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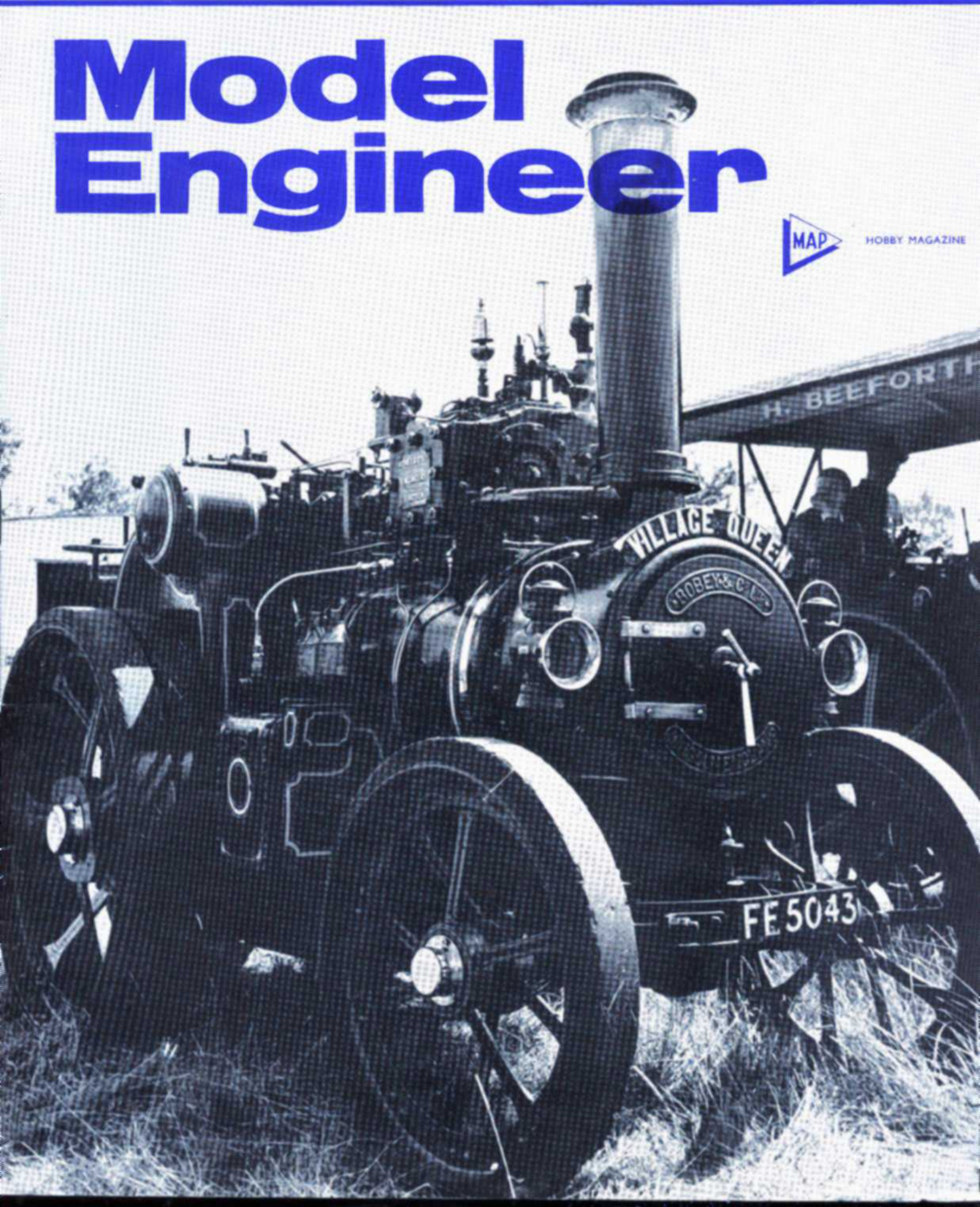

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November 4 1966 Volume 132 Number 3308

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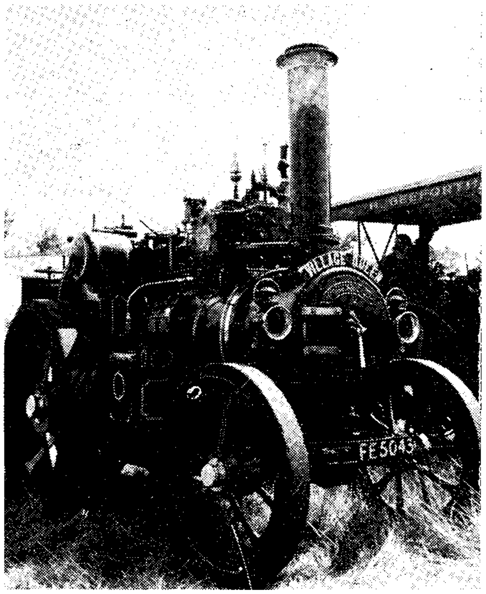

Cover picture

A Robey 4 n.h.p. engine built in 1913 and now owned by Mr. M. Brewer of Pickering, Yorks. Photograph by Mr. F. W. Argument.

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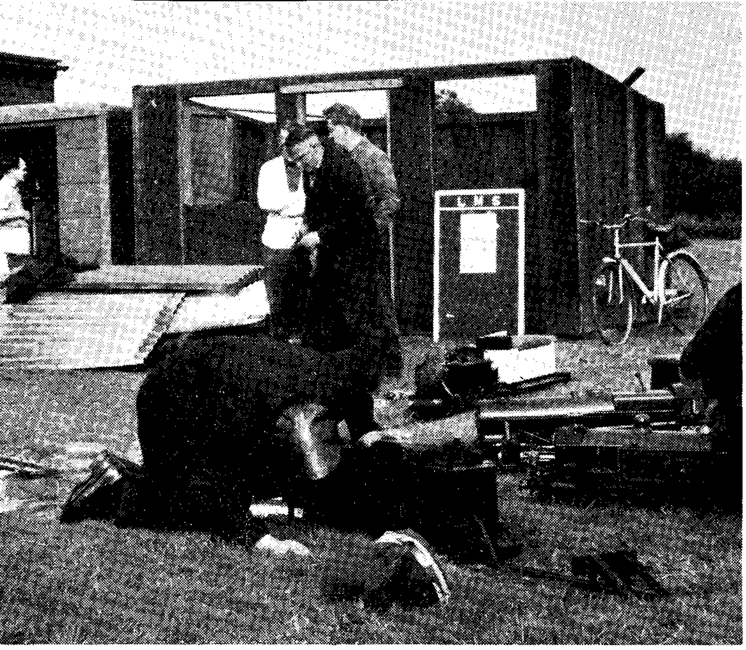
Next issue

E. Hallam of Australia describes a lathe boring head and Martin Cleeve returns with instructions on how to make a lathe saddle apron.



SMOKE RINGS

A commentary by the Editor

Ground level tracks

Those locomotive enthusiasts who have driven 1½ in. scale engines on ground level tracks invariably claim that such operation is much more interesting and satisfying than the more common raised track. My picture, however, shows what can be done on the ground with the smaller gauge of 5 in. The photograph, which was taken by Dr. G. P. Stilley, shows some of the locomotives of the Derby Society. They include a LTSR 4-4-2 tank, a 3-cylinder Stanier 4-6-0 *Fiji* and a Great Western taper-boiler Pannier tank. The poster seen in the background is of interest as it is actually an ex-Furness Railway poster from Crieff, Perthshire.

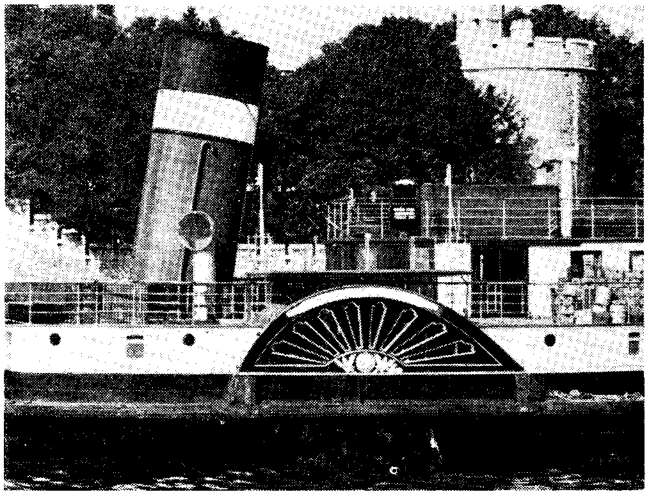
Queen of the South

I hear that the famous old paddle steamer *Queen of the South*, formerly the *Jeanie Deans*, has been withdrawn from service.

Jeanie Deans was launched in 1931 in the yard of the Fairfield Shipbuilding Company of Glasgow. She gave countless years of pleasure mainly in Scottish waters except for her war service, when she was converted into an anti-aircraft vessel to try to combat German mine-laying in the Thames estuary. For several years she was based with the Thames Local Defence Flotilla at Sheerness.

Last year, the *Jeanie Deans* was to be broken up, but was saved at the last minute by enthusiasts who formed the Coastal Steam Packet Company to operate the vessel once again. Towed to the Thames for re-fitting and re-named *Queen of the South*, she made several more trips, but was dogged by ill luck, suffering damage to her paddles and difficulty in keeping a suitable crew. Her final fate has not yet been settled as I write these notes.

Below: The "Queen of the South" pictured amidships.



Small Lathe Design

THE recent correspondence in our columns on the design of the small centre lathe has shown that there is considerable divergence in readers' views. Some professional turners have a preference for left-hand saddle traverse wheel; some much prefer the right-hand position. It is however good to see many readers rallying to the defence of British machines for a change.

I say "for a change" deliberately, for in recent years it has become the fashion to denigrate anything made in this country, and while no sensible person would maintain that everything in the garden is lovely where our manufacturing industries are concerned, it does no good to criticise where criticism is unjustified. Those who extol the American centre lathe may be interested to know that in June this year, £105,000 worth of British centre lathes were exported to the U.S.A., while in the same period, £90,000 worth were imported from U.S.A.

Referring to Mr. E. H. Jeynes's remarks in our October 21 issue, he says that the vertical turning mill is now doing the job previously done by the gap-bed centre lathe, and talks about a crane being used to lower the work on to the faceplate. But I thought the discussion was about the smaller centre lathes, that is those of say 7 in. centre height downwards. There does seem also to be some confusion over the use of the word *production*. I think Mr. Jeynes, in his comments on Mr. Whitworth's shop, must have meant repetition turning, as distinct from one-off or jobbing work. The automatic lathe is of course the machine used today for large quantities of similar parts, which are generally of the order of 10,000 off and upwards. But in jobbing work, as Mr. Whitworth says, it is necessary at times to remove a lot of metal as quickly as possible, if the job is going to pay.

But in spite of all the elaborate automatic and semi-automatic machines with which industry is now equipping itself, there will always be a limited demand for the medium-sized centre lathe, for the inevitable one-off job and for toolmaking.

Last of the "A.4s"

The last of Sir Nigel Gresley's most famous class of locomotive, the streamlined A.4, has now been withdrawn. No. 60019 *Bittern* enjoyed the distinction of being the final engine of this notable series to run in normal service when she hauled a Glasgow-Aberdeen excursion on September 3.

Probably no locomotive designer had a more enthusiastic following than the late Sir Nigel, and in his final batch of Pacifics, he built not only the fastest steam locomotives in the world, but some of the most economical. In pre-1939 days, these engines were also extremely reliable, though they occasionally ran into trouble through overheated inside big ends towards the end of the war and for some years after. But given good maintenance they had no peers.

The recent discussions on the good and bad points of the Bulleid Pacifics incline one to the view that if the over-running of the inside valve of the Gresley conjugated gear could be completely overcome, this gear might have been the solution. It is generally said that the over-running experienced in the Gresley engines was due to whip in the longer lever of the "two-to-one" gear. Examination of the drawings of the levers leads me to think that this could not be the sole cause. Wear in the bearings may have been a contributory factor, for it must be remembered that the bearings lay just beneath the smokebox door, where the possibility of dust and ashes getting into the motion was very great.

Another factor was the outside valve gear, from which the movement of the inside valve spindle was obtained. If this was not sufficiently rigid, and if there was play in the various pins, the adverse effect of either would be transferred to the inside spindle. The Gresley outside Walschaerts gears were invariably most carefully designed and neatly laid out, but in the best of valve gears in good condition, there is always a certain amount of play.

A possible solution might have been to arrange the two-to-one conjugation to the rear of the cylinders, where the parts would not only be more easily protected from dirt, (they could be almost entirely enclosed and lubricated mechanically) but the expansion of the outside valve spindles under steam would not have to be allowed for. Given, also, an even more substantial big end—for which there was plenty of room—and really good lubrication, the over-running problem might have been cured.

Model Heightfinder

The picture below shows a scale model of a Plessey HF 200 Heightfinder which was one of the features of the display of British electronics at the Vienna Trade Fair, September 11-18. The model, which is to $^1/_{10}$ scale, was made at the Plessey Radar factory at Cowes, Isle-of-Wight. The prototype forms an important part of today's complex air defence equipment.

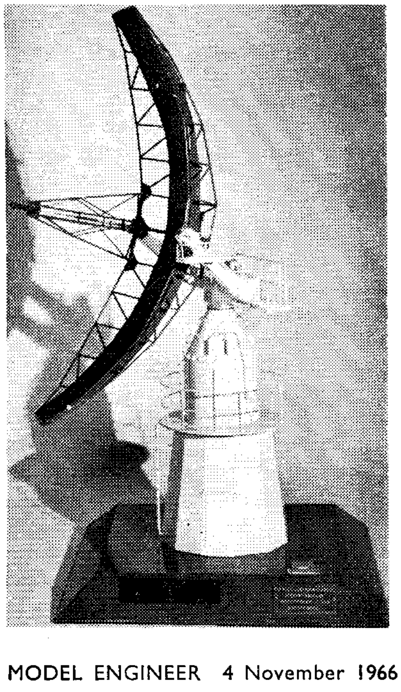
Gift Locomotive

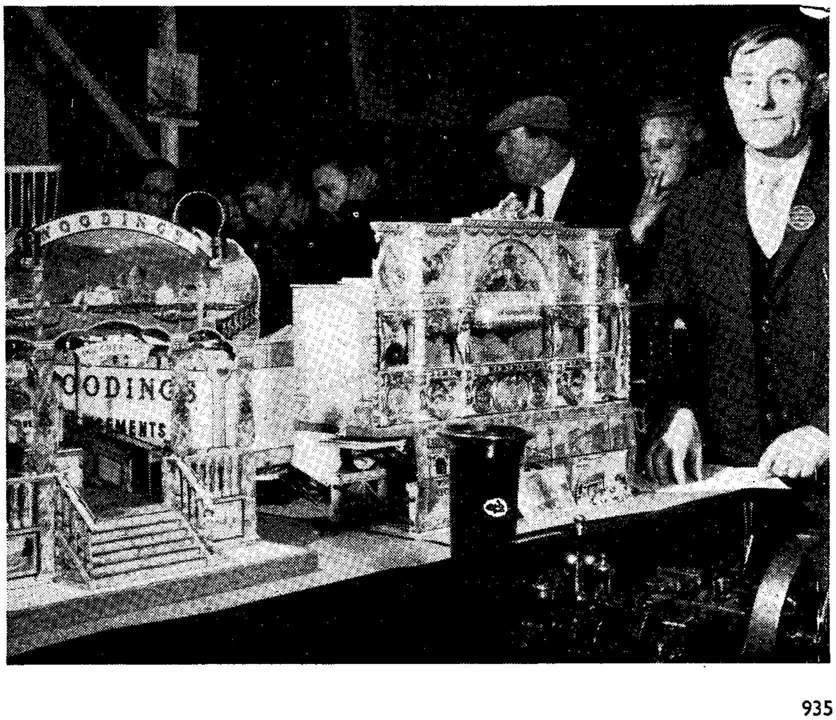
The gift locomotive offered by our contributor C. R. Tyler recently was awarded to 15-year-old reader R. Bird, of Heath, Cardiff, whose application was the first suitable one opened. Readers will be interested to hear that no less than 38 applications altogether were received, from readers whose ages varied from 13 to 20. Evidently there is no lack of interest in steam locomotive building among our younger readers!

Miniature Sparking Plugs

Several readers whose interests lie in the direction of small petrol engines tell me that they are having difficulty in obtaining suitable miniature sparking plugs. I understand that Mr. J. Drew of Luton has a quantity of ¼ in. × 32 plugs surplus to requirements, and if anyone wishes to take advantage of this, would he please write to Mr. Drew c/o the *Model Engineer* offices.

Below right: Bill Beagley's two exhibits at the "Leisure 1966" exhibition at Leicester last April, a model of Wooding's Cake Walk and Pat Collins' Scenic Organ.
Below: A scale model of a Plessey Heightfinder.





FOUR-STROKE PETROL ENGINES

A review of progress in pre- and post-war years

by Edgar T. Westbury

PART TWO

(Continued from Oct. 21).

THE KIWI has never been claimed to be a super engine, neither is it implied that it was better than any other engine built by model engineers in the early 1930's. There were, in fact, several very good engines in existence at that time, of sound design and construction, and successfully employed in model boats of various kinds. But in general, traditional ideas in design still persisted, and attempts to improve on them often introduced complications and difficult constructional problems, with no real guarantee of better performance. I claim that the *Kiwi* was the first published design which was sound in wind and limb, and in which the requirements of amateur constructors had been seriously considered.

In making this rather dogmatic statement, which may be challenged by other designers of the period, I would point out that it is one thing to put a good design on paper, and quite another to ensure that it can be built successfully. I have never under-estimated the capabilities of model engineers to execute difficult or complicated machining or fitting operations. Some of them produce remarkable work and surmount difficulties with very limited equipment. But there are many others who, though quite competent to do good work, need to be shown how; and even some skilful and experienced craftsmen hesitate to undertake operations which are unfamiliar, and perhaps seem a little mysterious to them. To induce them to build petrol engines, which were—and still are—often looked upon with suspicion, it was necessary to convince them that they could carry out the work successfully and also that there were sound practical reasons for the particular features of design.

In the "traditional" petrol engines of the time, lubrication was generally a very haphazard affair, mostly carried out by injecting an indeterminate amount of oil into the crankcase, and hoping for the best. Providing that the oil was not immediately thrown out through the breather, or leaked out of the joints, this served more or less effectively for the low speeds and working pressures then employed, but it was hopeless if any attempt was made to improve things in either respect. It was difficult to adjust the amount of oil so that all important working parts got their share, without oiling up the sparking plug. No special provision was made for supplying oil to the big end bearing, except by drilled holes in the bearing itself, often in the wrong place. A few engines, mostly those intended for racing, were fed with oil by means of a syringe type of spring-loaded pump, with a needle valve for metering control, as used on many early motor cycles.

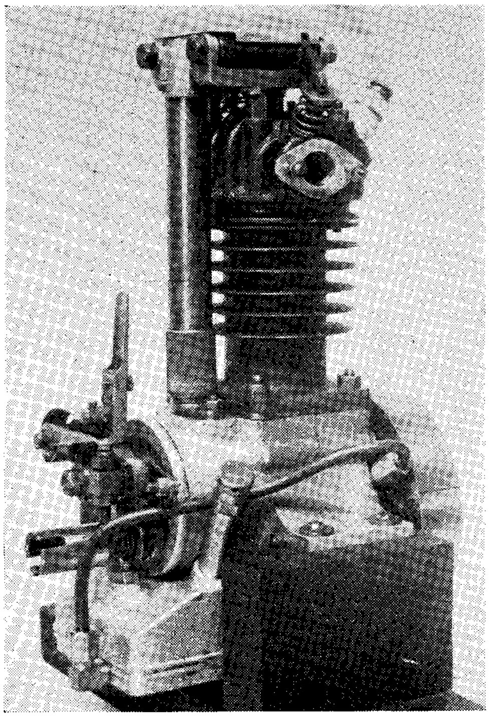
The obvious means of supplying oil directly to the big end bearing was by drilled oil passages in the main shaft, but it was generally considered too difficult to drill the deep passages which were involved. To avoid the necessity for this, the *Kiwi* was fitted with a simple method of collecting oil from the inner end of the main bearing and feeding it to the hollow crankpin by centrifugal force. This device generally known as a "banjo" lubricator, was by no means original in principle, as it had been used for generations on stationary and marine steam engines. It consisted of a flat brass plate attached to the outside of the crank web by two small screws, plus a retaining bolt which also formed a closure for the other end of the crankpin. The centre was bored to register on the main journal, and opened out, with an annular groove, to run with a small clearance over the flange of the main bush. A very shallow oil way in the bush, continued radially across the face of the flange, conveyed oil by way of the annular groove, and a radial hole in the banjo, into the crankpin and thence to the big end bearing. Oil was fed to the main bearing through a radial feed pipe in the housing by any convenient means.

To avoid destroying the oil film in the main bearing, the oil way was made only just large enough to convey a very small quantity of oil into the banjo, but sufficient to keep the big end free from any risk of seizure. By fitting a non-return escape valve to the crankcase (a light disc valve was found best in practice) the mean pressure therein was kept slightly below atmospheric, so that the oil could be fed to the main bearing either by gravity or suction, and regulated by a needle valve. Apart from variations in the viscosity of the oil, the amount supplied to the engine was constant when once adjusted. This method of lubrication was highly effective, and I think it has an influence on the practical success of the *Kiwi* engine.

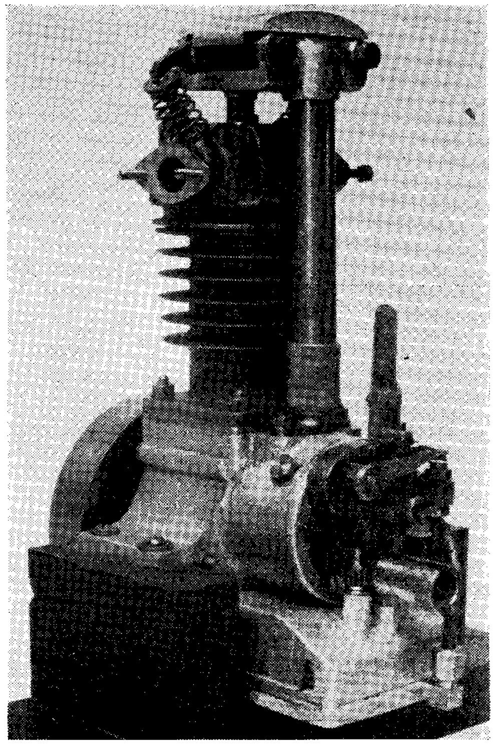
Valve gear

A good deal of thought was devoted to the design of the valve operating gear, as I thought that this might well present a formidable problem to the inexperienced constructor. To avoid undue complication of the crankcase casting, the timing case, or "cam box" as it was often called, was cast integral with it, and in conformity with other features, had to be kept as compact as possible. The smallest gear wheel which could conveniently be fitted to the camshaft was one of the 1 in. pitch diameter, which must necessarily mesh with a pinion of ½ in. pitch diameter on the main shaft, and this limited the size of the shaft at the timing end to ¼ in. A larger bore in the pinion would make it too weak for safety, and for the same reason an internal keyway was impracticable; it was therefore located by a cross peg in the shaft, and clamped endwise by a nut, which could be incorporated in an outboard runner sleeve, and also a coupling if required. These measures proved successful and reliable in practice.

The formation and timing of the inlet and exhaust cams presented another problem which had to be tackled in such a way that it would not deter constructors. I decided to play safe by using tangent cams, which could be shaped fairly accurately by simple means, such as by using a filing rest in the lathe and indexing the cam blanks to the required angle between the cam flanks. At the same setting, the base circle could be filed concentrically, or machined by circular milling, but the nose radius was formed by hand filing. The cams were made a tight wringing fit on the camshaft so that they could be timed by trial with the aid of soft-nosed pliers; the spur gear was a press



Two views of Mr. Westbury's original Kiwi petrol engine showing the inclined valve head and forced lubrication system.



fit, and after the cams were set, a $\frac{1}{16}$ in. hole was drilled through the assembly, and the flange turned integral with the shaft, which was left soft to enable the contact breaker cam to be fitted. Though crude, this was easy to make and worked fairly well up to moderately high speed.

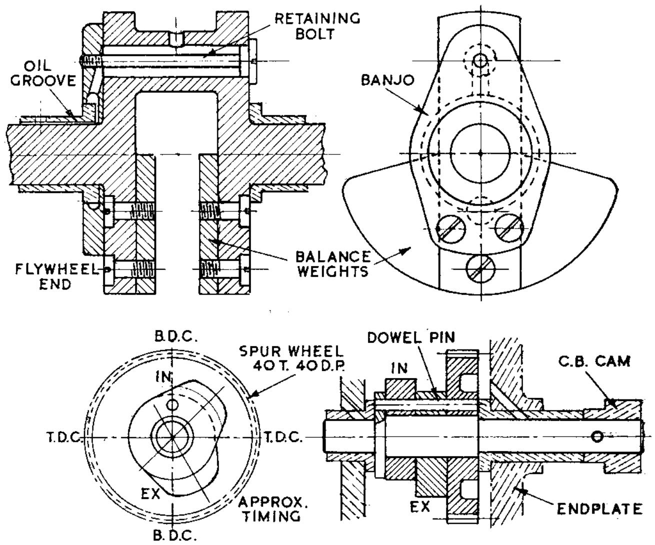
Tangent cams normally work in conjunction with roller followers, but these were not practicable within the space available, and in any case their advantages are dubious. As an alternative, the tappets were formed with convex-curved faces to work directly on the cams, and prevented from turning by flat sides which fitted slots in the base of the tappet guide. This was made in the form of a flanged bronze spigot, bored to take the two tappets side by side. In this way the minimum number of parts were used in the timing gear assembly, and this, with reasonable lubrication by oil mist, was in my opinion conducive to mechanical efficiency.

It may be mentioned that motor cycle practice at the time favoured the use of rocking followers with curved faces to transmit the motion from the cams to the tappets. I had tried these out in earlier engines, including the type in which a single cam is used in conjunction with followers set at suitable angles to obtain the required inlet and exhaust timing. This simplifies the cam, but tends to complicate both the geometry and construction of the rest of the gear. Pivoted rockers introduced deviations in the motion of the tappets in relation to the lift of the cams, and often increase inertia of the moving parts. For these reasons, I have avoided them in most of my engine designs, though I have often been tempted to take advantage of their attractive possibilities.

With engines having vertical valves in the head, straight rockers, pivoted in the centre, can be used, so that in this case also, the movement can be transmitted directly from the cams, using straight push rods. A certain amount of misalignment between the tappet and the heel of the rocker is tolerable, though this was often overdone in early motor cycles, and the bad geometry of the gear caused excessive angular trust and other troubles. I remember many cases where push rods flew out of their sockets, and one in particular when a rider of a certain machine (which had better be nameless), in accelerating smartly from a traffic stop, spiked a policeman's helmet with a push rod which tried to emulate a javelin!

Wear of the valve gear on early o.h.v. motor cycles was generally very heavy and it was many years before steps were taken to avoid this by enclosure and improved lubrication of the upper parts of the gear. This is not so important in a model engine which only runs for relatively short periods, but it is worth taking into consideration as a factor in the design. Simplicity was, however, the main theme of the *Kiwi* valve gear, in which plain push rods were used, fitting sockets in the (hardened) rockers and tappet heads. Tappet adjustment was obtained by means of eccentric rocker bushes, a method which is still extensively used in full-size practice and which I have

Below: Method of lubricating big end bearing of Kiwi engine, and the camshaft assembly.



always found more satisfactory than fitting turnbuckles in the push rods, or set screws in the rocker ends. These are invariably delicate to operate and lock effectively, and often increase the inertia of the moving parts. Tubular push rods, often used in full-size engines with the object of reducing inertia, are rarely of any advantage in a model, because of the difficulty of making them any lighter than a solid steel rod.

However well the minor features of engine design are arranged, this is of little avail unless the major working parts are made and fitted to work efficiently. In the *Kiwi*, plain bronze bearings were used throughout, because they are the easiest to fit, and work reliably under normal conditions. The potential advantages of ball or roller bearings are not always realised in practice, especially in machines where the rigidity and accuracy of the housings are open to question. It is always possible to correct a *minute* error in plain bearings by running a reamer through the pair of bearings *in situ*, but rolling bearings, except those of the self-aligning type, cannot be corrected after insertion. This is no excuse for bad fitting of any kind of bearing, but I know of many cases where an engine has been saved from the scrap heap by just that bit of latitude in fitting which plain bearings can provide.

Split crankcase

The type of split crankcase employed for the *Kiwi* and many other four-stroke petrol engines is relatively easy to machine in such a way as to ensure alignment of the main bearings. The individual halves can be held in the four-jaw chuck in turn for carrying out machining operations, including boring of the bearing housings, turning the joint face spigot and recess to a close fit, and any internal machining which may be necessary, at one setting for each component. But the boring of the camshaft bearings, and their correct location for proper meshing of the timing gears, presents a somewhat more difficult problem, which in this particular case was dealt with in the following way:

The timing half of the crankcase was mounted on the faceplate, timing case outwards, and the rim of this was set up to run as truly as possible, though its accuracy was not critical. It was then faced and the register recess machined. Before proceeding further, the timing endplate was then machined on the inner face and spigot, to fit closely in the timing case. Holes were then drilled and tapped for the countersunk screws to hold the endplate in position. The half-crankcase was then shifted on the faceplate to centralise the main housing bore previously machined. Any available aids to setting up, such as a mandrel of a size to fit the bore, set up between centres, should be used to obtain the closest possible concentric truth. After withdrawing the mandrel, the timing endplate is fixed in position, by its two screws, centre-drilled, drilled and bored.

The half-crankcase is again shifted by the amount necessary for the correct meshing of the timing gears—in this case $\frac{3}{4}$ in.—which can be gauged in any convenient way such as by clamping a guide strip against the top face, and interposing a $\frac{3}{4}$ in. gauge piece after shifting the casting. The camshaft bore is then centre-drilled, and drilled through both the endplate and the wall of the crankcase. Should there be any tendency of the drill to run out in the inner bore, the endplate can be removed and a boring tool used to correct it, as the size of the hole is not critical so long as the bush is made to fit. All bearing bushes are made to a tight press fit, and will contract slightly, so that reaming *in situ* will be necessary in any case. The outer camshaft bush is made long enough to project outside the endplate and form a seating for fitting the adjustable contact breaker bracket.

To machine the top face of the crankcase and the register recess for the cylinder spigot, a mandrel may be fitted through the two main bearings and turned down and screwed at the ends for securing matched angle brackets, by which the assembly is mounted on the faceplate. Temporary bolts or studs should be fitted to secure the two halves of the crankcase together during this operation, and it can be further steadied by parallel packings under the feet of the bearers. The latter may need machining or filing on the underside, which can be done after the top has been faced. The methods described here ensure parallel accuracy of the surfaces with the crankshaft centre, and I make no apologies for describing them in detail, as the principles involved are just as sound as ever, and can be applied to most types of engines. The *Kiwi* design has been modernised in the Mark II form, described fully in Vol. 123 and is still popular; some constructors may welcome some guidance on the important machining operations.

My original *Kiwi*, besides being used very successfully in three model hydroplanes, became a guinea pig (pardon the mixed metaphors!) for experimental work in the development of new details of design. These included an aluminium cylinder head with valves inclined at 60 deg. to each other, inserted hard seatings, enclosed push rods, and partially enclosed rockers with oil mist lubrication.

A dry sump forced lubrication system was developed, with a worm-geared plunger pump, which provided for circulation of oil and ensured a constant feed to the main and big end bearings. These were later incorporated in other self-contained engines, which by popular demand were fitted with ball races for the two main bearings. All these features were obvious improvements, and eventually resulted in higher performance besides more handsome appearance than the *Kiwi*, but it was not so easy to realise these advantages as it might seem, and one of the lessons these experiments taught me was to beware of the obvious and never take anything for granted.

To be continued

L B S C

Describes some more components for his 5 in. gauge MABEL, and then goes on to deal with some recent criticisms.

RETURNING to our 5 in. gauge version of Mabel, I mentioned that the same kind of horns as used for the coupled axles of the 3½ in. gauger could be used for the leading axle of the 5 in. job. Here are the drawings showing the small amount of alteration required. The height has to be reduced as shown to clear the sides of the cylinder castings. The only other variation is that the spring pins must be shortened, as there isn't much room under the front end of the frames. It was just the same on the full-size engines, and was the reason why old Francis Webb put the front springs above the running boards. Any of our more experienced workers who cares to take the trouble to make working leaf springs could follow his example, but the arrangement shown will be quite satisfactory. A couple of 19 s.w.g. springs under each leading axlebox will carry the weight of the cylinders and smokebox quite well.

Wheels and axles

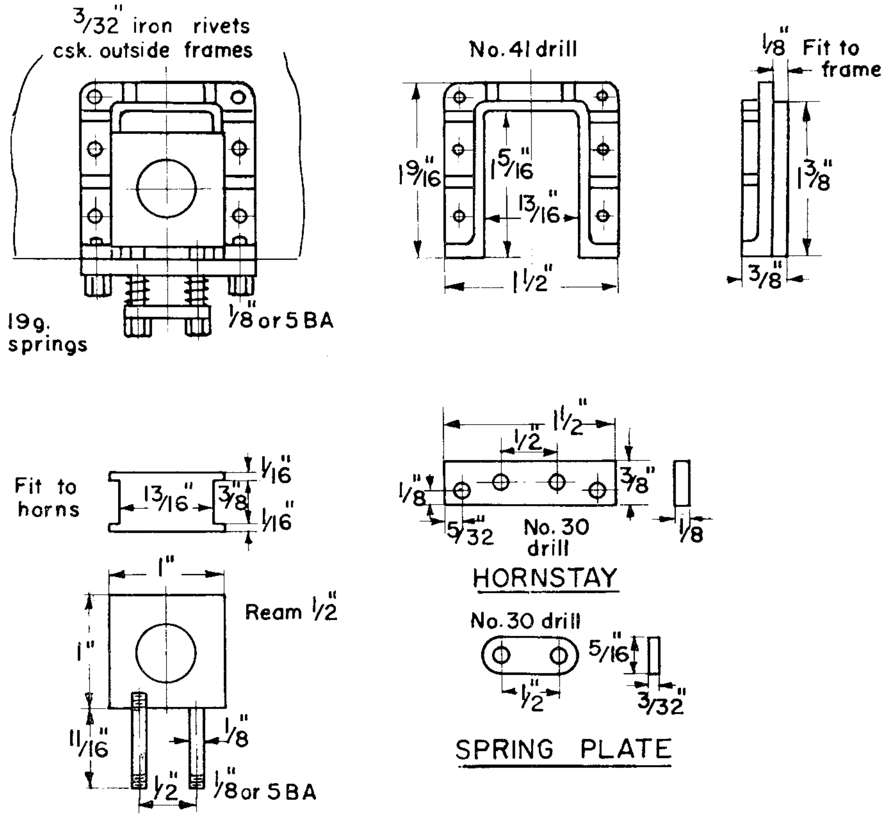
The leading wheels can be machined exactly as described for those of the 3½ in. gauge job, but unless you have a big chuck, the coupled wheels will have to be bolted to the faceplate. Fix them, back outwards, with four bolts between the spokes, a washer under each nut, and pieces of parallel packing between wheel and faceplate. Set to run as truly as possible, then face off the back (says Pat) true the flanges, and drill and ream the bosses. To locate them truly for turning the treads, turn up one end of a short length of ¾ in. or larger round mild steel to fit the taper hole in the lathe mandrel. Put it in tightly, then turn the projecting end to a nice sliding fit in the hole in the wheel boss, without any shake. Put on the faceplate, slide the wheel over the peg, and bolt it to the faceplate as before, with parallel packing between. As the peg will locate the wheel truly, you can go ahead with the turning with full confidence that the wheels won't wobble.

Unless your lathe has a hole through the mandrel large enough to allow the entry of ¾ in. round steel, and a chuck which holds truly within aero limits, it would be advisable to turn the axles between centres. The centre holes will come in handy afterwards for starting the drill when drilling the oil ducts.

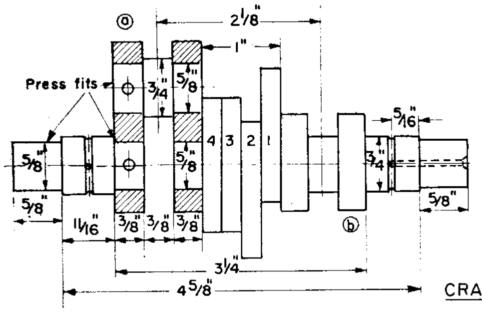
Crank axle

This is similar to the one I described years ago for the 0-6-0 GWR pannier tank engine *Pansy*, a 5 in. gauge job. I specified a three-piece axle with shouldered ends and press-fitted webs and crankpins. About the simplest method I have ever tried for getting all the holes in the webs dead square with the sides and true to diameter, is as follows: Saw off four pieces of 1¼ in. × ⅜ in. mild steel bar to a length of 2⅜ in. Rub both sides on a piece of emerycloth or similar abrasive, laid on something flat. Clamp them together, dead in line and not too tightly, and solder them into a solid block. On one end, carefully mark the position of the holes for shaft and crankpins, and centrepop them. Chuck the block in the four-jaw with one of the pop marks running truly. Put a 3/16 in. drill in the tailstock chuck and drill a pilot hole right through, keeping the drill well supplied with cutting oil. Follow through with a 23/64 in. drill, and don't force it, or it may forsake the straight and narrow path. Keep that well oiled, too.

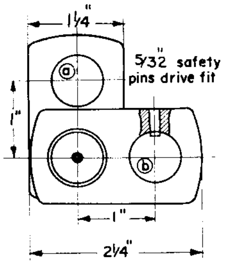
Details of the 5 in. gauge engine.

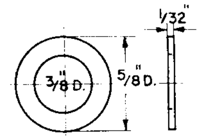


LEADING HORNBLOCK AND AXLEBOX

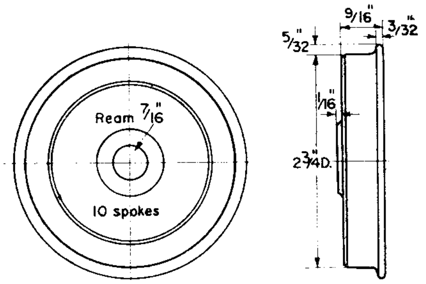


CRANK AXLE

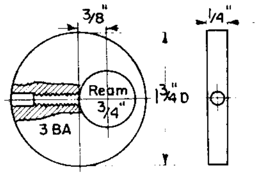




RUBBING WASHER



LEADING WHEEL



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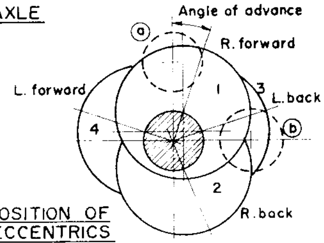


POSITION OF ECCENTRICS

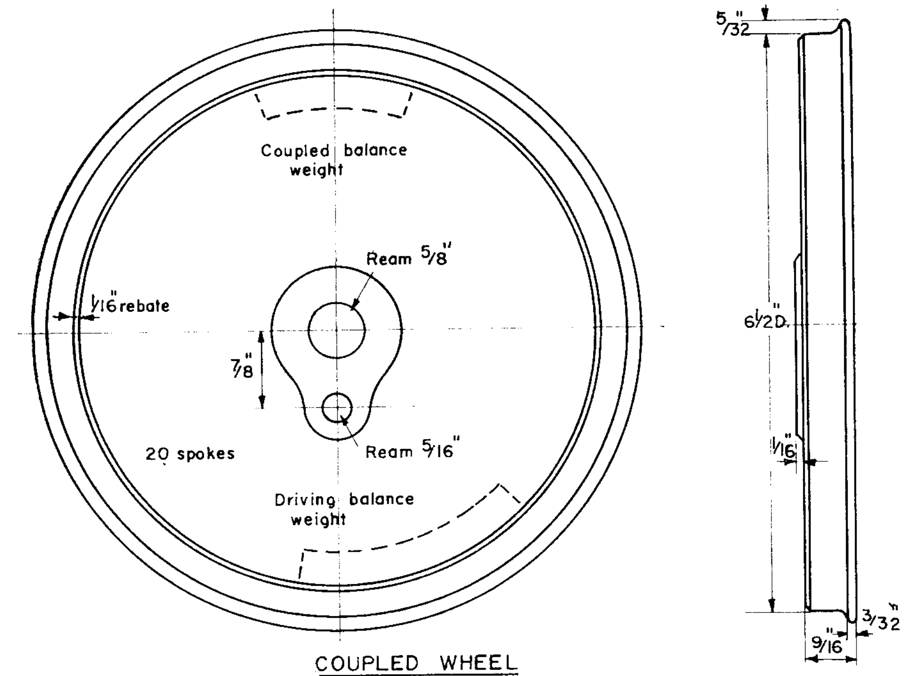
Now try the leading end of a ⅝ in. parallel reamer in the hole. The chances are, that it will just enter, as I have never yet met a drill which makes the *exact* size of hole that is marked on the shank. Anyway, if it won't enter, put a small boring tool in the slide-rest toolholder, and take a very fine cut through, like boring a cylinder. This will do the trick, and you can then put the reamer right through in the manner I described for cylinder boring, using plenty of cutting oil. Then reset the block in the chuck with the other centrepop running truly, and ditto repeato. To get the ends of the webs rounded to the radius shown, mount the block on a short mandrel driven into one of the holes, and held between centres. Use a round-nose tool, take light cuts, don't forget the cutting oil, and for goodness sake be careful how you feed the tool into cut. A little too much at the time, and BANG! Out flies the whole bag of tricks, and either gives you the K.O. or demolishes the workshop window. After rounding one end, drive the mandrel into the other hole, and perform an encore. Finally heat the block until it splits into four pieces, wipe off the superfluous solder, and Bob's your uncle.

Turn up the three pieces of axle, the crankpins, and the four eccentric sheaves; I've already explained how to turn press fits. Press the crankpins into the webs as described for the 3½ in. engine, press in the two end sections, and one end of the middle piece. Put on the eccentrics, and finally the other crank. Take the sharp edge off the spigot with a fine file while the axle is running in the lathe, so that you can start the crank on the spigot while you set it at right angles to its mate by eye. To get it exact, lay the axle with the pressed-on crank flat on the lathe bed or something equally flat, pushing all the eccentrics up out of the way. Then apply a try-square to the other crank, adjusting it so that the blade touches the web full length with the stock resting on the flat surface. The non-credit squeeze can then be applied —don't forget packing between the webs—and the whole gadget should then run quite truly. Put in the "safety-pins" as described for the smaller job.

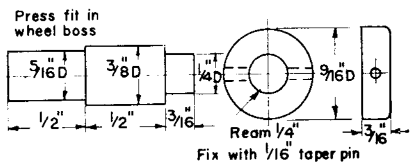
Erection

Instead of being nutted as in the 3½ in. gauge engine, the coupling rod pins have plain ends, the rods being kept in place by turned collars secured by 1/16 in. taper pins, similar to full-size practice. The erection of the wheels and axles can be carried out just as I described for the smaller engine, each inside crank being set exactly opposite (180 deg.) to the coupling rod pin on the same side. This brings the balance-weights right.

There are two ways of making the coupling rods. If you are lucky enough to own, or have the use of a fairly hefty milling machine, the rods can be milled up from two 10 in. lengths of ⅞ in. × ⅜ in. mild steel bar, in the same way as described for the 3½ in. gauge job. Any of our young readers who have plenty of muscle and the necessary energy, could



COUPLED WHEEL



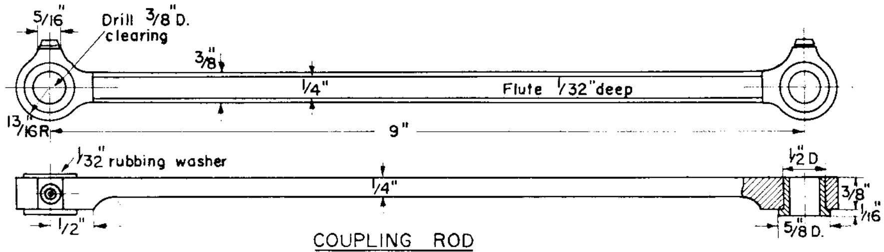
CRANKPIN AND COLLAR

tackle the job with saw and file. However, there is another way which cuts out much of the labour, and that is to use ⅜ in. × ¼ in. mild steel for the rod itself, brazing on pieces of ⅜ in. × ⅞ in. for the bosses. These can easily be machined up to the dimensions shown, on an ordinary small lathe or milling machine. In that case there is no need to bother about fluting the rods, as the flutes are merely for appearance sake in a small locomotive, and don't affect its performance in any way.

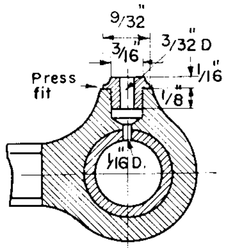
Mention of appearance calls to mind that little brass oil cups add a finish to the coupling rod bosses of a 5 in. gauge engine, so I have shown how they may be made and fitted, in a separate detail drawing. Turn them up from round or hexagon rod, as preferred, and press them in. On the L.B. & S.C.R. we used to put little cane plugs in the holes, cane being used in preference to corks, as it was porous and allowed air to enter the cups, so the oil flowed freely. On the D class 0-4-2 tanks, the coupling rods came very close to the underside of the running-boards on top centre; and if we went around a sharp curve, such as the one at Mitcham Junction, in a dickens of a hurry with an evening suburban train (the timings were all pretty tight) the engine would lean over, the plugs would hit the underside of the "gangway" as the enginemen called it, and be knocked in so darned tight that it was the very devil of a job to get them out if we wanted to pop in a drop of oil before making the return trip!

Curly Ejector

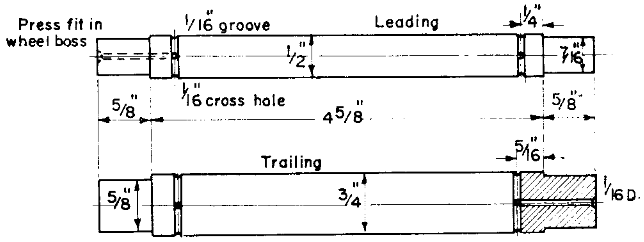
That will give builders of the 5 in. Mabel plenty to go on with, so let's now adjourn to the enginemen's lobby and deal with some of the points raised by correspondents. When building my Southern-type 4-6-0 mixed-traffic locomotive, I made and fitted what I fondly thought was—in the innocence of my heart—a Giesl ejector, and as I didn't like the idea of disfiguring the smokebox of my pretty *Swanhilde* with a flat fan-shaped chimney, I arranged the choke tubes and blast nozzles in a circle, and put them in a neat looking stovepipe. From a working point of view, the result was perfectly satisfactory, the engine steaming very well with a nice soft even blast, quite distinct from the sharp loud cracks of an engine fitted with the usual single blast nozzle and chimney liner. Now our worthy friend Dr. Giesl-Gieslingen says that my arrangement is not by any means the equivalent of the outfit with the fan chimney. All right, then we will just call my version a Curly



COUPLING ROD



COUPLING ROD OILER



STRAIGHT AXLES

ejector, and give Dr. G.G. credit for the idea!

However, there are two things that I don't quite understand. Dr. G. G. says that the ejector in a circular chimney has been tried out both in U.S.A. and Germany without *lasting* success. It's that word *lasting* that has me puzzled. As there are no moving parts to wear out and presuming that the ejector worked alright when first fitted, how is it that the effects didn't last? Anyway my engine has worked O.K. so far, but if the performance shows signs of going off, it will come out and be replaced by an ordinary single blast nozzle, with liner to match, before you can say Giesl-Gieslingen!

Item No. 2 is that Dr. G. G. says that his ejector is notable for quite a sharp blast, throwing the exhaust steam well clear of the chimney, Curious, but after reading the description of it, I gathered that a sharp blast was the very thing he wished to avoid. I must be getting dense in my old age! I haven't seen the Giesl-fitted Talyllyn engine, but correspondents who have, say that she doesn't puff, only purrs, and that is just what mine does. Our Editor is quite correct in quoting what I wrote, but I would remind him that this is when the engine is hauling my weight only; a very light load indeed for an engine of her power. As the intensity of the blast of any engine depends on two factors, the load she is pulling, and the percentage of cut-off, it is obvious that with a dozen passengers behind the tender, and the lever set to cut off at about 50 per cent, the blast would be sharp enough to throw the exhaust steam well clear of the chimney. I've tried it with the lever well over, and the car brakes on, to give her an artificial load.

Mention of light blast calls to mind that in the old days on the L.B. S.C.R. we frequently had to run "light"—that is, without any train—during the off-peak hours; for example, after working a train into Victoria, we might have to run light to Sutton, or Coulsdon, or some other place, to do the next spot of passenger-hauling. When a Stroudley D class tank was running light, there was barely enough blast to keep a small amount of fire going, and it was necessary to open the blower a little. No engine crew ever ran with a bigger fire than was necessary for the job. The coal allowance was 17lb. per mile for the engine, and 1¼ lb. for every two axles in the train. We were paid a penny per cwt. for all that we didn't use, and some drivers and firemen could make thirty shillings in a month, which went a long way in those days.

Sorry, Mr. Perrett

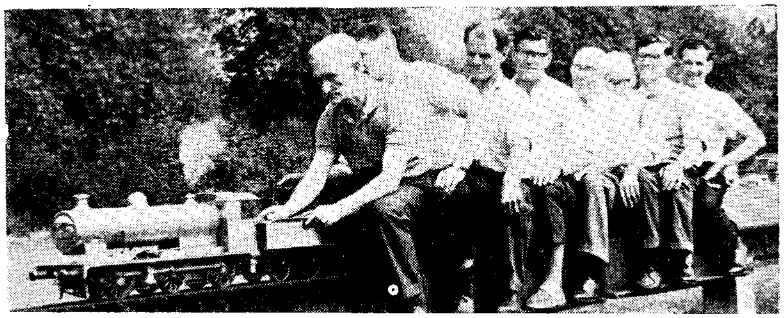
I hope that Mr. W. H. Perrett (Postbag, Sept. 2) will accept my sincere apology for anything in my notes about his engine that was incorrect, but in common fairness must explain that the blame doesn't lie entirely on my doorstep. My information came from a source that has hitherto been absolutely reliable, and so I took it for gospel. I would also like to congratulate him on the various blobs and gadgets that he has added to it.

Everybody has an undeniable right to make whatever modifications he pleases to any published design. I believe that there are 67 ways of running from Victoria to Dover—or there were, before Dr. Beeching got busy!—and what route you take matters little, as long as you get there. Similarly, if anybody fancies to put oil in the cylinders or water in the boiler by other means than those I specify, then it is just their choice, and that's that. All my engines are designed as simple as possible, and to be built in the easiest way, and once the basic work is finished, the job can be dolled up with all the trimmings and accessories that the builder desires.

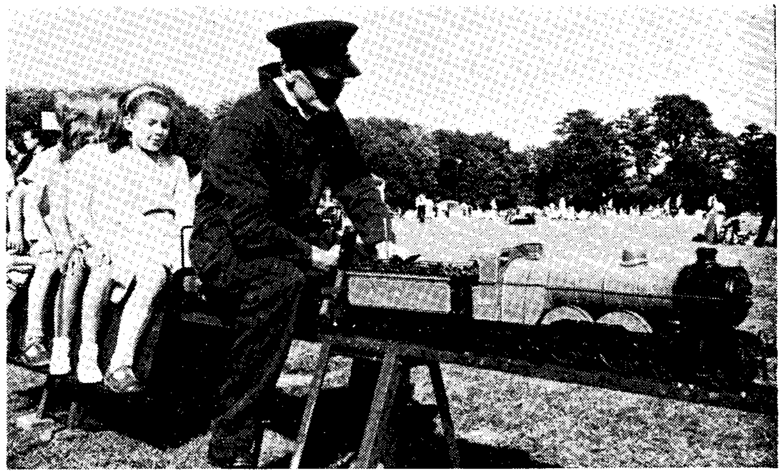
While on the subject, I might as well clear up once and for all, the quibble raised by certain people about the *Speedy* valve gear. As many shunting engines (they call them "switchers" in U.S.A.) were arranged for limited cut-off, to reduce steam consumption, I did the same with *Speedy*, as an experiment. It meant slower acceleration, but a saving of steam. She is a shunting engine, not a racing car! Anyone who preferred a longer valve travel, had only to lengthen the return crank a little, and reset it with a pair of dividers as per instructions. I intended to mention this in the articles on *Speedy*, which ran as a serial in the now defunct "Mechanics"—formerly "English Mechanics,"—but it was inadvertently overlooked.

In direct contrast to the above, one of my pictures shows a 5 in. gauge locomotive of LBSC design that *was* built to my instructions, and what is more to the point—it was built at a full-size locomotive works: to be exact, the Eastleigh Works Training School. It was built by the apprentices under the supervision of Mr. Denis Pack, who is driving the engine in the illustration. Mr. Pack is in charge of the school. He is the son of an Ashford top link driver, and migrated from Ashford Works to Eastleigh. His knowledge and experience of locomotives is therefore beyond all question, otherwise he wouldn't have been appointed to his present position. He says "I'm sure that many boys have had their introduction to the steam locomotive through this engine."

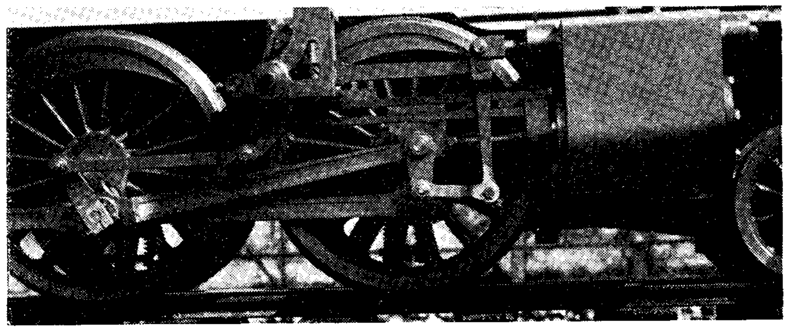
The engine does the job in the approved manner, taking little notice of the load shown in the photograph, which was taken last August on the line in Riverside Park, Southampton, by Mr. C. A. Bealing. She has had a few extra details added, in conformity with the full-sized engines (rebuilt C class) but basically she is a *Minx* (though not by nature!) just as I described how to build, in parallel with the much-maligned *Maid of Kent*. In passing, I might mention that a *Maid of Kent* is being built by someone who lives right close to my home. The chassis is finished, and goes fine on air pressure. The valve gear is exactly as I specified. Work is temporarily held up by the excessive price of the copper required for the boiler, but it is hoped that work will soon be restarted on the engine.



A Minx to 5 in gauge built by apprentices at Eastleigh Training School.



A 3½ in. gauge Maisie built by Mr. J. H. Mabbott.



The valve gear of Betty.

Another picture shows a *Maisie* built by Mr. J. H. Mabbott, of Guildford, who is delighted with her performance, and sent me a very nice letter of congratulation on the instructions. However, it isn't so much the instructions, but the way they are carried out, that makes a locomotive a success or otherwise, so I'm glad to congratulate Mr. Mabbott on his careful workmanship that made the engine a success.

Betty's valve gear.

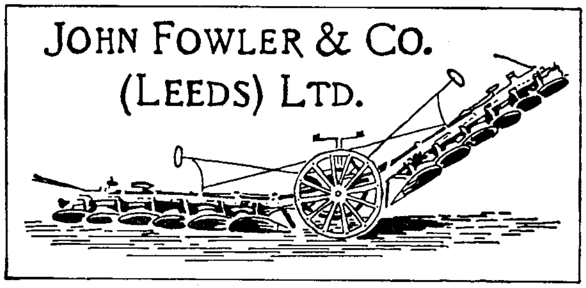
About 14 years ago, when looking through some journals of the Institute of Locomotive Engineers (my name was on their roll for many years, I only quit for personal reasons) I found a small drawing of a proposed 2-6-2 locomotive for the Southern Railway, designed at Ashford but never built, as she would have been too heavy for the line and bridges at the time. I thought, what a pity to waste the design, so I built one in 3½ in. gauge. She was really an enlargement of the 2-6-0 "mongolipers", and I called her *Betty*.

I made the usual Curly variations, one of which was in the valve gear. The "mongolipers" used the top half of the expansion link for going ahead, and the radius rod was lifted from behind the link. In my version, I used the bottom half for going ahead, and lifted the radius rod with the Gresley slot-and-pin arrangement just in front of the expansion link. I've had queries about this from time to time, the latest only a few days ago; and as luck would have it, happened across a close-up photo of the valve gear, which is reproduced.

Continued on Page 945.

FOWLER COMPOUND PLOUGHING ENGINE

TWO INCH SCALE



The Bunker, by J. Haining and C. R. Tyler *Continued from October* 21.

CONSTRUCTION of the bunker is a straightforward job, and can be approached as a separate unit from the rest of the engine.

It consists essentially of a water tank with upward extended sides and back to provide space for coal and a platform for the crew to stand on, and two alternative methods of manufacture are described, either being quite satisfactory and can be employed at the discretion of the builder.

The first method used by John Haining consists of utilising the sides, back and bottom of the bunker as the water tank Fig. 1, following full-size practice. The floor or platform forms the top of the tank, and it is filled through the filler casting on the back. Thence the water is pumped by mechanical pump, driven from the crankshaft, or by injector, to the boiler. A hand pump can and has been employed but is a diversion from full-size and requires constant pumping to keep the thirsty boiler replenished—a job one can well do without when the fire is getting low or a signal from the other engine of the pair indicates that the "pull" may be started. A mechanical pump is virtually essential, with the injector to provide extra water if required.

Make the side plates of $\frac{1}{16}$ in. mild steel sheet. Cut to shape with a bandsaw or hacksaw and clean up with a file not forgetting to remove sharp edges, a point which is well worth bearing in mind on all parts of the engine, as a sharp edge in a vulnerable position can provide a nasty gash. Mark out rivet pitches and cannon bracket mounting holes, centre punch and drill $\frac{1}{8}$ in. dia. holes, ensuring that the lines of holes are straight.

Nothing looks worse than a row of rivets which have the appearance of "a dog's hind leg". The riveters of the full-size engine were rightly proud of their straight lines of rivets, the heads of which in the early days were formed red hot and with sheer muscle power. Modellers of miniature engines—take note and keep up the tradition!

Cut the back and bottom from $\frac{1}{16}$ in. copper, leaving $\frac{3}{16}$ in. allowance around the developed shapes. Make two wooden formers from blocks of hardwood, and beat the copper

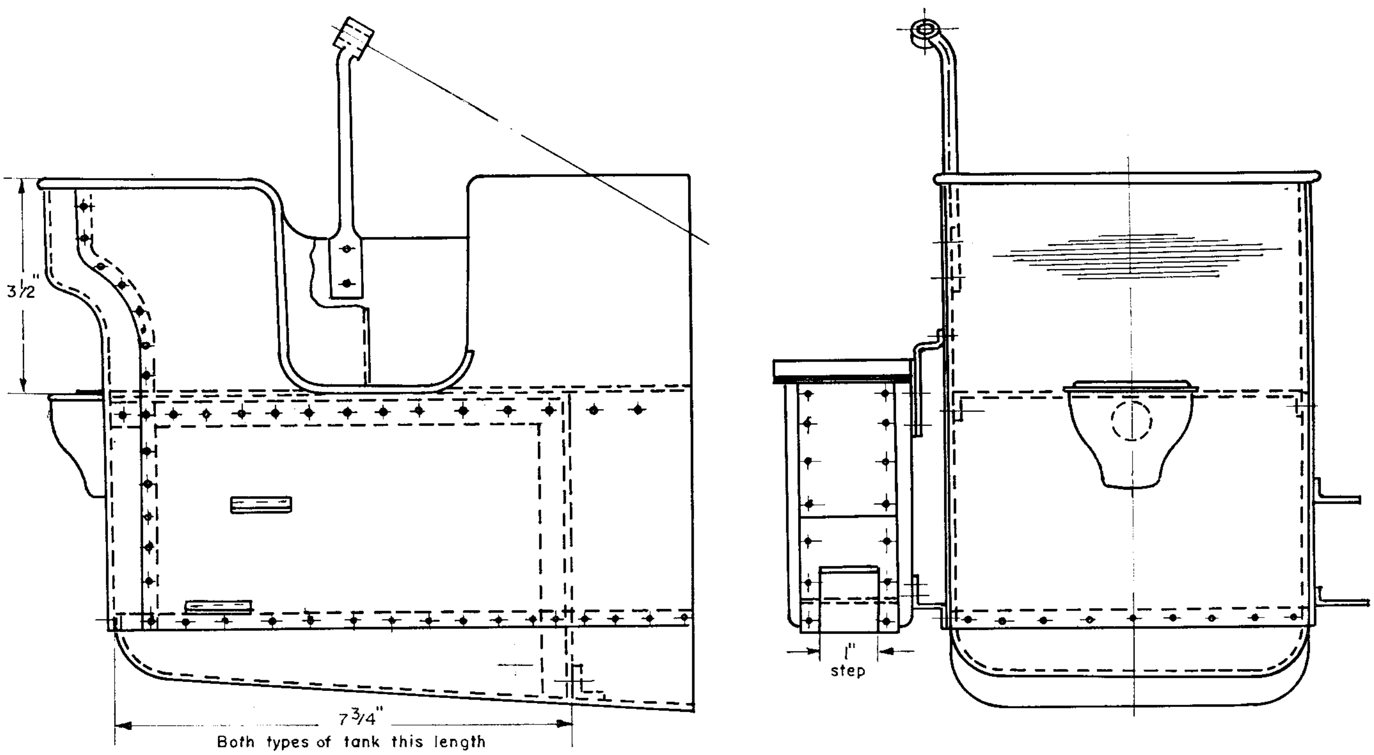


FIG. I TANK INTEGRAL WITH BUNKER

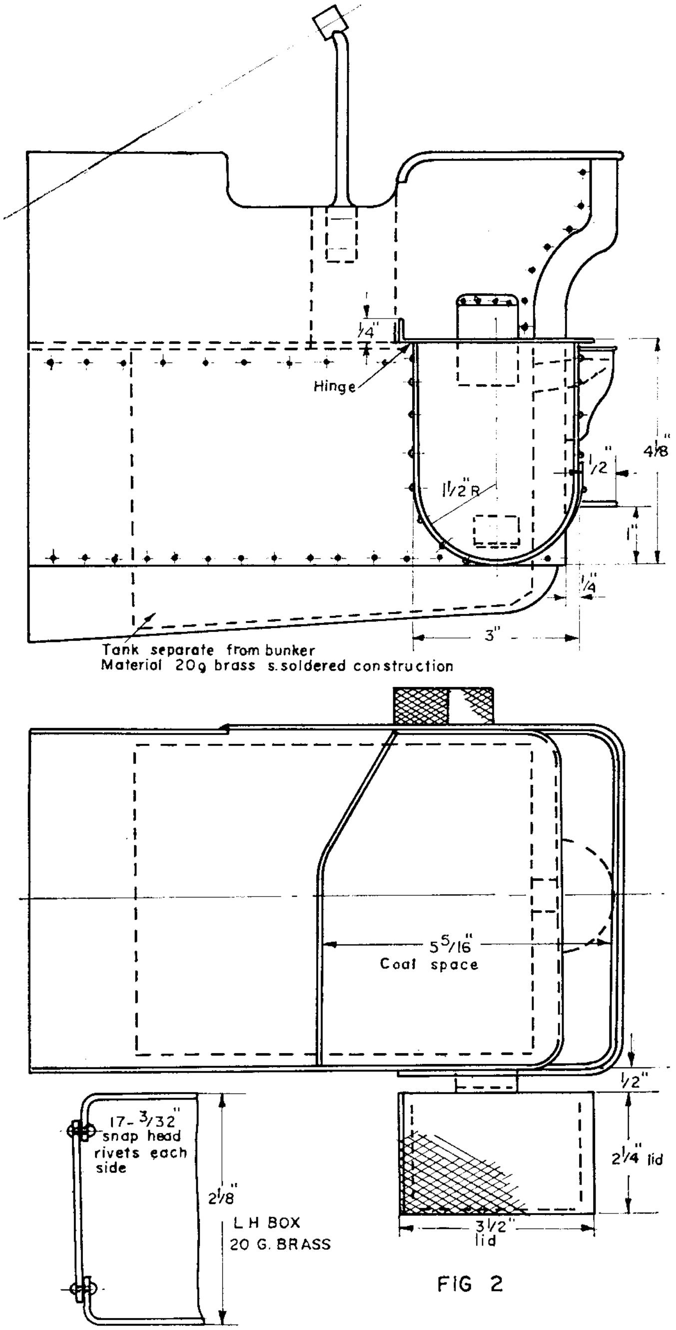
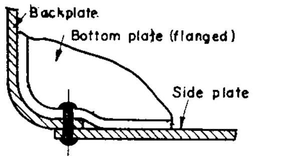


FIG 2

to shape on them. Work in easy stages from the inside of radii to the outside. In this way kinking can be avoided on corners. Should the copper work harden during forming, anneal by heating to a dull red and quenching in cold water. Take particular care on the back plate as the form takes a rather complex shape where the flanges and horizontal line at the top of the outward sweeping radius meet.

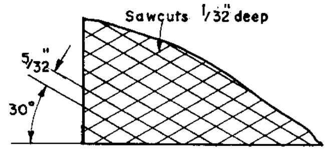
For forming, use a 2 pound ball-pein hammer, tapping round curves with the ball and smoothing surfaces finally with the flat end. Trim off excess material from the flanges. Drill $\frac{1}{8}$ in. dia. locating holes through the corners of the back and bottom, using the side plates as a jig and assemble the four items, using a sealing agent between mating flanges. Bostik sealer or equivalent is satisfactory for this.

Use $\frac{1}{8}$ in. dia. round head rivets of copper and "bump up" the corner rivets inside the tank, leaving the preformed heads



DETAIL OF PLATE JOINT. (BACK AND BOTTOM PLATES MAY BE CASTINGS)

FIG. 3



CHEQUER PLATING ON STEPS AND LID OF BOX

FIG. 4

on the outside and of course, using a dolly to support the preformed heads. Prior to each rivet being formed, place some sealer in the hole. It is unnecessary to countersink or form the rivets inside the tank. Now drill through the side plates into the located back and bottom, utilising them as jigs, and rivet up as previously described.

Care should be taken that the two corners where three plates abut fit snugly and are not distorted when riveting. Ensure also that the inside dimension between the forward ends of the side plates matches the outside dimension of the cannon brackets.

Make the tank top and front from 18 S.W.G. brass, form the flanges, rivet and seal to the side and back plates as above, thus making a watertight tank which is now ready for the addition of details.

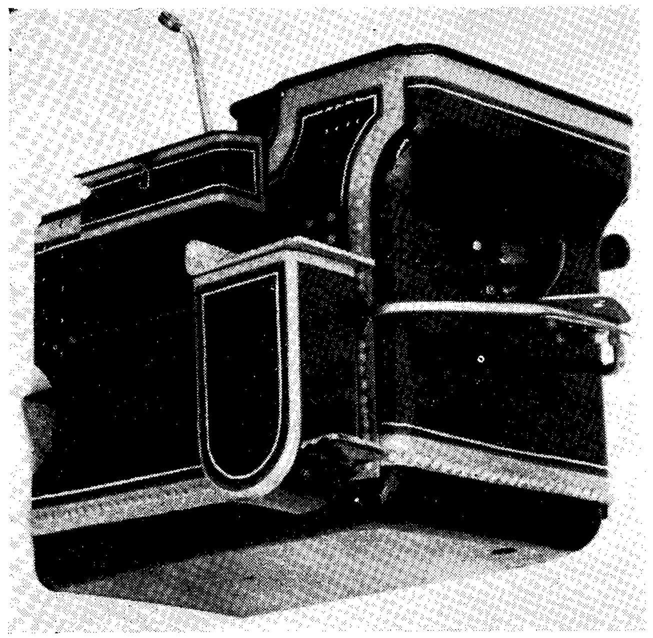
Before proceeding, an alternative way of construction as shown in fig. 2 may be outlined. This consists of making the bunker as a shell, inside which is inserted a separate water tank. Advantage is gained by utilising castings for the back and bottom plates in place of the copper items, thus saving time and expense on materials. For that matter, cast aluminium parts can be used in the first method of construction, but care must be taken to fit the corners snugly. By using castings and an independent water tank, the problems of sealing the bunker watertight are greatly relieved.

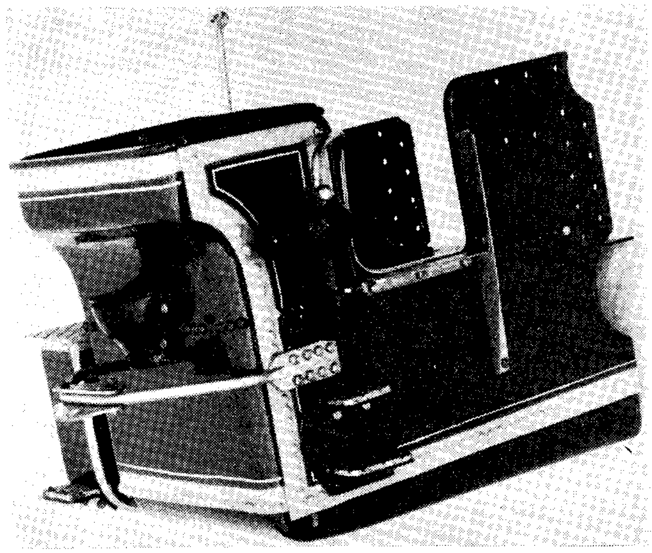
The tank is made of 20 S.W.G. brass of silver soldered construction and formed to have approximately $\frac{1}{8}$ in. clearance all round inside the bunker. Where the radii of the castings approach the corners of the tank, these can be made at 45 deg. angle to clear. The tank top forms the floor of the bunker, and the whole tank can be made easily removable by fixing in with 6 BA round head screws placed in strategic rivet positions to disguise them. All remaining rivets, which would otherwise be used to fix the floor to the sides, can now be made dummy and require a small countersink inside to retain them. Clean the dummy rivets off flush inside the tank to enable the flanges on the tank top to seat snugly on the bunker side.

Having made the bunker sides and drilled for rivets in exactly the same way as in the previous method, clean up the back and bottom castings and assemble again as above. Use soft aluminium rivets and omit the sealer. This type of material for rivets provides ample strength and is easily "bumped up" inside the restricted space of the bunker. A filler tube, $\frac{1}{2}$ in. dia. is silver soldered into the tank as is also the drain cock and connection to the injector. This last incorporates a gauze water filler to prevent ingress of dirt to the boiler and injector.

The filling tube is inserted through the $\frac{9}{16}$ in. hole in the bunker back, and this in turn is covered by the water filler proper, a casting which is first machined flat on the front surface and then riveted to the bunker back. Clean off the tube flush with the top of the casting and finish off with a hinged flap of 18 S.W.G. brass.

To overcome the problem of rolling the edges of the $\frac{1}{16}$ in. steel bunker edges, use $\frac{1}{8}$ in. dia. mild steel tube filed along its length to half the diameter. Drill $\frac{1}{16}$ in. dia. holes at $1\frac{1}{2}$ in.





Two views of the bunker of the model Fowler ploughing engine.

pitch along the length and form round the bunker edges, taking care that the radii on corners does not kink. Drill through the bunker edge, countersink both sides and rivet up with copper rivets. Finally, file the rivets, bunker edge and half tube smooth to give the required beaded appearance.

Add the manhole cover and two footsteps to the offside bunker plate. These are made from 16 S.W.G. mild steel, the steps formed to right angles and diamond pattern chequer plate riveted to them with $\frac{1}{16}$ in. rivets. The three items are then attached with $\frac{1}{8}$ in. rivets.

Two towing brackets are required and made from $\frac{1}{2}$ in. dia. mild steel with $\frac{1}{8}$ in. mild steel plates silver soldered to the ends, drilled for attaching to the bunker sides. A boss $\frac{7}{16}$ in. dia. drilled $\frac{3}{16}$ in. dia. is silver soldered to the end of the plough towing bracket. This enables the end of the plough to be hitched up to the engine for road towing. The second bracket has the general purpose tow pin which passes through two plates, in turn bolted to the brackets. A 4 BA bolt and distance tube are used to stiffen the assembly.

Similar construction to the tow brackets is employed for the steering column support bracket.

Make the two toolboxes from 20 S.W.G. copper or tinplate. The larger tool and spud box is a strip of material formed into a radius and flanges along the edges, using a wooden former. Cut the sides to shape and rivet together with $\frac{3}{32}$ in. dia. roundhead rivets. Diamond pattern chequer plate material forms the hinged lid. Owing to the high cost of purchasing this we made our own, using $\frac{1}{8}$ in. aluminium strip with hacksaw cuts $\frac{1}{32}$ in. deep cut at opposing 30 deg. angles, and pitched at $\frac{5}{32}$ in. thus giving the required diamond effect. A bracket of $\frac{3}{32}$ in. mild steel fixes the larger box to the bunker, while the small one is bolted on direct.

The water lifter is made in two halves from aluminium castings and bolted to the bunker side just behind the bunker door. This item can be made for appearance only, or working, as desired.

LBSC

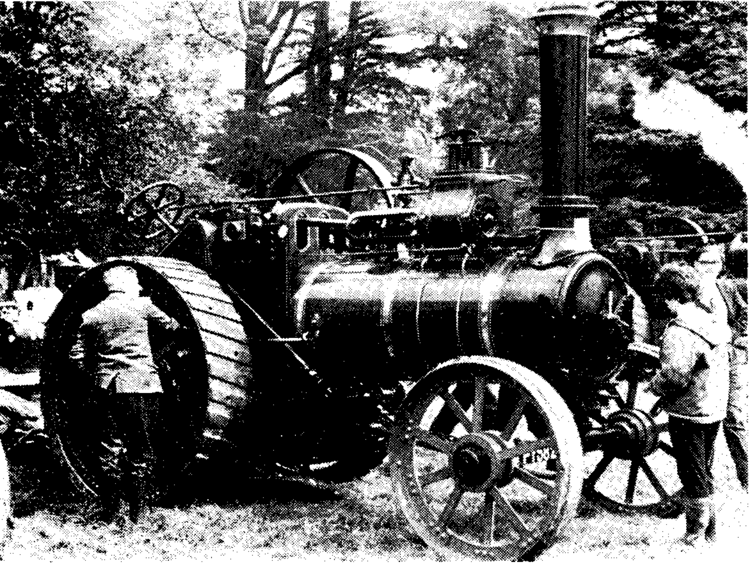
Continued from Page 942.

I arranged the whole doings to be as simple as possible, and at the same time to be robust enough to stand up to hard wear. An ordinary open expansion link is used, with a very long bearing pin on the outside only. This is carried in a cast bracket with a long bearing to match. The radius rod, to which the die-block is attached, runs against the inner side of the expansion link, and cannot get away from it, as the lifting arm bears against the inner side of the radius rod, and carries a die-block working in the slot in the radius rod. The lifting arm can't move sideways, as it is pinned to the reversing shaft, so the whole lot stays put.

The whole bag of tricks has done the job perfectly since the day it was erected; the engine will run with the die-blocks almost in mid-gear, and there is very little wear indeed in the long expansion link bearings, so that the timing is not affected.

The good folk who criticise LBSC should really make sure of their facts. The gentleman who wrote (I quote) "Perhaps LBSC was peeved because Mr. Bulleid refused at some time or another to pop round and play trains in his backyard", may be interested to learn that Mr. Bulleid, when lunching in London with Mr. R. F. Hanks, who at that time was Chairman of the Western Region Area Board, expressed a desire to see my four-cylinder 4–6–2 *Tugboat Annie* at work, also my workshop and railway. Mr. Hanks said it could be arranged, and I was looking forward to the visit, but unfortunately Mr. Bulleid was unable to make the trip up from Exmouth owing to failing health. I had previously had some correspondence with him about the engine, while he was in charge of Inchicore C.I.E. Works, and he told me about the one he was devising to burn peat.

There is just one other point that critics should bear in mind. I was building little locomotives (I have 23 highly efficient specimens here now) when some of them were either wearing nappies, or hadn't arrived on earth. During the latter half of the Kaiser's war I was in charge of a small works making aero-engine parts, and had to train unskilled girls to turn out work on lathes and other machinery, to limits set by the Aeronautical Inspection Dept. of those days. I had no difficulty in holding that job down, and those who follow my locomotive-building instructions are reaping the benefit of my actual personal experiences. ▣



Marshall No. 32092 "*Black Bess*" at Harewood

NORTHERNER

Reports on the Harewood Rally and the Market Drayton Carnival

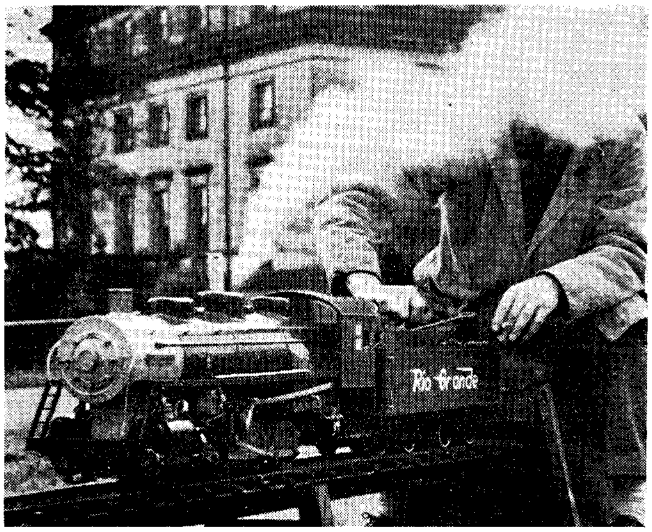
ARRIVING early—comparatively speaking!—at the Harewood Rally, we parked near the Leeds S.M.E.E.'s portable track, where some of the lads were raising steam ready for the fray. First on the track was Harry Barton with his *Caribou*, which performed, and looked, very well. This, his first locomotive, had occupied three years' spare time, and Harry emphasized that he had no trouble in its construction.

There was also plenty of other pre-rally activity going on with the big engines; motion being cleaned down, paint and brass being polished energetically, bunkers being filled, and Liversedge's famous Sentinel S-type tanker *Prince*, No. 8992 of 1933, going the round filling engine water tanks. Most engines can use their own hose and water-lifter to take water from *Prince's* 3000 gallon rear tank, but in case of difficulty there is always the 1903 Locomobile steam car engine and centrifugal pump on the Sentinel's running board.

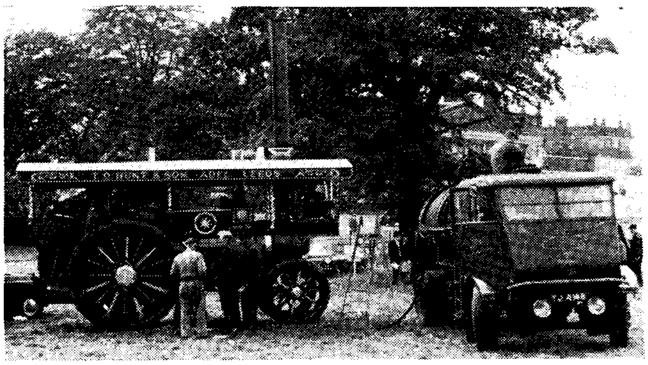
Prince's first "client" was T. O. Hunt and Son's 5 h.p. showman type Burrell *Marshal Foch* No. 3849. Built in 1920 as a 2-speed road locomotive, it was altered to 3-speed the following year and used for general haulage. During the war, in common with quite a few other engines, it was used on the demolition of bomb-damaged buildings, and it eventually finished its working days threshing.

True showman's engines—that is, built originally for the fairgrounds—included the Burrell No. 3256 *Lightning* of R. Preston and Son and the big Foster *Success*, No. 14632 of

Below: Harry Barton's "*Caribou*"

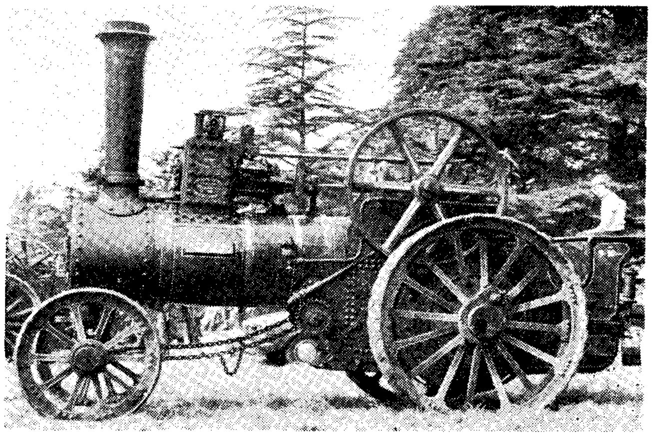


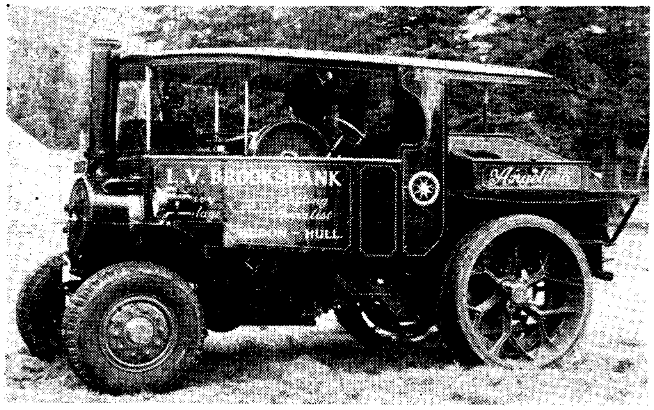
Savage 3-abreast Gallopers, owned by the Ashley Brothers.



Burrell 3849 "*Marshal Foch*" taking water from "*Prince*".

Below: Burrell No. 2426, "*Laddie*"—Norman Boyes of Bradford.





Foden timber tractor No. 12782 *of* 1927

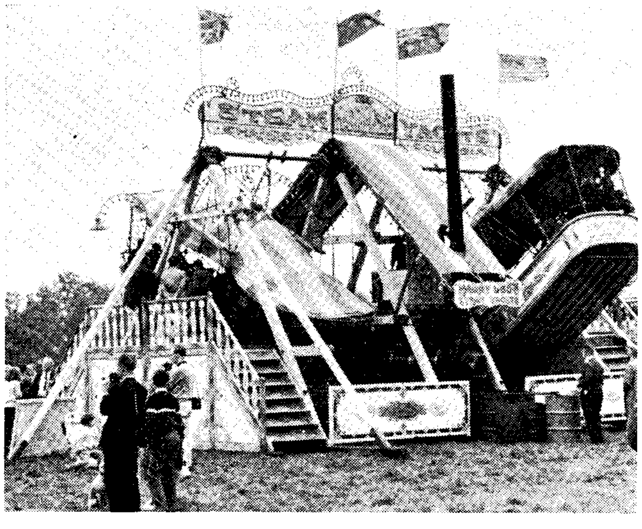
1932, delivered in 1934 to Hibble and Mellor and now owned by L. C. Byass and Son. The Fowler, No. 14862 *Evening Star* of M. D. Thackray and Sons, may also be counted as a true showman's; though it was built originally for the Ministry of Munitions in 1917, it was rebuilt by Fowlers as a showman's locomotive in 1919 for Jacob Studt, and spent its working life in fairground work.

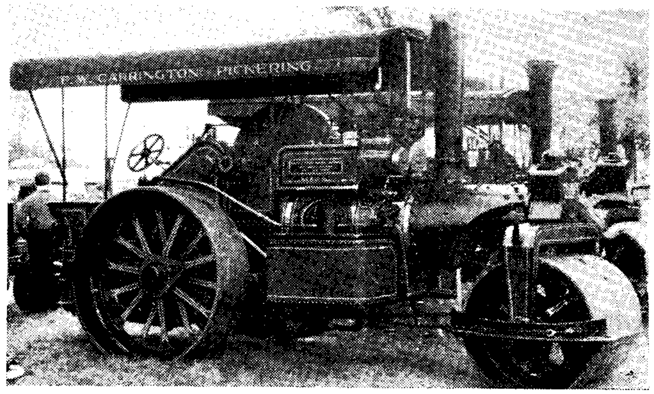
Besides *Marshal Foch*, there were two further modern conversions to showman style: the 8 n.h.p. Fowler No. 14948 *Prince of Wales* owned by E. and E. M. Meadowcroft of Crayke, and the Aveling and Porter tractor No. 12115 owned by A. Walker of Scarborough, believed to be the only Class AL tractor left.

To many people, one of the most impressive engines—tall and stately—was the Fowler 8 n.h.p. road locomotive *Perdita*, No. 9381, which was new to John Smith's Tadcaster brewery in 1902. They used it until 1918 for hauling beer and coal; it was then purchased by Johnsons, Amusement Caterers, and used as a showman's engine until 1938. From then until 1963 it was used by a firm of agricultural engineers, and is now the property of W. Chilvers of Selby.

In contrast was the rather unusual (and rare) Mann tractor No. 1260 owned by L. and W. Cole of Leeds, which is the vehicle's home town. This design was built principally for agricultural work, small and light in an endeavour to stave off the threat of the i.c.-engined tractor, and for one-man operation. The driver sits on a small footplate on the offside, with the coal bunker before him and the firehole door in the side of

Harry Lee's Savage Yachts "Britannia".





Fowler 12 *ton Roller No.* 16439 *"Billie".*

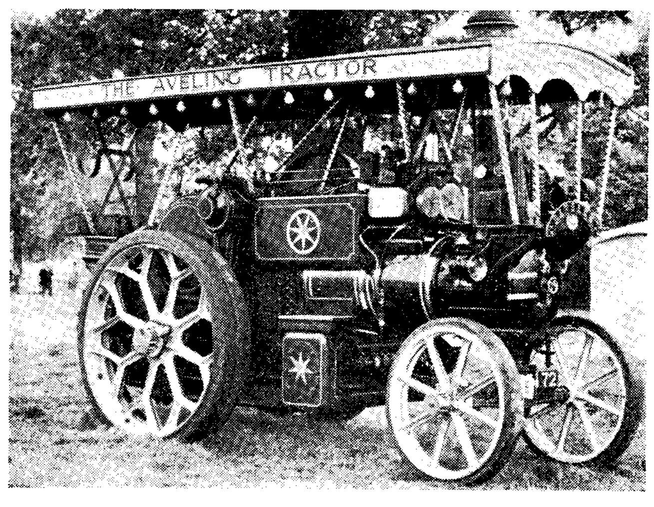
the box at his left hand. A wagon version was made, and I have also seen a photograph of a steam roller conversion.

Among the seven or eight other tractors were Fearnley's famous Fowler *Pandora* (*No.* 14406 of 1917), J. M. Crowther's very highly finished Aveling and Porter *Oberon* (No. 11839 of 1927, which worked for Dumfries C.C. until 1958), Duke Brewer's Robey No. 33957 *Village Queen* of 1922, and W Payne's Aveling No. 9228 *Barbara*, ex *Mons Star*, new to Hereford C.C. in 1920.

Besides the Sentinel tanker *Prince*, there were some seven or eight other assorted Fodens and Sentinels, including the very nice timber tractor *Angelina*, Foden No. 12782 of 1927, which has a winch on the rear axle and is owned by L. V. Brookbank of Hull. Six or so steam rollers included two originally from Dumfries C.C., F. W. Carrington's *Billie*, a 12-ton Fowler No. 16854, and Bert Barker's *Beatrice Mary*, a 10-ton Fowler No. 18507. This was new in 1931 as a "Fowler-Wood" tar-sprayer, with steam-heated tar tank, and was in constant use for roadmaking for the next thirty years. *Billie* worked until two years later, 1963.

Harry Lee of Bradford had his Savage steam yachts *Britannia* and *Columbia* well patronised (I described them in these pages in 1962) ,and the steam gallopers of Ashleys of Nottingham had plenty of riders too. This is one of the few sets of gallopers, if not the only one, to have remained steam-driven throughout its long life, and in the ownership of the same family. It dates back to 1888, the centre-engine being Savage No. 422 and the organ-engine No. 423, according to my records. Long may these two fine rides continue to entertain the crowds with their thrills and their organ music.

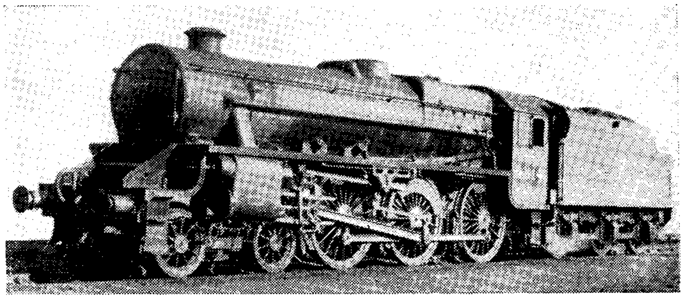
An Aveling tractor converted to "Showman's type" No. 12115.



The smokebox door and the boiler mountings

by Martin Evans

(Continued from page 864)



HIGHLANDER a $7\frac{1}{4}$ inch gauge LMS 4-6-0 Class Five Locomotive

TO COMPLETE the smokebox of our $1\frac{1}{2}$ in. scale LMS "Black Five" locomotive, we need the door and front ring, together with the usual details. A gunmetal casting would probably be the most convenient way of making the door, though a cast iron door is feasible. Instead of the door bearing against the flat front face of the front ring of the smokebox, *Highlander's* is a little more elaborate. The front ring, which may also be made from a gunmetal or iron casting, is first machined to fit the smokebox closely, then the front is faced in the usual way, but the register for the door is bored at an angle of 30 deg. as shown in my drawings. This can be done quite easily by swivelling the lathe top-slide to the required angle.

The smokebox door is now machined to match. It is not necessary to machine the inside, except to face the centre part for the hole for the "dart". I think this method of obtaining an air-tight joint between the door and the smokebox is rather more reliable than that usually used in smaller models, and it is also more in line with full-size practice.

It should not be necessary to secure the front ring positively in the smokebox. If it is turned to a nice hand push fit—which takes a little care—and then the joint smeared with plumbers' jointing, the ring should be firm enough to stand normal handling; but if builders have any doubt on this score, three or four countersunk steel screws—rustless steel for preference—may be put around the periphery in positions where they are not too obvious, yet accessible after the smokebox is assembled for keeps. In an engine of this scale, it should be comparatively easy to gain sufficient access through the door to the inside of the smokebox for routine chores such as tube sweeping etc.

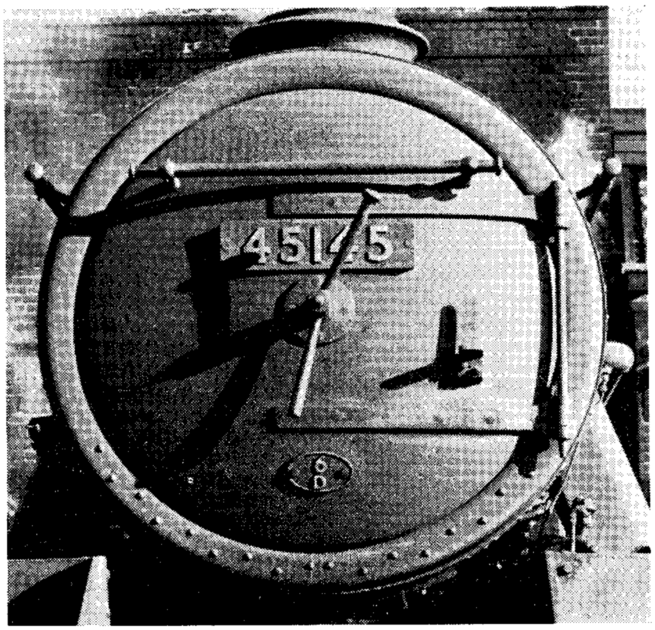
The door hinges could be made from German silver about $\frac{3}{8}$ in. square, which when polished up, would look nice against the black surface of the door, but enthusiasts will probably use stainless steel once again, which would look even better! It is important, in this connection, not to have the hinges too tight a fit on the hinge pin, otherwise the door will not close truly, and the engine won't steam.

Instead of the usual single cross-bar for the door, we can use two bars of $\frac{3}{4}$ in. $\times$ $\frac{3}{16}$ in. b.m.s. laid endwise and riveted together. A crossbar of this type is much more resistant to bending in the middle under the pull of the dart than the single bar. The crossbar is held loosely in position on the back of the front ring by two little brackets machined out of b.m.s. about $\frac{1}{2}$ in. $\times$ $\frac{5}{16}$ in., and riveted to the ring with two $\frac{3}{32}$ in. iron rivets each.

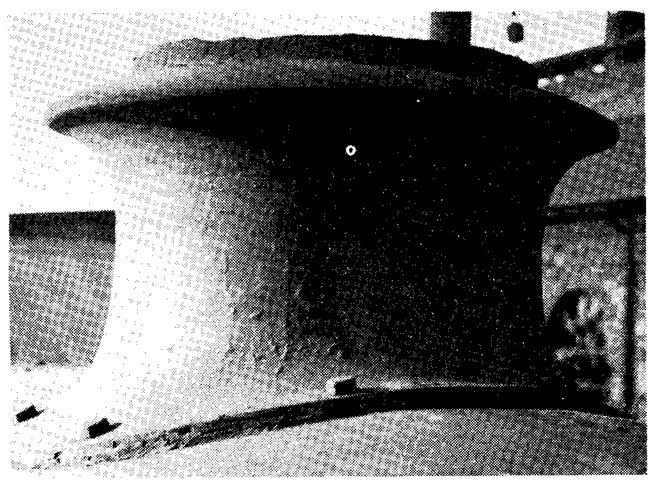
The dart is machined from $\frac{5}{8}$ in. $\times$ $\frac{1}{4}$ in. b.m.s. bar, or the nearest larger, and the inner end is shaped to provide an easy entry and pick-up with the cross-bar. The handles could also be made in stainless steel with advantage, though mild steel would be quite strong enough, the handles being silver soldered into the bosses, one of which is tapped 2 BA and the other opened out to a $\frac{3}{16}$ in. square.

We now come to the final assembly of the whole boiler,

Below: Details on the smokebox door.



Below: A close-up of the chimney.



and to obtain the correct alignment, the boiler must first be held temporarily at the firebox end, while bolts are put into the saddle, through the holes in the main frames. To ensure that the boiler is fitted truly horizontally—not as easy as it sounds with a taper-barrel boiler—the engine should be set up on some true surface, and the driving and coupled axleboxes clamped in their correct running position. A measurement should then be taken from the base to the top of the barrel where it joins the smokebox, and another measurement taken over the top of the barrel just where it enters the throatplate. The difference between these two measurements is then the key to the situation, as the difference in the diameter of the two ends of the barrel can be measured fairly accurately beforehand.

A further check should be made at each end of the smokebox.

It will now be possible to determine the exact position on the sides of the firebox to which to attach the upper angles of the "expansion joint". These are 2¾ in. lengths of brass angle ½ in. × ½ in. × ⅛ in. and are screwed to the firebox with four 2 BA gunmetal screws, the threads of which are smeared with jointing to prevent leakage.

Incidentally, great care should be taken to ensure that the chimney stands up quite vertically. Nothing spoils the appearance of a locomotive so much as a crooked chimney. A good dodge to get this right is to obtain a straight length of round material, almost any metal will do if true, machine one end to a close fit in the blastpipe orifice, and to the upper end fit a turned washer an exact fit in the top of the chimney liner, the rod being long enough to stand at least 18 in. above the top of the chimney. We then have something to "sight", or better still something against which an accurate measurement can be taken from the base.

The upper angles of the expansion joint rest on top of the frames, so that the weight of the rear part of the boiler is taken here. All we then need to do is to cut and fit two similar pieces of brass angle to rest on top of the angles fitted to the firebox, and put further screws, which may be hexagon-headed here, through the second angle and into tapped holes in the frames.

Finishing Touches

We now come to some of the finishing touches of the engine, the chimney, dome and top feed cover, and the buffers and couplings. Gunmetal castings are probably the most convenient way of making the chimney and dome cover. The underside of both these components can be filed by hand, but this is a long and tedious process, if a good fit is to be obtained. As it is unlikely that a chucking spigot would be provided in such large castings—for reasons of economy—some other way must be devised to hold the castings for fly-cutting. A method which I have used with success is as follows: First the chimney. The casting is set up to run as truly as possible in the 3-jaw chuck, underside outwards. It is now bored right through to finished size, that is to a tight push fit on the inner liner, which is nominally 2¼ in. outside diameter. A length of heavy gauge steel tube is then chosen of such a diameter that it can be turned to a tight push fit inside the chimney casting. The exact length of this tube will of course depend on how it is to be held in the lathe while the fly-cutting is carried out, but it should not be less than 3 in. not including the length of the chimney.

Before pushing the tube into the chimney casting, file two flats on the protruding part, so that it can be more readily clamped on the top-slide or wherever it is decided to hold it on the lathe. On many lathes, it will be found quite convenie to clamp the tube directly under the toolholder, if this is of the old-fashioned English type. Alternately the top-slide could be removed and an angle plate used with a substantial vertical slide. In fact there are several methods of holding the chimney that will occur to the lathe expert. The actual fly-cutting operation is quite a simple one. I have several home-made fly-cutters, with chucking bodies ranging from ¾ to 2 in. dia. and these are fitted with ¼ in. round H.S.S. toolbits set cross-wise and clamped with an Allen screw. All one has to do is to set the cutter point out to 4 in. from lathe centre, when an exact fit on the outside of the smokebox can be obtained.

To complete the chimney, all we now need to do is to drive the casting off the tube "mandrel", and put it back again the other way round, alternatively simply drive it down to the other end of the tube. It is then mounted in the 3-jaw, with the top now on the outside for machining as far as possible, though the outer radiused edges will of course still have to be finished by careful filing, using small round and half-round files and plenty of patience! The edges should be finished off quite thin, not more than $\frac{1}{32}$ in. thick, otherwise the chimney will look rather clumsy.

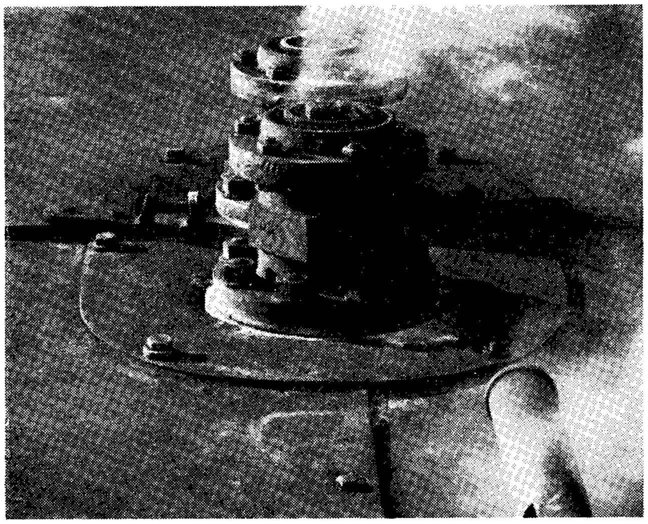
Although not essential, the chimney can be additionally secured by eight 8 BA hexagon head screws, put into tapped holes in the smokebox. The screws should be those having 10 BA size heads to look right.

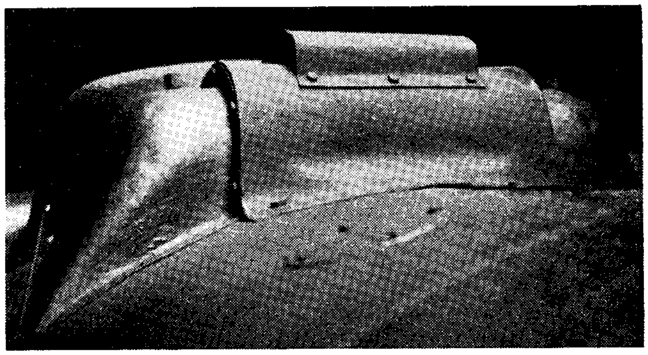
Machining of the dome casting may be done in a similar way to the chimney, except that brass rod or thick tube must be used, soft soldered to the top (which must of course be cleaned off first) and when clamping the dome by its temporary holder, it must be set at a slight angle to the horizontal, to compensate for the taper on the top of the boiler. After fly-cutting, the inside can be machined and a $\frac{3}{16}$ in. dia. hole drilled through the top, after which the brass chucking piece is melted off and re-soldered to the inside. Rod is better in the second case, as a 2 BA hole can be drilled and tapped in its end, and this used to locate the dome accurately for machining the outside.

The top feed cover is a tricky component to make, unless the builder is an expert in sheet metal work. Those who are not, may prefer to make the outer parts from solid brass, finishing the outside by filing, and the inside by end milling. The middle part, which is really like a box of semi-circular section, can be bent up from sheet brass and soft soldered to its base, and the outer pieces, which form covers for the feed-water pipes, soldered to the centre part.

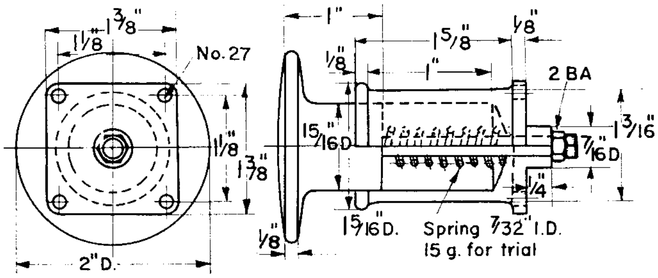
Just a word about the screw couplings. The type shown in my drawing is the original design, with left and right-hand threads. I believe this dates back to the Fowler era, but was used on some of the early Stanier engines. The type seen in one of my photographs uses a single right-hand screw and double links to connect to the drawhook. A drawing of this variety will be given later.

No difficulty should be experienced in making the buffers, which are a simple round-headed type. The stocks are machined from 1⅜ in. square b.m.s., and are held to the buffer beams by four 4 BA hexagon-head screws. The heads are turned from 2 in. dia. round mild steel, and the spindles are made from $\frac{3}{16}$ in. dia. silver steel. For the springs, 15 s.w.g. should be about right, though many builders may prefer something a bit heavier for the engine buffers, perhaps 14 s.w.g. Care shou1d be taken to trim the springs off square at the ends, which will help to give a smooth action when the heads are closed.

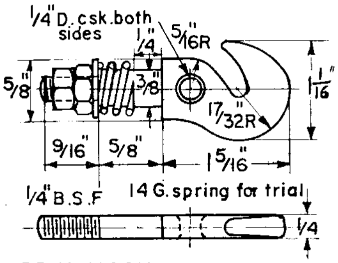




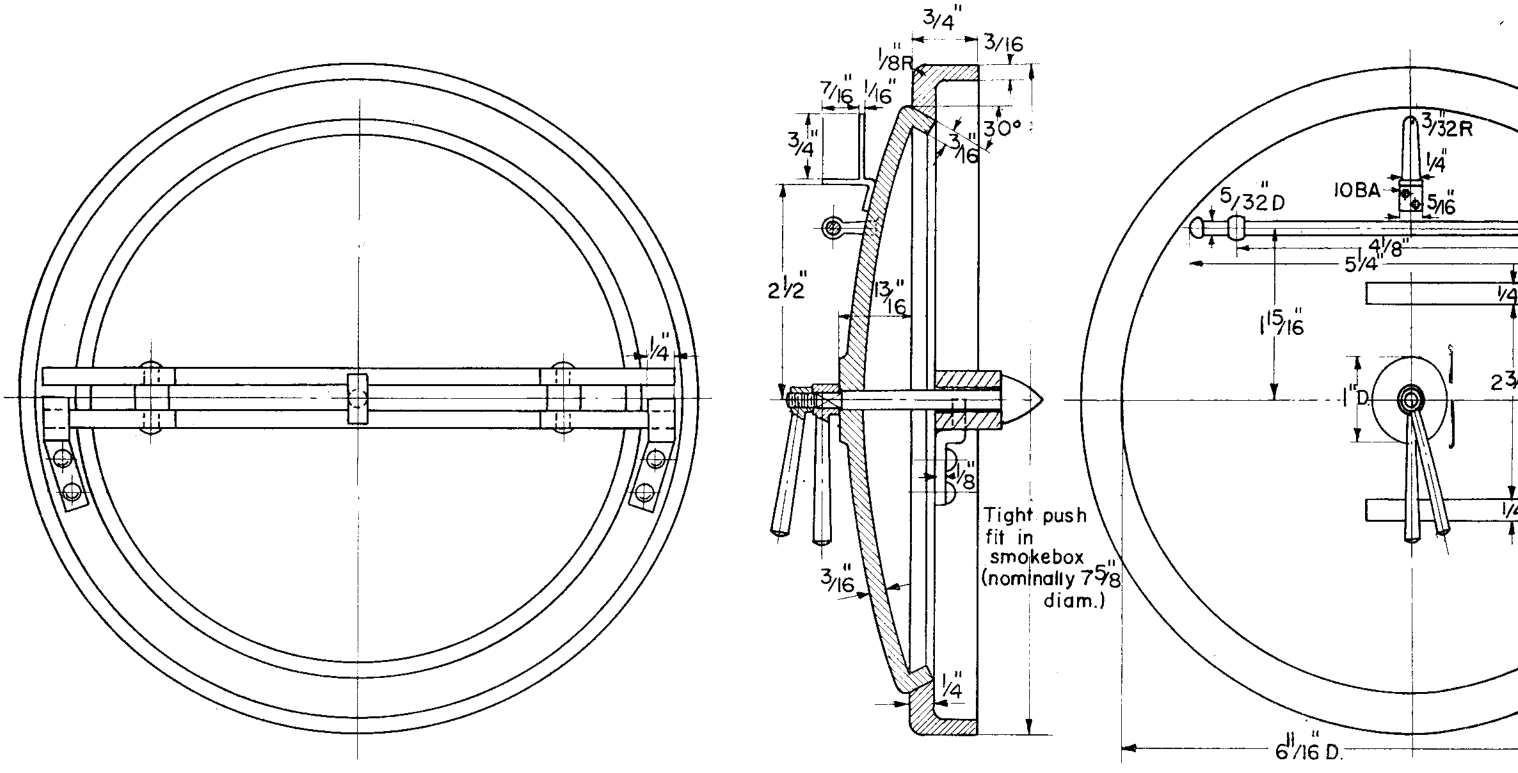
The top-feed cover
Left: A view of the two safety valves.
Photographs by E. G. Webb



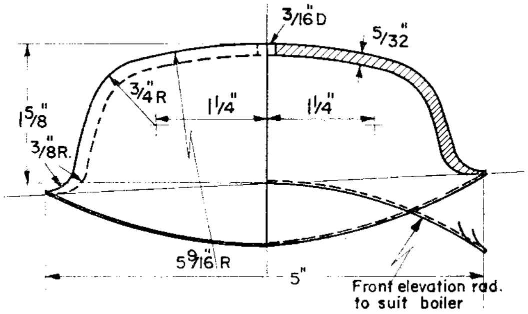
BUFFER 4 OFF BMS



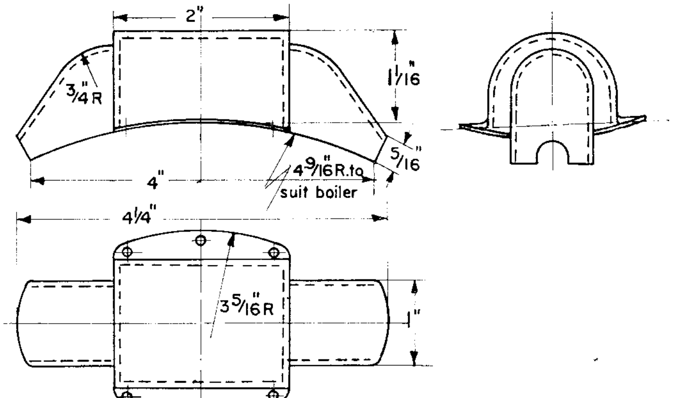
DRAWHOOK 2 OFF BMS



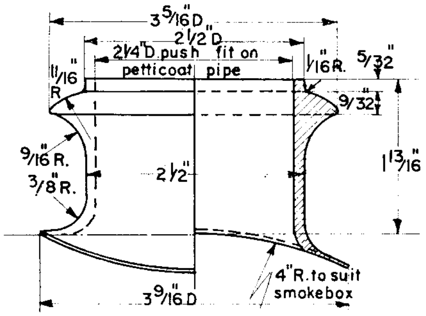
SMOKEBOX DOOR AND RING Door Brass Ring-Brass or Gunmetal



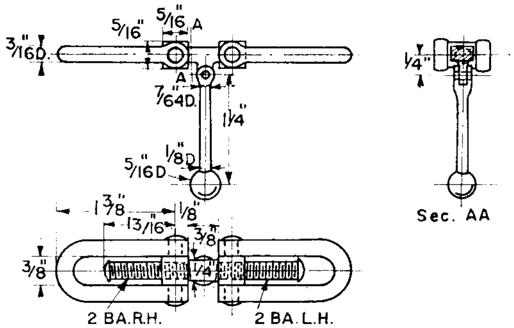
DOME   1 OFF   GUNMETAL



TOP FEED COVER

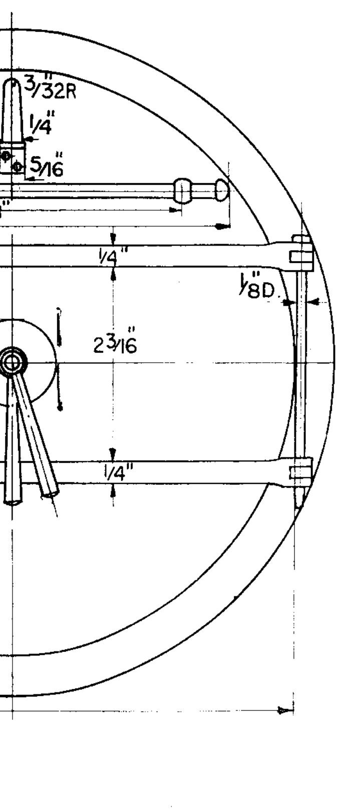


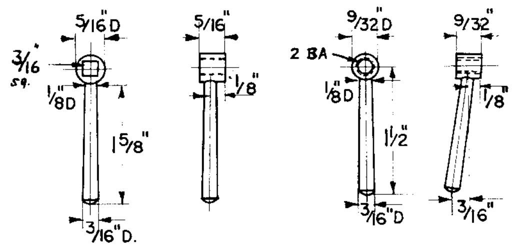
CHIMNEY   1 OFF   GUNMETAL



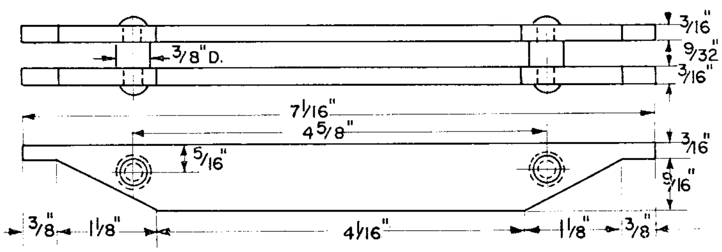
COUPLING   2 OFF   BMS

FURTHER DETAILS FOR THE 7¼" GAUGE L.M.S. 4—6—0 LOCOMOTIVE

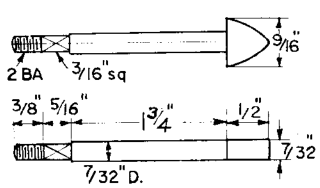




SMOKEBOX HANDLES
1 OFF EACH   BMS



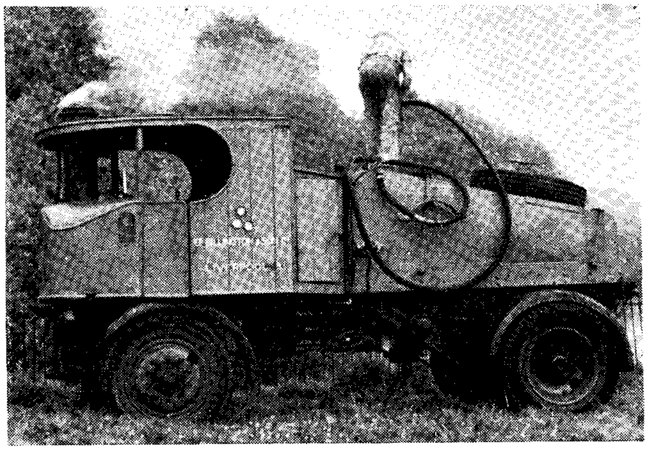
CROSS BAR   1 OFF   BMS



SMOKEBOX DOOR DART
1 OFF   BMS

MARKET DRAYTON CARNIVAL

by W. J. Hughes



Norman Harrop raising the hose after water lifting at Winterley Mere: Super Sentinel No. 5558.

DESPITE heavy showers at intervals, Norman Harrop and I had a good time taking our Super Sentinel No. 5558 down to the carnival and rally at Market Drayton. (Our third partner Edwin Clarke couldn't make it that day). The engine had been left at Goostrey, along with Les Mellor's Sentinel No. 3899, following the previous Chelford rally.

When we arrived to light the fire, we found Les and his mate already had theirs going well in No. 3899. This engine, believed new in 1920, was until recently one of the fleet owned by a well-known Sheffield steelworks; several engines are still running there. It is still on the original wheels shod with solid rubber tyres, though the latter are very tatty indeed by now. The platform is covered with heavy steel plate, and the back of the cab is similarly shielded, to prevent hot ingots and similar loads from accidentally joining the driver behind the wheel.

Les set off long before us—we had to wait until sufficient steam was raised before we could move forward to refill our big tank from a maddeningly slow-running tap and hose. During the previous week we had re-made the steam connection to our water lifter, which is mounted on top of the tank, but had had no opportunity to try it out and did not feel like chancing it, in case it refused to lift at a crucial time.

On the road, however, we did have a good opportunity to test the lifter at Winterley Mere, which lies at the side of the A534 between Sandbach and Crewe. It used to be a regular watering-place for steamers in the old days, but a local inhabitant, pleased to see us using it, remarked that we were the first he had seen to do so for more than twenty years. Happily the water-lifter worked well, though with a nasty "blow" from the upper connection. But another copper washer in the gland nut has cured that.

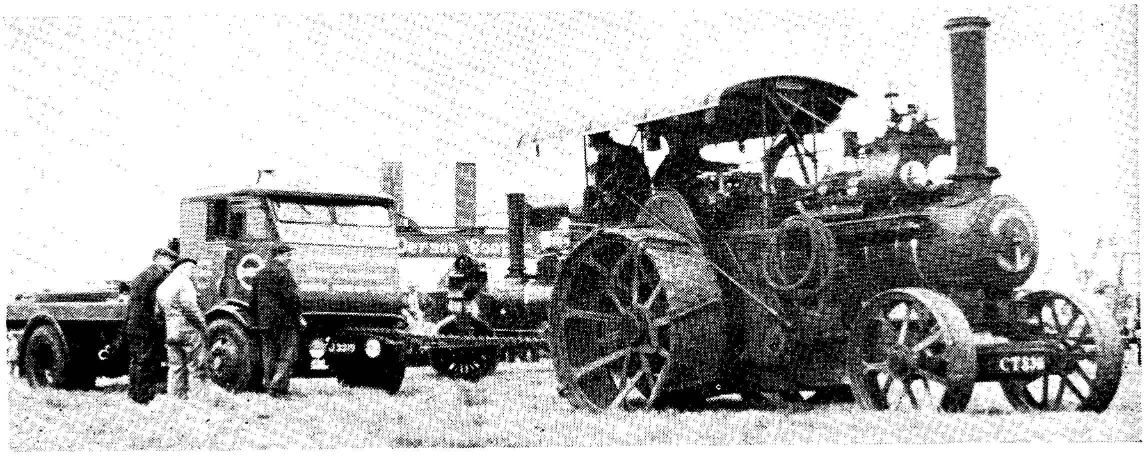
We passed the solid-tyred Sentinel a few miles out of Market Drayton, and soon joined a long queue of cars all heading for the field. This was frustrating, but gave a good opportunity to practise the slow manoeuvring which the controls of a Sentinel allow.

On the field itself, the ground was very soft, but we managed to keep going by avoiding the worst of the ruts until we reached the rally field beyond. Here conditions were much the same, and after one or two events had followed the grand parade it was very dicey indeed. In an obstacle race, for example, No. 5558 was lucky enough to get away, and to complete the course whilst Phil Wedgwood, in Alan Williamson's Sentinel S4 (No. 8884) was stuck with spinning wheels digging in and a dozen onlookers trying to push.

Bob Lee then came to the rescue with his 8 n.h.p. Fowler No. 15771, which with spuds on extra-wide hind wheels was able to make light of the conditions. A little later, at the very chewed-up entrance to the paddock, it was our turn to require assistance from Bob and his engine, which was to help several others too before the day was over. This big Fowler was originally used by the Smith's Crisps firm on one of their Lincolnshire farms: hence the wide-rimmed Fenland wheels.

Music was provided by Alan Barber's Mortier organ, a very melodious instrument of which he is justly proud. Jim Deakin's famous Foster compound *Winnie* (No. 12539) provided the electricity for part of the day, following Phil Swindlehurst's Burrell Showman's engine *Rajah*, No. 3509.

This was a one-day event, but several of the engines were to be left at Market Drayton to travel on to Church Stretton the following weekend. These included Les Mellor's Sentinel, and we had agreed to take him, his mate and young son back to Goostrey to pick up his transport there. The cab of a Super Sentinel looks pretty large from outside, but a big coal-bunker and boiler do not leave much room for five people! However, we managed quite well, though we were not sorry when just before the half-way mark we saw Edwin approaching with his Oxford "Traveller" empty, to relieve the pressure. ▣

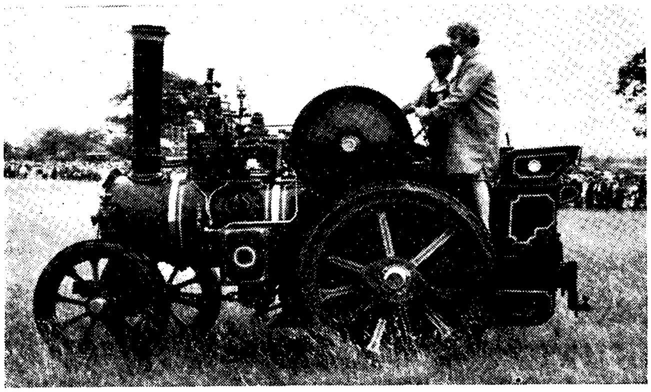


Bob Lee's 8 n.h.p. Fowler lends assistance to Alan Williamson's S.4. Sentinel.

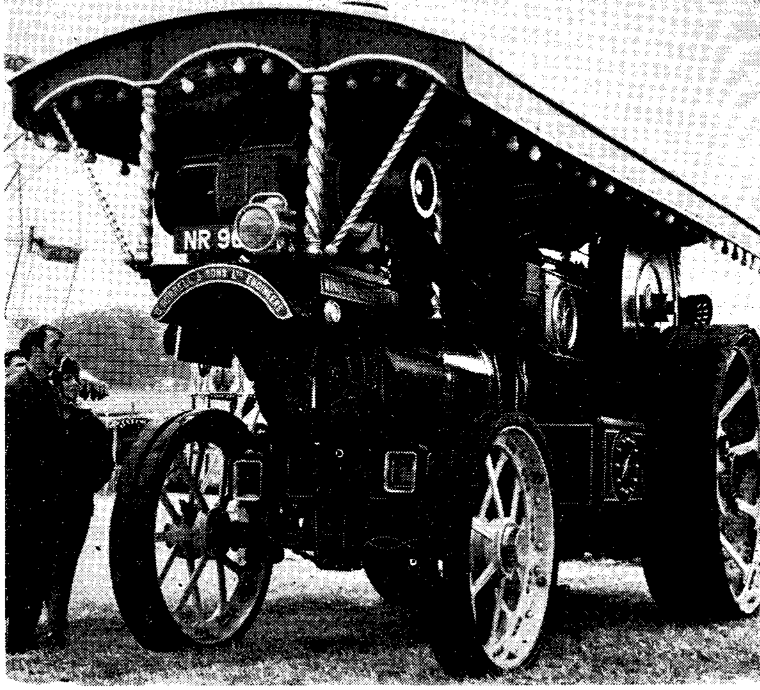
THE PICKERING RALLY

August 6th — 7th

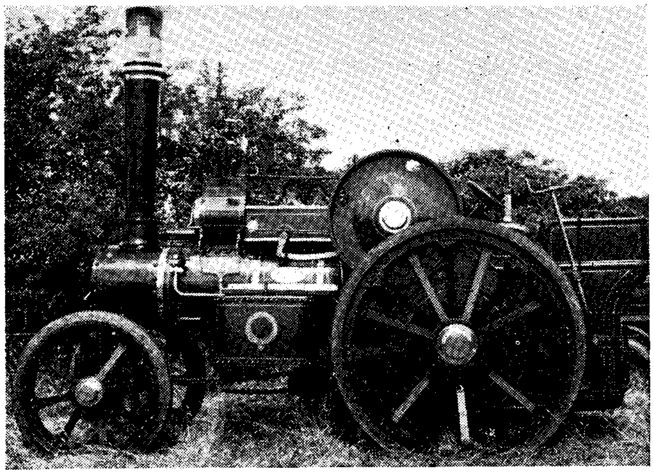
PICTURES BY F. W. ARGUMENT



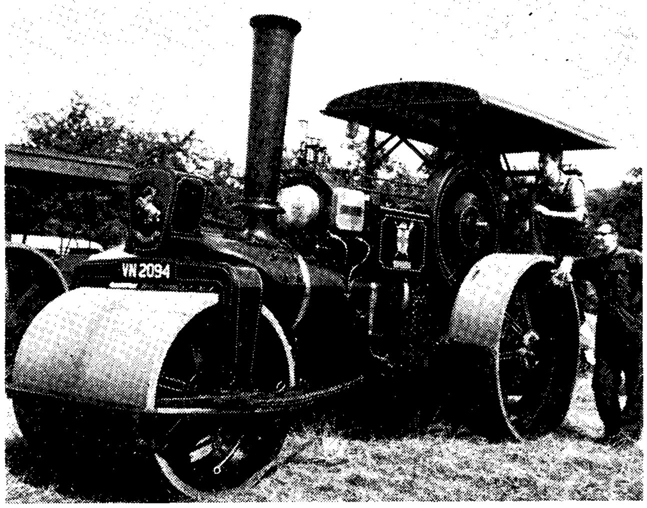
Katie Boyle at the wheel of "Village Queen".



Burrell engine "Winston Churchill".

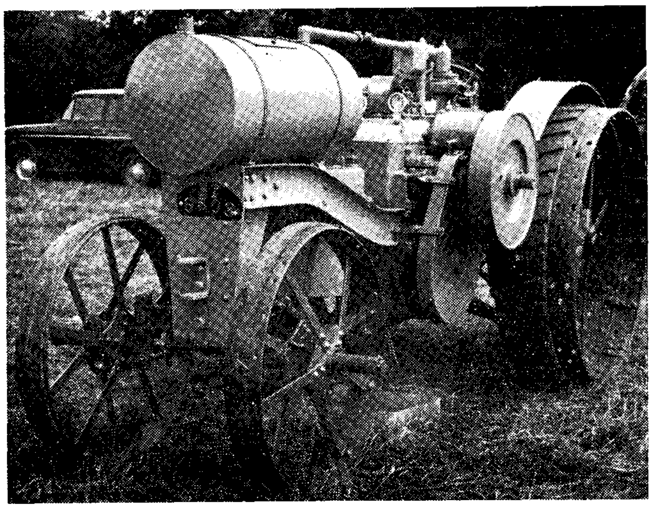


Fowler 4 h.p. tractor No. 14406 *owned by Mr. A. Fearnley of Castle ford.*

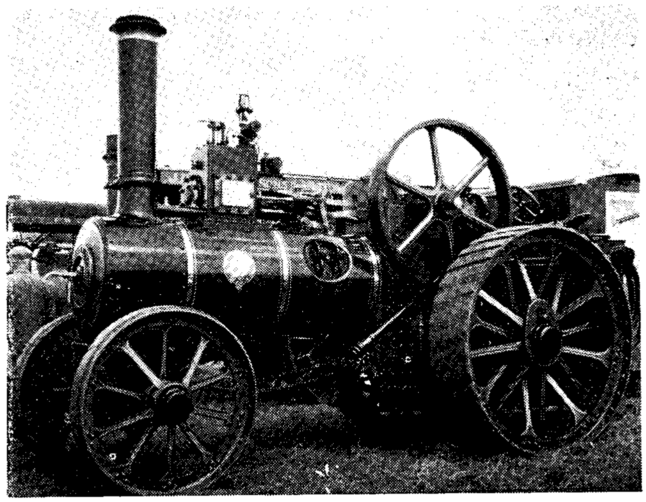


Aveling & Porter roller No. 14070, *built* 1930 *and now owned by Mr. G. W. Proctor.*

Below: "Titan" i.c. engined agricultural tractor.



Below: Ruston Hornsby 7 *n.h.p. No.* 115100 *now owned by Mr. J. Swingler.*



AFTER READING all available material regarding various steam engines, old and new, plus building several conventional types, the desire to build an engine that is a bit different eventually exerts itself with the serious builder of power units.

The various types of engines briefly described were built with several ideas in mind. I had the idea several years ago to make a few engines, each driven by a different valve movement for my own satisfaction. Although I had seen drawings and read descriptions of unusual types, it had never been my good fortune to run across pictures or actual models of them all. Secondly I realized that other modelmakers might well have the same wish to see a particular valve drive, but not the desire to make one from scratch.

The twin-cylinder single-acting type was finally decided upon since the location of the valve gear might readily be seen, and the basic design was familiar among most model builders. Also the design makes for a better balanced, smoother running engine even without counter-balance weights on crankshaft webs.

HIGH–SPEED STEAM ENGINES

by Arthur M. Balling

The Stuart Turner "Sirius" and "Sun" twin cylinder single-acting engines are the most familiar of this type to be seen. (Also similar in design but smaller, the "Star" had a cylinder block and crankcase of aluminium alloy with bronze liners instead of cast iron as used with its big brothers). A similar lightweight version of the same bore and stroke as the "Sun", $\frac{3}{4}$ in. × $\frac{3}{4}$ in. with liners of cast iron might have extended the popularity of steam speedboat types for a few more years. Also a less heavy twin of this size might well be looked upon favourably for a destroyer or yacht type where every ounce saved may be a matter of satisfaction. The method of valve drive has its advantages, but it is difficult to get at the screws securing the bevel gears to change the valve setting, which was something I wanted to experiment with. In designing my series I have the gears (where used) outside the crankcase where they are readily available.

A bore and stroke of $\frac{7}{8}$ in. for the engines was decided upon as I plan to run tests with the engines and record steam consumption, r.p.m. and h.p. at various pressures. The $\frac{3}{4}$ in. × $\frac{3}{4}$ in. of the "Sun" seemed too small for accurate readings, and the 1 in. × 1 in. of the "Sirius" too large when it came to generating steam. Also the time required to build a larger size increases with volume hence the in-between size was finally decided on. A simple test stand with an adjustable engine bed designed to hold the various engines will have suitable generator with ammeter, voltmeter, tachometer, etc.

Originally I thought of making a template for the cylinder head so that the various valve types might be tried on the same cylinder block in order that the final readings might be more accurate, eliminating possible differences between engines such as worn piston rings, tighter fitting of connecting rods, etc. At the same time I wanted each engine as a complete unit for demonstration purposes. The idea has turned out to be an ambitious one.

Simple sketches of valves were made for some of the engines, but usually the work continued without the need of drawings.

Crankshafts are turned from one piece. To save work, the flywheels were turned on the crankshafts, all in one piece. I therefore have no fear of setscrews working loose during runs with a free spinning flywheel! Centre holes for crankpins are drilled through at flywheel and tapped for driving pins. A small pop on the side of flywheel rim above centre hole used for nearest crankpin serves as a reference mark when setting the valve. Driving pins are lined up vertically with pop mark uppermost and you know the engine is on dead centre with piston nearest flywheel at top.

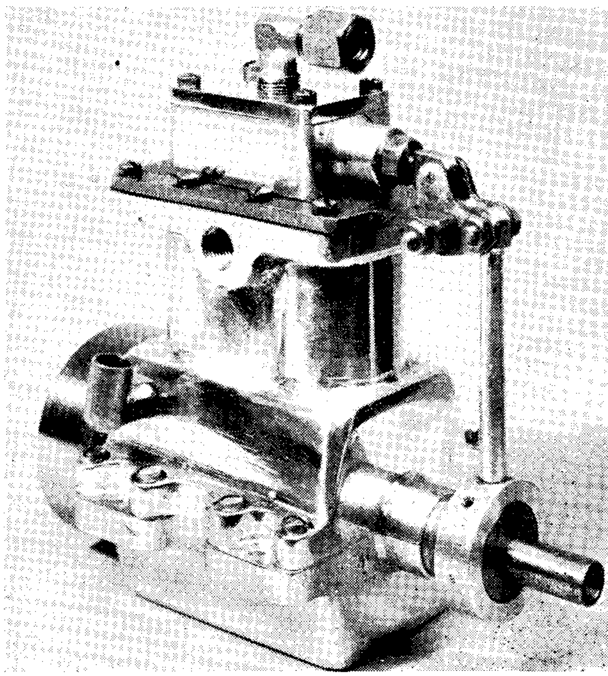
Crank webs are cut to form counterbalance weights for smoother running and weight reduction.

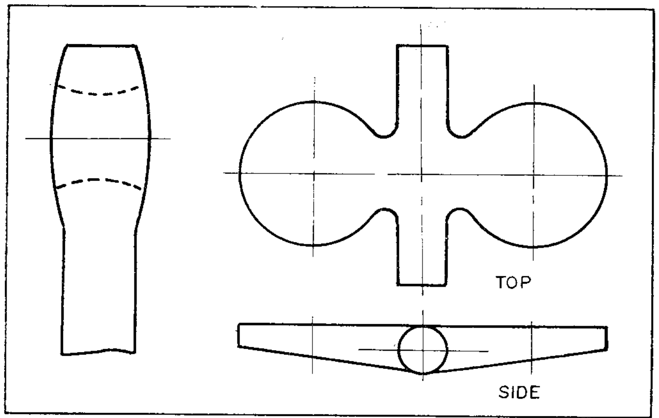
The bell crank with eccentric drive is not to be scorned. It is simple to make and dependable. In model speedboats this type has seen the upper 20's.

Many times I have been asked, "But how is the side to side motion at the top of the eccentric rod taken care of?" The side motion is very small; the face at each side of the rod is relieved as per sketch to prevent binding between the arms of the bell crank. Also the ends of the hole in eccentric rod are tapered with a small taper pin reamer. The pins in the bell crank may be hardened for long wearing. After many hours of hard service I have found the main bearings and connecting rods to require locking up before any noticeable wear is shown by the valve gear, and the first signs will usually show up at the eccentric strap.

The use of bevel gears, or to be more correct, mitre gears (an identical pair) is an improvement over the bell crank, as more of the motion is rotating which is an advantage where really high speeds are required. My first engine of this type drives a slide valve, and has driven a hydroplane at over 40 m.p.h. Also this identical design can be used in tugs as the speed range is very wide.

Slide valve engine with eccentric and bell crank drive.





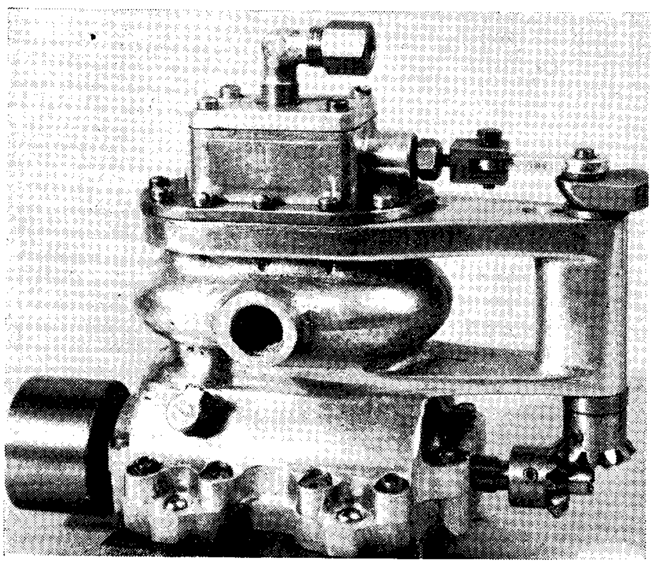
Above left: eccentric rod of bell crank engine. Right: the "rocker" type valve.

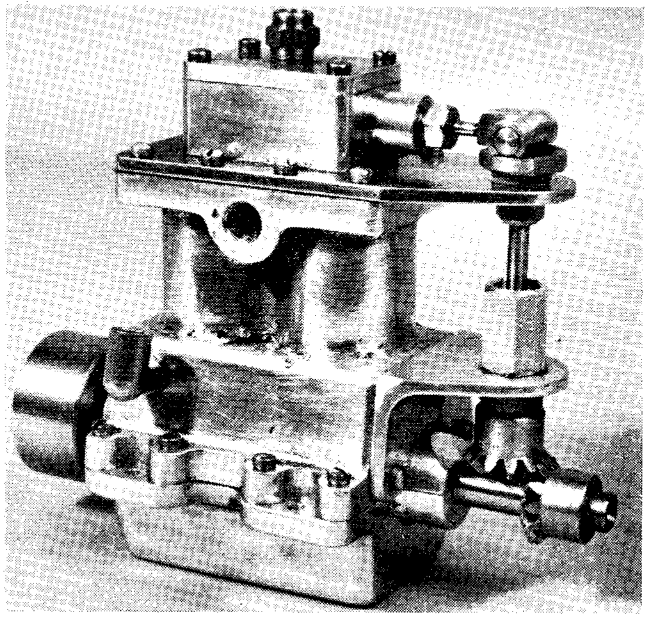
Next in order of construction came the piston valve design which has certain advantages over the slide valve, but not all! The advantages are that the valve is balanced, and an increase of steam pressure does not result in as great a strain on the valve gear as it does with a slide valve. Also the friction of the valve stem packing gland is eliminated. The one big disadvantage is that it does not remain as steam tight as long as the slide valve. The well known saying that "A slide valve wears in, but a piston valve wears out," was never more true.

In the conventional design of a compound engine with piston valve on h.p. and slide valve on l.p., this is very well illustrated. Any leakage past the piston valve is not a total loss as it serves to increase the pressure in the l.p. valve chest and will not find it so easy to escape going to work. Both the slide valve and piston valve types may be driven by means of a connecting rod or scotch yoke between valve and driving pin.

The rotary valve type fascinated me because all of the motion was rotational which at first glance seemed to be an improvement over the slide and piston valve types. There are, however, two disadvantages: (1) The fit must be at least as good as a well made piston valve if anything in the way of efficiency is desired, (2) The friction of the rotary valve is more, as the circumference of the valve is greater than the combined distance back and forth a piston valve of corresponding diameter will normally travel in one revolution of

Slide valve engine with bevel gear drive.





Slide valve engine with Scotch crank drive.

he engine. Also the contact surfaces are greater in a rotary valve type.

A semi-rotary valve has the advantage that the valve travel is reduced, but because the valve must reverse its direction twice each revolution its usefulness for high speed is minimized. For the same reason the strain on valve gear is increased.

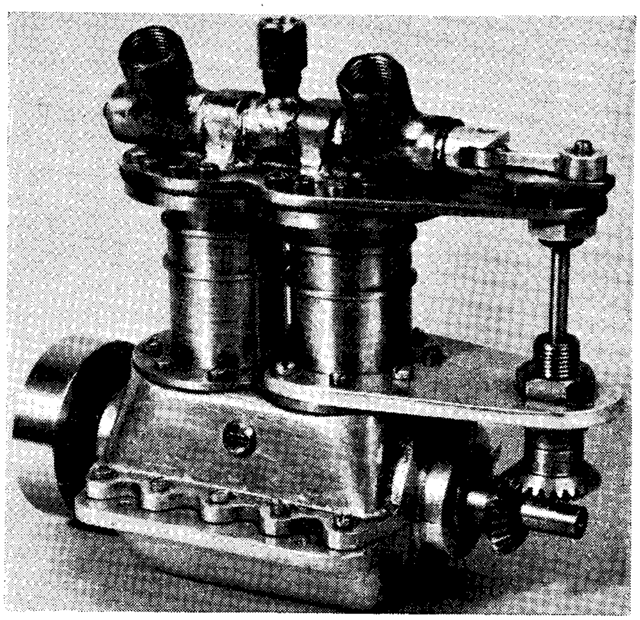
Valves for rotary and semi-rotary types may be drilled for weight saving and exhaust flats opening into cavity so that the exhaust from both cylinders comes out at the open end of the valve chest.

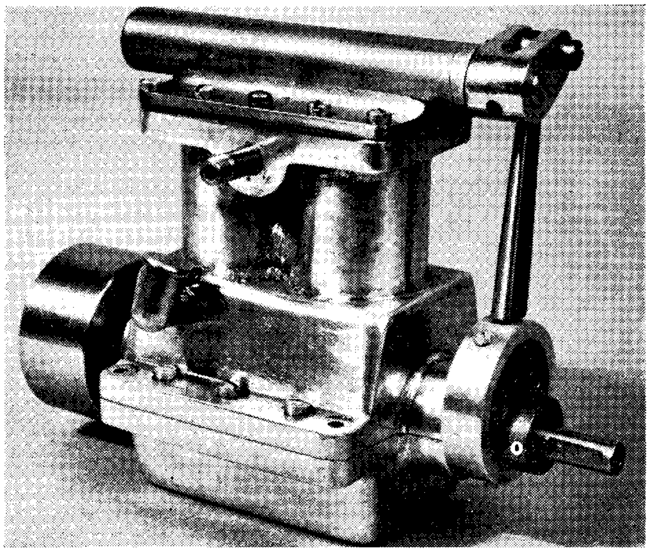
The poppet valve engine has several bright advantages:

(1) The valve opening and closing intervals are quick and sharp.

(2) Valves remain steam tight longer with high speed and temperature.

Piston valve engine with bevel gear drive.





Steam engine, with semi-rotary valve driven by an eccentric.

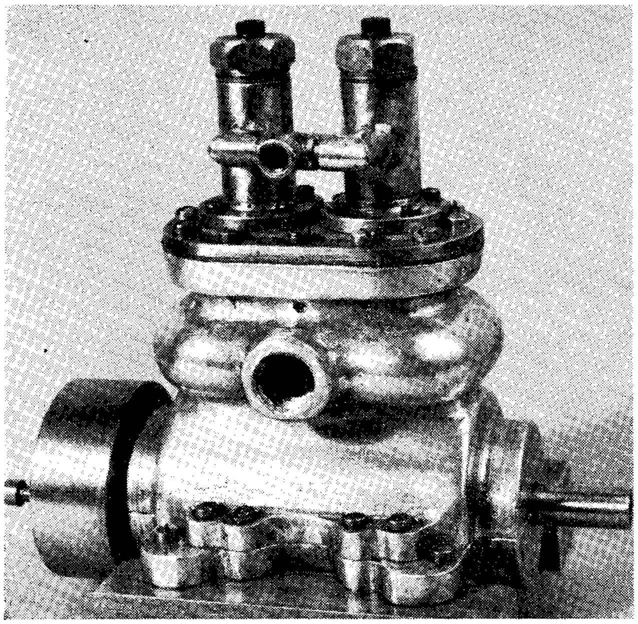
(3) Early cut-off allows more time for steam to expand, resulting in greater efficiency.
(4) Moving parts of valve gear are lightweight, and valve travel distance is not excessive.
(5) Strain on valve gear is not a serious problem.
(6) Engine rotation is left or right whichever way you flip the flywheel. (Same as with slip eccentric).

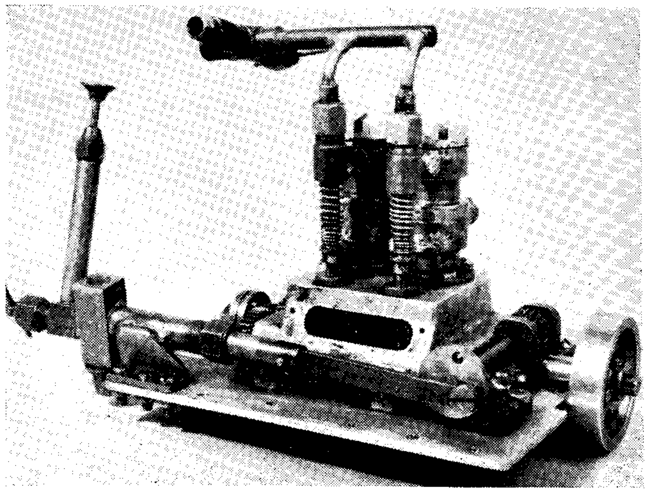
Poppet valve engines

My first poppet valve (illustrated) has a projection secured to piston heads for lifting $\frac{5}{16}$ in. stainless steel balls from their seats. A free floating tappet above the ball serves to help seat it after cut-off. This works fine particularly with smaller size engines.

The engine is easier to start if the valve clearance is restricted but does not develop as much speed or power as when valve

A poppet valve high-speed steam engine using stainless steel balls.





A twin-cylinder poppet valve high-speed engine built by Mr. Anton Bohaboy of new Jersey.

clearance is increased. Adding one copper sparkplug gasket under the screwed-on valve cover and increasing valve clearance, makes a very noticeable difference. Although the period the valve opens is not changed, the admission time is extended due to the greater distance the valve travels up and down.

If the poppet valve is of the cam operated type, valve float may develop at high speeds, resulting in uneven operation. Unless a second poppet valve is used for exhaust in addition to uniflow ports, the back pressure builds up more rapidly than in conventional slide or piston valve types. A "T" design with steam valves on one side and exhaust valves on the other side of cylinders might eliminate this problem.

One of my pictures shows a twin of the more conventional poppet valve type built for speedboat use by Mr. Anton Bohaboy of New Jersey. Engine is $\frac{5}{8}$ in. bore $\times$ $\frac{3}{4}$ in. stroke.

Other valve types contemplated for future construction are the so called automatic engines. One design recently brought to my attention after many years is the rocker type valve which is actuated by the varying pressures in each cylinder during operation. The increasing back pressure in cylinder of rising piston and decreasing pressure in cylinder of descending piston eventually act to rock the valve over admitting steam to cylinder with piston at top of stroke. Advantages are simplicity, light weight for power developed and low valve friction loss. Inadequate lubrication is not a problem with this type valve as it may well be with some of the others. Bearings for valve shaft may be rectangular pieces of bronze stock with a small oil hole drilled above shaft. Although engines of this type develop high speed they are "steam hogs" as the admission period is almost full stroke.

Externally the engine looks like the slide valve uniflow type minus external valve gear. A sketch of the valve will serve to clarify the description.

Numerous other methods of valve drive have been tried with varying success. Valves between cylinders; piston and rotary types; separate oscillating valves for steam and exhaust, etc. Combinations of valve types such as piston valve for steam and oscillating valve for exhaust among others.

With the descriptions and photos of some of the various valve types as a guide, the prospective builder of a twin cylinder single acting engine has a choice when it comes to construction. Depending upon steam pressures to be used, r.p.m.'s expected, and reliability, at least one of the designs should fill the bill.

Jeynes' Corner

A commentary on current topics

E. H. Jeynes talks about a neglected type of model

The first sight of the cover picture of Model Engineer, July 1, instantly reminded me of John Haining, the builder of the first model ploughing engine I had ever seen. Even before I turned to page 594 my thoughts had raced through five years or so, to the 2 in. scale model of a single-cylinder ploughing engine I saw at Worcester. The only thing that seemed to be missing was signs of wear on front wheel rims, where the rope had rubbed when working in difficult terrain; half closing the eyes, the illusion was perfect, and now a model BB is portrayed, and not only that, drawings, castings, and advice are there to be drawn on.

The difficulty of obtaining details and measurement have in the past been a great obstacle, which has prevented many who might have liked to model a ploughing engine; while the thought of having to produce a pair of engines and gear may have seemed to many to be too big a job to tackle in limited spare time.

Of course one engine can be built and used with a portable anchor as was originally done in full-size practice, and as the authors remark, very few people would take notice of the fact that the engine was a comparatively modern BB. Considerable trouble can be experienced with full-size anchors in some kinds of soil, and I think this trouble would be more apparent in model size.

Where an actual ploughing demonstration is taking place, two engine drivers will be required just as in actual working: most certainly some experience would have to be acquired, otherwise a good deal of damage could speedily be done. There is a lot more than just opening and closing the regulator, which the driver of a model traction engine can ordinarily do without trouble; an over-run with a balance plough could have a greater effect in model size than in full-size. I would say that a ploughing engine driver could step off his engine, and take over an ordinary traction engine driver's duties, as he would be well versed in manoeuvring a larger engine in confined spaces without the benefit of a differential: but I do not think any owners of ploughing tackle would let an ordinary traction engine driver take over one of their engines, unless they knew he had previous experience, and plenty of it.

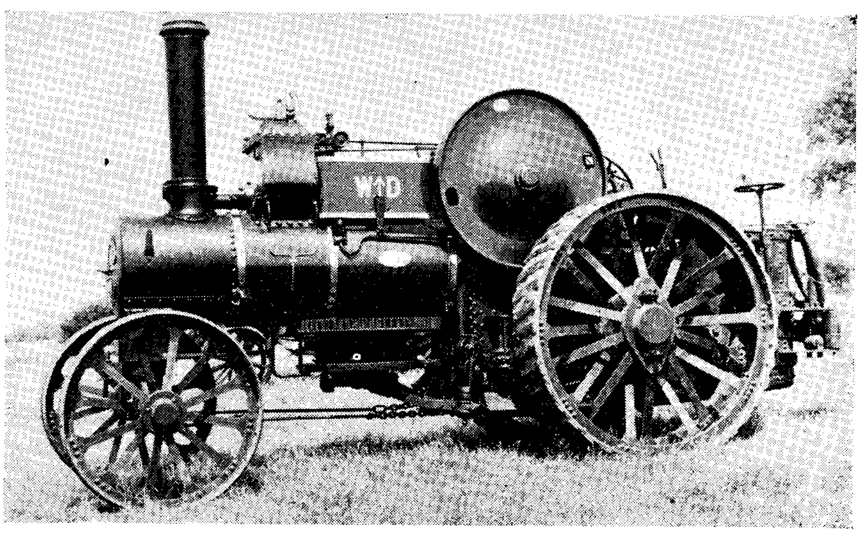
Now that Mr. Haining and Mr. Tyler have produced drawings, and made available castings for a pair of model Fowler BB engines, I hope many will take advantage of their efforts, and I do not only mean individuals. The curator of every museum worthy of the name ought to preserve a set of Fowler ploughing tackle, which led the whole agricultural world, performing miracles of tillage, and as the impossibility of this dawns on one, so does the solution: a set of authentic model ploughing tackle, which can easily be housed. If it is essential to preserve model steam locomotives for the enlightenment of posterity, it is just as important to my mind that the ploughing engine should be represented.

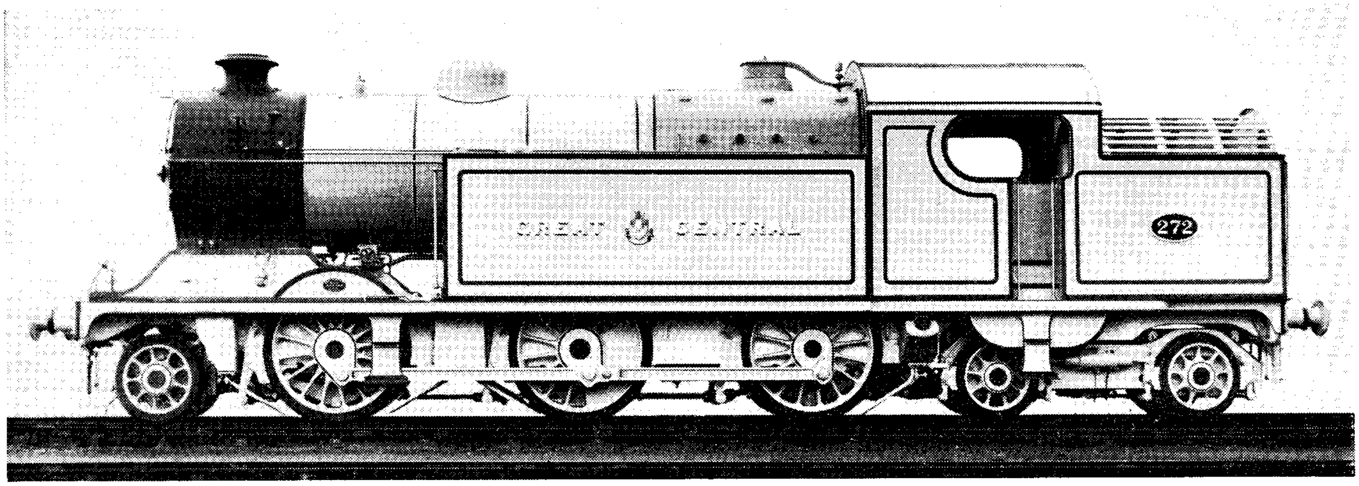
Reverting to my second paragraph, concerning the deterrent thought of there being two of everything, I have not yet been able to ascertain how many of Messrs. Haining and Tyler's castings would work in for another type of Fowler engine, the haulage and winding engine built to government specifications for military purposes. They were employed during the first world war in hauling guns etc: and worked up to much nearer the front line than was possible for railway locomotives. One of the great troubles in France was that most of the main roads were stone-paved in the centre, and the steel straked wheels did not agree with this surface in bad weather.

I recollect seeing one hauling a six inch naval gun, which had been mounted on Aveling and Porter traction engine rear wheels, descending the slight incline into Bethune: under the wintry conditions the whole outfit appeared to be on skates and was completely out of control, there being no convenient curb-stones to shear the wheels against. Although only about six kilometres behind the line, the driver cock-crowed all down the hill; fortunately everyone managed to keep out of its erratic course.

I have never seen this type of Fowler engine modelled, it could perform duties between that of the ploughing engine and the road locomotive, I think this type is worthy of consideration sa a prototype for a model.

Fowler hauling and winding engine No. 14950, *built in* 1918 *and now in the possession of Mr. T. B. Paisley of St. Ives, Hunts.*





Robinson's 2–6–4 goods tank engine for the Great Central Railway.

BRITISH 2-6-4 TANKS *(Continued from Oct. 21)*

by K. N. Harris

The Metropolitan Railway, which we often tend to overlook, had some most interesting steam locomotives, notably perhaps the most graceful 4-4-4 tanks (unusual type for this country) ever put on rails, and they produced in 1925 the "K" Class 2-6-4's. These had cylinders 19 in. × 28 in., coupled wheels 5 ft. 6 in. dia., carrying wheels 3 ft. 1 in. and a boiler pressure of 200 lb. per sq. in., whilst the tanks held 2,000 gallons and the bunker 4 tons of coal. Adhesive weight was 54.8 tons and total weight in working order 87 tons 7 cwt. These engines were the most powerful in the Metropolitan and were used mostly on freight work, and operated chiefly between Verney Junction and Finchley Road.

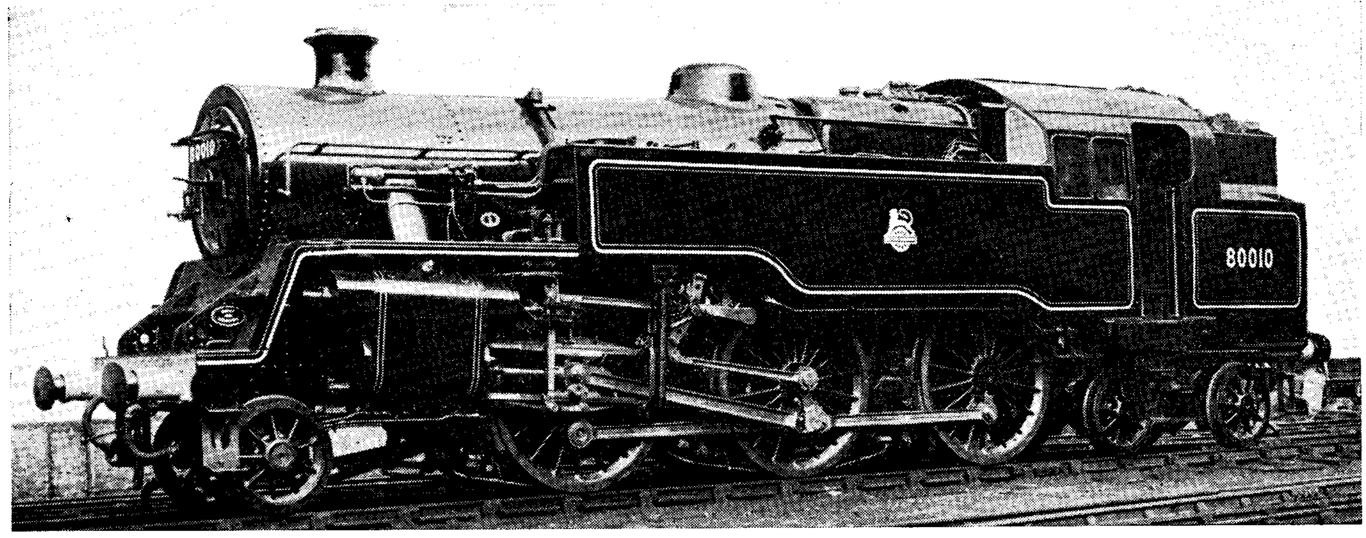
They had a curious origin. They were supplied by Geo. Cohen & Armstrong Disposal Corporation, and had been built at the Newcastle Works of Sir W. G. Armstrong Whitworth & Co. using parts made at Woolwich Arsenal after the 1914-18 World War to SE & CR (presumably Maunsell) designs; they were intended for 2-6-0 tender engines; the adaptation to 2-6-4 tanks was carried out to the designs of Mr. Geo. Hally, of the Metropolitan Railway.

It should be recorded that the original SE & CR engines, which under the Southern Railway became known as the "River" class, were later largely converted to tender engines. This arose from an unfortunate fatal accident in which one of them, in its original form, was involved, and which almost certainly was due entirely to defective track. The Government Inspectors, concerned with railway accidents, had for many years shown a marked prejudice against the use of tank engines for fast passenger work. After the accident an engine (or engines) of the same class was tested on the old Great Northern main line at very high speeds, well into the 80's, with perfectly satisfactory results; nevertheless to appease Officialdom and possibly to some extent the general public, the management of the Southern Railway decided to convert them to tender engines.

From the model locomotive man's point of view, the type is an excellent one, though like all modern tank engines, it involves the provision of a partially removable cab and cab-roof to allow of easy access for firing and handling controls. Some care is necessary in arranging the proportions of the pivoting arm of the leading truck, and the side controls of this and the trailing bogie.

During the Gresley regime (nearly 30 years) on the LNER, a number of designs were prepared for 2-6-4 tank engines, most of which were on very similar lines, with proportions closely related to the general run of engines described previously. These designs extended over the period from 1919 to 1939. ▣

British Railways two-cylinder 2–6–4 tank locomotive. (Photographs courtesy British Railways).



FOR THE SCHOOLS

SIMPLE PRODUCTION METHODS

by Duplex

THE OBJECT of these notes is to furnish readers with guidance to enable them to make small quantities of repetition parts, such as nuts, washers and the like, using the centre lathe and normal facilities for the establishment of diameter and length.

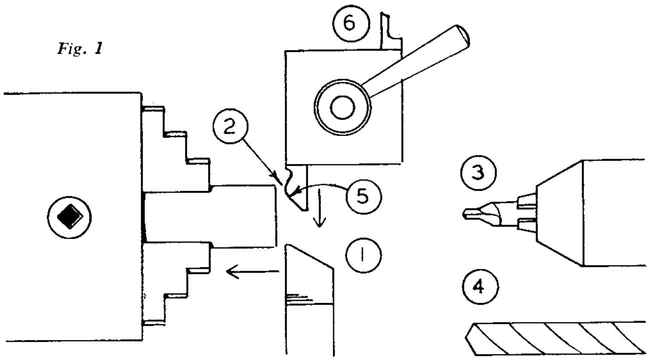
To this end, it is assumed that the quantities we are considering are of the order of six to twelve components, this being typical of the requirement for a special piece of work. At a later date we hope to elaborate on this theme and deal with the manufacture of more complex components.

Making Washers

Probably the most commonly needed repetition item is the plain washer. Commercially produced examples, for the most part, are punched from strip, are not chamfered and have no place in a well finished piece of work, though of course perfectly suitable for ordinary purposes. Moreover, their dimensions are seldom correct when considered in the context of scale size.

To turn, then, to the actual machining of washers. The equipment needed is a front toolpost or a slide-rest with a turning tool mounted. In addition a back toolpost needs to be mounted carrying two tools, one for chamfering and the other for parting off. Furthermore, a self-centring chuck must be set in the tailstock to carry drills necessary for forming the holes in the washers themselves.

Fig. 1

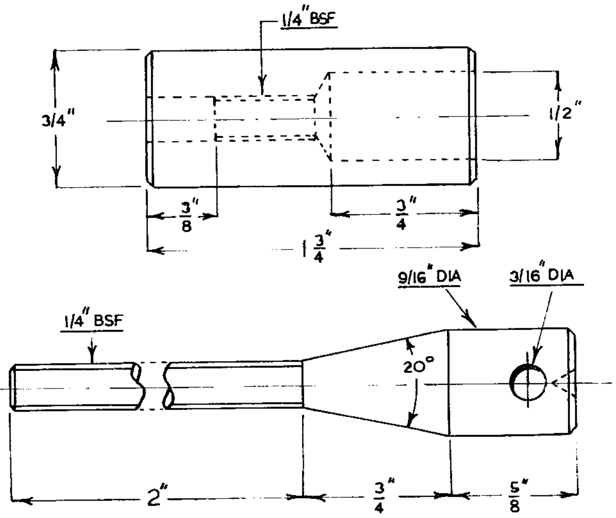


To make the washers, a length of rod should be chucked and an inch or so turned to the required diameter (Op. 1, Fig. 1). Next, the work is faced by means of the combined facing and chamfering tool in the back toolpost (Op.2, Fig.1). The work can then be centre drilled (Op.3) and drilled to size (Op. 4), the chamfer on the edge of the washers being imparted by the back toolpost chamfering tool (Op. 5). Finally, each washer in turn is parted off by means of the parting tool set in the back toolpost (Op. 6).

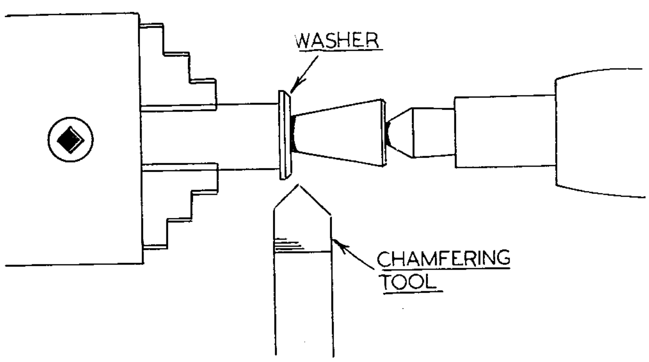
To ensure that all washers are parted off at uniform thickness, the following procedure should be employed: First, bring the side of the parting tool into contact with the face of the work by means of the leadscrew and note the reading of the leadscrew index, if fitted. Assuming the lathe has such an index, the parting tool is withdrawn from contact with the work by means of the cross-slide feed screw without moving the saddle. Next, the saddle itself, and thus the parting tool, is moved along the work by means of the lead screw handwheel for a distance equal to the width of the parting tool plus the width of the required washer. We can take as an example a parting tool 0.070 in. thick and a washer 0.055 in. wide. In this case one turn of a leadscrew of $\frac{1}{8}$ in. pitch would give washers of the required thickness.

Chamfering

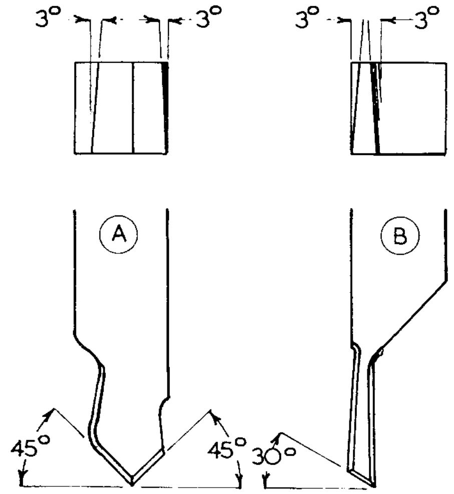
In addition to the method of chamfering by means of a special tool set in the back toolpost, two other ways of chamfering may be employed. In the first of these the chamfering is carried out by the parting tool itself having a special shoulder formed upon it for the purpose. The chamfering is performed as an extension of the parting-off operation AFTER the previous washer has been parted from the parent stock. The second method makes use of the special fitting illustrated in Fig. 2. As will be seen, this device consists of but two parts: a body A to be gripped in the chuck, and a tapered mandrel B provided with a screwed spigot to enable washers mounted on the mandrel to be secured against the face of the body. The mandrel itself is centred so that the tailstock can be brought up to support the work as seen in Fig. 3. The method of using the fitment will be clear from this illustration so it will be appreciated that a number of these devices will be needed if a wide range of washer size is to be covered.

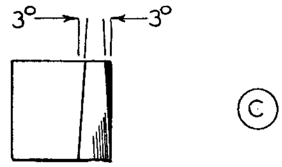


Above: Fig. 2 *Below: Fig. 3.*



It is perhaps appropriate at this point to deal with the tools needed for the operations we have been considering. First, then, the chamfering tool for the back toolpost. This is illustrated in Fig. 4 at A. The tool we use in our own back toolposts is made from a $\frac{1}{4}$ in. square high-speed tool bit, ground to the form seen in the diagram. This provides two cutting edges, the obvious one ground at an angle of 40 deg. for chamfering, the other slightly rounded for use in facing operations. The tool, of course, is mounted inverted in the back toolpost.



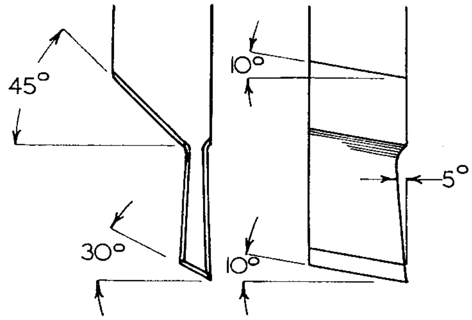


Top left: Fig. 4, A and B.

Top right: Fig. 4, C.

Bottom left: Fig. 5.

Bottom right: Fig. 6.



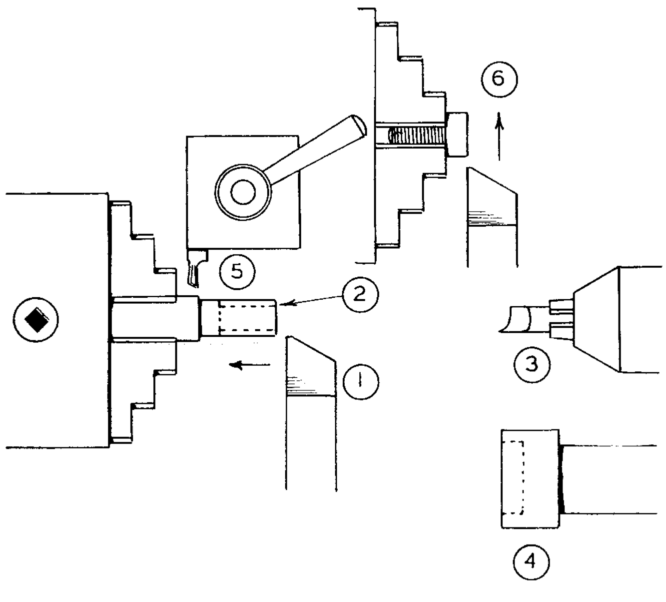
The second tool for the back toolpost is the parting tool. This is illustrated in Fig. 4 at B. The point of the tool is ground back at an angle of some 20 to 30 deg. and the purpose of this procedure is to ensure that when the tool is set with its point on the lathe centre line, the component being made will be parted cleanly from its parent material.

When in addition the parting tool is to be used as a chamfering tool, the cutting edges are ground to the form represented diagrammatically in Fig. 4 at C. The parting tool itself is ground as previously described and the chamfering edge is formed at its root. Chamfering tools for the slide rest are similar in form to that shown in Fig. 3.

Having established the various types of tool needed for machining washers, we may now pass on to the making of other repetition details, since all the tools described are basic to the processes.

MAKING SCREWS

Screws are examples of small components that often need to be specially made, if only because in many instances their form makes them otherwise unobtainable. For the sake of clarity we shall consider the making of plain screws, but the methods employed are, of course, equally applicable to shouldered screws having a thread diameter smaller than the body of the screw itself.



A piece of material should first be set in the self-centring chuck and the head diameter turned to size, a note being made of the cross-slide index reading so that subsequent screw heads can be made the same size. This turning operation is performed with a right-hand knife tool set in the lathe top-slide, and is seen at (1) in Fig. 5. Next, the body is turned to size, again noting the cross-slide index reading for the purpose of subsequent turning. Fig. 5 (2). The length of the screw under the head can be established by measurement

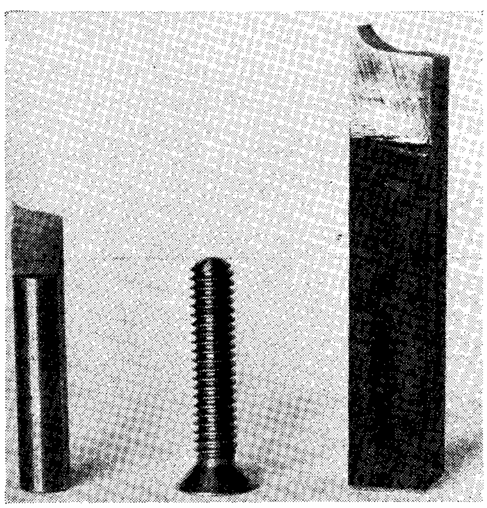
(i) with a rule if accuracy is not essential.

(ii) by means of the leadscrew index if this is available and greater accuracy is required.

(iii) using the top-slide index when a leadscrew index is not fitted.

The next operation is to round the nose of the screw, both for appearance sake and to ease the starting of the screw-threading die. Fig. 5 (3). The work is most conveniently carried out with a tool set in the tailstock drill chuck and illustrated at A in Fig. 6. At B is seen a similar tool but for use in the slide rest, the tool being again fed axially to the work.

Following the nose rounding operation the screw blank is threaded using a die-holder, as at (4) Fig. 5.



Postbag

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

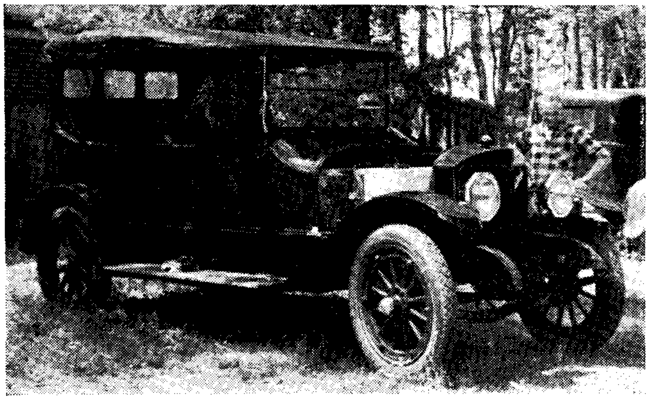
Steam Cars

SIR,—I read Mr. K. N. Harris's article on steam cars with much interest. I have long been intrigued by the boiler design and automatic controls on these cars. His discourse has answered many of my questions regarding this type of conveyance.

Previous to the "Steam Cars" story I had never seen and knew very little regarding the Stanley Steamer. While I was visiting my wife's home on Dominion Day of this year, I heard rumours of a Stanley Steamer owned by a Mr. Gordon Armstrong, who lived nearby. I hastened over with my camera to investigate. Mr. Armstrong lives in Harvey Station, York County, N.B. Canada. He is a collector of vintage automobiles and spends many hours rebuilding the old cars.

I couldn't have arrived at a better time! Mr. Armstrong was just starting to fire up the boiler when I drove into his yard. After I asked him a few intelligent questions regarding the design and operation of the car, he was more than willing to talk. We had a very interesting conversation, covering all aspects of the joys and trials of owning and operating a 1917 Stanley Steamer.

Mr. Armstrong acquired his car the hard way. He purchased bits and pieces from all over the North American continent, as far distant as California, U.S.A. Assembly proved to be difficult. No manuals or handbooks were available for this car and Mr. Armstrong was a novice as far as steam cars were concerned. However, he had a lucky break. He discovered a vintage car expert in the State of Maine, U.S.A. After several visits and many questions the mysteries of the cars "internals" were revealed. The car was finally assembled, painted, and ready for the road. The results of much hard effort and perseverance may be seen in my picture.



In brief, the car is a 1917 Stanley Steamer. The boiler is located where one expects the engine to be; i.e. behind the radiator. Operating pressure is 500 lb. The boiler is all-steel, vertical flue type with approximately 140 flues of $\frac{3}{8}$ in. dia. It is equipped with a superheater. Water may be fed into the boiler by means of (1) A hand driven pump while the car is at rest. (2) An axle driven pump while the car is in motion and (3) an injector for taking on water from a stream, etc. during the trip. The boiler is equipped with a safety valve and also with thermostatic and pressure operated mechanisms as an additional safety feature. These secondary safety devices will shut off the burner in case of above allowable temperature or pressure conditions in the boiler.

The burner is the conventional vaporizer type with a preheater. Air pressure for the burner system is 40 lb., obtained by use of a hand pump beside the front seat of the car. Kerosene is used for fuel in the burner. Exhaust gases from the burner pass through an exhaust pipe from the top of the boiler down and under the chassis of the car.

A horizontal twin-cylinder engine supplies the motive power. I was told that it is approximately 4 in. bore by 4 in. stroke, has slide valves, can be notched up for cruising speeds and is equipped with a mechanical lubricator. The engine is located under the back seat, just ahead of the rear axle. The complete drive from the engine crankshaft to the rear axle is enclosed and runs in an oil bath. Exhaust steam from the engine is piped into the "radiator", which is actually the condenser.

The centre of operations is, of course, the front seat of the car. While raising steam pressure in the boiler, the front floorboards are removed. This reveals the location of the compressed air tank for the burner, the hand operated air pump and water pump and the axle driven air and water pump. All pumps are piston type. Above the floorboards are located two pedals for reverse motion, and for brakes which appeared to be conventional. Large pressure gauges indicated steam and air pressures. A "blinking" eye on the instrument panel indicated that the mechanical lubricator is working. A valve near the steering column allows adjustment of the burner needle valve while the car is in motion. The throttle is a simple pivoted hand lever just under the steering wheel. It is identical to the shift lever used on modern cars. The car is equipped with an electric horn and electric lights for night driving.

The car tyres are a very large size and dwarf a modern car tyre. Large raised rubber letters reading "NON SKID" were placed diagonally on the tread of the tyre in row after row. This seemed to give the tyre a very sturdy grip on the road.

Steam pressure soon built up to 200 lb., which is sufficient to move the car. To my delight I was invited to accompany Mr. Armstrong for a drive along a quiet country road near his home. The road was hard surfaced and we ambled along at a sedate pace of 30 to 35 m.p.h. No one was in a hurry. We relaxed under the cool shade of the large canopy overhead and watched the landscape roll by. The ride was surprisingly smooth. Mr. Armstrong remarked that the car handled quite heavy on the steering wheel, much like a truck. Cruising speed of the car is around 50 m.p.h. and the maximum speed is uncertain. I was told that the manufacturer of the car offered $1,000 to anyone who would maintain full throttle on the engine for one minute. Apparently no one ever collected the money!

Bathurst, N.B., Canada. W. H. DYKEMAN.

Model Trevithick Engine

SIR,—Re the Collins queries page 778 M.E. September 2, 1966, if he will refer to "Life of Trevithick" by his son (1872—two volumes) and "Richard Trevithick" by Dickinson & Titley (Cambridge University Press 1934), the answers are in one or the other.

Trevithick himself claimed water consumption 9 gallons per hour between refills at 6 hour intervals. He called the engine 4 h.p. its speed 30 r.p.m.—working pressure not given. No pump was fitted to the original, which I think is preserved at the South Kensington Museum. This had an overhung crank, although double-arm cranks were also in common use at the time.

E.T.W.'s opinion re the unbalanced slug in the flywheel seems corroborated in Life Vol. II page 65. On the second engine, not preserved, the flywheel size was limited by the installation space, and in line with Trevithick's instructions to the builder (Life Vol. II page 18) the moment of the unbalanced "slug" could have been some 300 lb. ft.

With the connected loads, it seems such a moment should ensure the engine always stopping at in-centre. If it "trailed" the crank about 25 deg. or 30 deg. the engine could stop with the crank enough off dead centre to assure starts without barring over by hand. The unbalanced centrifugal force developed by the "slug" at 30 r.p.m. could be about 325 lb. or so, in the second engine.

Rastrick's design of a "diagonal" Trevithick engine (D. & T. page 142) shows a flywheel counterweight conventionally positioned.

From the quoted sources it seems the original valve was cam-operated, but it is not clear to me whether the valve itself was 3 way or 4 way. Westbury's choice of 3 way operated by conventional eccentric for present purposes seems wise.

Any T drilled 3-way valve needs careful work. With all holes of given diameter, d, the diameter of the valve plug D, at the plane containing the axes of the ports, should be 2.523 d, for "line-on-line" setting, just to avoid blowby between steam and exhaust ports. The ratio of Westbury's diameters is 2.641:1, taking his nominal dimensions—providing in effect a little "lap"—made to drawing there should be no "blowby".

Michigan, U.S.A. R. V. HUTCHINSON.

Steam Raising

SIR,—With reference to the letter from Mr. A. P. Russell of Australia in M.E. September 16, regarding steam raising, I would suggest that the simplest way to do this, at least for 3½ in. gauge engines, is to couple a tyre pump to the engine's own tender feed connection. Air is then pumped into the boiler via the water feed line and check valve and the steam blower used for draught.

I have used this method for many years and find even on a 3½ in. gauge Pacific boiler that steam can be raised from cold in 10 minutes or less.

By firing paraffin-soaked wood or charcoal a good bed of fire can be built up and coal introduced gradually so that by the time the boiler generates its own steam it can take over on coal alone.

Whilst writing, I would like to touch on another matter which causes quite a bit of trouble when running engines on "foreign" tracks—namely passenger car running boards or footrests. Due to considerable variation of different club tracks, the car foot-rests sometimes foul the track bearers, particularly on curves, and it might be possible for M.E. to ask for ruling dimensions from Clubs in order to compile a loading gauge, in effect, so that anyone building cars could give adequate clearance.

Kenilworth, Warwicks. J. H. OWEN

Model Locomotive Design

SIR,—Everybody is entitled to their own opinion. That was what the old drivers of the LBSCR used to say after having a terrific argument in the drivers' lobby over some point or other in locomotive design and operation, and then going out and buying each other drinks at the Railway Tavern on the corner.

Now our friend who wields the blue pencil has made certain statements and fired off certain criticisms at my devoted head; so in exactly the same spirit that animated the old drivers, I propose to take him up on a few matters.

On page 811, September 16, Mr. Evans states in effect that as long as my locomotives look alright, are reliable, and will steam, pull and go, I am not interested in thermal or any other kind of efficiency! If ever there was a statement that was absolutely, utterly and completely incorrect, that is it, and it takes the whole box of biscuits! The one thing that I have always aimed at, right from the early days, is—capitals please Mr. Printer—EFFICIENCY.

Everybody who has followed my instructions on locomotive building doesn't need reminding of that fact! The amount of experimenting that I have done with boilers, to get the greatest amount of steam from the smallest amount of coal is just nobody's business. I have also done the same thing with the oil or spirit fired water-tube boiler, as those who are building the 1¾ in. gauge *Mabel* will find in due course.

Same with cylinders and motion. I have always arranged my valve gears to get the maximum power from the minimum steam consumption. The valves, ports and passages in my engines pass the required amount of steam for efficient operation, without having a lot of "dead" space to be filled with steam which is then blown away without doing any useful work. Mr. Evans not only ignores this, but states that the whole point of Mr. K. N. Harris's arguments is that any contribution to efficiency is worth the time and trouble in investigating it. *Just the very thing that I have always maintained*! I build locomotives and put them on the road to prove my contentions.

I would like to thank Mr. Evans for his acknowledgment that many of his *Jubilee* details were taken from LBSC drawings. From my correspondence, I know that details of many little locomotives now running in all parts of this benighted world, incorporate Curly components. Regarding his comments on boiler staying, I found by actual experiment that ⅛ in. or 5 BA firebox stays at the closer spacing that I specify were far more resistant to pressure than $\frac{5}{32}$ in. stays at a wider spacing. Trying both under excessive pressure, the firebox sides with the latter arrangement assumed the appearance of a buttoned cushion, the swelling between the stays being very pronounced; whereas with the ⅛ in. stays at closer spacing, the button-cushion effect was negligible. In using a large number of closely-spaced small stays, I am actually following full-size practice, so his crack about 16 BA stays in a full-size boiler falls rather flat! I could retaliate by saying that by *his* logic, the full-size boiler should have 6 in. dia. stays at 3 ft. spacing!

When all's said and done, experience still teaches—and I've had the experience. I reckon to learn something fresh from every job, even at my age.

Another example of where I followed full-size practice was in the return crank of my Class 5 LMS 4-6-0 *Doris*. Mr. Evans says that a worse method than fixing it by four countersunk screws would be difficult to devise. Well that's his opinion! I have here at the moment two photographs, one of a Class 5 and another of a Class 4 2-6-0, both of which show the four screws securing the return crank. I had the general arrangement drawing of a Class 5 but lent it to a correspondent who never returned it, so unfortunately I am unable to trace the return crank arrangement for reproduction here, but I had it by me when I made the drawings of the *Doris* valve gear. Of all the *Doris* engines that have been built to my instructions I have never heard of a return crank failing in service. When properly fitted, there is far more strength in those four little screws than Mr. Evans imagines.

South Croydon LBSC

Regarding return crank fixing, LBSC is badly off the rails! If he is able to examine the official drawing of the LMS Class 5, he will discover that the actual "driving" of the return crank is done by a tongue on the inside of the crank, engaging in a slot cut across the end of the crankpin. The four bolts or studs (not countersunk screws!) merely hold the return crank on end-wise. Naturally LBSC would not see this "tongue and groove" drive in a photograph as it is completely hidden when the crank is in position. I repeat that countersunk screws should never be relied upon for such a drive. Apart from their obvious weakness for such a purpose, it is not an easy matter to tap fine threads in the end of a crankpin, which is probably made of a high-carbon steel—and still maintain exact alignment.

As to the size of firebox stays, 5 BA are of course quite suitable for boilers up to the smaller 1 in. scale sizes, but obviously the larger the scale of the boiler, the larger in diameter the stays may be, up to the ⅞ or 1 in. dia. of the full-size boiler.—EDITOR.

SIR,—I have much enjoyed the correspondence in Postbag recently regarding model locomotive design summarised very interestingly in our Editor's article of the current issue. I thought that my own experience might be of interest.

I have a 1 in. to the ft. Great Western "Hall" locomotive which follows the original Greenly design but with more modern approach to cylinders, portage and valve gear. The cylinders are 1⅛ in. bore (a little undersize) × 2⅝ in. stroke (a little oversize) so they are roughly to scale, and therefore the capacity of the cylinders is proportionate to the cube scale. The grate area is almost exactly to scale and is therefore proportionate to the square of the scale.

The boiler design caters for about as much fire tubing as can be conveniently packed in. The model is a very free steamer and in fact it is difficult to use all the steam that the boiler makes. My line has a fair amount of 1 in 30 gradient, more than can be taken at a rush, so the train has to slow down to the speed at which it can make this gradient.

The locomotive will consistently haul 750 lb. on two ball bearing passenger trucks up this gradient at a fair speed, not measured but estimated to be 5 m.p.h., the limit of load is not one of power but of adhesion.

The total weight of the engine (without tender) is 120 lb. and I have arranged the springs so that only 24 lb. is on the bogie and therefore there is 96 lb. adhesive weight.

Now if one considers the cube relation of the locomotive, the prototype should therefore haul about 600 tons up such a gradient which I think would be quite impossible. If, however, one argues (neglecting adhesion) that the power should be proportionate to the grate area, then the 750 lb. is equivalent to the protoype hauling 480 tons up such a gradient which is probably much more realistic.

I do not know what my "Hall" will pull on the level as I have not a sufficient number of passenger trucks, but if one makes a direct calculation from 750 lb. up 1 in 30 the weight would be very considerable.

My leading passenger truck has hydraulic brakes taken from Mini Minor parts and weighs 40 lb. It takes only 1 lb. to pull it at walking speed on the level. This is the reason of course why model locomotives are capable of hauling such apparently out of scale loads.

London S.W.7. G. H. BUCKLE

Prize-winning Locomotives

SIR,—In reply to Mr. W. J. Hughes (ME Sept. 16) I think that most readers will have realised that my remarks were intended as a leg-pull. I am of course fully aware of the trouble taken by judges at the Exhibitions to reach a fair decision, but it should be noted that there is nothing in the competition rules to allow for the difference between a practical working model and a "glass-caser". Thus although a model may get a high award, it does NOT follow that it will necessarily work.

This has been a bone of contention for many years, and it is my considered opinion that if the usefulness of a model (locomotives in particular) as a revenue-earner was taken into account at exhibitions, there would be far more entries.

Now I would like to raise a point for general discussion.

What performance makes for a good locomotive? If a locomotive will run with a full complement of passengers, for the whole of an 'open day' (about 3½ hours) without undue trouble, then I suggest that its performance is satisfactory. I will not accept less than 7 hours running from my own locomotives, but would indeed be interested to learn other opinions.

Harefield. K. E. WILSON.

The Stephensons

SIR,—I see that Mr. E. H. Jeynes wonders if any descendents of the famous Stephenson family are still alive. By a coincidence, while reading M.E., I noticed in the *Daily Express* of the same date a reference to a Squadron Leader Robert Stephenson, who won a D.F.C. in the Western Desert in 1941, and is now chief executive of the Business Aircraft Users' Association.

Squadron Leader Stephenson's grandfather's grandfather was a brother of George Stephenson of *Rocket* fame.

Bournemouth. H. H. NICHOLLS.

Hall Engine

SIR,—Despite the gradual elimination of the steam engine in the forms that we have known and admired, I have never doubted that it would emerge again in a new form,—It has indeed, in the extremely novel idea outlined in Mr. Hall's patent. Congratulations Mr. Hall.

His analysis and appraisal of an observed incident with subsequent trying out his theory in practical form as described in M.E., is surely a classic example of realising the possibilities of a simple phenomenon. The explosive effect of steam has been present for all to see through the ages—Hot spring geysers, volcanoes and even the mere act of placing a wet bottomed cooking utensil on a hot plate has actually lifted the utensil *and* nobody has realised that this principle could be used in a prime mover—I have often noticed this "utensil effect" for many years.

I well remember, 40 years ago, motorists fitting water drips to the induction pipes of petrol engines to scavenge the cylinders! But nobody appears to have thought of injecting water instead of oil into a diesel engine. It is surprising. Both these methods come so near to a revolutionary means of producing a power impulse, yet have not pointed the way until Mr. Hall's invention.

I believe it has endless possibilities, providing that vested interests do not set out to eliminate it,—in the motoring world it may have to compete with the fuel cell and also the electric car, for which according to press reports, a new lightweight accumulator is being developed.

However, the Hall idea is so good that it should find, on its own merits, a high reputation for reliability.

A water tank, gas cylinders, a Hall engine as prime mover, with either hydraulic or electric drive should give a really clean steam locomotive, or car, or speed boat.

Wallington, Surrey. C. L. BENNETT.

Crosshead Fixing

SIR,—I note that Mr. Busby is not convinced about the efficacy of the method of screwing crossheads to piston rods, with, of course, a locknut. In his original letter, he wanted to know how many reciprocations it would take before the threads worked loose, or broke. I cannot tell him.

What I can tell him, and what is germane to the issue is that Stanley White and Doble all used this form of attachment on their steam car engines; incidentally they all used it for valve spindles as well. I had four Stanley cars at different times, and six or seven Whites, from 15 h.p to 40 h.p. I ran many thousands of miles with these and never had any case of breaking or working loose. The Stanley was a comparatively slow-running engine, geared about 7 to 5 to the rear axle, having twin cylinders 3¼ in. × 4¼ in. working at around 550 lb. per sq. in. The White had a compound engine and a two-speed gear on the back axle; in those I owned all except the 40 h.p. were geared 3–1 on the direct drive, the 40 h.p. was 5–2. The working pressure was 600 lb. per sq. in. and the engines were constantly running at 1500–2000 r.p.m. None of these cars ever gave any *mechanical* trouble.

The same system of screw fastening was used by a number of makers of small launch engines, and small special purpose steam engines. In locomotive practice, the piston rod was not infrequently screwed direct to the piston.

What earthly connection there is between a screwed piston rod fastening and an internally screwed gland and an externally screwed stuffing bush, I entirely fail to see. This form of gland *is* bad, and I don't mean maybe; not because it involves threads, (all the glands I have come across, do this in one form or another) but for perfectly obvious constructional reasons. Firstly, packing gets stuck in the threads and becomes a general nuisance; secondly, and at least equally important, for the reason that if this horrible arrangement *is* used, the internal thread in the gland should be screwcut in the lathe and at the same setting at which the cylinder cover is turned faced and bored, whilst the stuffing bush itself should be screwcut at the same setting at which it is bored. This is, practically speaking never done, the internal thread is tapped and the external one die cut, and the chances of the resulting threads being truly concentric and perfectly lineable with the axis of the piston rod are very remote indeed. If they are not, undue friction and wear, together with leakage are inevitable.

I wonder if it has occurred to Mr. Busby that his strictures on piston rod to crosshead fastening by means of threads apply with equal, or even greater force to marine type connecting rod big (and in some cases little) ends?

Reverting to the number of reciprocations necessary to cause breakage or slackening of lock-nuts, I had one White through my hands which had done 220,000 miles before I had it and did another 30,000 with me. Revolutions per mile would average about 1750, or in hilly country (I was living in the Peak District in those days) more. I leave it to Mr. Busby to estimate how many more would be needed before trouble arose.

Rustington, Sussex. K. N. HARRIS.

Small Lathe Design

SIR,—It was very interesting to read Mr. Jeynes' remarks (p. 327, April 1) regarding the position of the carriage handwheel and that he much prefers the American left-hand position and also the letter from K. N. Harris (p. 473 May 20) who prefers the right-hand position. I have worked on various lathes, mostly American, for sixty years and much prefer the left-hand position for convenience and ease of operation, although as Mr. Harris points out, with this position you are liable to be burnt with hot chips, especially when using Tungsten Carbide tools.

I can appreciate it might be more convenient and even necessary to have it on the right-hand side on gap-bed lathes, even some gap-bed American lathes have been built in this way. But I have never known of a case of an American straight-bed lathe with the carriage handwheel on the right.

Another point worth mentioning is that with the carriage handwheel on the left-hand side, the carriage will be pulled towards the headstock whereas if on the right it will be pushed.

Something which has always bothered me is the apparent inconsistency in the design of a line of English lathes. I am not thinking so much of lathes for the amateur; with only one machine they need the maximum capacity such as a gap-bed provides, but I do think they should concentrate on straight bed lathes as standard and treat gap-bed lathes as more or less special. Looking at some lines of English lathes, some will have the carriage handwheel on the right and others on the left for no apparent reason. Again, one size in the line will follow a particular pattern but other sizes will be entirely different. Also they adopt different methods of guiding the carriage. At the 1960 Olympia Machine Tool Exhibition a variety of lathes were exhibited on one stand with four different arrangements of flats and Vs. One American company still in business have not altered their design of four V's. for the bed, for all sizes from 6 in. to 24 in. centres, to my knowledge, for close on seventy years.

Again, I cannot see the idea of having facing feeds half the turning feeds. On most American lathes I can remember, the facing and turning feeds were identical.

Regarding the Editor's remarks, I would say even prior to 1914 American lathes were much preferred to English. A shop I was in prior to that date had a dozen American lathes of seven different makes all in continuous use, but the eight English were seldom used and only then because they were fitted with some special chuck. G. W. Whitworth may be interested to know that one of these lathes was a 15 in. (swing over bed: 22 in. in gap) Sebastian and was the first American lathe I worked on and despite the gap-bed and right-hand handwheel was much preferred to English lathes previously used. It must be remembered that the Sebastian was a light cheaply constructed lathe built down to a price; it had no tumbler reverse for screw-cutting, provision was made for an extra gear to be inserted in the gear train so as to cut left-hand threads. There was a reverse for feeds in the apron and it would be unfair to compare it with lathes in the class of the Hendey.

I believe I am correct in saying that although Hardinge lathes may be built in England, they were of American origin.

I have not found standard American lathes to have large bore mandrels. It is only of very recent years that there seems to be a tendency to fit mandrels with a larger bore than average. The Hendey lathe mentioned by Mr. Jeynes may have been special but on looking up a catalogue for the 1920's., 18 in. and 20 in. lathes had 1½ in. and 24 in. swing, 1¾ in. spindle holes.

As G. W. Whitworth says, it is probably a waste of money having all lathes in a shop fitted with quick change gearboxes, I think the same applies to gap-bed lathes. All standard lathes should have straight beds and gap-bed lathes treated as specials. Anyway, I consider the gap-bed lathe has a most untidy appearance.

I do not like the Myford type of toolpost mentioned; I prefer the American type with a solid ring on which to clamp the tool instead of the swivelling shoe arrangement and use convenient packing for each tool as the Editor mentions, so that only one screw has to be tightened to secure the tool in the correct position and height. Further, as the toolpost goes into a Tee slot it can be easily removed out of the way if not required. I am quite sure anyone who has not worked on a lathe where the toolpost is secured in this manner can appreciate what a boon it is to be able to quickly remove it so as to get a better view of the work when using the tailstock as in drilling.

The Hendey lathe has become well known chiefly, I think, because it is so closely coupled with the Norton quick change gearbox, which it was the first to use. However, other great names in the American lathe world should not be forgotten, such as Le Blond, Lodge & Shipley, American Tool Works, Monarch and Pratt & Whitney and the once popular and well known Star lathes made by Seneca Falls. The two latter names were household words in many machine shops, but have now disappeared and are no longer made.

Some years ago I made a list of all the American lathe makers I could find, many now non-existent, and the total came to over eighty.

Nearly two years ago I purchased a *Bantam* lathe as illustrated in M.E. September 15, 1964; the main attraction, besides the good range of threads through the gearbox, was the well designed V bed and tailstock, cam-lock spindle nose and American type toolpost which would take ½ in. × 1 in. tools. I had quite a variety of toolholders of this size taking $\frac{5}{16}$ in. square tool bits.

Wembley. J. H. Davis.

Synchros

Sir,—Regarding Mr. Jeynes' letter, Postbag, August 19, I must first make it clear that I did not intend to claim that the motor produced from a synchro is an efficient one. It does, however, serve a useful purpose, and efficiency in the small workshop is not a matter of great importance, particularly on such a small scale.

The second point which needs to be observed is that the synchro used must be designed for 50 cycle operation—a 400 cycle one will overheat very rapidly.

I arrived at my present operating conditions by trial and error, partly based on available components, but I have since carried out one or two experiments, and I find that although the machine will motor with the phase changing capacitor omitted, the result is rotation at very low power, and it is easy to bring the rotor to a standstill with the fingers. The actual size of the capacitor is not I find of great importance, (provided it exceeds a certain minimum value which appears to be about 25 mf.) and in practice as mentioned, a motor starting capacitor does the trick beautifully.

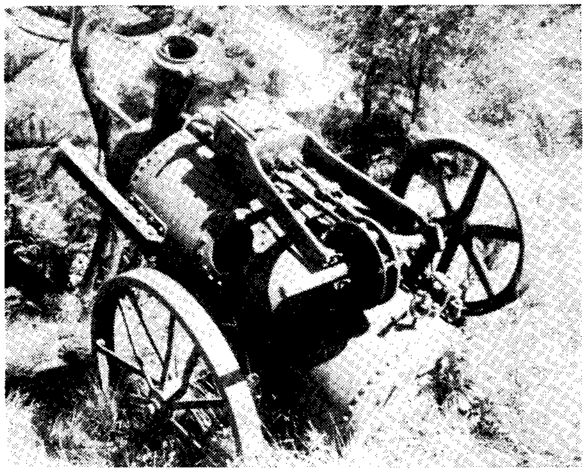
I have investigated with another motor which is, as yet, unmodified and find that the circulating current in the armature is about 1 amp on a 60 volt supply. I have not, however, taken the trouble to investigate its phase relationship with the input current.

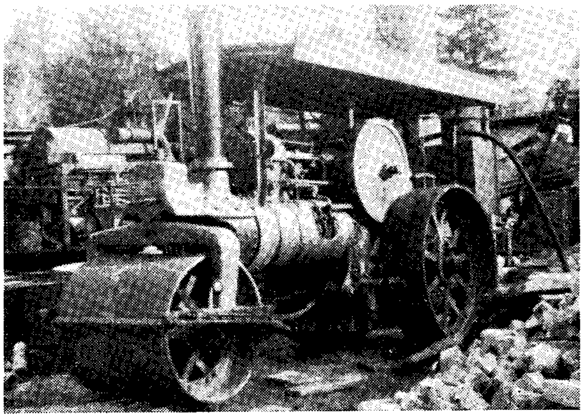
Spinning the rotor up to speed by hand is quite practicable, but the resultant condition is, of course, similar to that produced by disconnecting the phase shifting capacitor, and little power is available.

As mentioned by Mr. Jeynes it is, of course, necessary to remove the anti-hunt device which is situated under the cover, and failure to do this results in very considerable vibration. These motors are beautifully balanced, and in fact, if one is run up to speed and the power then switched off, it will take two or three minutes or sometimes even longer to run to a standstill.

I agree in principle with Mr. Jeynes that the system is electrically indefensible, and would only conclude by remarking that I can make no claim to having originated it myself, but that I got the idea from an issue of Model Engineer published in about 1947, in which Duplex described a lathe attachment driven by one of these motors.

Dorchester. M. C. Matthews.





Unusual Portable and Roller

Sir,—I wonder if any of your readers can identify the small two-wheeled portable shown in one of my photographs? It was seen recently near Pietermaritzburg, South Africa. Despite careful examination, no maker's plate or markings could be found. Note the provision for fixing horse shafts, also the crankshaft-mounted governor which apparently is intended to vary the cut-off by altering the position of the eccentric. Not so obvious from the picture is the tubular marine-type firebox.

The other photograph depicts a 12 ton single crank compound roller at Buchs, Switzerland. The low pressure cylinder is mounted directly above the high-pressure, and both piston rods are secured to the same large crosshead. She was built by HUB ZETTLE-MEYER, Conz. a.d. SAAR, No. 464 of 1929, and is still in regular use. Her owner Armin Koppel has in addition an Aveling and Porter roller which he uses in his road-building business.

Ayr. J. A. Ritchie.

The Burnerd Griptru Chuck

Accuracy is only measurable against the standards accepted by general usage in a particular field, or, as now laid down by various Standards Authorities. With the rising standards in our daily lives has come a rise in standards of accuracy required in machining components in work and in pleasure.

Many engineers have looked for a more accurate means of holding the work in their lathe. One answer to this problem is the Burnerd Griptru Chuck, which grips the workpiece with a normal geared scroll movement, which can then be adjusted without releasing the grip to an accuracy of .0002 in. total indicator reading.

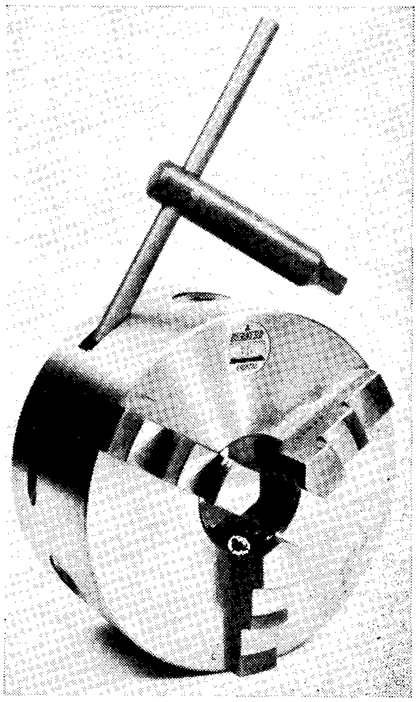
The Griptru Chuck is available with either 3 or 6 jaws. The choice of these two alternatives depends on the type of workpiece which it is intended to hold. The use of the 6-jaw chuck does not increase the gripping force, but spreads it more evenly round the gripping face. This is important when a thinnish component is being held for, if only 3 jaws are used, the component can be distorted to a triangular shape, and though it is machined true when the pressure is released, the machined surface is no longer true. An interesting example of the possibilities of this is one firm who uses these 6-jaw chucks to hold glass tubes while machining.

The Griptru Chuck is very simple to use and to adjust. The chuck is supplied with two sets of jaws for inside or outside gripping and, once the required set has been fitted in the chuck in the normal manner, the workpiece can be gripped as in any other geared scroll chuck, using the key in one of the pinions in the normal manner, remembering that for consistent gripping one should always use the same pinion. To adjust for concentricity, a clock gauge is ideally suitable and it should be set up touching the workpiece, either above or below, at an angle at which it can be comfortably read.

The micro adjustment for concentricity consists of three cone screws, situated around the edge of the back half of the body, which can be used to move the front half of the body, which contains the geared scroll, relative to the back half. When adjusting the chuck, one uses the screw which is directly opposite the probe of the clock gauge. To start off with, all the screws should be slackened off and then that which is opposite the low point on the workpiece is tightened until the gauge reading moves. The screws are adjusted by tightening, if they are opposite a low point, or slackening, if they are opposite a high point. Care should be taken that the screws are never over-tightened as, with the very fine cone angle, considerable forces can be built up in the chuck body, sufficient to damage the chuck. In practice, one will find that the adjustment to within a total indicator reading of .0002 in. can be obtained in less than half a minute.

If the workpiece is removed from the chuck and replaced, it is sometimes found necessary to alter the micro adjustment again.

The 3-Jaw Griptru Chuck is available in a range of sizes, starting at 3¼ in. outside diameter going up to 12 in. dia. The 6-Jaw model only starts at 5 in. dia., as there is insufficient space in anything smaller to get 6 jaws in a body with any strength left. On some chucks the key to adjust the adjusting screws is on the tommy bar of the chuck key, and in others it is an extension of the ordinary end of the chuck key.



Burneed chucks are obtainable from all good tool dealers.

Coles' Power Models U.S.A.

The new catalogue of Coles' Power Models, of California, a copy of which was received recently, contains several items of outstanding interest to model engineers.

One of Coles' outstanding models is a 4-cylinder 4-stroke petrol engine of 1 in. bore and 1¼ in. stroke, based on the Holt "75" caterpillar engine of 1915. Coles also supply a complete set of drawings and castings for building a one-inch scale Case steam traction engine. A set can be purchased which includes not only the necessary castings, but 380 other separate items including flanged boiler plates, steam fittings and valves, gear, screws, rivets, sheet and bar material, etc., etc. A kerosene burner can also be obtained.

Another interesting Coles model is a 0-4-0 Switcher locomotive for 4¾ in. gauge tracks. This engine is fitted with Walschaerts valve gear, a copper boiler and cylinders 1⅛ in. bore × 1¾ in. stroke. A complete set of drawings and castings are once again available.

Coles' are, we believe, the only model company in the world who supply castings and drawings for an old type steam fire engine. The model measures 25 in. long (not including horses!) and has a double acting two-cylinder engine of 1⅛ in. bore and 1¼ in. stroke, the pump being ⅞ in. bore by 1¼ in. stroke. Books are also available on the history of American fire engines.

Other interesting items include a model Corliss engine—again an unique type of model—for which a complete set of castings, drawings and materials are supplied, and finished piston rings for all types of engines ranging from ⅞ in. dia. to 2 in. dia.

Model petrol engine enthusiasts will find that miniature sparking plugs are also stocked by this enterprising American company, both in ¼ × 32 and ⅜ × 24 thread sizes. Finally, a complete flash steam plant is offered, fired by propane, utilising a Stuart Double-10 vertical engine.

Enquiries should be addressed to Coles' Power Models, at Box No. 788, Ventura, California, U.S.A.

Expanded Polystyrene

SIR,—I cannot let your reply to F.F.S. of Leicester go unchallenged, re expanded polystyrene. You have in fact misled your correspondent.

The moulding of E.P. is not an injection process. E.P. is supplied in the form of beads of approx. $\frac{1}{16}$ in. dia. It is ordinary Polystyrene to which a gassy agent has been added. This gassy, or blowing agent, expands at approx. 200 deg. F. (98 deg. C.). The process is as follows:—

The E.P. beads are first expanded (in a mesh basket?) either in boiling water or wet steam for from 1 to 2½ min., depending on the density required of the finished product. The expanded beads must then be aged, in air at normal temperature and pressure, for a minimum of 24 hours. The expanded beads are packed into the mould, the mould closed and steamed in wet steam for approx. 15 min. The mould is then cooled either naturally or by dropping in cold water, and the moulding extracted.

The moulds can be of wood, brass or aluminium. Aluminium, is preferred for heat transfer, lightness of working etc.

From my own experience I can tell you that wood is perfectly satisfactory for small quantities, cast aluminium for large; (500,000 and up) with a minimum of trouble the density of the finished moulding can be varied from 8 to 1 lb. per cubic foot. At 11 lb./ft.^{3} E.P. is fragile, ceiling tiles etc. are usually between 2 and 3 lb./ft.^{3}.

In conclusion if F.F.S. so desires, I can supply him with a quantity of E.P. beads, for experiment.

Radford, Coventry. L. HARRISON