) crank being set back on the horizontal centreline with the H.P. (right-hand) crank hanging down on the vertical centreline, as shown on the official works drawing covering forged items.

Some engine owners used to get over the dead centre starting problem with single-cylinder traction engines by removing some metal from the bottom of each main bearing to drop the centreline of the crankshaft by half an inch or so, first making sure that rear tooth meshing would be unaffected. This greatly assisted starting, and I carried out the same modification on my old single-cylinder 2 in. Fowler ploughing engine.

A point to remember when fitting the crankshaft main bearing is that they fit *outside* the left-hand hornplate and *inside* the right-hand one, that is, looking from the driver's position towards the chimney. The lower half of the bearing has a rounded protrusion which fits into the circular hole in the hornplate, and the bearing flanges fitting outside and inside the hornplate respectively.

The second shaft bearings fit both inside the hornplates, the shaft revolving with no outer sleeve or covering, between the hornplates behind the boiler backhead.

Looking over the crankshaft drawing again, there are a few points that perhaps should be enlarged upon. The crankshaft webs (*not* the counterweights) have absolutely square corners, without chamfer or radii. The makers' drawings show this characteristic for the main webs; the counterweights are nicely rounded and radiused, and must fit tightly over the main webs before pinning.

I have carefully worked to the scale length as converted from the makers' crankshaft drawing, but it is still not a bad idea to allow, say, a $\frac{1}{4}$ in. extra on each end, when building up the crankshaft, to be turned off on final assembly. The flywheel rim, shown as 3/16 in. thick, may be reduced down to 5/32 in. if desired. I have kept the thickness slightly up on actual scale thickness to retain the correct and necessary weight—this applies, too, to the thickness of the flywheel disc. The piston rod inserts into a counterbore in both the piston and the crosshead. This is important in order to retain concentricity between piston, rod, and crosshead o/dia. It is very difficult to maintain squareness between rod and piston at crosshead if the rod merely screws into a tapped hole running all the way through, without counterbore. The crosshead, in accordance with correct full-size practice, just appears out of the end of the trunk guide on the back stroke, thus leaving no "wear ridge" in the guide. I have tinned the small holes in each connecting rod instead of fitting very thin bushes as an experiment, to see how they wear.

Several readers have asked why stainless steel is not specified for valve motion and other exposed steel parts on my engines, and whether they can use this material instead of the bright mild steel usually specified. There are a couple of reasons for not calling up this steel; one is that I always try to use the same material in a model component as was used in the full-size engine for that part, and secondly, apart from the highest price it does not machine as well as mild steel, at least not in my hands. The latter was used on valve gear and other open parts, case-hardened where necessary, and to my mind when well-finished and highly polished looks far superior to stainless. Admittedly some care has to be taken to prevent rusting, but a light oil will look after this, and keeping an engine covered will help to prevent dust.

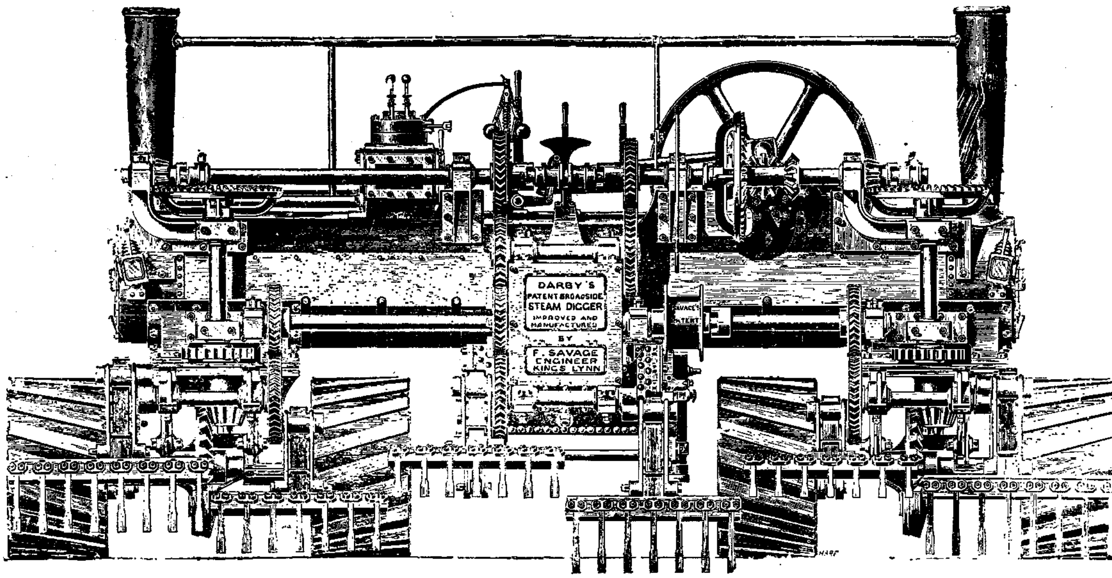
Case-hardening of valve gear and other parts was done by packing the steel articles in a heat-resisting steel or nickel-chrome alloy sheet metal container, together with the carburising material, e.g. wood charcoal, bone black, charred bone, hoof parings and other carbonaceous materials. The box was then sealed with fireclay to exclude air, and placed in a furnace for heating to temperatures of 850°C to 950°C for a few hours, after which the parts were removed and quenched in water.

This process increased the carbon content of the surface layer of mild steel, for example, and gave a depth of case-hardening sufficient to resist wear over a long period of time, being particularly effective in preventing metal surface "picking up" when short of lubricant.

For small steel parts such as links and levers etc., a workshop method of case-hardening is to heat the parts to a bright cherry red, and then to sprinkle powdered potassium ferrocyanide or a commercial case-hardening compound such as "Kasenit" evenly over the surface to be hardened. The parts should then be re-heated to about the same temperature, removed and then re-sprinkled with a further quantity of the salt. After reheating again, quench in cold water.

The depth of the "case" depends on the period of heating with the hardening medium, and as only a thin case of the order of about .002 in. is usually necessary, care must be taken that the components are not distorted by overlong or too fierce heating.

To be continued



DARBY-SAVAGE DIGGING ENGINE

Part VIII

From page 1186

by Colin Tyler

FREDERICK SAVAGE in the best of traditions utilised as many standard parts as possible for use in the Darby Diggers. This was true of both the 6 and 8 h.p. engines. By their very nature, diggers were of unusual design compared with other, more familiar traction and ploughing engines. However, at least the power unit was of conventional type, departing only in detail for standard components. In the case of the 6 h.p. digger the production traction engine cylinder and motion were utilised as far as possible.

Externally there is very little difference between the 6 and 8 h.p. digging engine cylinders, the main one being the bore and stroke which were 8 by 10 and $9\frac{1}{8}$ by 12 inches respectively.

Savage's half scale original drawing of the cylinder is neatly inked in on heavy cartridge paper, entitled "6 h.p. cylinder for small digger and dated 21st February 1889" in beautiful copperplate writing which puts this poor chronicler's scribble to shame! The drawing shows the three side, end and plan elevations of the outline of the cylinders and only details internally the dimensions of the slide valve ports. Drawings like this would not have been used in Savage's workshops, but kept in the foreman's office. If particular parts or dimensions were required to be made, a hand drawn sketch—usually made on the spot by the foreman—would be issued to the workshop for manufacture. The sketch would go from department to department through the various stages of making until the final part was ready for assembly on to the engine. Of course, without a system of limits and fits as is used today, the old system was fraught with the danger of producing a part incorrectly. One must say that having studied the set of drawings for the 6 h.p. digger that it is something of a wonder that any engines were in fact completed and made to work. We know that they did however and this can only be a credit to the skills of the engineers of long ago, who really knew what it meant to make parts fit together and work. The gas-lit, steam-powered workshop of nearly one hundred years ago produced much technology which was the result of the workshops using their skills in interpreting, and in some cases developing, the ideas of the designers. Drafting of drawings had not yet progressed to the stage where every detail was drawn and dimensioned — a delightfully loose system which although workable at that time would not do today.

The cylinder of the 2 in. scale digging engine is of $1\frac{1}{2}$ in. bore by 2 in. stroke and from the model engineer's point of view is of quite standard design, requiring extra care at only a couple of stages of machining.

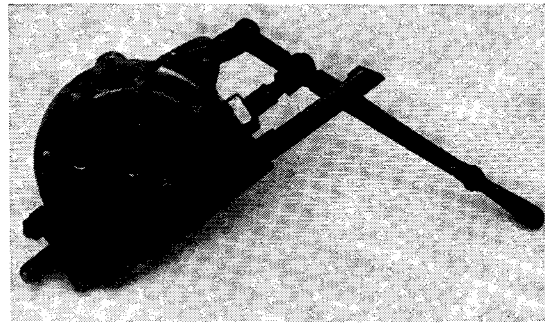
Mounted directly on to the boiler, it is conveniently situated from the driver's point of view, as the regulator lever is mounted directly on the top of the cylinder within easy reach. A double slide bar is supported by a cast bracket. The weighshaft bracket is situated approximately half-way along the slide bars and the casting carries the reversing lever quadrant in addition to the governor which is belt driven from the crankshaft.

The long connecting rod is of conventional construction as is the crankshaft, except that in the last item a slipping clutch is incorporated. This is to prevent damage to working parts of the engine which may be transmitted as shock, back through the digging mechanism when the forks hit an obstruction in the soil.

Rigidity of the platework—described in a previous article—is considerably added to by the spectacle plate which forms a strong box section around the crankshaft. The flywheel is assembled to the crankshaft at the manstand side of the engine and is of typical Savage traction engine design. With six oval section straight spokes it is of 7¾ in. dia. and 1 in. face width. On the other end of the crankshaft is keyed the first bevel gear of the drive train.

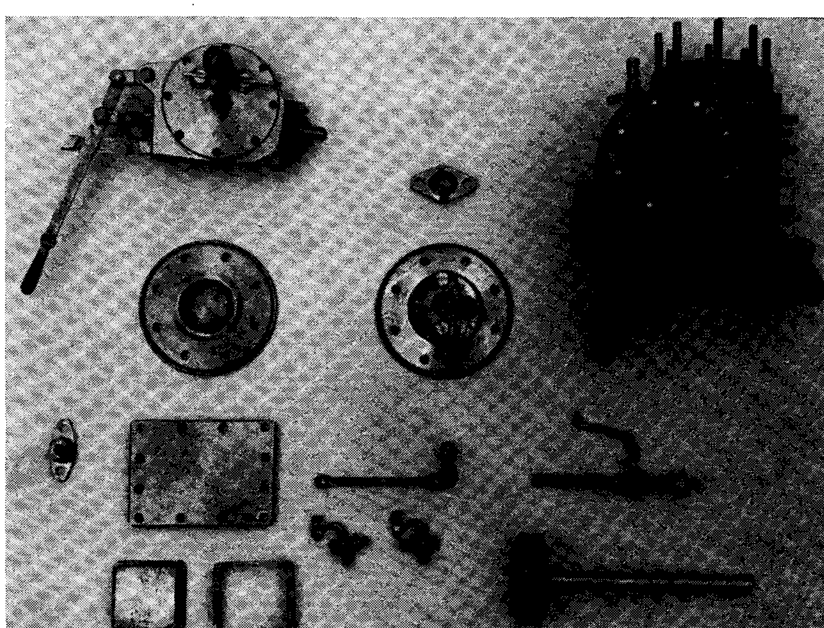
A third eccentric of the same pattern as the valve eccentrics operates a water pump which is situated on the hornbracket by the crankshaft.

Machining the cylinder casting is quite a straightforward job which should present no major problems. A 3½ in. gap bed lathe is capable of accommodating it if one is prepared to spend some extra time in setting some of the component castings up.



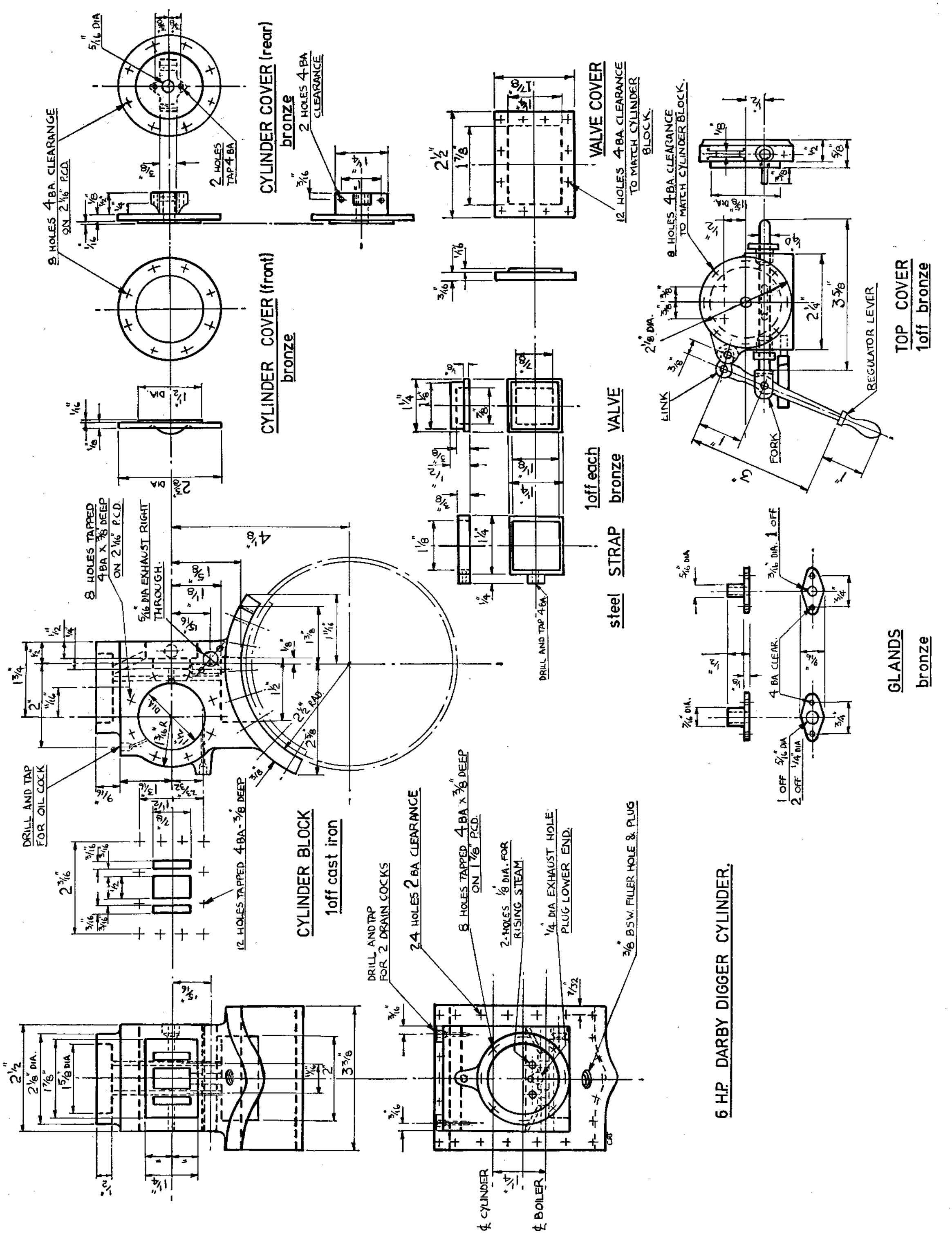
Using the four-jaw chuck, bore the cylinder to 1½ in. dia. and face both the block and saddle ends. When finished the block should be 2½ in. long. Machine the saddle with a flycutter to 2½ in. radius. This can be done by setting the block up on the lathe cross slide—after removing the tool post—and mounting it on the previously machined valve face as a datum. Using packing pieces, ensure that the correct centre height in relation to the cylinder bore is achieved. Great care must be taken to ensure that the bore is square to the saddle before finally clamping up and machining with a flycutter held in the four-jaw chuck.

Of course if a somewhat larger lathe is available, it will be found time-saving to set the block up directly in a four-jaw chuck for all machining operations, but one must again reiterate that it is of prime importance to keep the cylinder bore square with the saddle.



Right: The component parts for the cylinder block.

Above: Top cover of the cylinder block showing the operating pin for the regulator valve projecting from the underside.


CYLINDER COVER (rear)
bronze
8 HOLES 4BA CLEARANCE ON 2 1/16" P.C.D.
2 HOLES 4BA CLEARANCE
2 HOLES TAP 4 BA
CYLINDER COVER (front)
bronze
VALVE COVER
12 HOLES 4BA CLEARANCE TO MATCH CYLINDER BLOCK.
TOP COVER
1off bronze
8 HOLES 4BA CLEARANCE TO MATCH CYLINDER BLOCK.
REGULATOR LEVER
LINK
FORK
steel STRAP
1off each bronze VALVE
DRILL AND TAP 4BA
GLANDS
bronze
4 BA CLEAR.
1 OFF 5/16" DIA
2 OFF 1/4" DIA
3/16" DIA. 1 OFF
8 HOLES TAPPED 4BA x 3/8" DEEP ON 2 1/16" P.C.D.
5/16" DIA EXHAUST RIGHT THROUGH.
DRILL AND TAP FOR OIL COCK
12 HOLES TAPPED 4BA - 3/8" DEEP
CYLINDER BLOCK
1off cast iron
DRILL AND TAP FOR 2 DRAIN COCKS
24 HOLES 2BA CLEARANCE
8 HOLES TAPPED 4BA x 3/8" DEEP ON 1 7/8" P.C.D.
2 HOLES 1/8" DIA. FOR RISING STEAM.
1/4" DIA EXHAUST HOLE PLUG LOWER END.
3/8" BSW FILLER HOLE & PLUG
6 H.P. DARBY DIGGER CYLINDER.
℄ CYLINDER
℄ BOILER

There are twenty-four 2 BA mounting bolts through the saddle and these are drilled radially in through the saddle flange. For this purpose an extra long drill of 3/16 in. dia. will be required, also a pin cutter or end mill of $\frac{3}{8}$ in. diameter. I extended both of these items with a length of appropriate diameter silver steel soldered on, but in the case of the drill, it is available as a serial drill of suitable length from tool shops.

To drill the saddle holes, first mark out on the topside and centre punch the position of each hole. Now prepare a jig by either forming a piece of fairly heavy gauge sheet metal into a $2\frac{1}{2}$ in. radius, or cutting a section from a piece of 5 in. dia. tube of about 10 s.w.g. thickness. Ensure that there is sufficient circumference to allow the cylinder block to move around the radius and provide vertical access for the drill to work square with the saddle flange at any point. The packing piece is set up and clamped to the drilling table so that the drill is directly over the centre line of the boiler, for accurate drilling and counterboring.

Machine the slide valve seating surface carefully, using a $\frac{1}{4}$ in. dia. end mill, also clean up the valve ports in the casting to the dimensions shown.

Turn the recess in the cylinder top to $1\frac{5}{8}$ in. dia. by $\frac{3}{8}$ in. deep. Ensure that the bottom of the recess is flat as this is the surface against which the regulator valve will work and must be steam tight.

Probably the potentially most hazardous machining procedure on the cylinder block is the drilling of the steam transfer holes. There is a thickness of only 3/32 in. between the radius of the cylinder bore and the nearest point of the steam ports. As the length of the holes to be drilled is $2\frac{1}{2}$ in. at $\frac{1}{8}$ in. dia., it can be seen that accuracy is needed in setting up and care taken while actually drilling the three holes. Ensure that the drill is equally sharpened on each side and that the cutting edges are of equal angle. Better still, use a new drill.

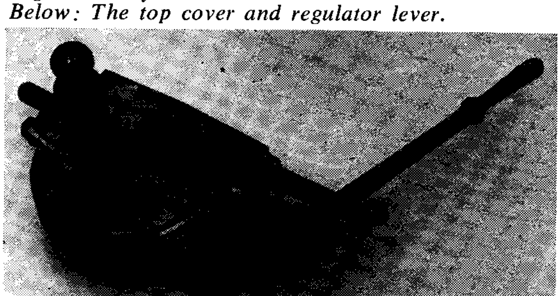
Drill the cylinder steam inlet holes 3/32 in. dia. from each end of the cylinder through to the valve ports. The exhaust holes are next drilled, one up through the base, which is subsequently tapped and plugged and one right through the length of the cylinder block which connects with it. This is a somewhat unusual feature of the block, and is included as the engine has two chimneys therefore requiring two exhausts: the steam from each side of the piston being taken separately to each chimney.

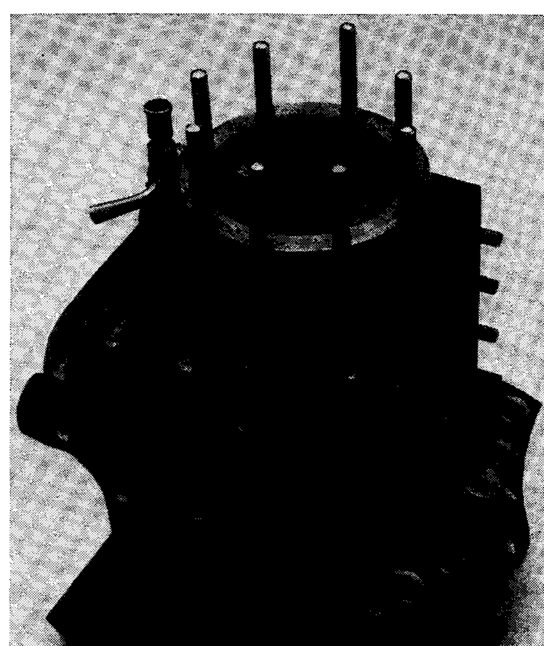
Mark out, drill and tap the 36 stud holes for 4 BA studs. These are situated on the front, rear, top and valve covers and should be positioned as shown on the accompanying drawing.

The top cover is a bronze casting which, in addition to its function of being a cover of the steam collecting chamber also has the regulator, safety valve and lubricator pipe connection incorporated. Turn the registering diameter and bore the regulator plunger hole $\frac{1}{4}$ in. dia., counterboring each end for the glands and end milling the slot which guides the operating pin for the regulator valve. Drill the eight 4 BA clearance holes to match the cylinder block studs, also drill and tap for the lubricator connection. The safety valve requires two drilled holes counterbored $\frac{3}{8}$ in. dia. to suit the two valves which are made of stainless steel, lapped into the counterbores for perfect seating. The spring of the safety valve is $\frac{3}{8}$ in. dia. by eight coils of 16 s.w.g. wire and can be adjusted for pressure by means of the nut and locknut on the single central column on which it is set. This is a very effective safety valve, and is completed by the addition of a polished brass shroud and dome, also screwed on to the central column.

To be continued

Right: The cylinder block.
Below: The top cover and regulator lever.





"HOLMSIDE"

A $7\frac{1}{4}$ in. and $7\frac{1}{2}$ in. gauge National Coal Board saddle tank loco by Martin Evans

Part VIII *From page 1168*

THE BOILER for *Holmside* is of very simple design, and should be quite easy to make. It is of the usual round-top firebox type, and being quite a small boiler for a $1\frac{1}{2}$ in. scale locomotive, will require very little more in the way of brazing equipment than the average 5 in. gauge boiler.

It will be noticed that the width over the lower part of the firebox—that part which goes down between the frames—is only a shade less than the diameter of the barrel, so that it resembles a typical traction engine boiler rather than a locomotive type.

Most of my designs for round-top firebox boilers have called for the firebox outer wrapper being made from the same tube as used for the barrel, that part forming the firebox being split and opened out. In most cases, this involves extending the lower, flat ends of the wrapper down to the foundation ring. This is a perfectly sound method, and hundreds of boilers have been made in this way. However, for a change, here is a different way of going about it, certainly no more difficult—some may say easier to build.

The barrel tube ends at the firebox, and a separate piece of flat sheet copper is used for the firebox wrapper. The bending of this should be quite easy, for after annealing it can be bent around the same tube as used for the barrel, and will only require short "reverse curves", where the wrapper has to narrow in to go down between the frames.

To join the barrel to the firebox wrapper, a "piston ring joint" is used, this consisting of a strip of copper $\frac{3}{4}$ in. x 3/16 in. This is annealed and bent into a complete ring a tight push fit into the rear end of the barrel, and is then cut away below the level of the "reverse curve", where the wrapper falls away from the barrel.

Before saying anything more about the construction of this boiler, perhaps I should make it clear that its design is not by any means the best that could be evolved from the point of view of all-round efficiency. Had there been the room available, I would have preferred to have the firebox a good $1\frac{1}{2}$ in. longer, as the present ratio of barrel length to firebox length is 17 to $7\frac{1}{2}$, not ideal by any means. However, had the firebox been extended into the cab, this would have brought the backhead rather too close to the back of the bunker, making reaching the controls rather difficult. To compensate for the rather short firebox, the tubes have been made $\frac{5}{8}$ in. diameter, and two superheater flues of 1 in. diameter are specified, for the now-popular firebox "radiant" superheater elements.

As a matter of interest, the figures of heating surface of this boiler have worked out as follows:

Tube heating surface—440 sq. in. approx.
Firebox heating surface—136 sq. in. approx.
Superheater flue heating surface—101 sq. in. approx.
Total—677 sq. in.
Grate area—$25\frac{1}{2}$ sq. in.

Readers will note that I have been able to work in my favourite type of crownstays, fitted direct to the firebox crown before the firebox is assembled inside the outer wrapper. As a sound variation, the arch-shaped members are stiffened by a cross piece, actually two pieces of $\frac{1}{8}$ in. sheet, shaped to provide plenty of clearance for the longitudinal stays to pass through. Incidentally, apart from the tubes and flues and the "piston-ring" joint ring, all parts of the boiler are from $\frac{1}{8}$ in. thick copper. Should this thickness be unavailable, as the changeover to metric continues, 3 mm. thickness may be used without appreciable loss of strength.

Australian builders may have to fall back on the old "traditional" crown stays, or rod stays connecting the crown of the firebox to the outer wrapper, as at the present time the Australian Standards Bureau do not allow the type of crown stays specified. But I would strongly advise other builders to fit those shown on my drawings, which are just as easy to make, easier to fit, plenty strong enough, and are less likely to lead to leakage, as all the silver soldering is done on the top of the firebox before assembly.

I have shown three ¼ in. diameter longitudinal stays, plus the usual hollow stay to carry the blower steam forward to the smokebox. I regard these as rather doubtful insurance (that is the three solid ones), though I know that many boiler builders would not be happy if they were omitted!

Readers will note the unusually large water space at the throatplate, a design point in which I am a strong believer, and also the quite generous water space between the firebox backplate and the backhead. Both contribute to good water circulation. Other points to note are the rather large diameter of the various bushes on the backhead, this being to stiffen this plate, rendering a plate thickness of more than ⅛ in. unnecessary, and the two bushes for blowdown valves, situated in the bottom front corners. I have not dimensioned their positions as it pays to mark them off with the boiler in position in the frames, so that the valves can lie in the centre of the large holes drilled for this purpose in the frames.

Returning now to constructional matters, those who are using propane blowpipes would get enough heat for the biggest silver-soldering job from (for instance) a single Sievert propane burner No. 2944—that is the big chap with a nozzle diameter of 1⅝ in. diameter, consumption about 145 oz. per hour, but I much prefer to use two smaller burners, such as two No. 2943, whose combined consumption is much the same as a single No. 2944. The trouble with No. 2944 is that the flame is so huge that the job becomes obliterated and it is very difficult to see what one is doing; apart from that, everything in the vicinity becomes uncomfortably hot! It is not of course easy to handle two blowpipes simultaneously, as an extra hand is required to deal with the silver solder and flux, but most builders should be able to commandeer the services of a fellow model engineer or club member to wield the second blowpipe!

On the subject of the best silver solders to use, at one time I made use of at least three different solders, such as C.4, Argoflo and Easyflo No. 2 (these are all Johnson Matthey products available from several advertisers in *M.E.*) as the different melting points of these alloys prevented the earlier joints from melting while the later joints were dealt with. But experience has shown that this is not by any means essential, and my last two boilers were silver soldered entirely with one alloy—Easyflo No. 2. The explanation is that, with a certain amount of care, the earlier joints made at a temperature of (say) 610°C will not melt if later joints are heated to the same temperature. This is due to a phenomenon called "liquation". This has been explained in these notes in the past, so I won't bore regular readers with a further explanation. As to the possibility of using some of the cheaper or "flux-less" silver solders, I can only say that I am in entire agreement with Mr. F. La Roche ("Postbag", 16 September) where he deplores the use of Silbralloy, Silfos, Silcop, etc. *inside* model boilers. It is false economy.

In the case of the boiler for *Holmside,* one cannot do better than use Argoflo for the initial joints, such as that between the barrel and firebox outer wrapper, and Easyflo No. 2 for the remainder.

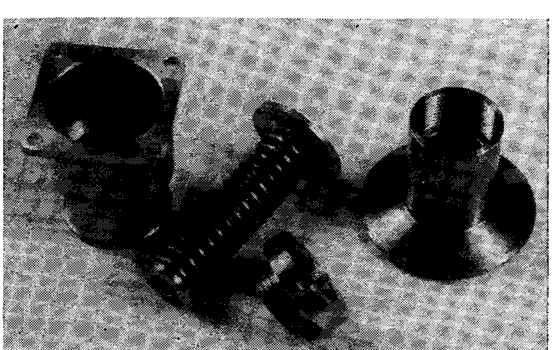
"Holmside" for 7½ in. gauge

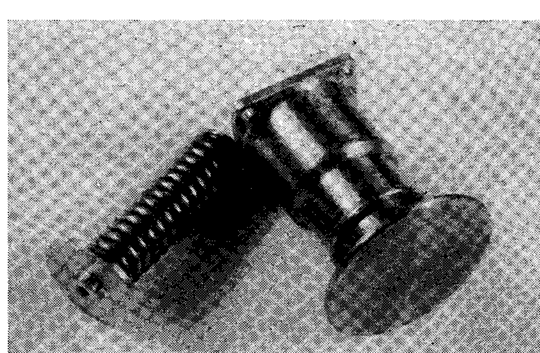
Builders of *Holmside* for 7½ in. gauge have not been forgotten. The side elevation shown here can be used without any alteration. There will however be a small alteration in the cross-sections and plate dimensions, which I will show in the next *Holmside* article.

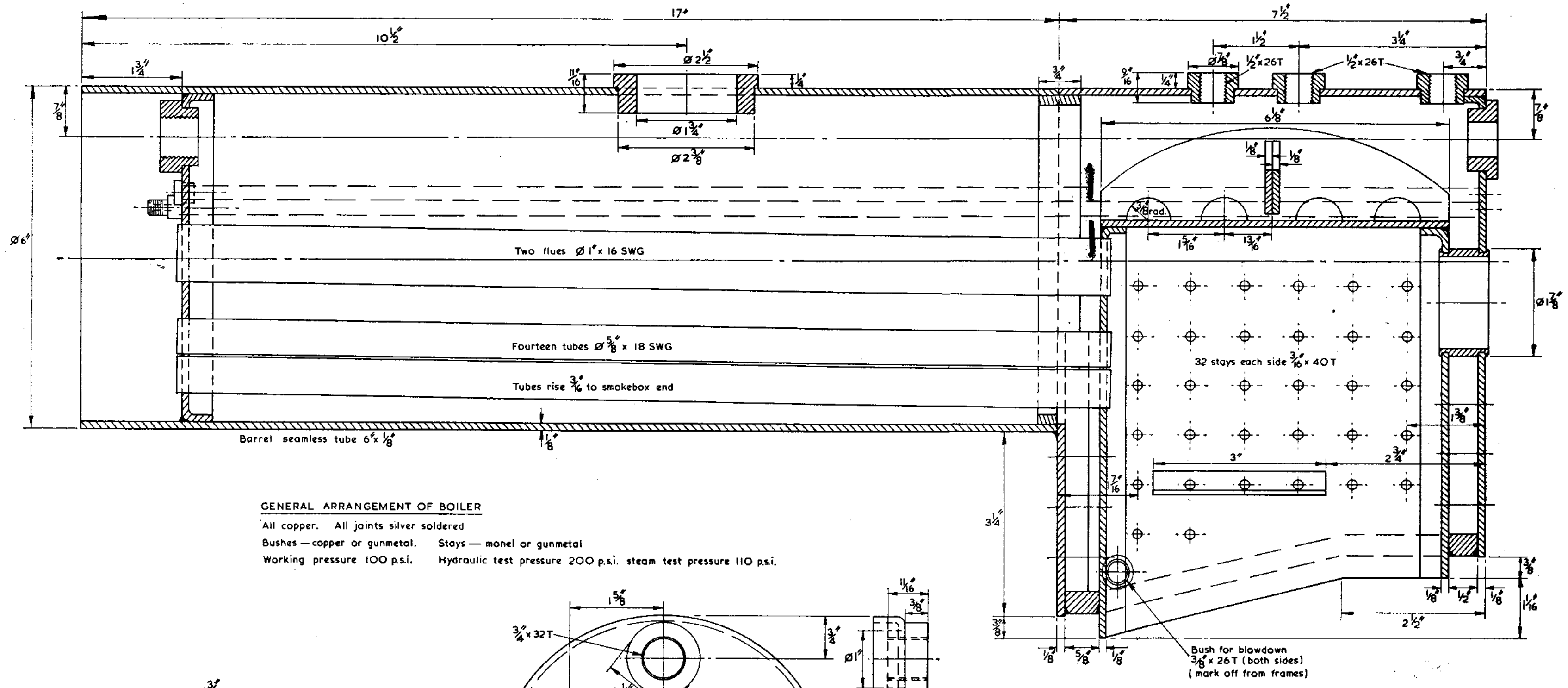
To be continued

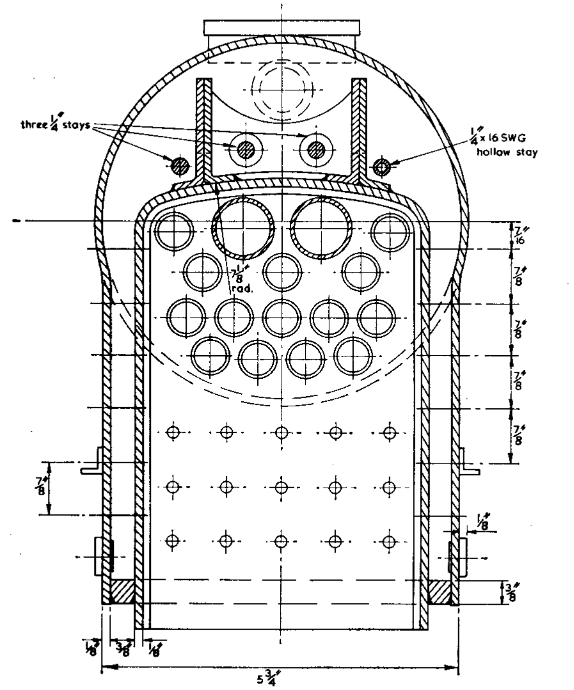
TENDER BUFFERS—*from page 1177*

Shown here are two photographs which should have been included in George Thomas's article "Tender Buffers" which appeared in 21 October issue. They show, on the left, the necessary parts, and on the right, the completed buffers. Sorry about that, George.







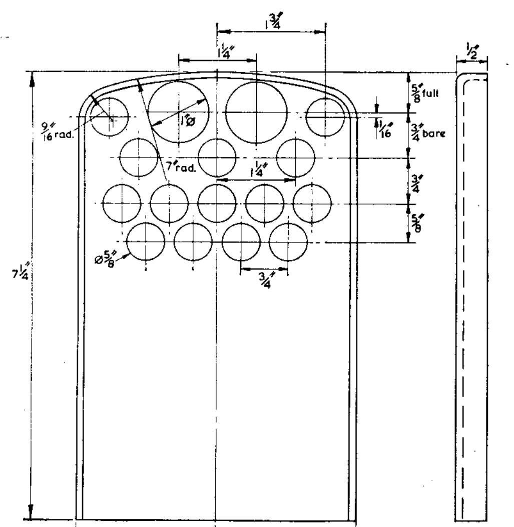


GENERAL ARRANGEMENT OF BOILER

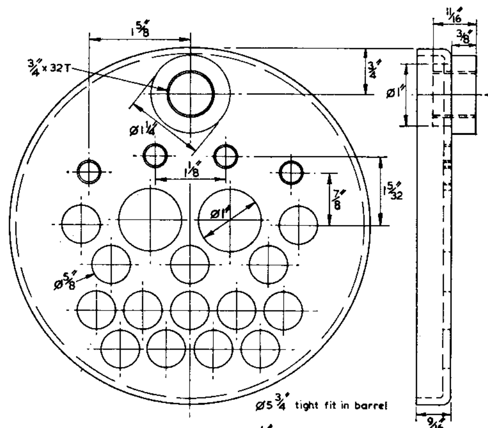
All copper. All joints silver soldered

Bushes — copper or gunmetal. Stays — monel or gunmetal

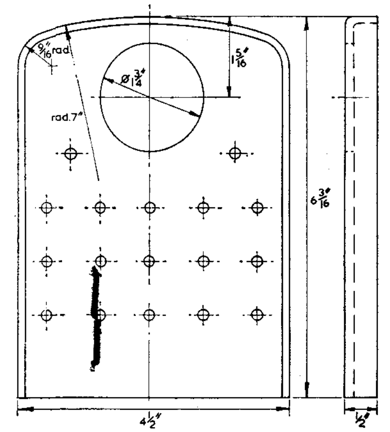
Working pressure 100 p.s.i. Hydraulic test pressure 200 p.s.i. steam test pressure 110 p.s.i.



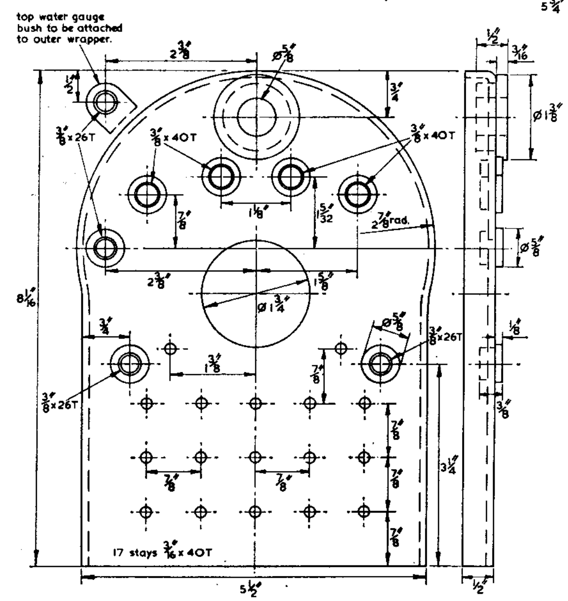
FIREBOX TUBEPLATE: 1/8" copper (or 3mm)



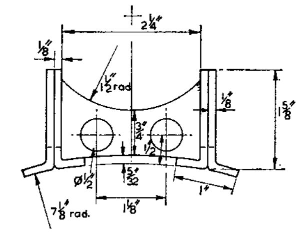
SMOKEBOX TUBEPLATE: 1/8" copper (or 3mm)



FIREBOX BACKPLATE: 1/8" copper (or 3mm)



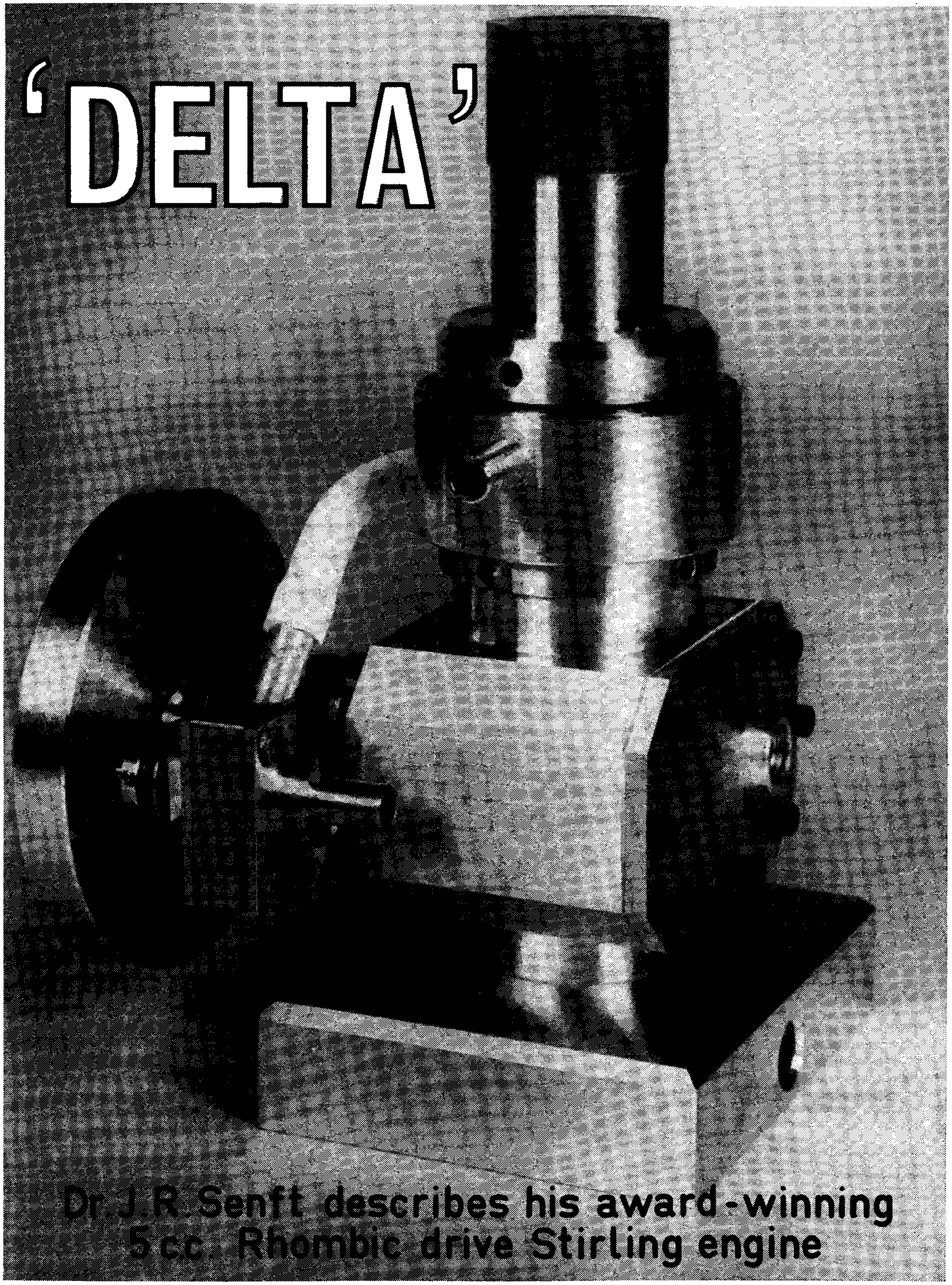
BACKHEAD: 1/8" copper (or 3mm)



END VIEW OF CROWNSTAYS: 1/8" copper (or 3mm)

'DELTA'

Dr. J. R. Senft describes his award-winning 5 cc. Rhombic drive Stirling engine



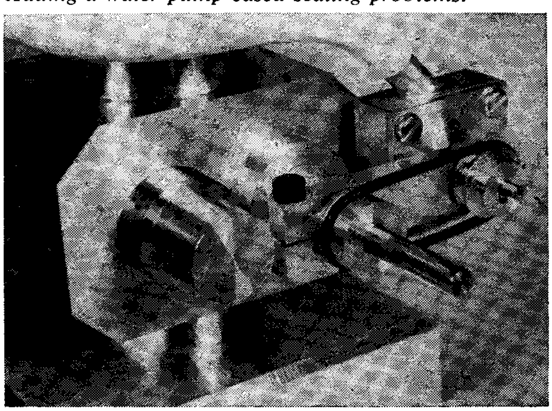
For his efforts in achieving the second highest power output with his entry in the last Hot Air Engine Competition, Dr. J. R. Senft received the runner-up prize. This is a description of his engine.

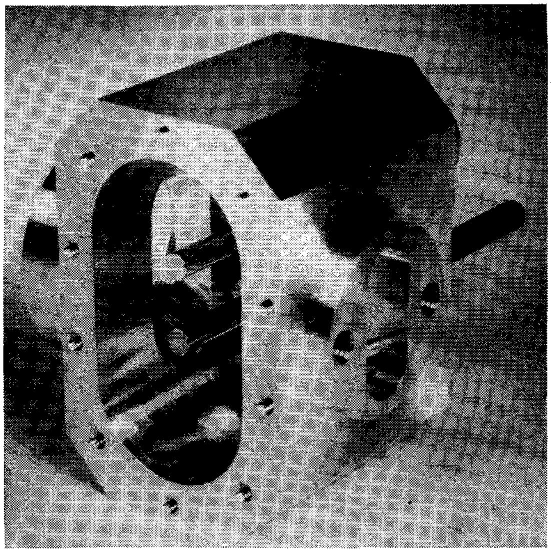
ALTHOUGH INSPIRED by the announcement of the contest, "Delta" was not designed for the utmost power. One has only to look at the advanced Philips engines — with the working cylinder dwarfed by heat exchangers and the heavy construction to deal with the high working pressures—to realise the severe penalties to be paid for a high power to total swept volume ratio. Rather, the object was to produce a reliable long-lasting self-contained and easily handled power plant of a size and weight compatible with its power output. In short, to retain as many of the virtues of the common two-cylinder piston-displacer atmospheric engines, including simplicity of construction, while obtaining more power. The eventual aim is to produce an engine which can be put to work driving say a model boat giving a good showing relative to electric and simple steam plants.

Just how well this goal can be realised by a simple miniature Stirling is an open question, but from all indications the potential exists. "Delta" in particular is far from a finished project. In fact, I was lucky to have it finished in any form by the time of the contest! The decision to prepare an entry was made just three months before the Exhibition. A month of design activity followed and construction began on 1 November. The entry form was submitted before the engine was half completed!

The rhombic drive geometry chosen for "Delta" was based upon an isothermal analysis first carried out by C. N. Takase. As can be seen from the illustration, the piston motions are characterised by the ratios L/R and (D-E)/R. The best values of these ratios are about 2.3 and .96 respectively for the estimated temperature and dead space

Adding a water pump eased sealing problems.





The crankcase—note the threading for the cylinder.

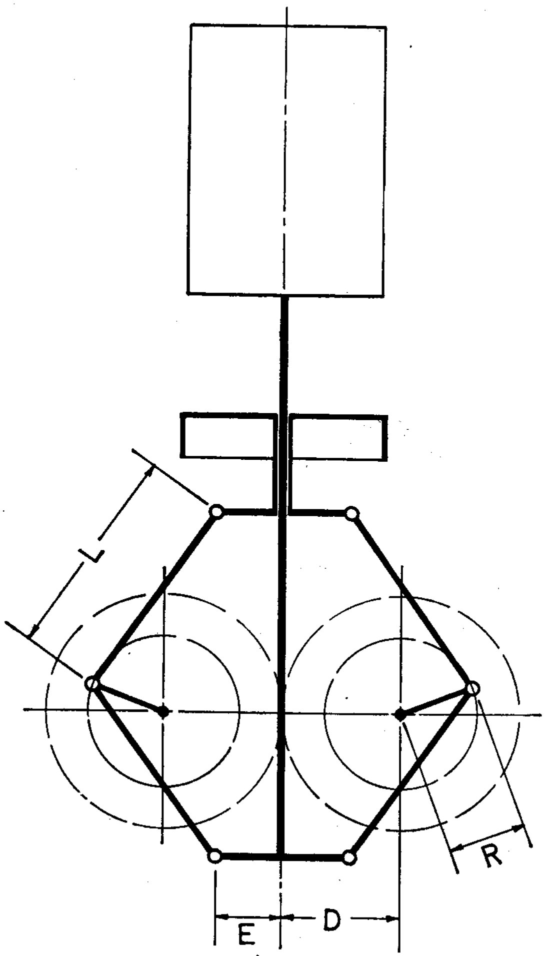
ratios of "Delta". However, these values give a maximum connecting rod transmission angle of about 58 degrees which was considered a bit too high for an engine without a positive lubrication system. Therefore, L/R was increased to 2.5 which gives about 52 degrees for the maximum transmission angle.

Although the applicability of an isothermal analysis is unrealistic at high speeds, it can serve as a simple general guide. In the present case, it results in a rhombic geometry which is in close agreement with intuition. The piston and displacer motions of "Delta" for one revolution of the cranks is shown. The upper horizontal line represents the top of the hot end, the upper curve is the displacer position, and the lower curve represents the piston position. Thus the distances labelled V_H and V_C are directly proportional to the volumes of gas in the hot and the cold spaces respectively, the proportionality constant being the cross sectional area of the cylinder. It can be seen that for a very large percentage of the expansion or "power" stroke, the piston and displacer are in virtual contact which is exactly what intuition dictates. The compression stroke is also good, but would be better with a smaller value for L/R. Having chosen a bore of $\frac{7}{8}$ in. and a stroke S = $\frac{1}{2}$ in., the formula

$$S = \sqrt{(L+R)^2-(D-E)^2} - \sqrt{(L-R)^2-(D-E)^2}$$

was then used to calculate the crankthrow R.

The range of possible values for D was determined by the availability of stock gears. Choosing D was then a matter of estimating the minimum value for E which in turn is a function of the rod dimensions and the clearances desired. The geo-



RHOMBIC DRIVE GEOMETRY

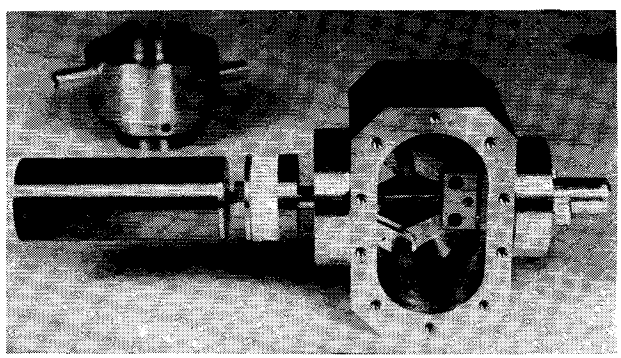
metry of "Delta" is such that the rods go "over centre" as they approach the displacer rod, the feature which produces the long expansion stroke. It was found that by "waisting" the displacer rod at a certain point, a smaller set of gears than was first thought necessary could be used. The thin portion of the displacer rod is especially visible in one photo. The net result is an extremely compact crankcase for a ½ in. stroke engine.

In fact the crankcase was the first item to be completed. The main features are shown in one of the photos. One can just see the threaded portion to accept the cylinder and the recess for the O-ring seal. O-rings are far superior to gaskets as is well known. In the first place, they seal very well when properly fitted. In the second, the O-ring does not occupy the entire mating surface thus permitting metal-to-metal flange contact making for accurate and rigid joints. The only gaskets used on "Delta" occur on the back cover plate and the lower rod guide. The seat for this latter item is visible in the crankcase photograph. Because the connecting rods "buckle in" during the expansion stroke, the displacer rod momentarily loses lateral stability and therefore requires a guide other than the short piston to prevent the connecting rods from contacting the displacer rod. A lower guide was therefore fitted. It was anticipated that later this item could become an automatic pressurisation pump, being an ideal place for it.

The crankshafts are carried in ball bearing housings inserted through the front wall of the case, sealed by O-rings, and secured by round nuts with pin spanner holes for tightening. One shaft is short and its housing nut is long, hollow, and closed so that only one dynamic seal is required. The seal is of Teflon and is similar to the seal used on the author's engine "Gamma" (*Live Steam,* November 1976). Both shafts are 3/16 in. diameter securely pressed into mild steel crankwebs carrying hardened 5/32 in. diameter crankpins, also pressed fitted in place. The connecting rods are of aluminium alloy and run directly on the crankpins. With aluminium as one of the bearing materials, it is essential that hardened steel, rather than soft, be the other. The connecting rods are spaced by thin brass washers slipped on the crankpins; the rear balance weights hold this assembly in place. The gears, drilled to serve as partial counterweights, are secured to the crankwebs by small pins.

The cylinder was machined from bearing bronze and the bore lapped to an accurate fine finish with home-made adjustable laps and special non-embedding lapping compound. The piston is a composite of a Teflon cup-type seal and an oil-impregnated porous bronze disc. Before building "Delta", Teflon piston seals were tried without much success on the author's 10 in. fan engine "Moriya" (*Live Steam,* December 1974), a double size version of the small fan appearing in this

Piston and crankcase assembly.

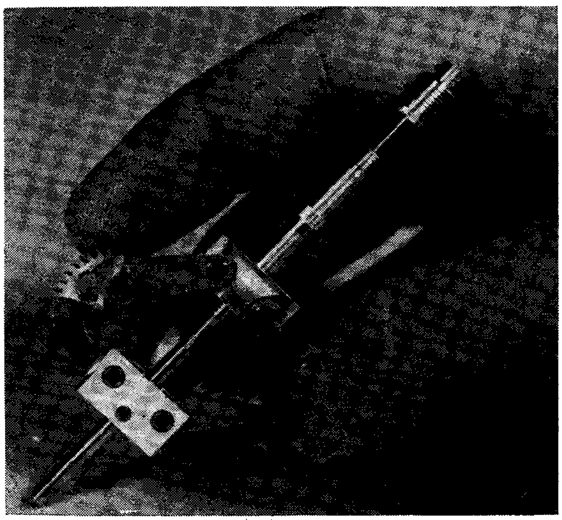


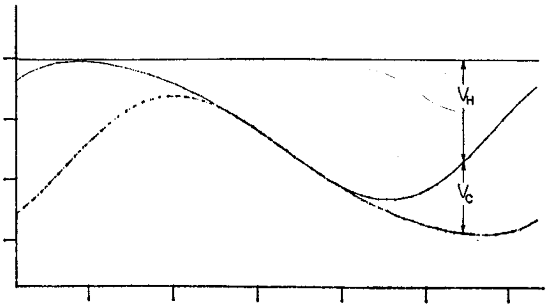
journal (October 1973). This engine is air-cooled, and therefore the cylinder and piston attain quite high temperatures after long periods of running. Teflon has a relatively high coefficient of thermal expansion and is extremely plastic at high temperatures. A newly-fitted seal would give excellent performance during its first run. But after cooling down, the engine would refuse to start for lack of compression until the entire engine — and the cylinder in particular—was again hot. The cause was at once obvious. As the temperature rose during the maiden run, the piston material expanded against the cylinder, and the resulting forces relieved by plastic flow. Upon cooling down, the seal parted from the cylinder wall, and "compression" was lost.

During the design period of "Delta", it was thought that water cooling would minimise this behaviour to the point where it would be negligible. With thermosyphon circulation of the cooling water, the first few brief runs indicated all was well. But later when the engine was tried under pressure and run for a rather long period, compression was nearly absent after cooling down. It was at this point that it was decided to add the water pump.

Not much time was available for a pretty job here; it was already 20 December. The pump is of the centrifugal variety with a 1 in. diameter four-bladed impeller. The 3/32 in. diameter stainless steel shaft runs in a porous bronze bearing and is sealed by a tiny Teflon bushing. The pump is driven at crankshaft speed via an O-ring "belt". The pump was made rather large to ensure a good flow at lower speeds when the engine is heavily loaded.

The displacer rod—note the thin portion.





PISTON MOTION OF 'DELTA'

A new piston seal was made and a few more test runs showed that the pump had apparently cured the problem. But the engine had not been subjected to the rigours of a power test before arriving in London. After cooling down from its first contest run, the seal had again contracted away from the cylinder, for although the water flow through the jacket was more than sufficient, the finite quantity of cooling water noticeably rose in temperature. But the problem was not as severe as before, and only a mild warm-up was necessary for subsequent runs.

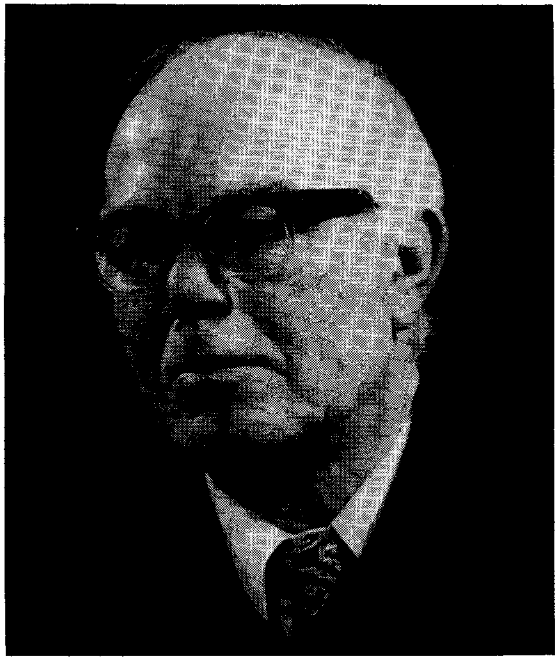
Further developments

Since returning home, a spring expander has been fitted to the cup seal which fully cured the problem at only a very slight increase in friction. The only other modification since carried out was to slightly thin the top portion of the stainless steel hot end. The latest test was carried out with Helium as the working fluid. At an absolute pressure of 4 Bar, a peak power of 12.9 watts was recorded at 2920 r.p.m., a very exciting run! The speed capacity of the rhombic drive is quite impressive. The highest observed speed of "Delta" was 3860 r.p.m. during the above test; but this was not the no-load speed for the engine was still doing 8.6 watts.

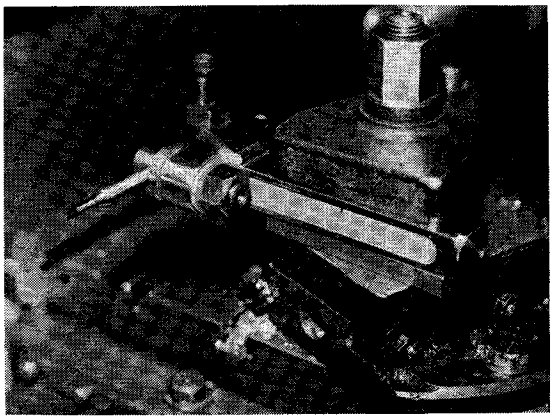
It is hoped that this very brief report will be of some assistance to those interested in experimenting with miniature Stirling engines. Much work remains to be done on "Delta" before its full potential can be assessed; the next step in the programme is the fitting of a heater/regenerator/cooler loop to permit higher charge pressures. Hopefully, a more detailed report will not be too far off.

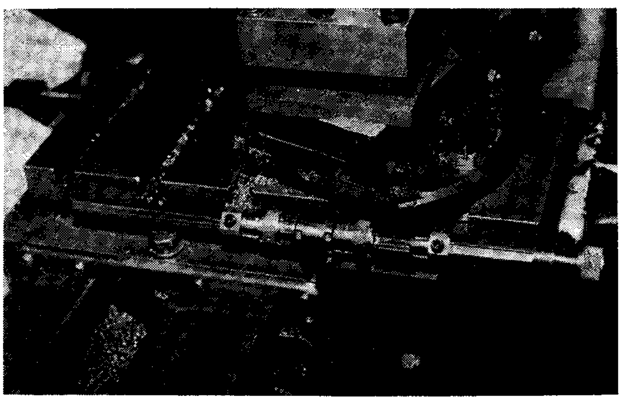
Finally, I must express my appreciation to all concerned for the kindness extended during my visit. But special thanks must go to Prof. D. H. Chaddock and Brian Thomas for their fine hospitality, generous assistance, and enlightening conversation.

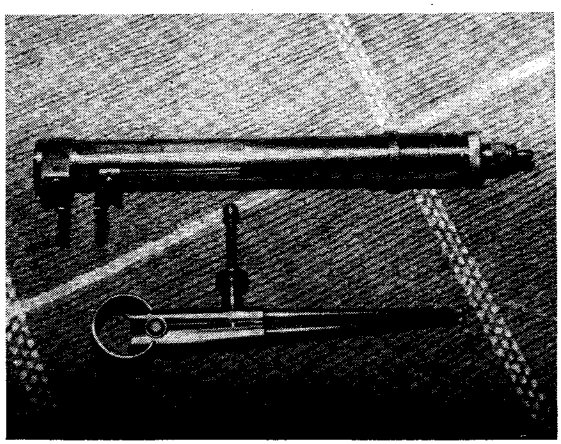
A ONE-MAN SHOW

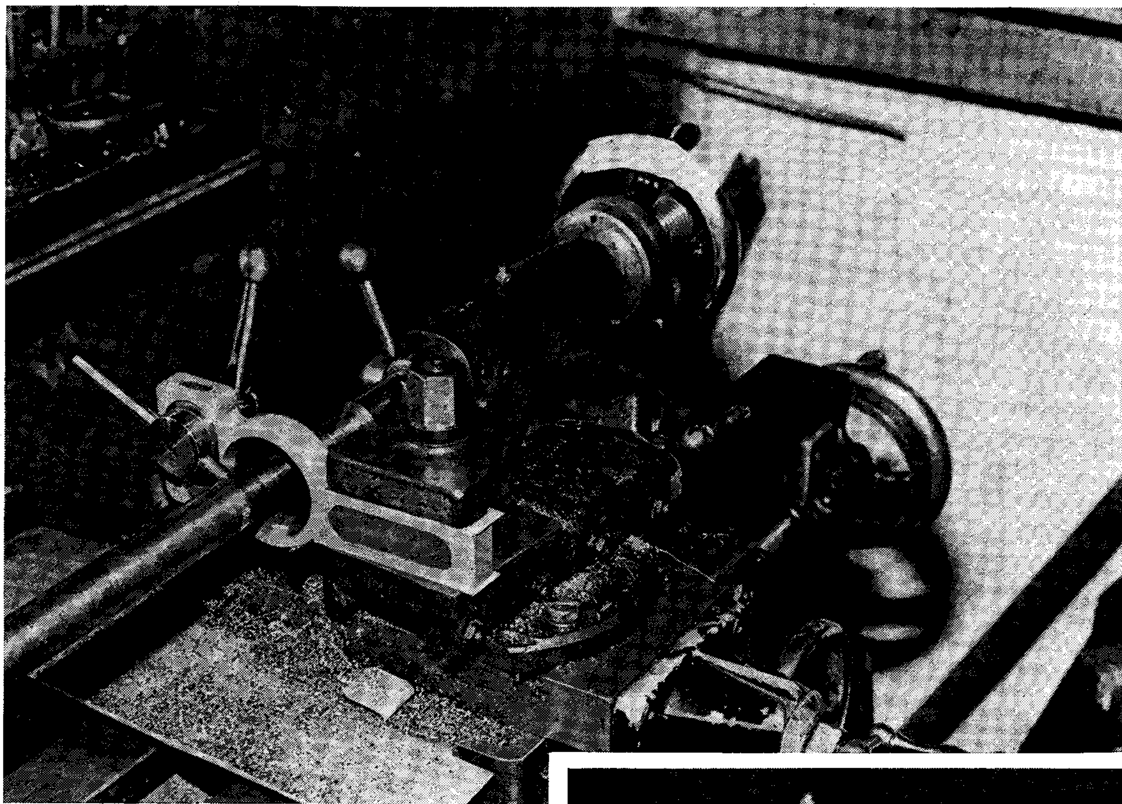


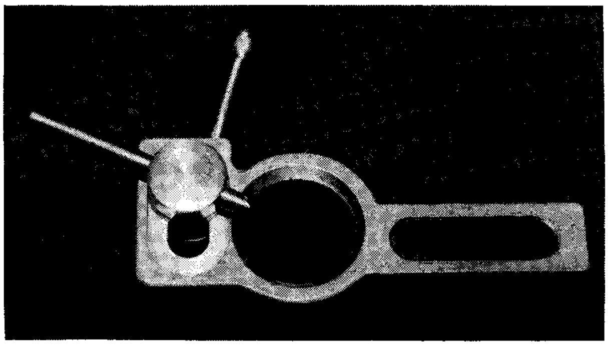
At the last M.E. Exhibition Mr. S. H. Willetts was awarded a "Highly Commended" for his exhibits in Class N, Tools and Workshop Appliances. Some of his work is shown here.











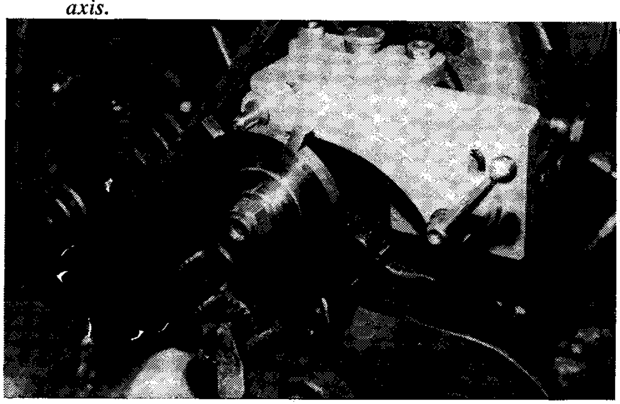
Far left: A cross-slide stop for the ML7 without drilling holes in the lathe.

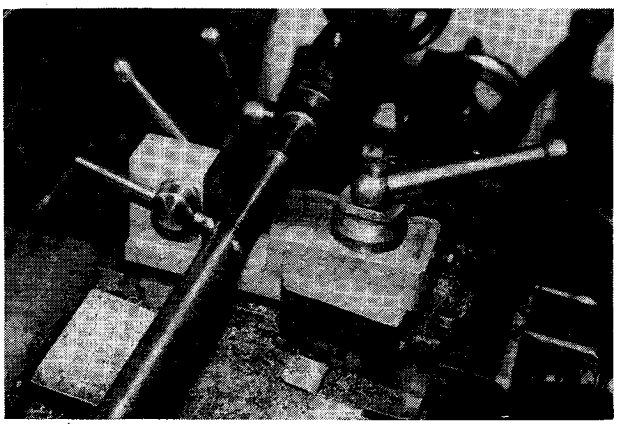
Bottom left: An inside micrometer from $-\frac{1}{4}$ in. to +2 in., and inside callipers starting at 7/32 in.

Centre left: Adjustable tool holder for turning and very small boring. It is capable of critical height adjustment.

Top and right: Two versions of an inverted cutting tool arrangement which is advantageous in cutting mating tapers with the top slide. Used on the back of a male taper it obviates the need for moving the slide from the position set for inside work.

Below: Controlling length of arc on work on lathe axis.





LATHEWORK FOR BEGINNERS

Part X

by Martin Evans

From page 1210

FEW BEGINNERS AT LATHE work will be fortunate enough to possess a milling machine, but milling is so useful that it is not long before the beginner wants to try his hand at milling in the lathe.

It is sometimes said that the lathe is too limited in its movements to be much use as a milling machine.It is also said that the average amateur lathe is not rigid enough. It is certainly true that the lathe cannot compare with the milling machine in respect of either range or efficiency when used for milling, nevertheless much useful milling work can be done on even the lighter lathes.

In general, milling may be described as a machine tool operation in which rotary cutters are employed. By this definition, fly-cutting, using a single point tool, might be described as milling, but in most cases, milling involves cutters having more than one cutting edge. The types of milling cutters generally used by the amateur include end mills, obtainable in standard or long types, slot drills—standard or long—which are very similar to end mills though generally having only two cutting edges, Woodruff cutters, face cutters and slitting saws, and side-and-face cutters. There are also many special types of milling cutters, such as tee slot cutters, dovetail cutters, etc., etc.

One of the arguments often raised against any form of milling operation is that it entails the use of expensive cutting tools, and that a wide variety of such tools is necessary to cover a reasonable range of operations. This objection certainly applies in those cases where the cutters have to be bought, especially side-and-face cutters (which can cost today around £10 each for one 3 in. dia. x ¼ in. wide, for instance). However, a great deal of useful work can be done with quite simple home-made cutters, such as the so-called "D-bits".

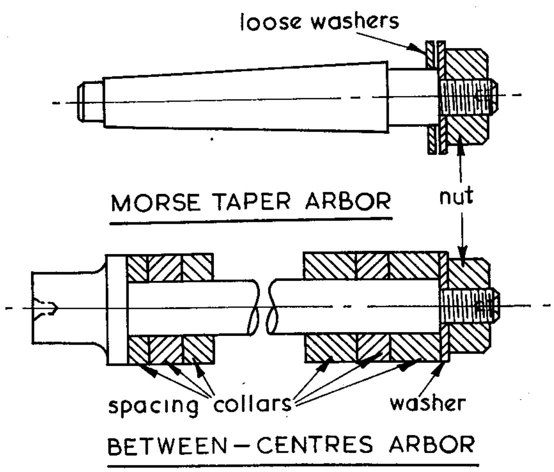
The compound slide rest of the normal type of centre lathe provides for movements in three directions—longitudinal, crosswise and angular—all of which are in the horizontal plane. But in most milling operations, some form of vertical movement is required, hence the popularity of the vertical slide. Nearly all manufacturers of the smaller lathes supply vertical slides, and these will be either the rigid type, where the table is presented vertically at 90 deg. to the lathe axis, or the swivelling type; the latter is of course more generally useful but is not quite so rigid as the former type. The beginner is therefore well advised to purchase a vertical slide as soon as funds permit.

Even if a vertical slide is not available, quite a few milling jobs can be done in the lathe. One well-known method is where the workpiece is clamped down on the cross-slide, and brought up to the required height by means of true packing pieces, the cutter being an end-mill or slot-drill, or perhaps a Woodruff cutter.

Another example of simple milling without a vertical slide is the slotting of small parts where the job is clamped under the toolholder on the top-slide, at 90 deg. to the lathe longitudinal axis, and the cutter used may be anything from a slitting saw, a face cutter or a side-and-face cutter. This last is a very common operation.

Woodruff cutters are most useful to model engineers. Although primarily designed for producing the "half-moon" type of keyway by a direct "plunge" cut, they can also be used for continuous keyways of any length within the capacity of the lathe. They are also most useful for fluting small connecting and coupling rods and valve gear components, where the "square-cornered" flute is not objected to. They are generally obtainable in high-speed steel from about 1/16 in. wide and ½ in. diameter, up to 5/16 in. or ⅜ in. wide by 1 in. or 1¼ in. diameter, and are not unduly expensive.

Reverting to the use of end-mills in the lathe, it is always a problem to decide on the best way to hold them. While the 3-jaw self-centring chuck is sometimes used, very few S.C. chucks are accurate enough for the purpose, and the three jaws do not hold the larger end-mills firmly enough, with the



annoying result that the cutter is gradually drawn out of the chuck in the middle of the operation. The 4-jaw chuck is sometimes used, on the grounds that the extra jaw gives a much stronger grip. The snag here is the time taken fiddling about with a dial test indicator or something similar to get the end-mill to run true! Where collets are available, these are generally to be preferred, holding the end-mill truly and firmly, and in most cases, with reduced overhang. However, even collets will not always hold the larger end-mills firmly enough and if funds permit, some kind of special end-mill chuck is the answer, such as the well-known Clarkson "Autolock", which is used with end-mills having threaded shanks.

Face and side-and-face cutters

Face milling cutters include slitting saws, which for cutting metal may be anything from about 0.008 in. thick to 1/16 in. thick, and from 1½ in. diameter upwards. A selection of these is extremely useful in the home workshop. Face cutters range from about 1/16 in. thick to ¼ in. thick, with diameters up to 8 in. or more, though for use on the average amateur's lathe, it is seldom that one over 4 in. diameter is called for and it must be remembered that it takes a lot of power to drive a 4 in. diameter cutter through steel.

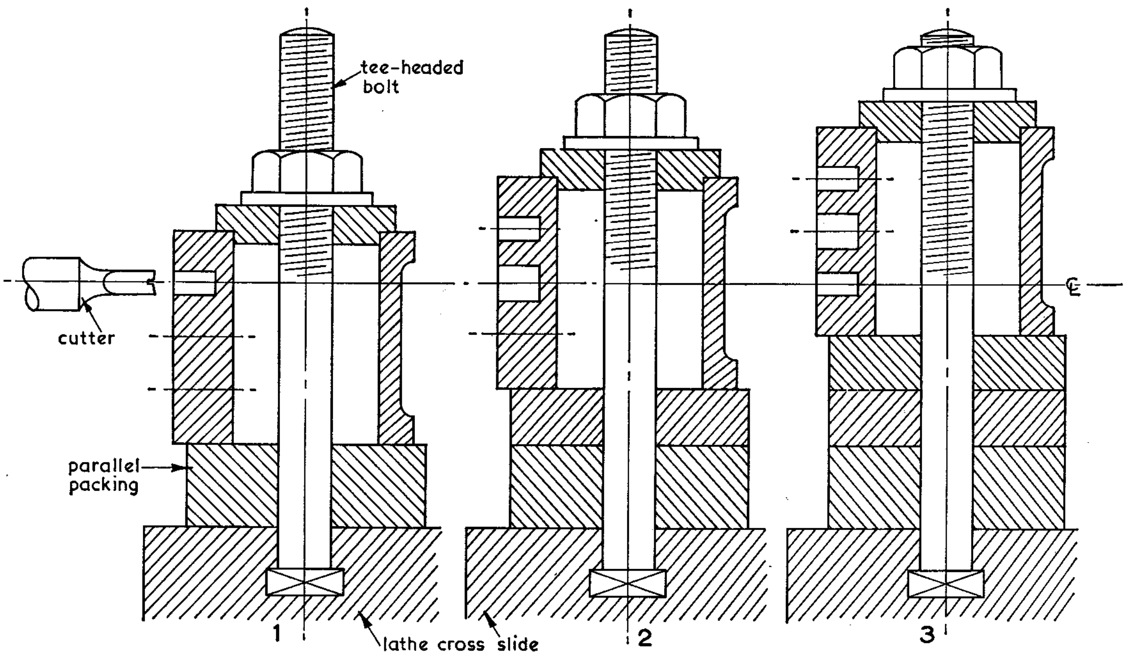
As mentioned earlier, side-and-face cutters are expensive, yet they are extremely useful, especially for machining such things as locomotive or traction engine axleboxes and hornplates. Again, 4 in. diameter is about the largest that can be handled in the average lathe of around 3½ in. centres, may also be fed into the work sideways.

Slitting saws, face cutters and side-and-face cutters are generally used on some form of arbor, according to the type of job and the clearances necessary. Two of the commonest types are the Morse taper arbor, fitting direct into the lathe spindle, and the between-centres arbor, the latter being driven positively as backlash must be avoided completely. Even short milling arbors should be given additional support by the tailstock wherever possible.

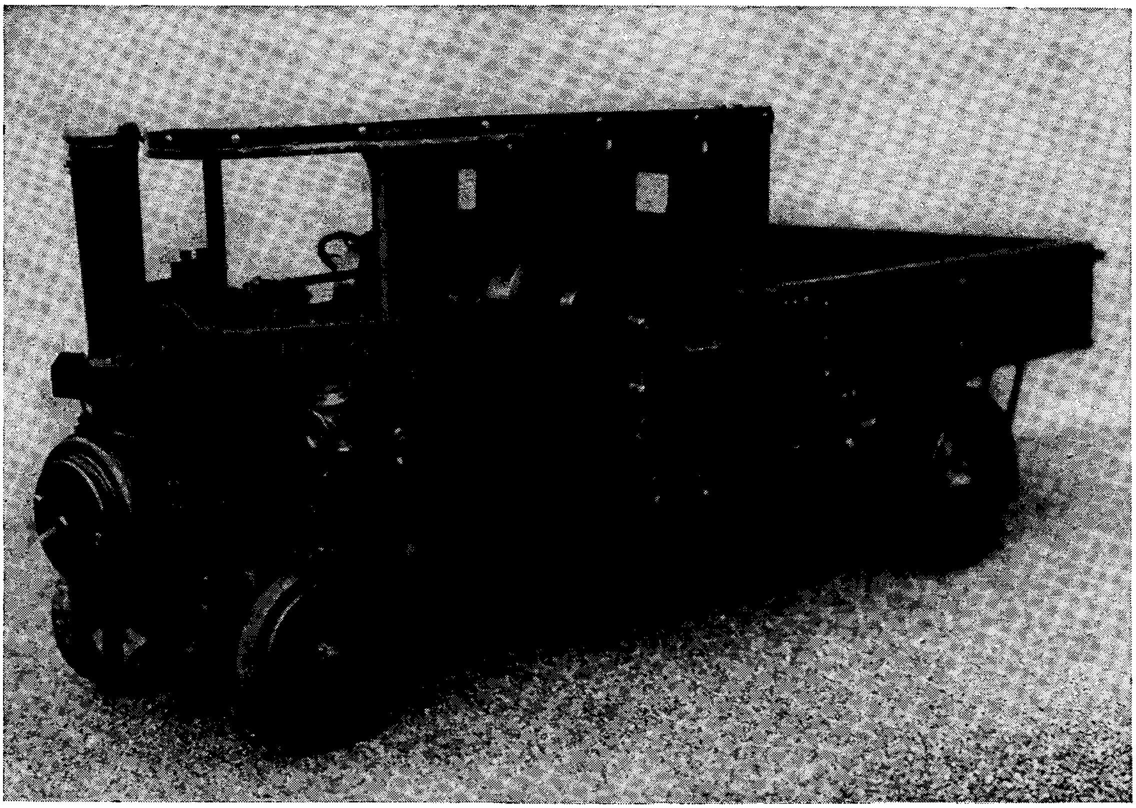
There are two important things to remember when milling. The work must be fed into the cutter against its direction of rotation whenever possible. If the work is fed in *with* the direction of rotation, so that the cutter tends to draw the work towards itself, the cutter will snatch and pull the work forward, due to the inevitable backlash in the lathe slides, and this will certainly spoil the finish of the job, if nothing worse.

The other important point to remember is that milling cutters must run quite true. If they run the slightest bit eccentric, all the work will be done by one, two or possibly three teeth, so that the cutter is acting more like a fly-cutter, with obvious loss of efficiency.

To be continued



SUCCESSIVE POSITIONS OF CYLINDER BLOCK FOR MILLING PORTS



A SUFFOLK MODEL BUILDER

John Haining describes an annual visit

JOHN STONE is a horticultural engineer with a busy workshop in one of the most charmingly unspoilt rural areas of East Anglia, near Woodbridge in East Suffolk.

Each summer I visit relatives living a mile or two away from his workshops, and one of the most eagerly anticipated events of the short stay in that lovely part of Suffolk is the walk down an ancient and overgrown grass lane skirting fields of barley and bounded by honeysuckle-hung hedges, to discover what new model awaits inspection on one of the neat benches of the little works set among fields alongside the winding road.

Most of John Stone's models are built to the scale of three-quarters of an inch to one foot, and all are constructed without drawings, using photography and catalogue prints as guidance, and without exception all his engines start and run with effortless ease and smoothness with no apparent trace of any of those teething troubles that so often beset engine builders.

Continued on page 1302

MODEL ENGINEER HOT AIR ENGINE COMPETITION

At the 1978 Model Engineer Exhibition

WITH THE CLOSING DATE for entries less than two weeks away, *M.E.* once again reminds entrants of the rules. They are as follows:

1. The engine entered must be the unaided work of the competitor.
2. No entry will be accepted from a professional model maker.
3. The decision of the Judge/s will be final.
4. Engines may operate on an open or closed cycle. The working fluid may be other than air and may be pressurised to a static pressure not exceeding 100 p.s.i. Engines may be pressurised either by:
   a. An air pump driven continuously by the engine but no allowance will be made for the power absorbed in so doing; or
   b. From an external source, foot or hand pump, at least one hour before the start of the test, after which they will be disconnected and no further topping up or re-pressurisation allowed.
   c. Externally-driven pumps and/or the permanent connection of the engine to a reservoir or container other than that of the engine itself will not be allowed.
   d. All engines intended for pressurisation shall be equipped with accurate pressure gauges and safety valves or blow-out discs set to not more than 10% above the maximum cyclic pressure.
   e. Before running, all engines intended for pressurisation shall be subject to a cold static pressure test to twice the maximum cyclic pressure or a certificate to the effect that such a test has been carried out shall be submitted.
5. Internal combustion and liquid/vapour cycle engines will not be accepted.
6. The swept volume of a single working cylinder shall not exceed 5 cc. Multi-cylinder engines, that is engines having more than one complete and separate working space, shall not exceed 5 cc. per cylinder and the total recorded power shall be divided by the number of cylinders in assessing the results. In engines having two or more pistons connected to the same working space, the swept volume shall be the difference between the maximum and minimum volumes of the working space. Double acting engines shall be treated as multi-cylinder engines provided that the working spaces are entirely separate.
7. Working fluids other than air may be used but inflammable and explosive gases such as hydrogen will not be permitted. In engines pressurised by air or other gas containing oxygen, hydro-carbon lubricants which might evolve explosive vapours when heated shall be excluded from the working space.
8. The fuel tanks of engines fired by liquid fuels, methylated spirit, paraffin, petrol, etc., shall not contain more than 100 cc. (3½ fluid oz. approx.). The tanks must be made of brass or copper with all joints silver soldered or brazed. Tinplate tanks with soft soldered joints will not be permitted. All tanks must be readily removable from the engine and fitted with screwed fillers so that they can be filled and closed outside the Exhibition area.
9. Engines fired by butane, propane, Calor gas, Camping Gaz, etc., shall be connected to the supply cylinders by copper pipes with screwed unions or by commercially-available and approved flexible pipes with screwed unions. Push-on plastic or rubber tubes will not be permitted. Preferably, standard commercially-available Camping Gaz containers and fittings shall be used, but other approved fittings and containers may be used. Modifications to manufacturer's equipment will not be permitted.
10. For engines not equipped with their own gas supply, the connection to the burner shall terminate in a male union with ¼ in. x 40 thread and an internal conical seating of 60 deg. inc. angle for connection to gas supplies which will be provided by the Organisers.
11. All engines shall be equipped with furnaces or flame guards so that no external flame is visible when the engine is running. Stop cocks, dampers, or the like shall be provided so that the flame may be rapidly extinguished in emergency.
12. The power output of the engine will be measured by a friction brake with a lever arm and weights.
13. Speed measurement will be by revolution counter and stop watch.
14. All engines must have a standard output shaft 5/32 in. dia. and approximately ¾ in. long.
15. All engines will be scrutinised by the Judge/s before being allowed to take part in the Competition and may be refused permission to run, if in their opinion, the design, workmanship or con-

struction might constitute a hazard to safety. The Judge/s may also order a trial to be terminated if, in their opinion, a hazard to safety has, or might have developed.
16. Competitors will have the option to run their engines themselves, under the scrutiny of the Judge/s.
17. Competitors should submit with their entry, notes for the Judge/s regarding lubrication, firing, warm-up procedure, minimum and maximum revs. at which the engine should run.
18. The duration of each run shall be left to the discretion of the Judge/s.
19. Winners will be required to submit details, a photograph and drawings of their engines for publication in *M.E.*
20. Although every care will be taken, the Organisers will not be held responsible for any accidental damage to the engines.
21. Details of entries must be sent to the Exhibition Manager, M.A.P. Ltd., not later than 1 December 1977.

PRIZES

1. A first prize of £50 for the engine developing the highest horsepower.
2. A second prize of £25 for the engine developing the second highest horsepower.
3. A consolation prize of £10 for the engine (other than those awarded the 1st and 2nd prizes) which displays the highest standard of workmanship.
4. A consolation prize of £10 for the engine which displays the most original design work.

SUFFOLK MODEL BUILDER *From page 1300*

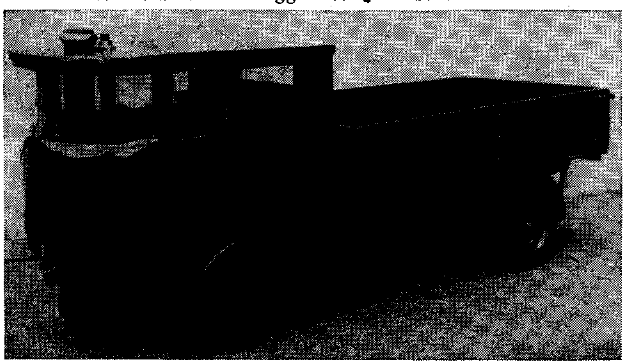
His range of road vehicles include a delightful Ransome Sims and Jefferies overtype steam wagon, a Sentinel undertype, based on the famous D.G. waggons (two g's in the Sentinel spelling of the word!), a ploughing engine, several intriguing stationary engines, and an American traction engine based on the Frick, and looking typically Trans-Atlantic with its unlagged boiler, over-hung crank, steam dome and round spokes. Awaiting my annual visit this year is a one-inch scale freelance steam roller, at present under construction, and like all the other models, built entirely without castings and using any odd pieces of material that can be machined to the required shape. Without any doubt whatsoever this engine will run as sweetly and be as well proportioned and finished as all the other ones in John Stone's collection when it too, reaches completion and steams for the first time.

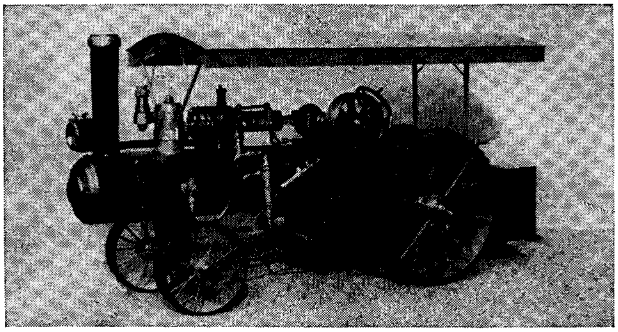
Heading: Ransomes steam wagon to ¾ in. scale.

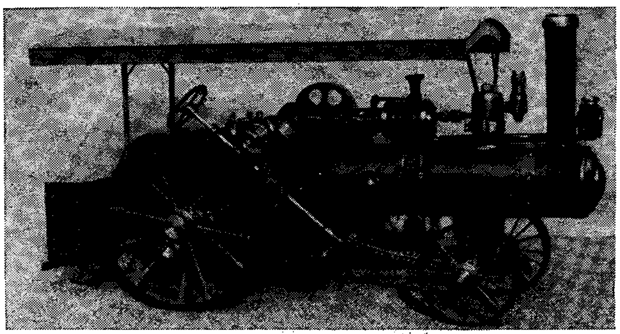
Top and centre right: "Frick" American T.E. to ¾ in. scale.

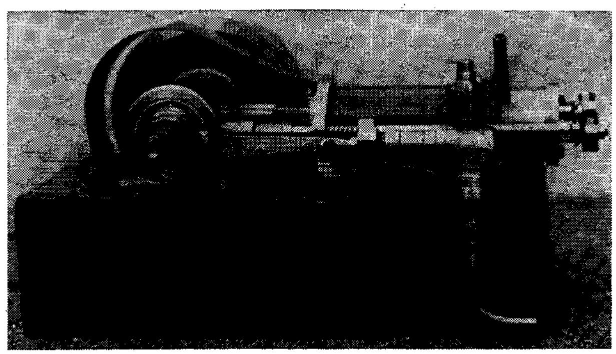
Bottom right: Freelance poppet-valve steam engine.

Below: Sentinel waggon to ¾ in. scale.









Club Chat... with the Editor

Film show

I know it's a long way ahead yet but it seems that no sooner have you shut yourself away in the den and stoked up the fire, than the spring comes around again and it's time to think of another season. At any rate, this invitation comes from the "O" Gauge Tram Group and it is for the annual film show and exhibition at The Fred Tallant Hall, 153 Drummond Street, N.W.1, which is near Euston Station. The date is Saturday, 18 March 1978, and the doors open at 2.30 p.m., the films starting at 5. Admission is 50p for adults, 25p for children. Further particulars can be had from the organiser. Mr. K. H. Thorpe, 42 Ravensbourne Road, Catford SE6 4UX.

Wigan meetings

Wigan & District M.E.S. have continued to enjoy interesting monthly meetings with a "Bits and Pieces" in September in which Barry Harrison described the progress on his *Firefly*. November meeting is a "Bring and Buy" session, and December is a Film/slide evening. The secretary is Mr. K. D. Moffitt, 32 Sedgefield Drive, Beech Hill, Wigan WN6 8QG.

Hastings welcomes visitors

A successful season has been reported by the Hastings S.M.E. and the club has played host to visitors from such places as Tasmania and British Columbia. The club has a ground level track with several points and any visitor bringing a loco (not on a Saturday in summer, please) should ensure that wheels and axles conform to M.E. standards. Meetings during winter are on the second Tuesday in each month at 7.30 p.m. The secretary is now Mr. L. J. Markwick, 577 Bexhill Road, St. Leonards-on-Sea, East Sussex TN38 8AX.

Nottingham's night run

On 8 October—Nottingham's Goose Fair week-end—eleven members brought along their locos for the Nottingham S.M.E.E. night run. Starting at about 5.30 p.m. and going on to 8 p.m., the evening seems to have been enjoyed by all despite the showery weather which accompanied it. John Tanner was the track superintendent and his co-organiser was Gerry Chester. As usual, the ladies rallied round to provide very welcome tea and cakes. Where would we be without them?

Successful Open Week-end

Crewe M.E.S. has been kept busy operating its track at Beech Drive, Wistaston Green, throughout the summer and has recently had a successful Open Week-end—the club's second. Steaming bays will be located inside the track rather than at one end. The club is already busy organising the Society's Annual Exhibition scheduled for next Easter.

Hon. Sec. enrols new member

We have been informed by the Willesden & West London S.M.E. that its Hon. Sec., Mr. Malcolm Saytch, was married to Miss Delia Faul on 17 September. *Model Engineer* would like to add its congratulations and best wishes and, I'm sure, those of all its readers, to those of the club.

U.S.A. report

It is always entertaining reading such club circulars as *The Call Boy*—journal of Golden Gate Live Steamers, Inc.—because of the comparison between how clubs work over in the U.S.A., and other countries, and those in the U.K. This club's Fall Meet, for example, held in September, brought discussions on what was being brought to eat and the Saturday night's dinner included hamburgers, pies and cakes, with hot dogs for lunch. One cannot help but be reminded of the atmosphere of a night run and barbecue such as the one I experienced at the Welling & District M.E.S. in August. Great stuff. Riverside Live Steamers also had a Fall Meet with a steak dinner (at $4.00 a head that can't be bad). Los Angeles Live Steamers played host to 315 staff members of a real estate firm and provided not only train rides but also baseball games and "other activities". Sacramento Valley Live Steamers attended a Golden Spike ceremony in August at the invitation of Paul and Barbara Quiring of Chico. The ceremony was to dedicate the Butte County Railroad, a 7¼ in. track on the Quirings' property. A meeting of the Golden Gate club in which colour slides were shown included some shots of the Cass R.R., by Kevin Lee. Which reminds me, our own Jim King visited the Cass Railroad in September and has given us a report, which will be in *M.E.* soon.

Rochdale a little quiet

The A.G.M. of the Rochdale Society of Model and Experimental Engineers was held on 7 October and indicated a successful though somewhat quieter season at Springfield Park. Next year the new 7¼ in. gauge track should be completed and with new bogies and several new locos running, hopefully the coming season should see more passengers carried. The new secretary is Mr. G. Williams, 70 Warwick Road, Alkrington, Manchester.

Help for Basildon please

Basildon Association of Modellers is going through a phase which most other clubs must have experienced from time to time. If you haven't heard of this Association, it is no doubt because of its recent formation from the various model clubs in the locality to negotiate with authorities on a united front. One aim is to provide a multi-gauge track in a local park (2½, 3½, and 5 in.) with all the usual necessities of steaming bay, etc. Initially intended for 1000 feet, the track will be extended considerably when the venture is proved a success. However, at present, the number of local steam enthusiasts is not very high and consequently the task of designing and building the track is formidable. The Association therefore asks for help—which, knowing the character of clubs in general, I feel will be readily given—in the design and construction of the track and advice on negotiation with local authorities. I know one club I visited recently expressed its willingness to help any other club in this situation. Furthermore, as this is a "from scratch" effort, the progress could be covered in detail in *M.E.* as a guidance to future societies. Offers, please, to Mr. D. Williams (Sec.), Basildon Model Steam Society, 9 Kirby Road, Basildon, Essex.

CLUB DIARY

Dates should be sent at least five weeks before the event to ensure publication. Please state venue and time. While every care is taken, we cannot accept responsibility for errors.

NOVEMBER
18 Ickenham & District Soc. of M.E. 8.00 p.m Members' slides.
18 Brighton & Hove Society. Arthur's moving pictures by A. Lynn.
18 East Sussex Model Engineers. Film night.
18 Stockport & District S.M.E. Auction The Parish Hall, Church Street, Cheadle, Cheshire. 8 p.m.
18 Rochdale S.M.E.E. Mr N. Hemingway: Broaching Press, Technical College, Rochdale at 7.30.
19 Society of Model and Experimental Engineers. Competition day. Working model display.
19 Wigan & District M.E.S. Bring and Buy Sale. Co-operative Guild Room, Thompson Street, Whelley at 7.15 p.m.
20 Basingstoke & District M.E.S. Track construction.
22 North London S.M.E. Evening meeting.
22 Romney Marsh Model Engineering Society. "00" gauge evening, Church Hall, New Romney, at 7.30 p.m.
22 Basingstoke & District M.E.S. Club meeting.
23 Birmingham Soc. of M.E. Ilishaw Heath. 8 mm film competition.
24 Rugby M.E.S. "The History of the Railway Mag." By J. N. Slater (Editor).
24 Gauge "1" Model Railway Assoc. M.R.C. Track Night from 6.30 p.m. Keen House, Calshot Street, King's Cross, London N1.
24 Leyland, Preston and District S.M.E. Meeting. Roebuck Hotel, Leyland.
24 Sutton M.E. Club. "Publish and be damned". George Love tells us how (not) to write a book.
25 Dublin Society of Model & Experimental Eng. Progress of Club Springbok. 8 p.m Star of the Sea School, Sandymount, Dublin 4.
25 Ickenham & District Soc. of M.E. 8.00 p.m. Slide show by J. Weeks.
26 Birmingham Soc. of M.E. Illshaw Heath. Maxines Nosh and night run 7 p.m.
26 Furness Model Railway Club. M.E. section Xmas special. Supper and entertainment. Hartington Hotel, Duke St. All members and friends welcome.
26 Yeovil College & District Model Eng. Soc. Model Eng. Exhibition. St. Johns Schoolrooms, Yeovil. 10.30 a.m. to 6.00 p.m.
26 The Society of Model & Experimental Engineers. Informal meeting—stationary engines, traction engines and road vehicles.
26 A.G.M. The Gauge "1" Model Railway Association. At M.R.C. club rooms, Keen House, 4 Calshot Street, London N1. 3 p.m.
27 Basingstoke & District M.E.S. Track construction.
28 Stafford & District M.S.E. Chairman's Evening. Doxey Arms, Stafford. 7.30 p.m.
28 N. Wales M.E.S. Penrhyn New Hall Penrhyn Bay, Llandudno. Meeting at 7.30 p.m,
28 Willesden & West London S.M.E. Preserved Engines. Talk. King's Hall Community Centre, Harlesden Road, London NW10. 8 p.m.
28 Bedford M.E.S. Informal meeting, loco building.
28 Clyde Shiplovers & M.M. Society. The Clyde Puffers—talk by Mr. D. Hammond.
28 Worthing & District S.M.E. Slide show by P. Guy, Broadwater Parish Room. 7 30 p.m.
29 Milton Keynes Model Society. Models evening. Royal Engineer, Stratford Road, Wolverton, Milton K. 8.00 p.m.
29 Sutton Coldfield & North Birmingham M.E.S. Slides Show: Railways.
30 North London S.M.E. Evening meeting.
30 Cannock Chase Model E.S. Meeting. Lea Hall club 7.30 p.m. "Rebuilding a 1937 Austin 7".
30 Bristol Soc. of Model & Exp. Eng. Ladies Night—building a camping trailer—M. Palfrey.

DECEMBER
1 High Wycombe M.E.C. Talk. Bassetsbury Manor, Bassetsbury Lane, High Wycombe, 7.30 p.m.
1 Sutton Model E. Club. Special general meeting followed by bits and pieces as usual.
1 Hull S.M.E. "Locomotive Building" by P. Truby. Trades & Labour Club (Room 3), Beverley Road, Hull. 7.45 p.m.
1 North Devon Soc. of M.E. Mr. K. Oxenham to speak on wartime experiences.
1 Warrington & District M.E.S. Photo etching by Len Hough, in Pavilion, Daresbury at 8 p.m.
2 East Sussex Model Engineers. Social evening and slide competition.
2 Ickenham & District Soc. of M.E. 8 p.m. General interest night.
2 Rochdale S.M.E.E. General Meeting. Rochdale Technical College at 7.30 p.m.
2 Wirral M.E.S. Annual Dinner at the Heatherlands.
2 Lincoln M.E.S. Monthly meeting. Unitarian Chapel, High Street, Lincoln. 7.30 p.m.
2 Stockport & District S.M.E. Bits & Pieces (Stationary Engines). The Parish Hall, Church Street, Cheadle, Cheshire. 8 p.m.
2 Romford Model Engineering Club. Competition & Watson Shield Night. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch, Essex. At 8 p.m.
2 Brighton & Hove Society. Members' slides.
2 Gt. Western Society. "A Miscellany of Steam" film show by John Wilson. 7.30 p.m. Palmer Building, Reading University, Whiteknights Park, Reading.
2 Gt. Western Society. "Memories of Eastleigh M.P.D." By S. C. Townroe, former S.W. div. motive power superintendent. 7.30 p.m. Small Court Room, Guild Hall, Winchester.
2 Steam Up, Foxhole Community Hall, Paignton, Devon.
3 Society of Model and Experimental Engineers. Talk—Steam Launches.
3 M.E.S. of N. Ireland. Monthly meeting. Strathern Hotel, Holywood, Co. Down. 3 p.m.
3 The Northern Mill Engine Soc. Ltd. At The Dee Mill, Shaw, Nr. Oldham, Lancs. Open day 9 a.m.—3.30 p.m. admission 25p. Engine house at the Diamond & Fern Mills also open.
4 Basingstoke & District M.E.S. Track construction.
4 Northern Mill Engine Society. Open day, Dee Mill, Shaw, Lancs.
4 Brighouse & Halifax S.M.E.E. Frozen Frolic at Ravensprings Park. Gates open at 1.50 p.m.
5 & 19 Peterborough Society of Model & Experimental Engineers. Meeting at Clubhouse, Lincoln Road. 7.30 p.m.

Boring Tools

Sir,—With regard to Mr. Kyle's letter ("Postbag", 16.9.77) re boring tools, may I comment, as an inexperienced model engineer, that I have used the forged type of commercial boring tool with little success, but obtained good results first time, with a boring tool with H.S.S. cutter bit.

One reason for my use of H.S.S. for cutters is the non-existence of heating equipment in my workshop, which I suspect goes for many other beginners as well.

In similar vein, same "Postbag", was a letter from Mr. J. H. Davis. I find myself using tungsten carbide tools quite a lot, just for the pleasure of not having to sharpen them so often. Just think, a whole day's work without recourse to the grinding wheel. They may be a little more expensive, but will have a long life, and also make the machining of cast iron a pleasure rather than a chore.

Surely model engineers with a hobby based on processes of science and technology, which have produced the modern indus^trial society (a product of which is the time and conditions to practise our hobby), should take advantage of every new technological advance which helps our hobby, cyanoacrylate adhesions as one example.

I bet Maudsley would have been one of the first to use carbide tools had they been available to him.

London, SE17. A. Mount

Walschaerts

Sir,—I was glad to see that you have kindly published my letter to you on the subject of Walschaerts' valve gear in the *M.E.* Unfortunately, between my letter and the typesetting some of the formulae have been a little scrambled.

The errors are:

1) At the top of col. 2 on page 1127 the expression for q should be:

$$q = \sqrt{\frac{d.c. \sin \emptyset}{d^2 + c^2}}$$

2) It is important that the expression for cos β should be on one line, also a root sign was somehow inserted. The correct equation is:

$$\cos \beta = \frac{d.c}{d^2 + c^2}\left\{ 1 + \cos \emptyset) \right\}$$

3) Your printer has chosen to use γ for return crank angle in place of my $\in$. This is only important inasmuch that the diagram, Fig. 1, was not amended to concur.

Axminster, Devon. A. Gettings

We have received several letters pointing out these errors, and would like to thank all those readers who have taken the trouble to write. We would also like to express our apologies to Mr. Gettings and all those who were confused by the error.—Ed.

Post Bag

The Editor welcomes letters for these columns. He will give a Book Voucher for £3.00 for the letter which, in his opinion, is the most interesting published each month. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

Bourdon Engine

SIR,—I enclose photographs of a Bourdon engine that I have recently completed.

The model has its origins in the article by A. W. Neal on page 605 of *M.E.* Vol. 135 which intrigued me at the time, especially as I had just acquired a large scrap gauge reading from 0 to 15 p.s.i. I saved the tube for immediate conversion to an experimental engine. Eight years, two steam engines and two hot air engines later, I made a start!

In the article it was stated that the Bourdon tube was filled with oil to reduce steam consumption. The result of this would be very generous displacement lubrication of the valve, but the condensate would work just as well. Running on compressed air the engine rotates at 100 to 200 r.p.m. on pressures of 10 to 100 p.s.i. and will tick over on under 5 p.s.i. It produces an uncomfortably sharp exhaust beat.

Filling the tube with oil makes it run at about five times the speed for a given pressure, at the same time reducing air consumption by about 90%. The exhaust, which escapes directly from the piston valve, is reduced to a relatively soft hiss.

The model is made from scrap brass, with a fabricated flywheel and a crankshaft built up using Loctite.

The drawing in Mr. Neal's article shows a direct coupled slide valve. I used a simple piston valve without glands, exhausting through an axial drilling. The drawing also shows a peculiar crank and big end assembly. I would be interested if anyone can throw any light on this. I made mine to a conventional pattern after checking the deflection of the tube under the influence of a likely range of pressures.

M. Bourdon used a swinging link to tie the free end of the tube to the floor. I have omitted this as it would apparently increase the stress on the fixed end rather than decrease it, and the engine works very well without it.

It is a fascinating engine to watch, and is frequently misunderstood even by those with some knowledge of steam engines.

Newtown, Powys. C. A. Small

Drummond Lathe

SIR,—I recently purchased an old Drummond flat bed lathe that I wish to try and find out a little more about. The engineer I purchased this lathe from had had it since the early 1930s and he tells me it was an old lathe then. It has a serial number 365 stamped on all the major parts. The basic dimensions are: 16 in. dia. in gap (face plate diameter); 6 in. dia. over saddle; 30 in. between centres.

The main bed is 39 in. long by 8½ in. wide and is set below the slideways of the tailstock by about 2 in. These ways are 31 in. long by 5 in. wide. It has a 7½ in., three-jaw, concentric, independent chuck made by the D. E. Whiton Machine Co. of New London, Conn., U.S.A. Originally the lathe was treadle driven, but was also supplied with fast and loose pulleys for line shaft drive.

I am in the process of restoring the lathe to some of its former glory. I have been very impressed with the condition of all the major components; none are badly worn, although I intend to replace certain items.

Perhaps you may know of someone who can help me with further information on the lathe. if not would it be possible to publish my letter in "Postbag", so that a reader may help me?

G. P. Quayle

Ross Winan Eight Wheeler

SIR,—Being one of those odd sort of fellows, I have been contemplating my proposed new model locomotive in 5 in. gauge and me being me it has to be something different. This time it is a Ross Winan eight wheeler "Mud Digger" of 1844, as built for the Western Railroad of Massachusetts. The type has the vertical boiler. I have never heard of such a model being built.

At the Guildford Rally in 1976 I met Fred Kiesel from St. Louis, Mo., and naturally told him about my three American model locomotives. He in turn said that he, too, was thinking of a new model to build in 7½ in. gauge and produced a photograph of a Ross Winan eight wheeler but with a horizontal boiler as built for the Baltimore & Ohio Railroad. Quite a coincidence.

My interest is also known among the members of the Bracknell Railway Society and John Abbott, another member, produced a full plate photograph of the full-size wooden model held in the Baltimore & Ohio R.R. Museum at Mount Clare.

Last June, while visiting Snub Pollard of Lorain, Ohio, for a four weeks holiday, I took time off to visit Bob Thomas of Philadelphia who took me to the museum at Mount Clare especially to see the full-size replica in wood as depicted in the photo referred to above. My main interest was to determine the type of valve gear and how it operated. A good photograph appears in *Model Engineer,* page 896, Vol. 136, No. 3401, but it does not show how the gabs are lifted out of engagement.

It is evident that the builder of the model in the museum, Major Pangborn, had access to the original drawings and it would be appreciated if any reader in the United States could tell me where I could obtain a copy of said drawings.

I thoroughly inspected the museum model but found that the gab lifting gear was missing although the Johnson Bar and square section cross shaft are in place. Any help in this question would be greatly appreciated and I would wish to thank all those who have assisted me so far.

Egham, Surrey. Jack Davies

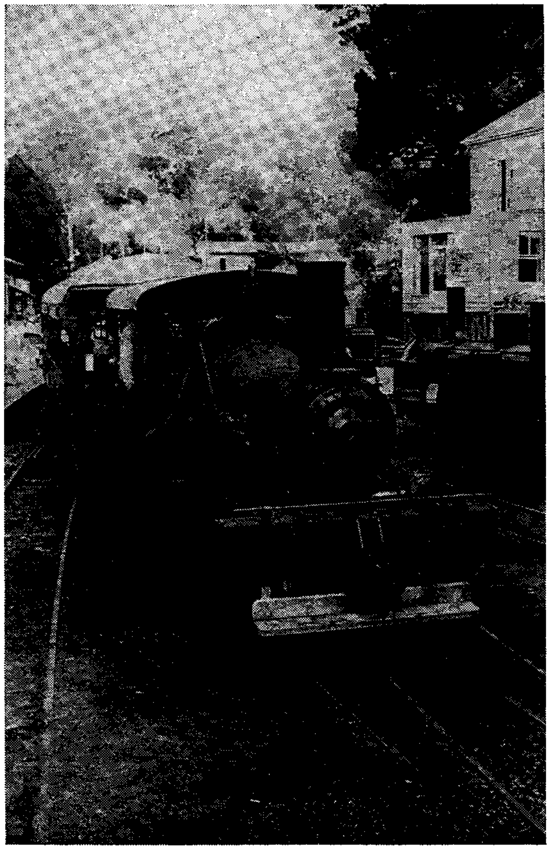
Steam Tram

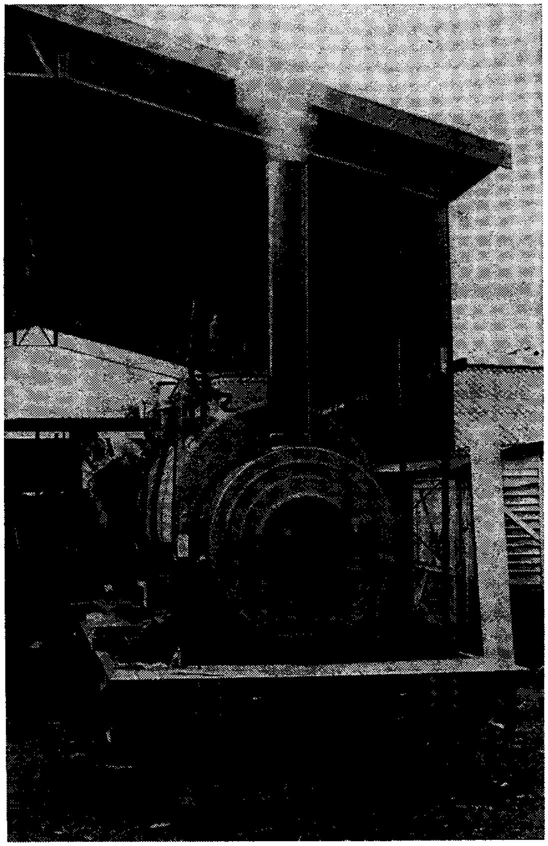
SIR,—I was most interested to read the article on the Sydney Steam Tram by Mr. Atkins in *M.E.* for 6 May 1977, which has just found its way out to this part of the world, and thought that your readers might be interested in another of these attractive machines which is currently being restored at the Museum of Transport and Technology of New Zealand (Inc.) here in Auckland. Tram Number 100 was built by Baldwin for the Sydney tramways in 1891 and sold by its first owners to the Wanganni Tramways in New Zealand in 1910. In 1950 it was brought out of storage to mark the closing of the tramways.

At Motat its restoration has been carried out by volunteer workers led by Mr. Ian Mison, who is seen at its controls in the photo. This photograph was taken earlier this year when the motor had its first steam trials for certification. It was passed to operate on 9016s, which is quite an achievement for an original Baldwin boiler—it should be good for another 10-12 years yet. After test it was partially dismantled again for lagging of the boiler etc., and is now ready to be shifted to the museum's main tramline where the bodywork will be refitted preparatory to its going into service.

The museum already has several electric trams in operation, with others undergoing restoration. Another popular exhibit is the railway featuring a complete railway complex typical of the turn of the century New Zealand Railways based on the old Waitakere Station built in 1879 and extended (before it had even been opened!) in 1880. Three steam locomotives are currently in operation: an ex-N.Z.R. "F" class 0-6-0ST and a Hiesler geared engine restored by members of a separate group, the Bush Tramway Club, who will shortly be shifting them to their own line South of Auckland, and an ex-N.Z.R. "L" class 2-4-0T. This was rather butchered when being used as an industrial engine and needs a lot of work to bring its appearance into line with its rather sweet performance. Later next year will see the 100th anniversary of it going into service and it is hoped to see it looking presentable for the occasion. The photograph shows the Hiesler in operation in May of this year.

Hiesler geared locomotive (3 ft. 6 in. gauge).





Ex-Sydney steam tram No. 100 in May 1977.

The museum was established in 1963 on the site of the old pumping station for Auckland's water supply in Western Springs. The lake from which water was drawn was begun about 1872 and the Pumping Station came into use in 1877. In 1910 it was relegated to an emergency supply and was taken out of use in 1928. The boilers were removed in 1939-40 but the pumphouse and beam engine remain and form the centrepiece of the museum. The pumphouse holds a number of small restored steam engines and pumps which are regularly run for the public.

The museum is fairly unique among institutions of its size in that all restoration work on its wide variety of exhibits from agricultural machinery and pioneer cottages through to space relics is carried out by volunteer workers.

New Zealand. K. L. Crosado

Light Steam Tractor

SIR,—In reply to Anthony Beaumont's letter (*M.E.* 3567) regarding the 4 n.h.p. Ransomes compound steam tractor, the illustrations in the opening article do in fact show the prototype tractor with single tee rings to the hind wheels, afterwards broken up. Forty-eight of these excellent little engines were built, of which five survive, Nos. 23266, 36220, 39088, 39127 and 39149. The original engine was 20047, and it differed from subsequent engines not only by having single tee rings but also in having the pump attached to left-hand hornplate instead of between flywheel and belly tank as on later engines and also in having the steering worm and wheel unenclosed.

There are minor differences among the surviving five tractors which I hope to touch upon in subsequent articles.

The good steaming characteristics were undoubtedly assisted by the five $2\frac{1}{2}$ in. dia. "smoke tubes" above the $1\frac{3}{4}$ in. tubes; total heating surface was 68.83 sq. ft.

Readers of *M.E.* 3568 may be a little puzzled by the rear view of an engine which accompanies my Ransomes article No. 3.

This is in fact my "Suffolk" 3 in. scale timber tractor, the prototype of which unfortunately never went into production. Perhaps at some future date the Editor may allow me to describe both the model and the design of a promising engine which did not survive the challenge of the diesel engine and the cheap tractors.

J. Haining

Model Engineer *is pleased to accept John Haining's offer of an article on the "Suffolk" tractor. Hopefully the series will commence later next year when his Ransomes compound tractor and its associated steerage plough articles are concluded.—Ed.*

Blast Pipes

SIR,—Being a very early reader of *M.E.*, actually of 1898 vintage, I remember what the original front covers looked like in those days. Reproduction of a photograph was an achievement similar to reproduction of a photograph on today's what appears to be smooth ivory paper to readers nowadays.

On page 626, issue 3-16 June 1977, just to hand, in the article on variable expansion blast pipes known as "Jeynes' Corner", the U.S.A. fire engine shown in the illustration as "Amoskeag Type" according to my information has the pump machinery placed between the boiler and the horse driver's seat, the whole being enclosed in an iron frame to a harp. This type of set-up was referred to as the "harp" type; according to the illustration this would appear to be so. These were frequently mentioned in *New York Fireman* in their heyday. Actually the Shand Mason appliance with the machinery at the rear of the boiler was known as the "Amoskeag" type. Our people always used Shand Mason or Merryweather types.

New Zealand. F. C. Wheeler

George Thomas

SIR,—Despite criticisms (Mr. Kyle's letter in No. 3569), I hope that George Thomas keeps up the good work.

One hundred per cent self-taught amateurs like myself desperately need the sort of information and guidance he provides. I could never tap anything straight until I built his tapping machine and I am now working through all his other devices, including the bending rolls.

Please, therefore, let us have the "finger plate" and any other ingenious devices that Mr. Thomas thinks could help the inexperienced.

Switzerland. Frank Gutteridge

Information Wanted

SIR,—I have recently acquired a most interesting old 2-4-0 locomotive model, of approximately $3\frac{1}{4}$-inch gauge, and hope that some reader of *M.E.* might be able to help me in its identification.

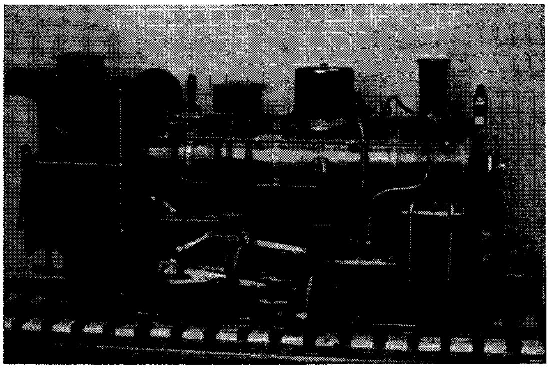
Superficially the engine looks like a working model, but actually it was not built as such as there is no provision for containing steam in the single-flue steel boiler, pipes are solid, and the cylinders are merely shells with guides for the piston and valve rods. The smokebox, however, is fitted with a blast pipe and the firebox with a grate.

Many of the cab fittings are functional, such as a lever to operate the blower valve which is just behind the stack, and others for the cylinder drain cocks, sander, and whistle. There is even a tool box with hinged doors on the left side of the cab. Above the backhead are very detailed replicas of injectors. Brakes are fully rigged, and connected to a steam cylinder just below the cab.

The Walschaerts valve gear is very well constructed and is fitted with oil cups where possible; the gear may be operated by the reverse lever in the cab. Oddly enough, there is evidence of considerable wear on the crosshead guides, which leads to the thought that the engine may have been a coin-in-the-slot model once common in railway stations, the wheels rotated by some type of friction drive.

The engine is completely devoid of any identifying markings, and is black with red frame and red trim. It appears to be of a European type, possibly German, but my limited collection of railroad books has failed to come up with a prototype. The detail incorporated in the model suggests, however, that it was intended to represent some specific engine.

Lakewood, Colorado. John W. Adams



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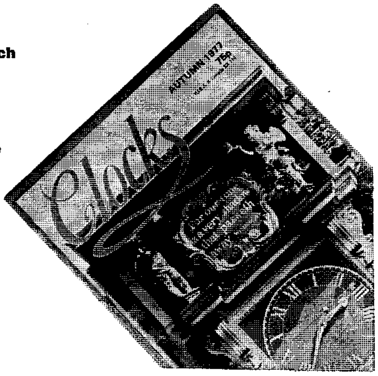

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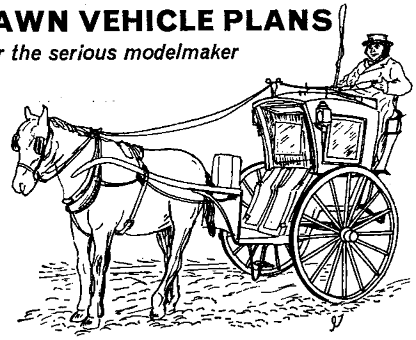

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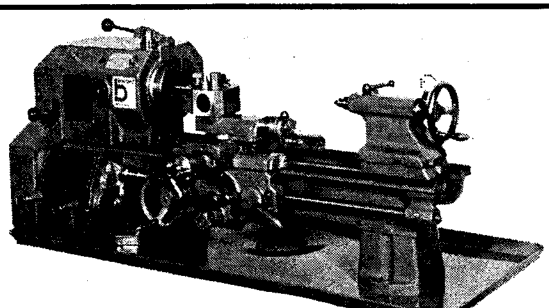

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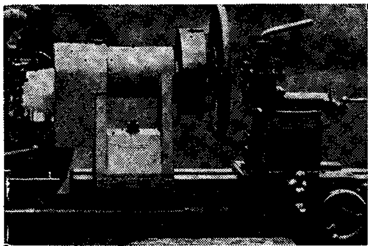

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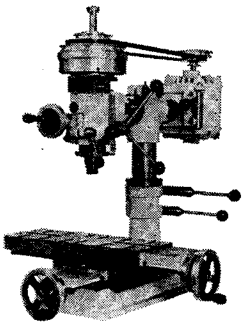

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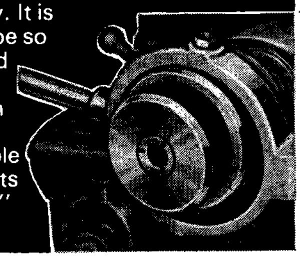

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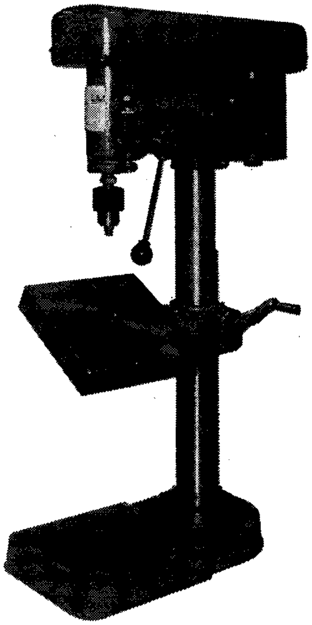

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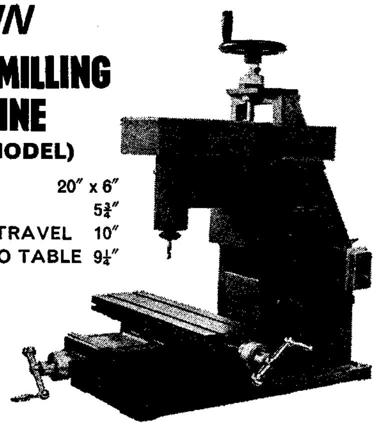

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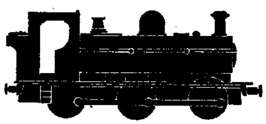

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Wanted good quality 3½" or 5" model steam locomotive. Tel: Kidderminster 61866 evenings. D

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£80 minimum offered for M.E. volumes 1-80 (portions welcomed, if available). Lambert, 60 Salhouse Road, Rackheath, Norwich NR13 6AA. D-O

POSTBAG *Continued from page 1307*

Horse-drawn Vehicles

SIR,—Mr. Murdock's article about horse-drawn vehicles rightly devotes its major part to wheel making (*M.E.* 3568). Lewis Turner's excellent article about his farm wagon, about three years ago, and also E. T. Westbury's precision methods of wooden wheel building for his fire engine model are most informative. My modest but well-illustrated article (*M.E.* 2897, 29 November 1956) shows how full-size wheels are made and tyred. It is important to stagger the circumferential line of spoke mortices in the nave if fidelity is aimed at. Any "dishing" of wheels serves two purposes in service and a third in the making. The spokes or spoke should be at right-angles to the ground when passing over it, thus giving the upper and opposite spoke twice the dish angle outwards. This allows a wider vehicle body. Secondly the alternate sideways thrusts caused by a heavy horse's stride serves to tighten the wheel. A flat wheel would soon become knocked loose in use. A farm wheel was good for 60 years' use. Thirdly and in construction, the "dish" allows for the contraction of the cooling iron tyre to close all joints without bending the oak spokes.

On the tyring platform, the wheelwright unscrews the central holding clamp and allows the hub to rise slightly as the tyre cools. All this amounts to a very scientific approach to an apparently simple design.

Probably a number of well (and correctly) made model vehicles in which the wheels are built up with separate felloes, have the wheels left unpainted to show that felloes have, in fact. been used as opposed to a continuous laminated "felloe".

I do not wish to carp, but I find Mr. Murdock's explanation of the profile of felloes ("wheel accuracy", page 995) rather confusing. The tyre face is at right-angles to the spokes, therefore the whole tyre is slightly cone-shaped because of the wheel's dish. Certainly the felloe section should be a little wider at the spoke face than at the tyre face, but this feature is insignificant visually compared to a correct (or incorrect) dish angle and wheel-setting on the axle. Obviously Mr. Murdock is an experienced wheel builder whereas I am not but I observed wheelwrights' and blacksmiths' wheel building for many years only a few yards from my home here. Alas, the old buildings are now full of general merchandise, cycles and household goods. Only the old tyring platform remains. Mr. L. R. Turner's wagon model, complete with horses, is on loan to King's Lynn Museum.

King's Lynn, Norfolk. Anthony Beaumont

Meccano

SIR,—I too well remember those pre-war days of Meccano when the only address outside Birmingham that I knew was Meccano Limited, Binns Road, Liverpool 13.

I would like to assure Martin Cleeve that Meccano is alive and well and in terms of volume enjoys increasing sales each year. As for the future, there are exciting developments ahead which will fully reflect the original genius of Frank Hornby who created the system. Incidentally, the office I occupy is the original Hornby office, in which the phrase "Dublo" was first coined.

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Director—Meccano Limited J. R. Higham

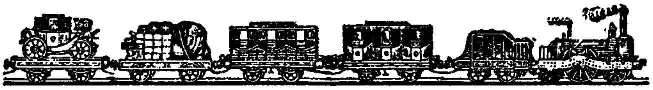
Myford Collet Ring

SIR,—I refer to the article on page 748, No. 3564, by Ian Bradley. My Myford Super 7 has a "C" spanner supplied. The nuts which it fits are 1⅞ in. dia. The Myford Collet ring is 2 in.

I machined a groove 7/32 in. wide by 1⅞ in. dia. and then using a 7/32 in. dia. shot drill machined six slots to a suitable depth. This has the advantage to my mind of leaving two rings of knurling which I find a help with ailing fingers.

The following issue, No. 3565, pp. 794, by Bert Perryman, contains references to draughting for locomotives as laid down by Sam Ell at Swindon. I have seen several past references to this man's work but never any details—do you think someone could be persuaded to write an article along these lines? I am sure many would benefit.

Hope Valley, S. Australia. C. S. Bamford



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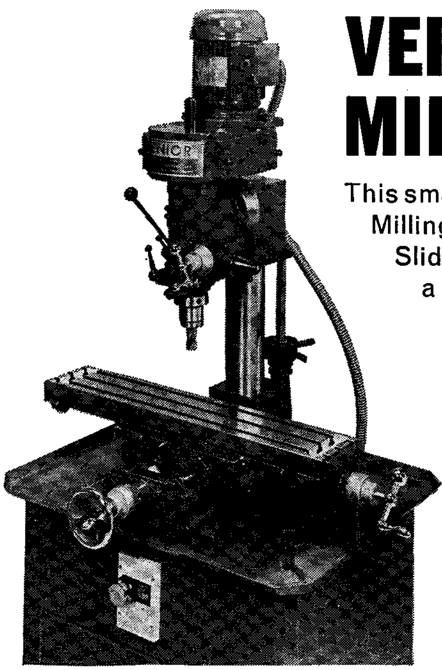

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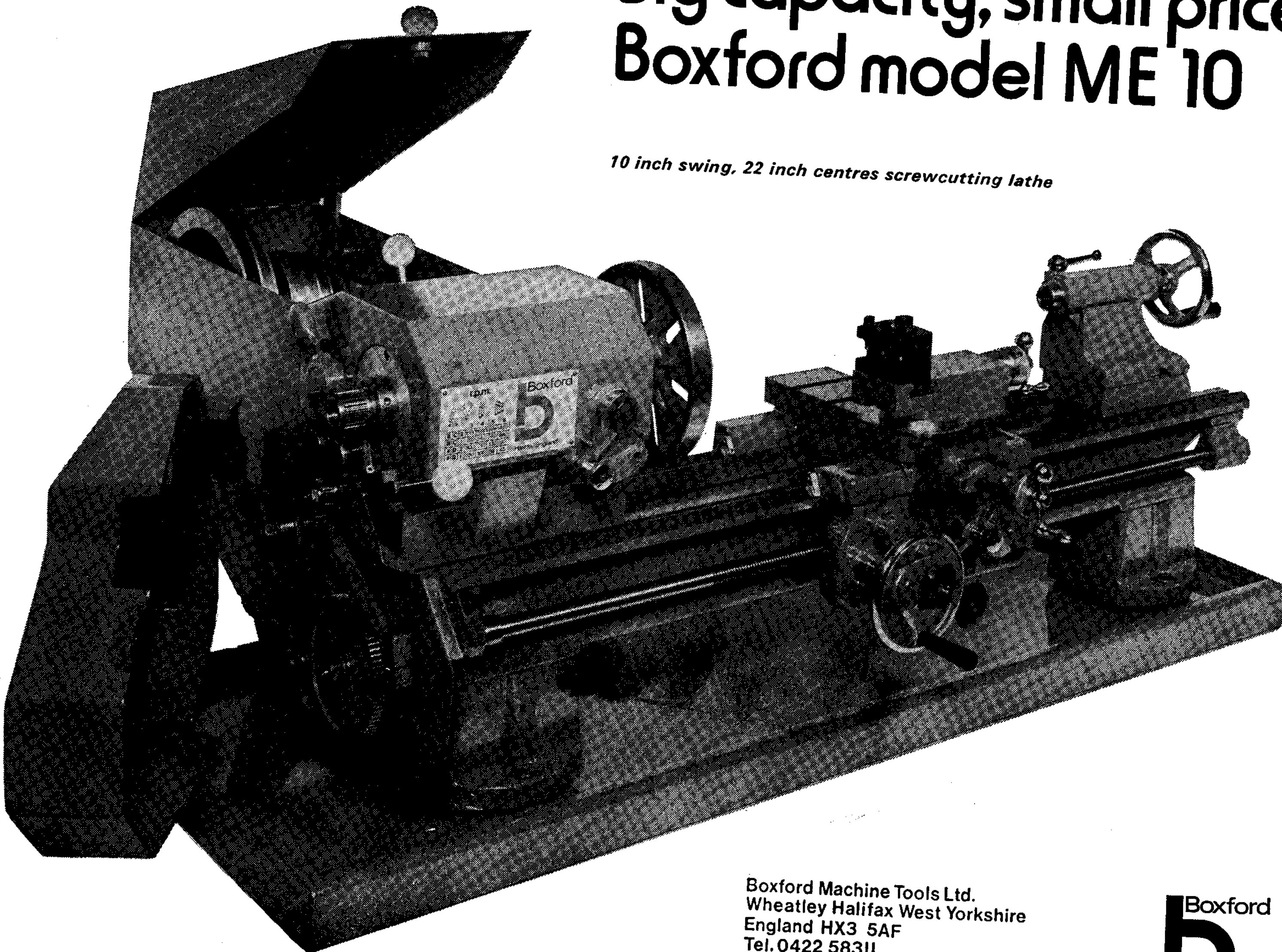

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