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Volume 132 Number 3297

MODEL ENGINEER

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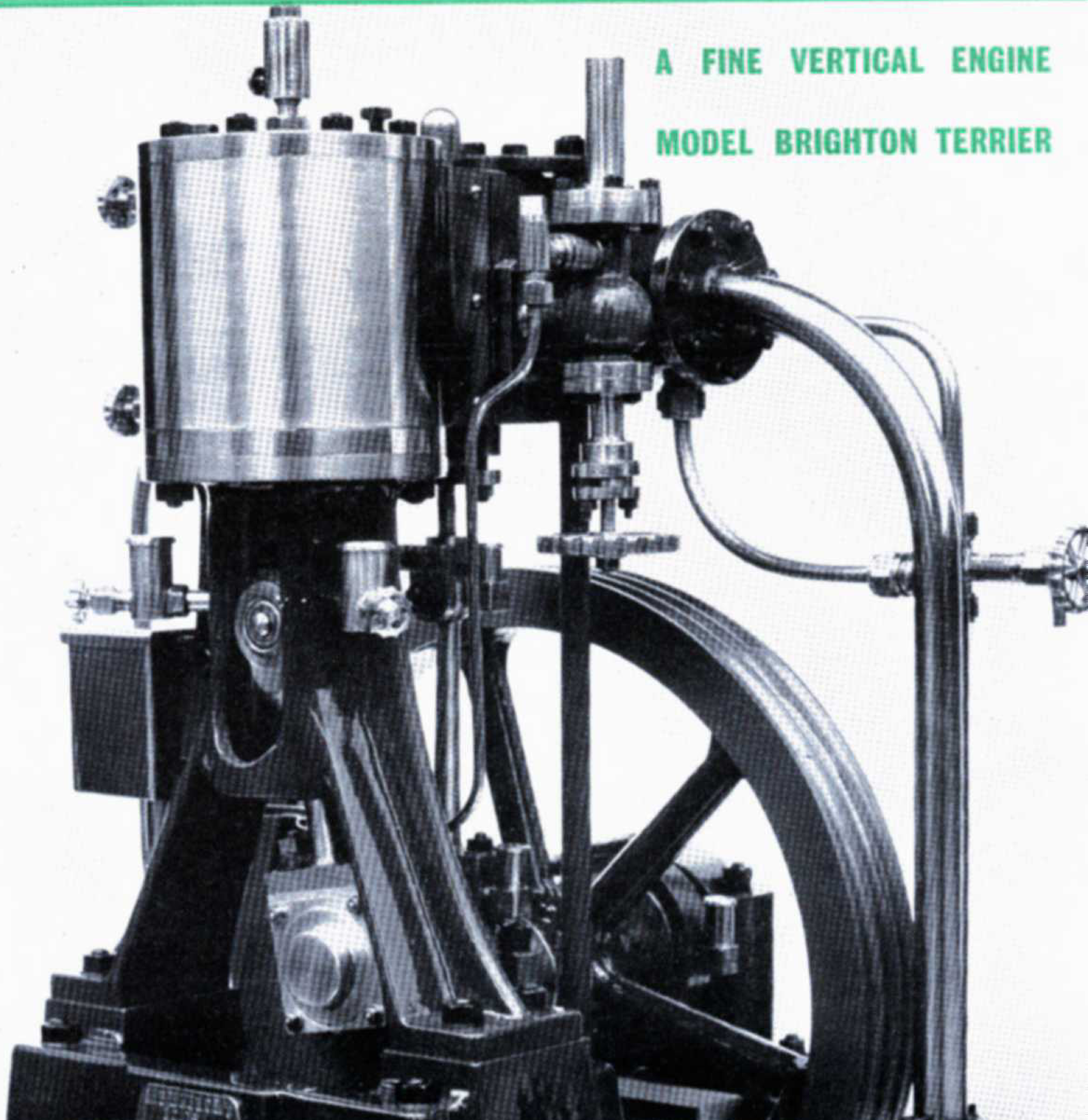

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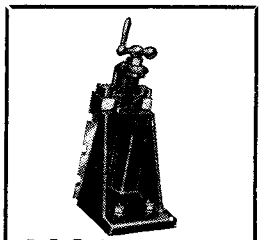

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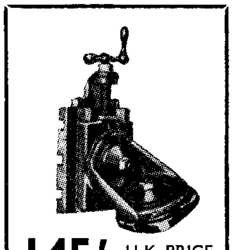

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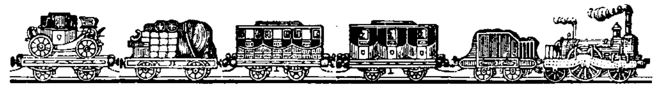

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20 May 1966 Volume 132 Number 3297

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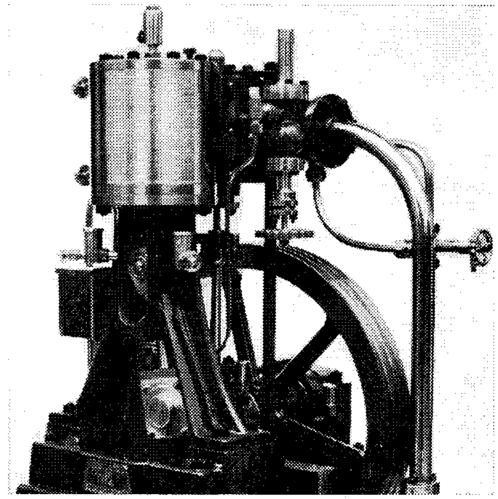

Cover picture

A fine vertical steam engine, built and photographed by Anthony Beaumont.

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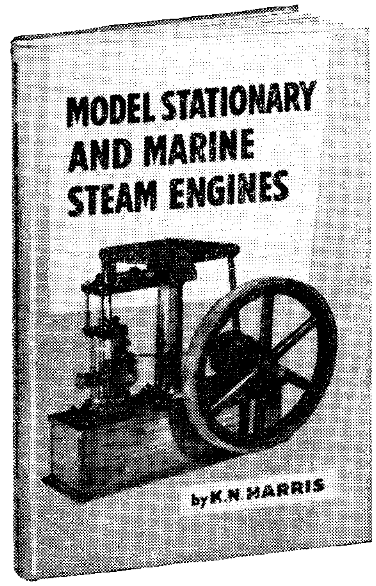

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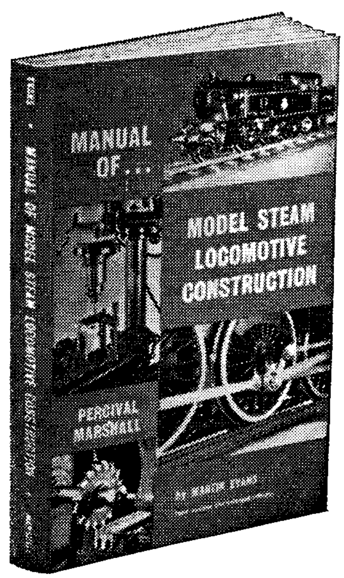

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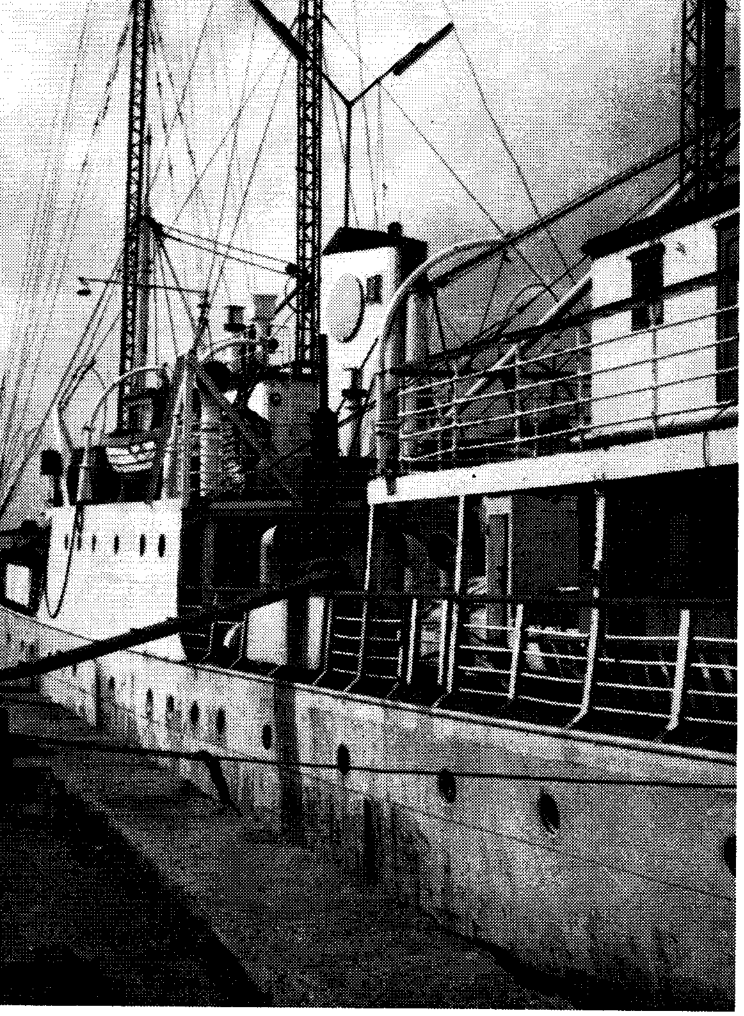


SMOKE RINGS

A commentary by the Editor

Pirate Ship

MY picture shows the pirate ship *Radio Caroline* at Lowestoft. She was recently towed into the East Anglian harbour by tug for repairs, after being battered by gales. Photograph by C. R. Temple.

Last Giant of Steam ?

IN this issue, Mr K. N. Harris reviews Sean Day-Lewis's book of the above title—a full-scale biography of Mr O. V. S. Bulleid, late C.M.E. of the Southern Railway, and C.I.E. Ireland.

Now I wonder if such a title is really warranted? Mr Harris clearly thinks it is, but in my view such a title needs some justifying, and it also does not do justice to another great steam engineer, Mr R. A. Riddles. As Mr Riddles's career comes somewhat after Mr Bulleid's, the impression is given that Mr Bulleid's is the more important of the two. I don't agree!

I would not deny for a moment that Mr Bulleid is a great steam engineer, but to describe him as a "Giant of Steam" is in my opinion going a little too far! It suggests to the layman that he is on a level with Churchward, Gresley and Co.

Mr Harris does not seem to appreciate that to the general public, a locomotive engineer is judged largely by his success or otherwise in designing new locomotives, and to a lesser extent, in rebuilding older or less-efficient engines, as required by the demands of the running department. Of course, there are other duties which a C.M.E. has to carry out, but those I have mentioned are, I think, the more important.

Now consider Mr Bulleid's designs for the Southern Railway. I quite agree with K. N. Harris that his Q.I. class 0-6-0 engines were good in every way, and that some observers only condemned them because they were ugly. But the whole point about the Q.I. class is that this was only a development of the Maunsell Q, with some of the "trimmings" left off for economy. The Q.I.'s had good cylinders and valve gear, but nothing startling or original. In any case, not many of these engines were built, so to judge Bulleid's designs fairly, we must consider his Pacifics.

Mr Harris says nothing about the many teething troubles with the Merchant Navy class engines, nor the troubles that beset them for long after they were running in regular traffic. No one would deny that they were powerful engines, and could run very fast at times. The Southern Pacifics did very well indeed during the great locomotive exchanges of 1948, but only so until their fuel and water (and oil!) consumption is examined. The plain fact is that in their streamlined form, they were never a success. They were bad starters, and certainly less reliable than say Stanier's Pacifics. They were dirty engines too, due to their sluggish exhausts.

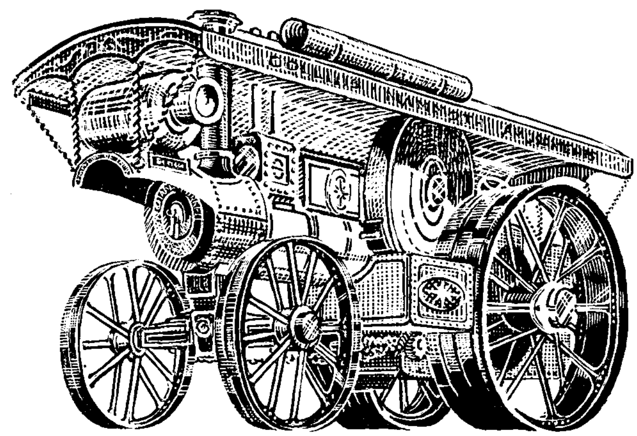
The fact that British Railways found it necessary to rebuild the Bulleid Pacifics surely proves that the design generally was not a good one. I wonder what Mr Harris really thinks of that extraordinary valve gear, with its chain drive and multitude of pins and joints? How a clever engineer like Mr Bulleid really expected such a valve gear to be successful, I find very difficult to understand!

I have so far said nothing about Bulleid's unsuccessful sleeve-valve engines. Granted that they were highly original, and Bulleid deserves the greatest credit for trying to break away from the conventional, in order to achieve greater efficiency. But the plain fact remains that he failed to do so, and in the long run, an engineer must be judged by what he actually achieves, and in the hard light of the profits or otherwise that finally reach the shareholders.

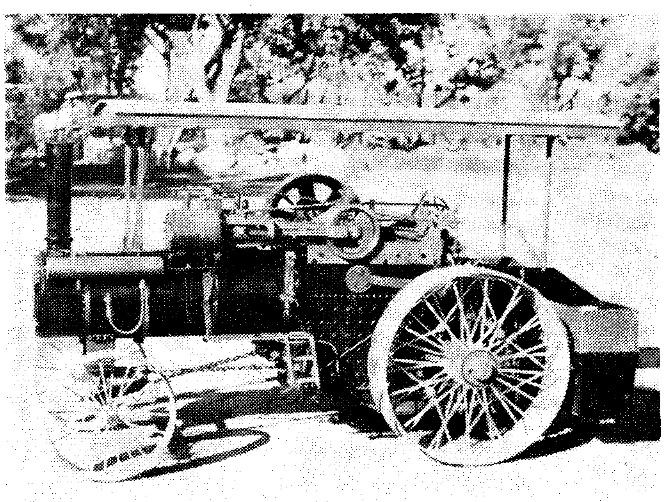
Returning for a moment to Mr R. A. Riddles, here, surely, we have an engineer whose designs were almost entirely successful. True there was a little trouble over the Britannias' wheels and axles, but this was soon overcome, and the engines came to be recognised as one of the most useful we had. Again, Mr Riddles said all along that steam should have been kept going for a few more years until all our railways could be electrified, on a really up-to-date system, as we now have on the old LMS main line. The diesels should never have been built at all; even today, they have not quite reached the overall reliability we came to expect without question from the steam locomotive.

However, I am digressing. Mr Harris's main point is that Mr Bulleid's work was sneered at, and he clearly has a low opinion of British locomotive engineers in general. He talks of their hide-bound conservatism and even obscurantism. I would agree that this country has had a few bad locomotive engineers, and some who were too conservative, but taken as a whole, Mr Harris does them less than justice. By and large they were highly competent, and if I may say so, if the non-technical departments of both the pre- and post-grouping railways had been as efficient as their respective locomotive departments, perhaps the railways would not be in such a parlous financial state as they are today.

Mr Harris refers to one of Mr Bulleid's quotations from a Arab proverb. I might well re-phrase it as follows: "The dogs bark, the Caravan proceeds on its way—to the shops for rebuilding!"



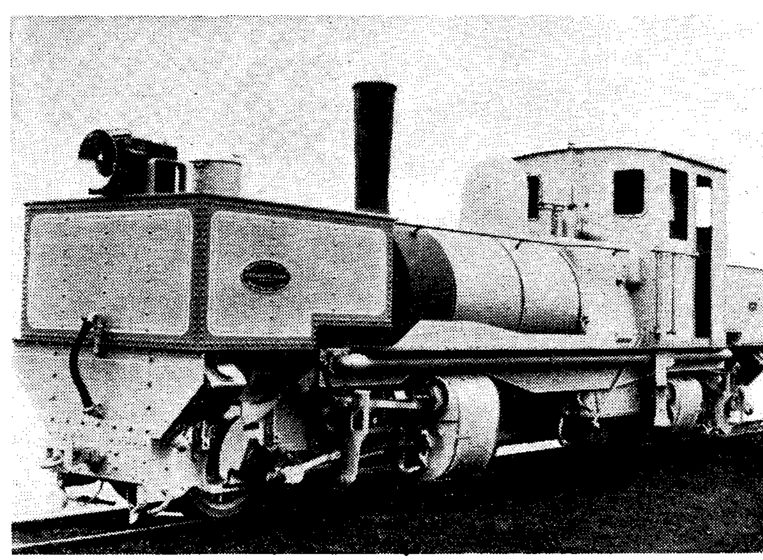
The above sketch is another sent in by reader M. A. Walmsley of the Isle of Man, and shows an imaginary Showman's Road Locomotive, based on the Burrell design. With the advent of the rally season, there will soon be reports in ME on many of the engines and their owners.



The 2 in. scale model Case Traction engine shown in the above picture was built by Jan Hugo, a country member of the Bloemfontein Model Engineering Society. The model steams and pulls admirably. Mr Hugo, who is a farmer in South Africa, also owns several other models including a $3\frac{1}{2}$ in. gauge *Jubilee,* and a $\frac{3}{4}$ in. scale Caledonian *Dunalastair*, built by Mr Tucker in England.

Above: The Garratt arriving at Boston Lodge.

Below: The Tasmanian Garratt in original condition.



Garratt for the Festiniog

WITH the two Fairlie locomotives getting rather old, the Festiniog Railway needed another engine of good hauling power. By a fortunate coincidence—for the Festiniog—Messrs Beyer, Peacock's locomotive works at Gorton are now being closed down, and since 1947 this famous Company have had on display there the first Garratt locomotive ever built, a 0-4-0 + 0-4-0 compound, constructed in 1910 for the Tasmanian Government Railways, and purchased back from them for preservation. The engine will require some alterations before she can be steamed on the Festiniog, but should prove a most useful and attractive addition to the Railway's stud.

WORKSHOP WAYS AND MEANS

Hole cutting and Trepanning by Artificer

THERE are several ways of cutting large holes in metal plates or sheet material. When no special tools of any kind are available, a convenient method in most cases is to drill a circle of small holes as close together as possible, and file or chip away the thin partitions of metal between them. To avoid unnecessary work, the holes should be evenly spaced and at an even radius. The size of the hole required should first be clearly marked out, by scribing a circle on the plate, and the pitch circle of the holes similarly marked at a smaller radius, depending on the size of holes to be drilled. Assuming that these are to be $\frac{1}{16}$ in. dia., the pitch circle should be about $\frac{3}{32}$ in. less in diameter than the finished hole.

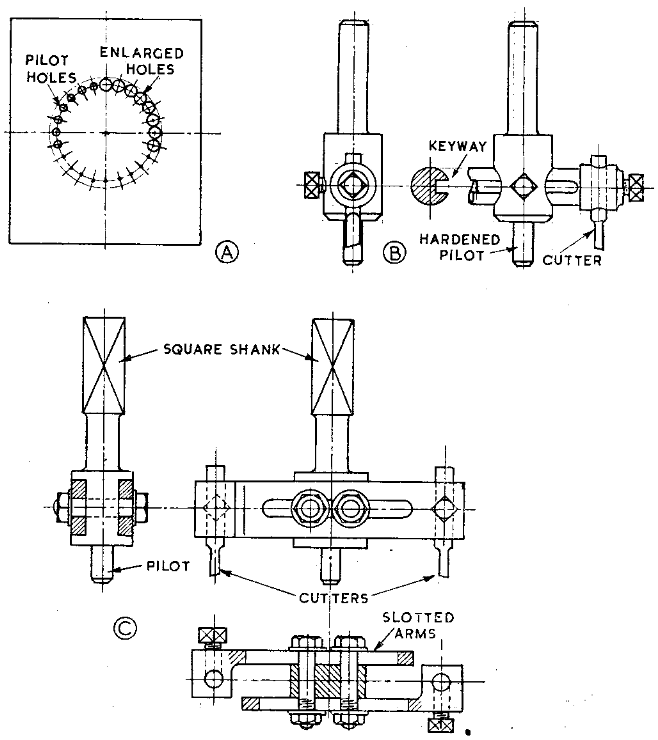
It is worth while to drill pilot holes around the circle as shown at *A*, and open them out to a size which leaves as little metal between them as possible. This reduces the risk of the holes running into each other, and with reasonable care, the breaking out operation, and trimming of the large hole by filing, are reduced to the minimum. But at best, this method is neither as expeditious nor as accurate as when special hole cutting or trepanning tools are employed. Among tools in this class, the "hole saws" which employ a length of hacksaw blade bent into a circle and attached to a suitable holder, are available in a range of sizes, and are efficient when properly used.

Single-point trepanning tools have the advantage of being capable of a wide range of sizes, and the cutter can be sharpened or renewed when necessary. Several kinds of these tools, sometimes known as "tank cutters," are available ready made, but some of them are badly designed, both in respect of cutter holding, and resistance to torque stress while working. To drill and trepan the hole in a single operation, a stub drill is usually fitted to the centre of the holder, but the steadying effect of this is very poor, and it is better to fit a hardened pilot, after drilling the centre hole separately. The shank of the holder is often inadequate to drive the cutter against torque resistance, and attempts to use such tools in a small drilling machine or hand power tool are often unsuccessful.

A simple but practical trepanning tool is shown at *B*. The holder is cross-drilled to take an arm of circular section, enlarged at the end to take a round or square cutter bit. To resist the tendency of the arm to turn, under cutting stress, a keyway is cut in it to fit a pilot on the clamping screw. This tool is suitable for holes up to about 2 in. dia. in steel, or larger in brass or aluminium. Most drilling appliances, even some of those equipped with reducing gear, run too fast for single-point trepanning tools, which work best at slow speed with adequate lubrication. The almost-forgotten ratchet brace, once an essential tool to boilermakers and structural workers, provides a useful means of applying trepanning tools of all kinds, if a suitable support can be rigged to withstand the axial thrust. This type of brace usually had a squared socket to take "bit-stock" tools, which withstand torque stress up to the breaking-point of the shank.

A twin-cutter trepanning tool which will cut holes up to 6 in. dia. is shown at *C*. The holder is made of rectangular material and grooved on the two sides to fit the slotted radial arms which are held in position by two bolts. At the driving end, the shank may be squared, or shaped as convenient to fit any form of driving socket or chuck. The arms should either be made from the solid or have the cutter holders brazed on. By using two cutters, the working load is balanced and stress on the centre pilot reduced. If the cutters are set to slightly different radii, so as to cut a wider groove, they will cut more efficiently and are less likely to jam in the cut.

Where it is possible to mount work on the lathe faceplate or in a chuck, a parting tool set parallel to the lathe axis, and having suitable side clearance, may be used as a trepanning tool. Risk of running the tool right through into the faceplate should be avoided, by interposing a backing plate of wood, cardboard or soft metal. Any form of trepanning tool may be used in the lathe if it is possible to support the work against a drill pad of adequate diameter, fitted to the tailstock socket.



A WEIGHT-DRIVEN REGULATOR TIMEPIECE

Part two

by

Claude B. Reeve

Continued from page 405.

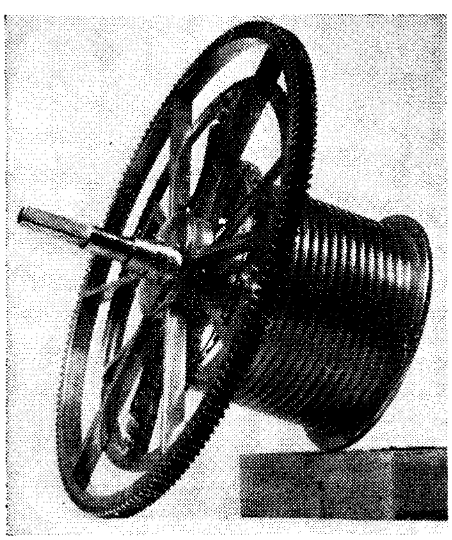
Front view of the dial and movement.

THE barrel ratchet teeth can now be cut with the same fly cutter; the cutter can be angled round to cut a larger sized tooth. The number of teeth required in this case is 50: note that the ratchet teeth of the barrel should point to the left when viewing the barrel ratchet flange from the front.

The great wheel and maintaining ratchet wheel can now be fitted to the barrel arbor which is approximately ¼ in. dia. after polishing, they should be quite an easy fit on the arbor.

Both these wheels can now be crossed out as shown in Fig. 4, Nos 1, 2 and 3. Although directions have been given in *Model Engineer* how to do this by machining methods, I much prefer to do it by hand with a piercing saw.

The Great Wheel and Barrel assembly.



Circular guide lines should be made on the wheels in the lathe with a scriber and dots made for centring the six arms which should be $\frac{1}{16}$ in thick finished size. The secret of success in obtaining a good finish on this operation is to use a medium gauge piercing saw blade, keeping close to the scribed line and avoiding cutting a chamfer or under-cut. A useful tip is to scribe circular guide lines on both sides of the wheel. If carefully cut out in this manner, very little finishing with fine files and emerypaper will be needed.

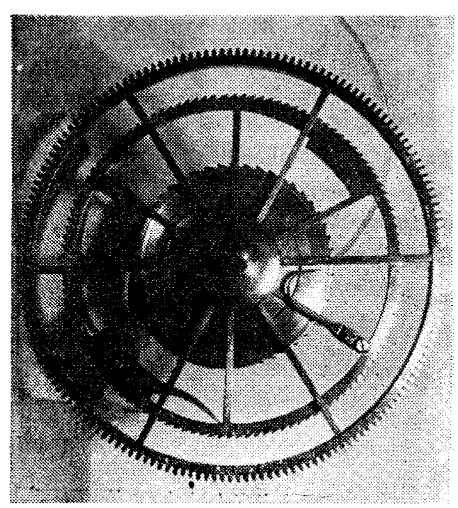
In a regulator movement, the aim is to reduce friction at every possible part of the mechanism, hence heavily constructed train wheels with massive arms or spokes are the reverse of what is wanted.

The maintaining springs

These are shown in Fig. 4, Nos 2, 3, 4 and 4a. They should be filed up from ⅛ in. square silver steel; the flexible part is made tapered and quite thin towards the free ends, afterwards smoothing with emerypaper. The spring part should be shaped by pressing over a piece of rod held in the vice, it is then hardened and carefully made bright with emerypaper and tempered to a pale blue colour. The temper of silver steel seems better taken somewhat beyond normal tempering shades. The two maintaining springs are attached to the extended rims of the maintaining ratchet wheel with 12 BA screws as shown in Fig. 4, No 2. The free ends of the springs contact the opposite sides of the great wheel.

The head of a screw positioned on the front extended rim of the maintaining ratchet wheel will allow for ¼ in. rotation of this wheel before butting against the arms of the great wheel. This constitutes the action of the

Front view of Great Wheel and Barrel assembly.



maintenance, whose function is to maintain the driving force of the great wheel during the period of winding up the weight. In non-precision clocks there is no maintenance mechanism, in consequence of which the clock stops during the winding up process, and spoils the precision time-keeping of the movement.

The maintaining click

We have pivoted in the movement frame, a pawl or click, the point of which is always in one of the teeth of the maintaining ratchet; when winding takes place, this prevents the backward rotation of the maintaining ratchet wheel and then the expansion of the two small springs exerts pressure on the great wheel arm, causing the wheel to turn anti-clockwise taking the place of the driving weight during the winding of the barrel. Details of this click will be given later.

The barrel ratchet click

This click can now be made. It is cut from mild steel plate 3/16 in. thick, using a piercing saw. Before cutting out, it is expedient to drill the hole for the fixing screw, the thread portion being 8 BA, a plain shoulder being made an easy fit in the bore of the click. The head of the screw is countersunk and recessed in the hole of the click. Fig. 4, No 5 shows the dimensions of the screw.

Fig. 4, No 6 shows the spring to the click of the barrel ratchet and is made from 1/16 in. brass strip. It is cut with a piercing saw to follow the shape where the fixing screws locate it, but the remainder of the spring should be cut in a straight line and afterwards bent to shape, while in the straight the spring can be filed up and finished with emery sticks. To bend it nicely to shape without kinks it should be pressed over a former of a large diameter rod or tube. It has to follow the diameter of the teeth of the maintaining wheel as shown in Fig. 4, No 2 and is held to the extended rim of the wheel by two 10 BA screws.

Retaining collet

Fig. 4, Nos 7 and 7a show the retaining collet. It is a push on fit to the barrel arbor and is kept in position with a small cross pin. The barrel and wheels can now be assembled taking care that the maintaining ratchet wheel will rotate easily.

Fig. 5, No 1 shows the barrel and wheels assembly as viewed from the back, the large hole in the face of the flange and the small hole in the tube of the barrel. These are made for attaching the driving line to the barrel. No 2 shows the barrel assembly as viewed from the front and No 3 is a side view of the assembly. Although the barrel arbor is shown pivoted to the motion plate, this should be left until the other wheels and pinions have been made. All the parts of the assembly from number two to number 002, can now be fine finished, using emery sticks, the cone centres must be carefully preserved from damage and must not be cut off until the movement is finished.

A suitable driving line can be obtained at a hardware store in the form of a nylon clothes line.

The centre wheel and pinion

Fig. 6, Nos 1 and 2 show the details of these items, this pinion gears into the great wheel. The wheel has 112 teeth and its full diameter is 2¾ in. and its thickness is 1/16 in. The most suitable brass for clock wheels is supplied by Messrs Smith & Sons, of Clerkenwell. Brass circular blanks in any thickness and diameter up to 9 in. in increments of ⅛ in. can be had. Not all brass is suitable for clock making, some kinds are too hard and stringy and do not machine well with saw or milling cutter. The centre wheel is cut with the same cutter as that of the great wheel; being thinner it should be well supported against the cut. It is crossed out and fine finished in a similar way to the great wheel. Whilst the cutter frame is still set up, it is worth while cutting the teeth of the third wheel. Fig. 7, Nos 1 and 2 give the dimensions.

The escape wheel

Fig. 8 gives the details of this wheel, the most important of the movement for accuracy. Good cutting of its teeth depends on a perfectly-divided division plate. No other wheel tests the accuracy of the division plate so well as an escape wheel, for any defects in dividing will be clearly shown up when fitting the escapement to the wheel. Turn a 1/16 in. thick brass blank to 1¾ in. dia., having previously mounted it on a 3/16 in. spigot wheel chuck. A fine slitting saw is now required and mounted in the cutter frame, the teeth of the saw to rotate anti-clockwise. Angle the cutter frame a little so that the saw will produce an undercut; although 10 deg. is usual, the amount does not matter within reason. The real purpose of the undercut is that only the tips of the escape wheel teeth shall contact the pallet pads of the escapement. Thirty teeth are required, and a large circle of holes of the division plate can be used—say, a 90 circle; feed the saw slowly through the blank to a depth of 3/16 in.; now angle the cutter frame round again and cut the backs of the teeth.

The thickness of the teeth at the tips should be approximately 8 thou. Theoretically, the thinner the tips of the teeth, the better the results; but there are practical reasons for not having them too thin. While the wheel is still on the chuck, scribe a circular line representing the bases of the teeth spaces and the inner rim of the wheel, also a circle for the hub of the wheel. Now remove the wheel from the chuck and cut the spaces between the teeth with a fine gauge piercing saw, at the same time the spaces between the spokes or arms of the wheel can be cut and fine-finished with files and emery sticks.

Lantern pinions

As this movement has lantern pinions, the question of obtaining pinion

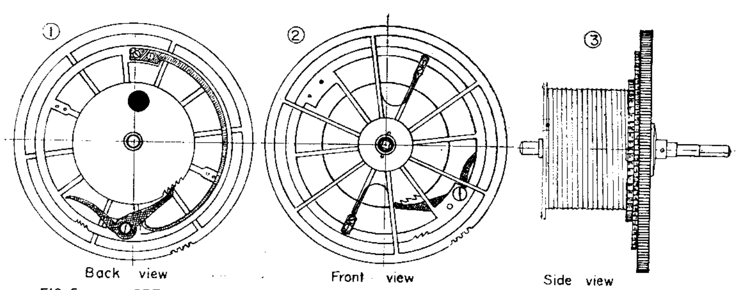


FIG. 5 GREAT WHEEL MAINTAINING RATCHET AND BARREL ASSEMBLY

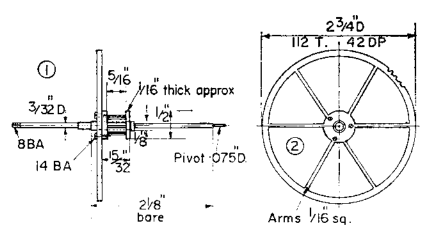


FIG 6 CENTRE WHEEL

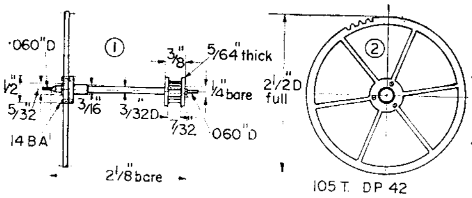


FIG. 7 THIRD WHEEL

wire does not arise. Pinion wire is rather difficult to obtain nowadays. From an efficiency point of view, lantern pinions are far superior, and especially so for a regulator. With leaved pinions it requires 12 teeth or leaves to the pinion for the teeth of the wheel to engage with them on the line of centres. Whereas, with lantern pinions the engagement of the wheel teeth with the pinion takes place past the line of centres, even when the teeth of the pinion (horologically known as the rounds) are only eight in number. With this particular movement the pinions all have 14 rounds, the engagement with the teeth of the wheel is well past the line of centres which is a very desirable asset. Although this timepiece has been going about 14 years with very little attention, there is not the slightest sign of wear on either the pinions or the teeth of the wheels.

Constructing the pinions

Chuck a short length of ½ in. dia. brass rod in the self centring chuck so that it runs reasonably true leaving about ⅝ in. of the rod protruding from the chuck jaws, turn a recess in the rod to form a bobbin to approximately the dimensions in Fig. 9A, No 3; a narrow parting tool is the ideal cutter for doing this. The sides of the bobbin are approximately 1/16 in. thick. Fourteen holes are now drilled through one side of the bobbin and half way through the thickness of the further side of the bobbin. No 70 drill size is suitable (.023 in.). Before drilling the holes, a circular line is scribed round the outer side of the bobbin 11/32 in. dia. This will eventually be the pitch line of the rounds. A drilling spindle will be necessary, fixed in the slide-rest. A twist drill will be quite suitable if care is taken. Protrude the drill beyond the chuck jaws only a little more than the thickness of the side of the bobbin for the first drilling, after which, advance the drill enough to drill through half the thickness of the other side of the bobbin. The bobbin should now be truly drilled through centrally, say, slightly under ⅛ in. dia. In Fig. 9A, Nos 2 and 3 it should be noted that a

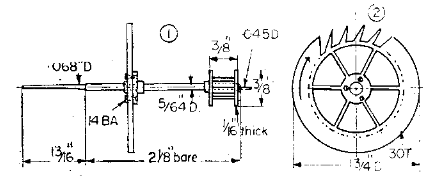


FIG. 8 THE ESCAPE WHEEL

small step is turned on the end of one of the sides to form a seating for fixing the wheel to the pinion head; this can be done now or later after the pinion has been fitted to the arbor. The step can be formed on parting off the bobbin.

For making the rounds, blue pivot steel is suitable. This can be obtained from such firms as John Morris & Co. or Pringle & Co., both of Clerkenwell. It is supplied in 5 in. lengths and can be obtained in single lengths or mixed bundles at a very cheap rate. As it is hardened and tempered it cannot be cut with cutting nippers, but if partially filed with a fine file it can be broken off. The rounds should be so fitted to the bobbin that the ends of the rounds are flush with the outer side of the bobbin. To hold them securely,

Continued on page 455.

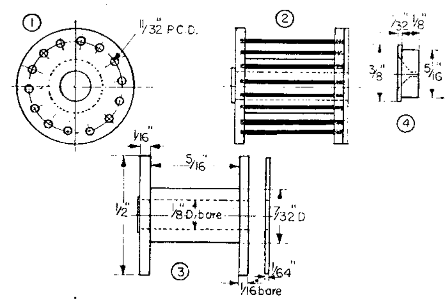
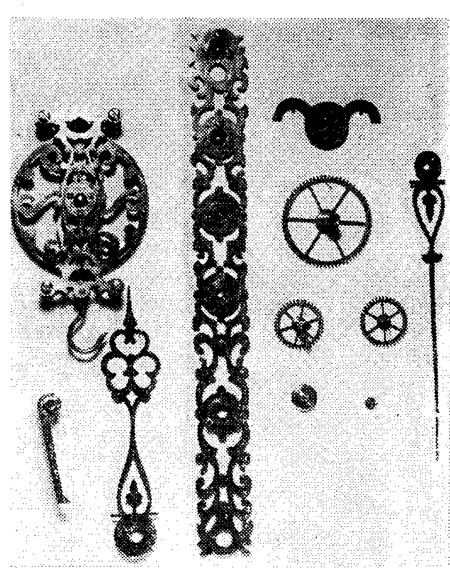


FIG 9A LANTERN PINIONS

Below: Some parts of the movement.



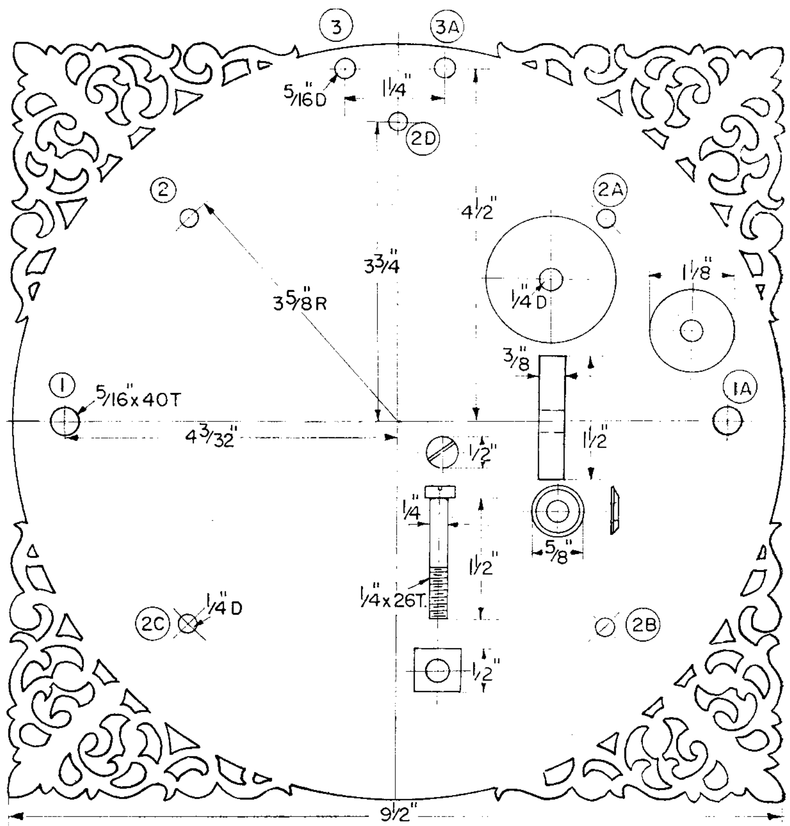
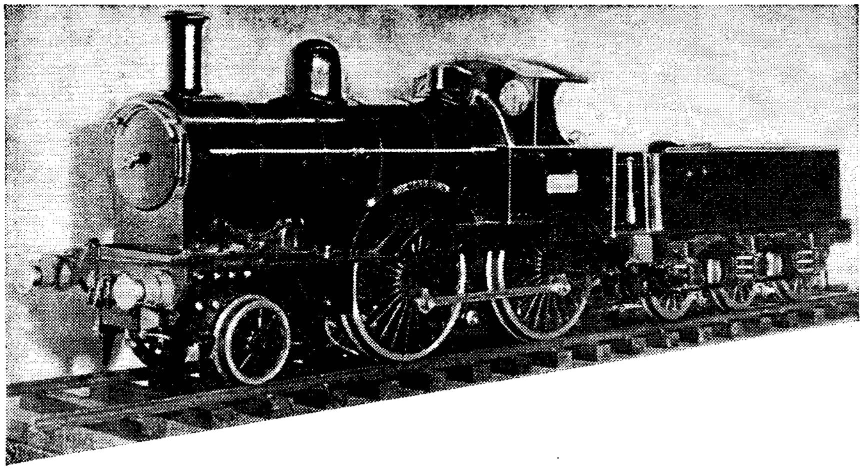


FIG. 9 BACK PLATE



MABEL

A $3\frac{1}{2}$ in. gauge LNWR 2-4-0 "Jumbo"

Continued from page 402

LBSC deals with the Crank Axle

Fitting crankpins

Put a brass 4 BA nut on one of the pins, set it at right angles in the scraped-out end of the hole in wheel boss, and squeeze it home between the jaws of the bench vice. Warning to beginners: don't put too much Sunny Jim on it, or you'll split the boss. If it goes hard, knock out the pin with a bit of rod through the back of the wheel, chuck it with the spigot outwards, and with the lathe running fast, apply a fine flat file, taking off just the tiniest bit for about three-quarters of the length of the spigot. That should allow the pin to press home nicely. The brass nut prevents damage to the thread.

Axles

I use either silver-steel or ground mild steel for axles, but the ordinary drawn or rolled steel will do at a pinch. You'll need one piece of $\frac{5}{8}$ in. dia. and two of $\frac{1}{2}$ in. dia. all $4\frac{1}{2}$ in. long. First, take a scrape about $\frac{1}{8}$ in. or so deep, out of each axle hole at the back of the wheel, using a big taper broach or reamer. Grip the axle blank truly either in chuck, collet, or split bush, face the end, and turn $\frac{1}{2}$ in. length to a press fit in the wheel boss, exactly as described above for the crankpin spigots. Centre deeply with a size E centre-drill, and drill down to a full $\frac{3}{4}$ in. depth with $\frac{1}{16}$ in. or No 52 drill. Another tip for beginners: drill $\frac{1}{8}$ in. deep. Withdraw drill, wipe the chips off the end with a brush dipped in cutting oil, and ditto repeato until the hole is full depth. Then you won't have to make a frantic dash for the tool store! At $\frac{1}{4}$ in. from shoulder, turn a groove $\frac{1}{16}$ in. wide and $\frac{1}{32}$ in. deep with a roundnose parting tool. Reverse axle and repeat operations on the other end, leaving $3\frac{9}{32}$ in. between shoulders, and facing off the wheel seat to $\frac{1}{2}$ in. length. Drill a $\frac{1}{16}$ in. or No 52 cross hole through the axle at the bottom of each groove.

One of the $\frac{1}{2}$ in. pieces is used for the crank axle. Four $1\frac{3}{4}$ in. lengths of $\frac{7}{8}$ in. $\times$ $\frac{1}{4}$ in. mild steel bar will be needed for the crank webs. Scribe a line down the middle of one of them, and mark the centre of it, then at $\frac{3}{8}$ in. each side make a heavy centrepop. Put a $\frac{3}{16}$ in. drill through first, making a pilot hole. These must go through dead square with the webs, so hold the steel in a machine-vice, either on the table of the drilling-machine or against a drilling-pad on the lathe tailstock barrel. Use the drilled web as a jig to drill the other three, then open out one hole in each web with $\frac{7}{16}$ in. drill, and the other with 31/64 in. drill, taking the same strict precautions as before, to ensure that the holes are dead square with the webs.

An alternative and exceilent way is to solder the four webs together, holding them with a toolmaker's clamp over a gas or spirit flame so that the solder runs well between them. Mark off the end one as above, then chuck the whole bunch in the four-jaw with one of the pop marks running truly, drill $\frac{3}{16}$ in., and open out to $\frac{7}{16}$ in. Repeat operation with the other pop mark, opening out to 31/64 in. Turn a short length of $\frac{1}{2}$ in. round steel to a drive fit in the larger hole, drive it in, grip the projecting end in the three-jaw, and you can easily turn the ends of all four webs to the radius shown, at one fell swoop—but be mighty careful how you feed into cut, or you've had it! Knock out the improvised mandrel, turn it down to fit the other hole, and repeat operation. Heat up the webs, and when the solder melts and they fall apart, wipe off any superflous solder. Separately-drilled webs must, of course, be mounted separately to finish the ends off.

The crankpins are made from two $\frac{7}{8}$ in. pieces of the same kind of steel used for the axles, the ends being turned a press fit in the $\frac{7}{16}$ in. holes in the crank webs, the process being exactly the same as when turning the axle ends, so we needn't go through the rigmarole again. Squeeze each pin into a web between the jaws of the bench vice, then turn a short bit of round steel to a sliding fit in the other holes in the web, and put it through to keep both webs in line while squeezing in the other end of the crankpin. The axle holes in the webs need opening out to a press fit on the $\frac{1}{2}$ in. axle, and I do this by setting my $\frac{1}{2}$ in. adjustable parallel reamer to a weeny shade under size, and putting it through both holes at once, with the complete crank held in the bench vice. However, I don't suppose many beginners have adjustable reamers in their kits; if not, use an ordinary parallel reamer, but only enter the slightly tapered leading end into the hole. Don't push it right through, but only far enough to allow the end of the axle to start in the hole.

Eccentric sheaves

As the four eccentric sheaves have to go between the cranks, make them right away, from steel or cast-iron. Steel sheaves can be made from a short bit of 1¼ in. dia. mild steel shafting. Chuck in three-jaw, face the end, and part off four 3/16 in. slices. As many beginners—*and* some experienced workers!—hit up against trouble in parting off, here is a tip. Grind the tool with a little more top rake than the textbooks say, and slightly oilstone the cutting edge. Set the tool *exactly* at lathe centre-height, run the lathe slowly, and feed as steadily as possible, taking care to avoid "crowding" the cut. Slop on plenty of cutting oil (I use equal parts of "Cutmax" and paraffin, but any good cutting oil will do) with a brush or drip can, and the cutting should come off coiled like a watch spring, with a sound just like bacon frying, though the smell isn't as appetising!

Chuck each truly in three-jaw, and take a skim off each side, to bring the thickness to 5/32 in. The toolmarks will show the true centre and at ¼ in. from this, make a heavy centrepop, drill it 3/16 in. and open out to ½ in. The sheaves should be a tight push fit on the axle. I made mine from cast-iron, chucking by the spigot provided, turning to size and facing off, reversing in chuck, parting off the spigot, and facing to required thickness.

Make a centrepop in the middle of the edge, opposite the thickest part, drill No 51 right into the axle hole, open out halfway down with No 40 drill, and tap the remains 8 BA.

How to assemble the crank axle

Jam a little block of ¼ in. square steel between each pair of webs, and squeeze the axle through one pair until the outer web is a full 9/16 in. from the shoulder. Put on the four eccentric sheaves, and squeeze on the other pair of webs likewise, setting the webs at right angles by eye (right-hand crank leads) and pressing until the eccentrics have no appreciable side movement, but can be turned on the axle with your fingers. Now check the crank setting by putting the assembly on the edge of a surface-plate, or the lathe bed, with one pair of webs lying flat on it, and apply a try-square to the other one. This shows at a glance if they are out of the right angle. If so, hold one pair of webs in the bench vice, with the axle vertical, and a hefty spanner applied to the other pair, will soon teach them good manners.

When O.K., drill a No 32 hole through the side of each web, right opposite crankpin and axle, both sides, letting the drill just penetrate crankpins and axle; see drawing. Squeeze in little stubs of ⅛ in. round steel, cut off and file flush. This is just a safety precaution for beginners, in case the "press fits" aren't pressy enough, but it is excellent insurance against the webs shifting! The way *Mabel* herself pulls away from a dead stop with a load, is enough to shift anything that is shiftable. Finally, mill or saw away the unwanted pieces of axle between the webs, trim up with a file, and Bob's your uncle once more.

How to erect wheels

Press one leading wheel on the axle, poke it through the axleboxes, take out the hornstay screws, and lift out the lot; then press on the other wheel, and replace the assembly in frames. Doing it that way prevents beginners from getting the axleboxes mixed up. Repeat operation with trailing wheels and axle, but don't press the second wheel right home; put it on about ⅛ in. setting the crankpins at right angles by eye. The crank axle and wheels need a little more jerrywangling. First cut two bits of bar, same kind as used for the webs, and jam them between the webs to make them like solid blocks, so that they can't distort under the pressing job. Put one of the driving axleboxes on the stub of axle projecting from the web—mind you don't put it on "inside out," it's easily done!—and press on the wheel with the crankpin on the opposite centre to the inside crankpin. Setting by eye will do quite well, a degree or two either way making no difference on a little engine.

Next, put on the other axlebox, taking the same precaution as before, and press the wheel on about ⅛ in, setting the crankpin as nearly opposite to the inside merchant as you can by eye. Now a lot of unnecessary fuss has been made by various folk about quartering the wheels, but really there is nothing to it. All I ever do, is just this: Stand the assembly on something flat, the lathe bed will do if you haven't a big surface-plate. Scotch up one wheel so that the lot can't roll. Set a try-square against the pressed-on wheel, and adjust the wheel so that the crankpin is exactly under the centre of the axle, the edge of the try-square blade lining up with centres of both axle and crankpin. Now put a scribing-block or surface-gauge on the opposite side, and set the needle to the centre of the axle, which will be indicated by the toolmarks on it. Hold the pressed-on wheel so that it can't shift, and turn the loose wheel until the centre of the crankpin is spot-on with the point of the scriber needle. That's all there is to it, and the wheel can then be pressed home, and the assembly replaced in the frames. For beginners' benefit I'll repeat—when the try-square blade on one side shows centres of axle and crankpin to be vertically in line, and the scribing-block needle on the other side shows centres of axle and crankpin to be horizontally in line, the quartering is O.K. Nothing very formidable about that, is there? The trailing wheel crankpins are set by aid of the coupling-rods, so make them the next job.

Coupling-rods

Materials required are two pieces of ⅝ in. × ¼ in. bright mild steel about 7 in. long. Coat one with marking-out fluid and mark out as per. drawing. Beginners ahoy—check distance between coupled axle centres on your frame assembly, in case you've slipped up anywhere, using a big pair of dividers. Set out the centres of the coupling-rods to correspond, then you'll be all sereny. Centrepop the centres, drill them No 32, drill the second one, using the first as a jig, and rivet them together with two bits of ⅛ in. round steel rod.

I shaped my rods on the milling machine, gripping the blanks in a big machine vice bolted to the table, and attacking with a ½ in. side-and-face cutter with the shank in the mandrel socket, and the outer end supported by the overhanging arm; but they can easily be done in the lathe. If you have a vertical slide, bolt a machine vice to it, and grip the blanks with the side to be milled set at right angles to the lathe centre-line, using faceplate as guide, as previously described. Put an endmill about ½ in dia. either in chuck or centre-hole if it has a taper shank, set the blank level with the business end, and feed into cut by moving the lathe saddle. Traverse across the cutter with the cross-slide, but stop well clear of each boss, leaving sufficient metal to form the radius, which can be put in with a round file. If the cross-slide hasn't sufficient travel to do the whole length at one go, take two bites, but be mighty careful when resetting the blank in the machine vice for the second go, to keep it at right angles to the cutter. Failing a vertical slide, clamp the blanks under the slide-rest toolholder, packing them up to the level of centre of cutter, same as for the axleboxes.

The fronts of the rods can be recessed in the same way, and the flutes put in by traversing across a 3/16 in. endmill or slot drill held in the chuck. This will leave the flutes with rounded ends, but anybody who is scared of what Inspector Meticulous might say, can easily square them off by judicious application of a little chisel made from 5/32 in. silver steel. The ends of the rods are rounded off on a peg arbor, same as described on page 158, February 18; but don't swing the end of the rod too far around, or you'll cut off the oil box and probably add a few new words to the Dictionary of Railroad Esperanto!

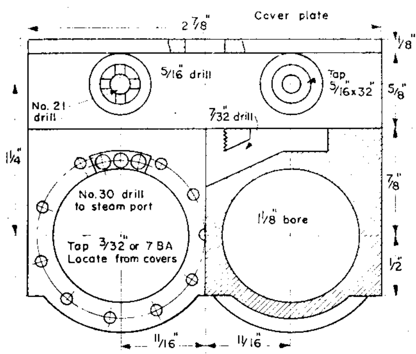
The job can also be done by hand. After marking out, grip the pair of blanks in the bench vice with the line showing the top of the rods, level with the top of jaws. File a gap close to the right-hand boss, wide enough to take a hacksaw blade on its side. Put a blade sideways in the hacksaw frame, and saw along, using the jaw tops as guide, until the other boss is reached. Then saw down to the cut, and out comes the superfluous bits of metal. The undersides and fronts can be done same way, and the bosses rounded with a file. I did them that way in my early days, with a little vice clamped on the corner of the kitchen table, when a workshop was just a dream.

Drill out the holes in bosses to 5/16 in. and turn up a couple of bushes from 7/16 in. bronze or gunmetal rod as shown in drawing, to a press fit in the holes. Squeeze them in, drill the oil holes, and another job is scratched off the list. Put one of the rods on the pressed-home side of the coupled wheels, and secure with 4 BA nuts and washers. Put on the other rod, adjusting the trailing wheel that isn't pressed home, until the crankpin goes through the hole in the boss, and the wheels turn freely without binding at any point. The wheel can then be pressed home, and the coupling-rod nutted. If you dislike commercial hexagon nuts, make round ones from 3/8 in. round steel, to represent the pinned collars on the full-size engines.

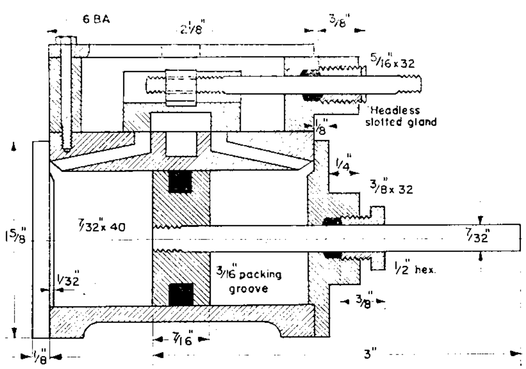
The cylinders

The cylinders on the full-sized engines are 17 in. × 24 in., but I made mine the equivalent of 18 in. × 26 in.—hey! did that loud snort come from the direction of Rustington, way down in Sussex, or was it the old-iron merchant's horse just down the road? His cart went by a few minutes ago. Anyway, I found that with the restricted length of the cylinder casting, the clearances were cut pretty fine, so to make matters easier for beginners, let's split the difference and make this pair the equivalent of 18 in. × 24 in. which will be 1 1/8 in. × 1 1/2 in. Incidentally, when the heavy bogie suburban coach sets first appeared in the Birmingham area, the tank engines with 17 in. cylinders couldn't keep time with them, so Francis Webb designed a new lot with 18 in. cylinders which had no difficulty in running to time—nuff sed!

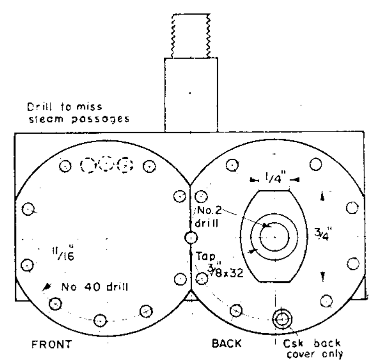
Beginners needn't have the slightest fear of tackling a set of inside cylinders; in fact, I would rather make them up any day in preference to two separate outside cylinders. If done in the way I'm going to describe, the bores will automatically come out dead parallel, square with the ends, ditto the portface, which will also be nicely at right angles to the sides which fit between the frames. What more could anybody want? The top and bottom



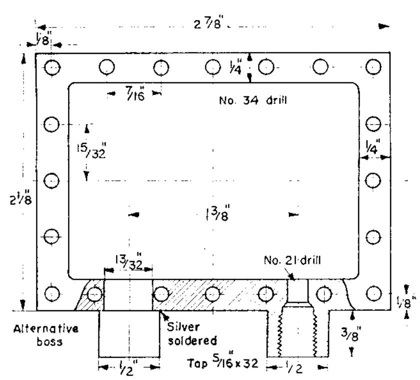
END OF CYLINDER   SECTION THROUGH EXHAUST PORT



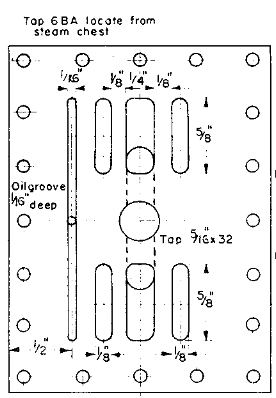
SECTION THROUGH CYLINDER BORE



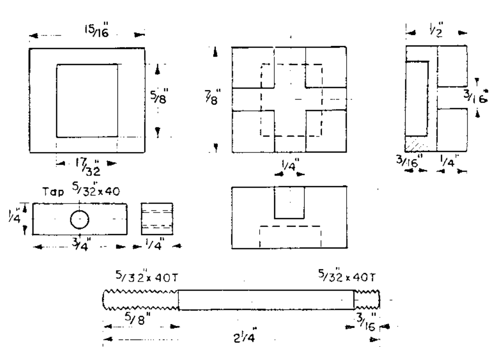
CYLINDER COVERS



STEAM CHEST



PORTFACE



SLIDE, VALVE, SPINDLE, AND NUT

of the steam chest will also be true and parallel, and as all the flat parts can be machined in the lathe, no milling machine nor attachment will be needed. Well, let's get down to business.

How to bore the cylinders

First check the position of the core holes. They should be in line, with the centres $1\frac{3}{8}$ in. apart, and approximately parallel with the portface. If they are (they were on the casting I used) no marking out is required. If they aren't, smooth off the end of the casting with a file, put a wood plug in each hole, and coat the end with marking-out fluid. Scribe a line down the centre, then at $\frac{15}{16}$ in. below the portface, scribe another one cutting across the first at right angles. On this line, set out two points at $\frac{11}{16}$ in. each side of centre. These will be the centres of the cylinder bores, so with a pair of dividers, strike out from each of them, a circle $1\frac{1}{8}$ in. dia., which will indicate the location of the actual bores.

The easiest way to set the casting up for the boring job, is to bolt it, portface down, to an angleplate. Bolt an angleplate (not less than 2 in.) to the faceplate, and attach the casting to it with a stout bar across its back, with a bolt at each end, and the casting overhanging the edge of the angleplate by not less than $\frac{1}{8}$ in. Adjust the angleplate on the faceplate until one of the coreholes, or the marked circle as the case may be, runs truly. Check with a scribing block on the lathe bed or saddle, with the needle set to the edge of the corehole or marked circle. See that all the bolts are tight, to prevent any shifting of either casting or angleplate, then bolt a balance weight to the faceplate opposite the angleplate, to prevent any vibration. I made up a few balance weights of various sizes by filling tin lids with lead, and drilling a bolt-hole through the middle, but anything handy, such as a changewheel, can be used. The faceplate with its load should stay put in any position, with the driving belt off. For this size of cylinder I usually run the lathe at about 240 r.p.m. and at this speed there should be no vibration.

I always use a tool with plenty of clearance and a fair amount of top rake. Tungsten-carbide tipped tools are the berries, but ordinary high-speed tools do quite well. Carbon steel isn't so good, as a hard-skinned casting takes the edge off before you can say (deleted by censor). Set the tool crosswise in the rest with the cutting edge level with lathe centres. If you have a Myford, Drummond or similar self-acting lathe, set it for the slowest feed. If your lathe hasn't any self-acting gear, you'll have to use the top-slide, and this must be set to bore parallel before starting operations on the casting.

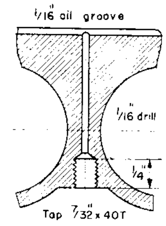
Take off the faceplate, and put on the three-jaw chuck, with a stout piece of round rod, brass or steel, in it with about 2 in. projecting from the jaws. With a small-radius roundnose tool, take a cut along it, full length, and about 1/64 in. deep. Check diameter both ends of cut, with a mike or pair of calipers. If the mike shows a greater variation than 0.001 in. or the calipers are tight at one end and loose at the other, adjust the top-slide and have another go. When the mike reading is less than 0.001 in. variation, or the calipers feel the same at each end, the top slide is as near parallel to the lathe centres as you can probably set it, and will be all right for the cylinder-boring job.

Remove the rough skin

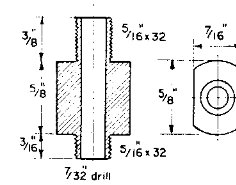
The first cut should be deep enough to clean the rough skin right out of the bore. After the first cut, I always put a roundnose tool cross-wise in the rest, and take a cleaning-up cut right across the end of the casting, starting from the bore. This gives a true face from which to finish the bore to size. Before replacing the boring tool, if it is carbon or ordinary high-speed steel, regrind it, as the skin on the casting will have surely dulled the edge. If you're lucky enough to own a $1\frac{1}{8}$ in. parallel reamer, bore out until the "lead" end of the reamer will just enter. If you haven't, take two or three traverses through the bore without shifting the cross-slide; this will give the bore a good working finish.

Note: if the end of the casting has been filed smooth and marked with circles to locate the bores correctly, there is no need to take a facing cut for cleaning-up purposes as mentioned above, otherwise circle No 2 would be wiped off the map, and a beginner would be properly sunk. However, the circle could be re-located by taking off the faceplate complete with the bag of tricks, and laying it on the bench while doing the job.

If the centre-hole in your lathe mandrel is big enough to clear a $1\frac{1}{8}$ in. parallel reamer, the bore can be reamed in the lathe. Put a lathe-carrier on the shank, or a big tapwrench, hold the shank of the reamer tight up against the tailstock centre, with the point in



SECTION THROUGH OIL DUCT



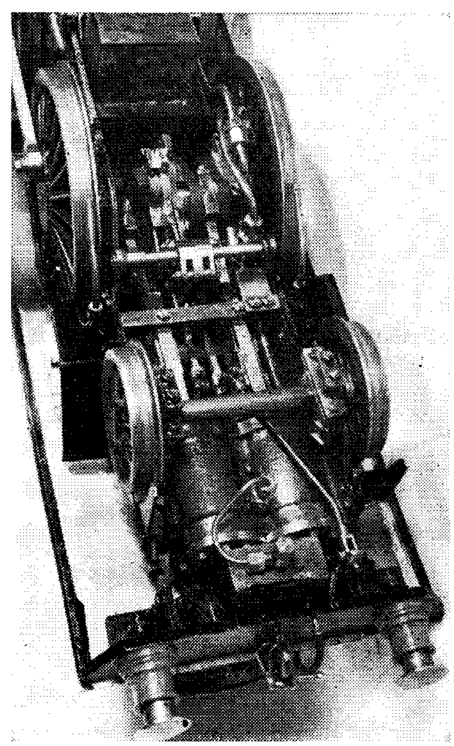
STEAM CHEST CENTRE STAY

the countersink in the shank; enter the end of the reamer in the bore, start the lathe and run the reamer through the bore by pushing the tailstock bodily along the bed, stopping only to reverse and pull it out again. This cannot be done on the small Myford or Drummond lathes, in which case the reaming must be done by hand, or the bores finished with the tool as described above.

To make certain that the bores are absolutely parallel, all you have to do is to slack the bolts holding the angleplate to the faceplate, and shift the lot bodily until the second corehole or marked circle runs truly when checked with the scribing-block needle; then tighten bolts and repeat operations.

To be continued

MABEL'S *cylinders seen from below.*



IN the early decades of this century, the firm of Whitney Bros was justly famous for the variety and ingenuity of its model products. One of the most interesting was the single-acting twin steam engine designed for driving twin propellers in model T.B.D.'s or other light craft. As seen in Figs 25 and 26, it had two crankshafts, with flywheels geared together and crankpins timed in opposite phase. Steam distribution to the two cylinders was by a horizontal slide valve moving at right angles to the axes of the shafts, and driven by an off-set bell crank from a single eccentric on one of the shafts, (the left-hand one in Fig. 25). The eccentric sheave, strap and rod are not shown, but their position and function will be obvious.

SINGLE-ACTING STEAM ENGINES

PART FOUR

by Edgar T. Westbury

The upper extension of the bell crank arm terminated in a fork which engaged a cross pin in a fork attached to the end of the valve rod. This provided a fairly efficient drive, but it would have been better if a piston valve had been used, and driven from the other end by an open bridle in a similar manner to that of the Stuart Turner engine. There was, however, a general reluctance to fit piston valves to small steam engines in the early days, because of the difficulty in making them steamtight and at the same time free working. But this can be overcome by using suitable materials, accurate machining and fitting, and above all, proper lubrication.

Of the many other twin single-acting engines which I have encountered—as I have stated, they were the favoured type among the model speed boat fraternity in the days when "steam was king"—little more need be said, as they mostly followed the same principles as those described, with variations of detail only. In more recent years, the twin engine has been rather less popular, and the desire to simplify steam plants has led to greater interest in single-cylinder engines with piston valves driven as directly as possible from an eccentric or return crank.

One of the pioneers of the high-efficiency single was the late J. Vines, of the Victoria M.S.C., whose famous boat *Silver Jubilee* had consistent success in steering and nomination events in the years immediately before the war. The engine of this boat looked anything but simple, with its elaborate auxiliary feed and oil pumps, driven through double-helical gearing, and separate oil feeds to each bearing; but its basic design was as described above. A. W. Martin, of Southampton, employed a piston valve single in his successful *Tornados,* with which I had several friendly duels in those days.

During the war, Jim Cruickshank built *Defiant,* which had a single cylinder engine with two piston valves, the second of which was intended to provide for a specially free release of exhaust. Singles were also used with success by Jutton Bros of Guildford, J. Bamford, and J. Pilliner, in post-war years. These have all embodied ingenious features of design, though so many issues are involved in a flash steam plant that it is difficult to say which, if any, really pay dividends.

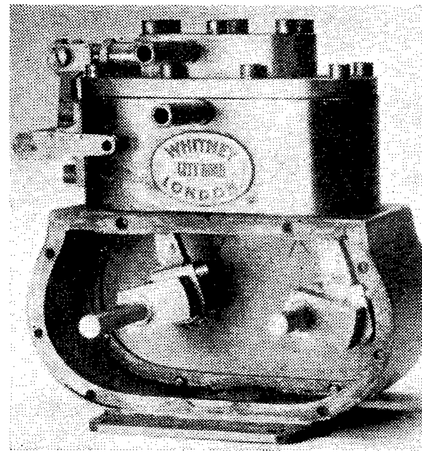
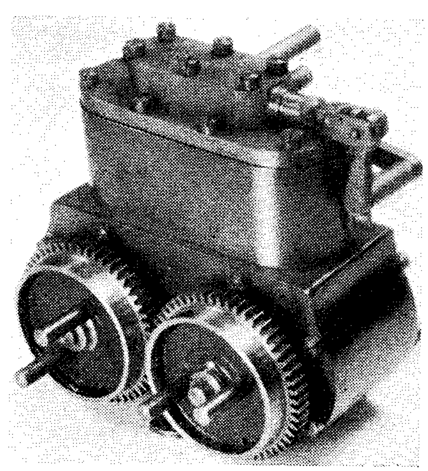


Fig. 25: The Whitney engine.

One of Juttons' engines employed a crank follower off-set from the main shaft axis, to drive the piston valve; this gave an unsymmetrical order of motion, in other words "quick return," similar to that employed in a power shaper, which can be utilised to good effect in timing the valve events. A special, if not indeed unique feature of one of Pilliner's boats was that the flywheel was located *outboard* at the stern, and fitted with helical vanes to act as a surface propeller. While ingenuity in design is not necessarily a guarantee of success, these experimental ventures at least demonstrate that there is a world of adventure in a simple steam engine, and it is a great pity that they have not been followed up by other enthusiasts of more recent years.

I have often been asked to design simple engines of a type suitable for construction by beginners, or workers

Fig. 26: Showing the twin geared crankshafts together.



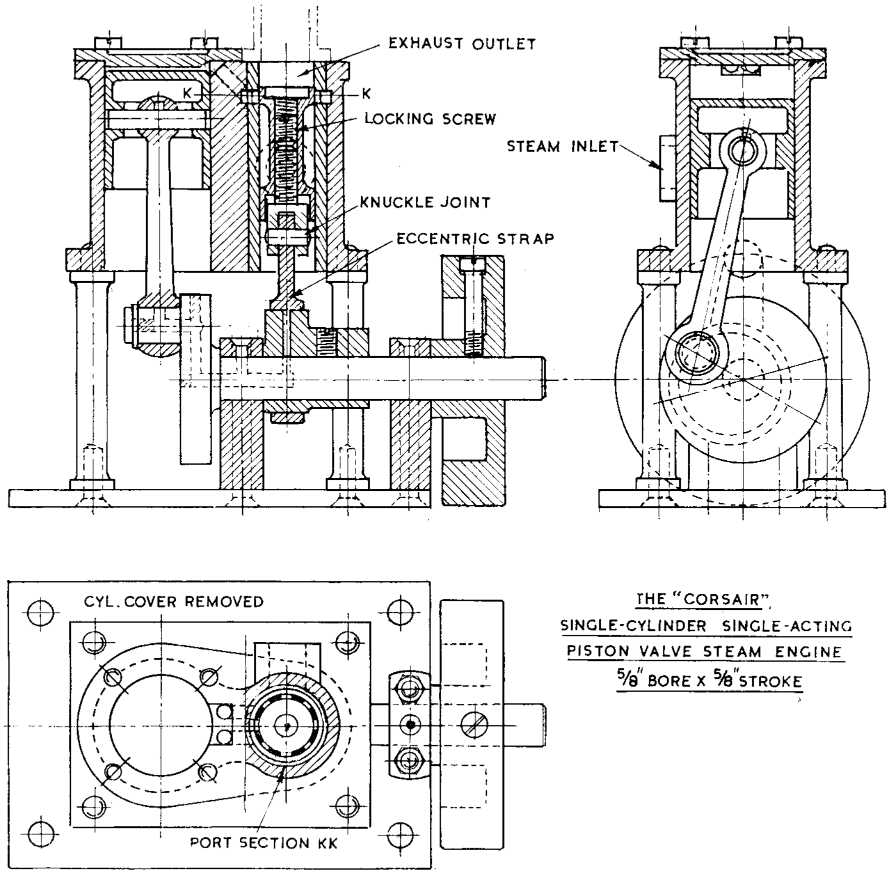


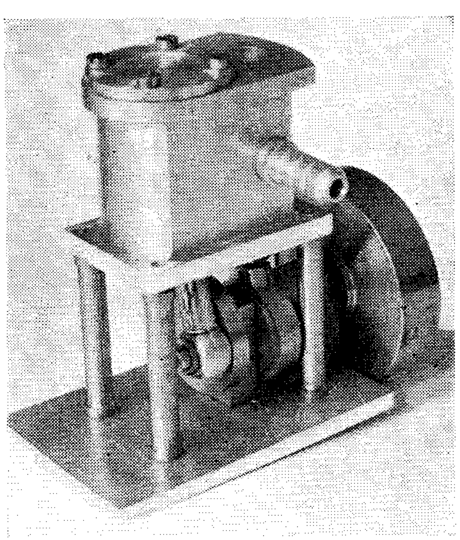
Fig. 28.

with limited equipment. So far as possible I have endeavoured to comply with these requests, but there are at least two great difficulties in producing designs which are simple without being crude. Firstly, nearly everything possible in *sound* engine design has already been done, and attempts to introduce originality are liable to finish up as mere gimmickry. Secondly, the beginner is a very difficult person to please, and very rarely appreciates the efforts of experienced designers to provide something they consider really well suited to his limited talent and equipment. The novice is only too often impatient to embark on the navigation of the ocean before he has mastered that of his local sheltered cove.

Two new engines

Some months ago I built two small steam engines with a view to providing exercises in machining on simple and inexpensive lathes, and also obtaining some comparison between the efficiency of the two types. One of these was of the oscillating cylinder type, generally considered to be the simplest to build and, therefore, most suitable for the beginner. I consider this to be a fallacy, but in any case this type of engine is outside the bounds of the present discussion. The other engine is of the single-acting piston valve type, built without the need for castings, and it has shown a decided superiority in power and steam economy over the oscillating engine of similar effective capacity. I, therefore, decided to use this engine, which is shown in Fig. 27,

Fig. 27: Single-cylinder single-acting piston valve engine.



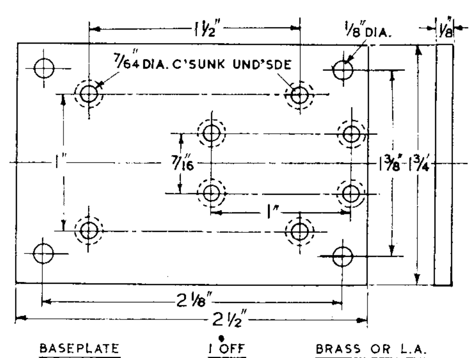
as the prototype for a design which I can confidently recommend, not only to beginners, but also to any constructors who require a small but powerful and economical engine to drive a boat; or for other "utility" duties.

The engine shown in Fig. 28 is not identical in detail with that in Fig. 27, though its working parts are the same. Such modifications as have been made have been mostly with a view to utmost simplicity of construction; for this reason more liberal dimensions of structural parts, also those of working parts which would otherwise be critical, have been provided. It is also recommended that a casting should be used for the cylinder, to employ metal economically and improve neatness of appearance; but if more convenient, a near-rectangular cylinder block, machined from solid metal or fabricated by silver soldering, may be used.

Structural design follows the "entabulature" principle, with pillars on "table-legs" at the four corners, such as commonly employed, with variations, in steam engine practice for generations. In many respects, enclosure of working parts would be better for an engine intended to run really fast, but the open construction is preferred by many model engineers, mainly on the grounds of accessibility of working parts. It is certainly the simpler method for fabrication from readily obtainable stock materials.

The piston valve liner with an all-round port belt has been adopted to obtain lively and positive control of ample port area. It is possible to dispense with the liner, if performance at

Fig. 29: The baseplate.



maximum speed is not of paramount importance. Two 1/16 in. holes, drilled at the correct location from the right-hand end of the block to meet the oblique holes leading into the cylinder, will suffice for most purposes; it will, of course, be necessary to plug the outer ends of these holes with small screws. The object of the increased port area is not to *admit* steam more freely—steam will get through very small openings with incredible velocity, even at quite moderate pressure—but to allow exhaust steam to escape with minimum back pressure in the short space of time available.

As designed, the piston valve has lap equal to about ¼ travel, and line-for-line exhaust. With the eccentric set to trail 45 deg. behind the crankpin in the direction of rotation, and thus timed to give about 10 deg. lead, steam is cut off at about 60 per cent, exhaust released at 45 deg. before B.D.C. and closed at 45 deg. before T.D.C. These settings give good results, but can easily be varied by simple adjustment, or by altering valve dimensions.

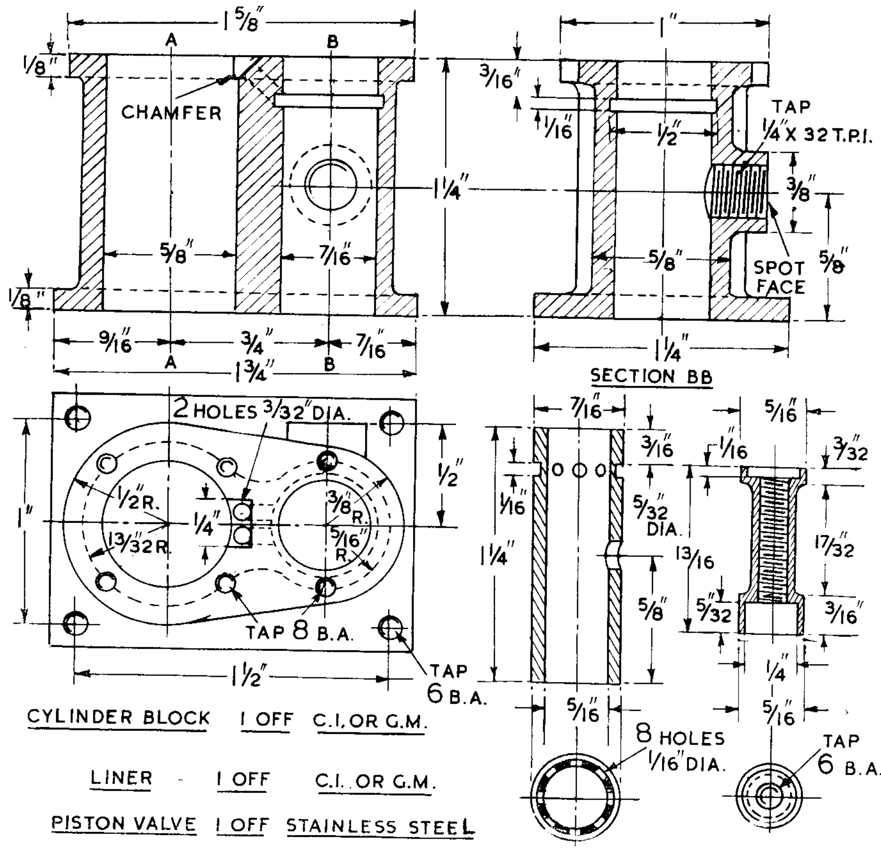


Fig. 30: Details of the cylinder block, valve and valve liner of the new Corsair engine.

The Corsair engine

This engine design has been labelled the *Corsair*, to distinguish it from many other steam engines I have designed in the past. (Incidentally, the name is associated with that of a certain ship which I remember, rather than with a modern motor car).

In the construction of the engine, the baseplate (Fig. 29) may be made first. It should be sawn and filed to shape from a truly flat and smooth metal; if light alloy is chosen, it should be of the hard or high tensile variety such as Duralumin. After trimming and squaring up the edges, a longitudinal centre line should be marked, and locations of holes related to it, to ensure symmetry. No machining is called for, other than the drilling and countersinking of the holes from the underside, but care should be taken to mark out and drill them as accurately as possible, preferably by preliminary drilling of pilot holes. The four holes at the corners are for holding-down purposes, and may be of any convenient size, but the others should be a fairly close clearance for 6 BA screws and countersunk rather more deeply than normal for standard screw heads.

The cylinder block (Fig. 30), assuming that it is made from a casting, or has already been more or less pre-shaped, should be faced truly flat on the underside surface, which is then used as a reference face for further operations. These should preferably be carried out on the faceplate rather than in a chuck, but as most lathes are unsuited to mounting small pieces in this way because of the central socket or recess, it will be found necessary to use a backing plate of any suitable material, to which the block may be attached. The baseplate may be adapted for this purpose, if it can be guaranteed flat and parallel, and the block can be mounted on it by four countersunk screws, provided that their heads do not project by the slightest amount from the plate.

To spot the positions of the tapped holes for the pillars, the cylinder block may be clamped to the plate in accurate location, and a 7/64 in. drill run in from the underside just deep enough to provide a starting point for the tapping drill (No 43 for 6 BA). After marking out the positions of cylinder and piston valve centres, the block can then be mounted on the plate, with parallel packings interposed between. The object of these is to prevent drilling into the baseplate when the bores are machined.

Each bore centre in turn can then be set up to run truly, and centre-drilled, then drilled undersize and bored. Every care should be taken to ensure a smooth and parallel finish to the cylinder bore, but the bore for the valve liner may be finished with a reamer if it is first bored to within 2 or 3 thou. of finished size. The top surface of the block should be machined to produce the correct height from base, and a small internal recessing tool used to produce a groove 1/16 in. wide, at a centre distance of 3/32 in. from the top of the hole. A suitable tool may be made by turning a piece of silver steel rod with a 1/16 in. wide, slightly undercut collar on the end, and a short portion of reduced diameter to give shank clearance. The end is then filed or ground to form the cutting edge, and hardened. This tool is illustrated in *Lathe Accessories*.

To be continued.

FOR THE SCHOOLS:

SCREW THREADS

Part Eight—Square and Acme Threads

by Duplex

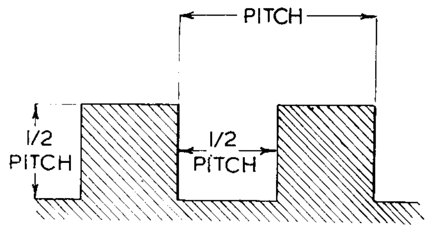


Fig. 68

Square threads

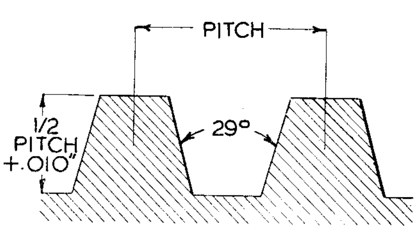
Square threads are principally used for transmitting motion, as for example in machine tool feed screws, some mechanical actuators and linear actuators where the operating force is imparted by a revolving nut.

Since the surface of a square thread is normal to the axial force, there is no bursting pressure on its accompanying nut; an advantage, as is sometimes the case, when this class of thread is used for fastening purposes.

The form of the square thread is shown in Fig. 68. The pitch, as will be seen, is measured from the face of one thread to the corresponding face of the next, and the space between threads is equal to half the pitch, whilst the depth of the thread is also made equal to half the pitch with a small additional clearance to ensure free running.

The Acme thread

A thread form that has become widely used for machine feed screws is the Acme. This thread offers certain advantages in mass production, especially when modern methods of generating the thread are employed. Its form is shown in Fig. 69, below.



Multi-start threads

When square threads are used for transmitting rapid motion, the pitch involved is often considerable, and if carried out by a single thread would, perhaps, result in the reduction of the thread core beyond acceptable limits. This reduction may be avoided by the use of multi-start threads as in Fig. 70. As will be seen from this illustration we now have to consider a new term, the 'lead' of the thread; this may be defined as the distance a nut turned through one revolution would travel along that thread. In the case of single threads 'pitch' and 'lead' are the same, but in double and triple threads the leads are twice and three times the pitch measurement respectively.

We must also consider the angle the thread makes with the axis of the work. This is known as the 'helix angle.' It is important because the cutting tool must be ground or set to the angle if accurate threading is to result; it may be determined graphically by the method shown in Fig. 71. Here a right-angle triangle is drawn having for its base line a measurement equal to the circumference of the work and a vertical to the base line corresponding with the 'lead' of the thread. The completion of the triangle by drawing its hypotenuse forms an angle with the base line; this angle, measurable with a protractor, is the helix angle we require to establish.

Forms of tool for cutting square threads

There are two forms of tool used for cutting square threads. The first of these, used when a male thread is being formed, is a short stubby tool made from rectangular tool steel and ground in the first instance to conform with the helix angle of the thread to be cut. Considerable clearance is then given to both flanks of the tool in order to ensure that they do not rub against

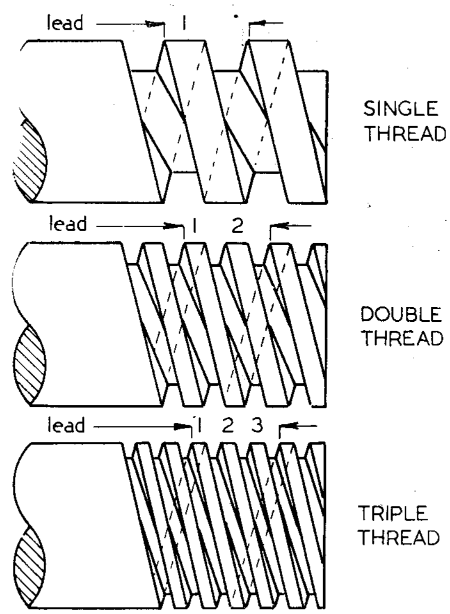
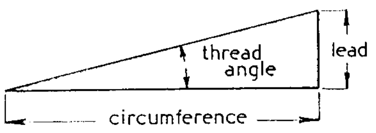


Fig. 70

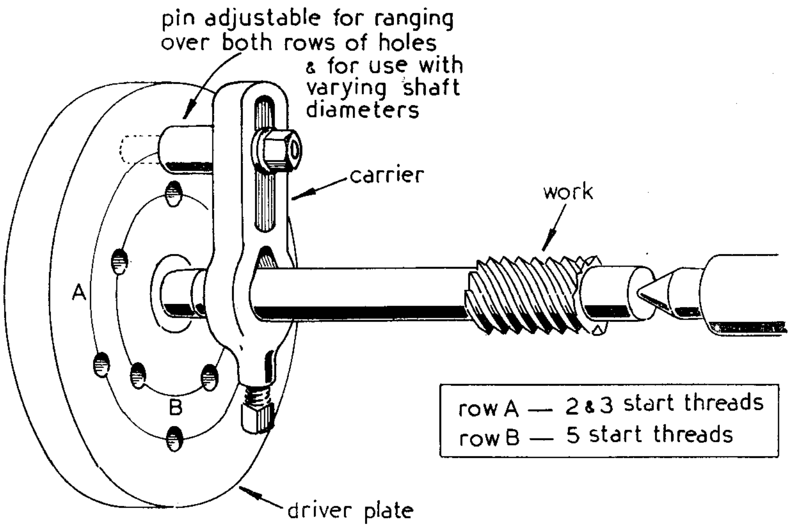
the sides of the thread during the cutting process. The tool form and the side clearance may be seen in Fig. 72, where it will also be noted that the upper face of the tool is at right-angles to the sides of the thread.

A fixed tool such as this is only suitable for the actual pitch and lead of the thread it was intended to cut. A more versatile tool may be made from round material and mounted in a holder that enables the tool to be adjusted to the helix angle of the thread. More often than not, when dealing with square threads, the pitch of the thread remains constant, but the lead increases according to whether the thread has double, treble or more starts. A tool of constant width, but with angular adjustment, is obviously quicker to set up when the need arises, because it avoids the special



Above: Fig. 71

Right : Fig. 73



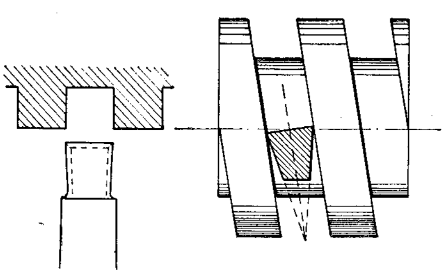
grinding required if a fixed tool is used.

Unfortunately, when cutting internal threads, it is not possible to use a tool that is adjustable for angle except when dealing with work of large diameter. For the most part, then, a normal tool must be used, and this should be as rigid as possible since the tendency for the tool to 'dig in' is considerable. Moreover, the finish of the work will be much impaired if there is any lack of rigidity in the tool and its mounting. In every case the tool has to be fed in at right angles to the work and it is not possible, for obvious reasons, to employ any method that involves setting over the top-slide in the way used for cutting V-threads.

We have touched briefly on the cutting of multi-start threads and have mentioned suitable tools and methods of feeding them into the work. Two important aspects of the matter remain, however; namely the methods employed to index the work and the means used for driving it. We must first define what is meant by the term 'indexing.' If a section of multi-start thread is viewed end-on, each separate thread will be seen to start at an even interval from the thread preceeding it. It is the method used to secure this even spacing that is called 'indexing.'

A little thought will show that, unless the indexing is carried out with reasonable accuracy, the elements of a multi-start thread will not be uniform and so it will fail to register with its corresponding part,

Below: Fig. 72

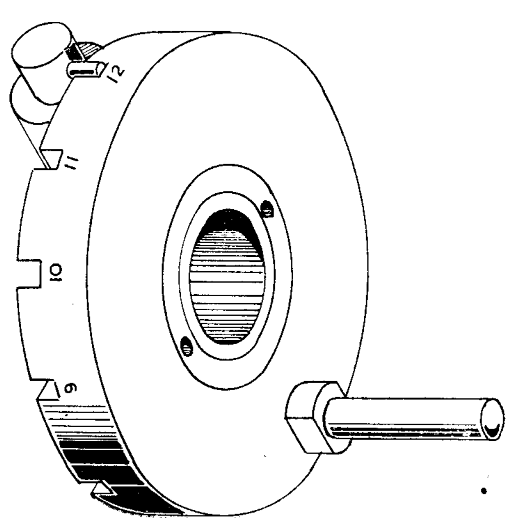


Indexing the work

When indexing is taking place it is the work only that is moved circumferentially. The thread cutting wheel train remains undisturbed, so the tool always retains its relative position in respect of the work. There is however, one exception to the non-disturbance of the wheel train and that is when the train itself is said to index the work. This practice involves disengaging the stud wheel from the remainder of the train, moving the lathe mandrel round the required amount and then re-engaging the train. To do this the number of teeth on the stud wheel must be divisible by the number of starts in the thread. This may not always be possible, but supposing that it is so and we are, for example, cutting a three-start thread and have a 60 tooth wheel mounted on the mandrel stud. Then every 20th tooth will need to be marked so that they can be engaged successively with *one* marked tooth space on the engaging wheel.

All in all, this somewhat primitive practice has little to recommend it, so more positive methods are advisable. One such example is shown in Fig. 73. Here a special driver plate fitted to the lathe mandrel is supplied with two rows of holes that enable a carrier fixed to the work to engage any series of holes at will. With such an arrangement there is no need to disturb the change wheel train, the work being indexed in relation to the driver plate itself which remains secured to the mandrel.

Below: Fig. 74



Another and more sophisticated device used to be available with the larger Boley precision lathes. This is seen in Fig. 74. The periphery of the moveable division plate has 12 equally-spaced slots and a spring-loaded detent to engage them. By means of this piece of equipment, work mounted between centres and driven by the pin attached to the face of the plate, may be threaded with 1, 2, 3 and 4-start threads.

REGULATOR TIMEPIECE

(Continued from page 445)

a cap in the form of a washer is made a press fit on the pinion arbor or the step on the side of the bobbin. In the case of the centre wheel, this itself forms the cap for retaining the rounds in position. See Fig. 6, No 1. Before finally fitting to the bobbin remove the blue from the pivot steel with fine emery paper.

All the train pinions are the same pitch and number of teeth. For making the pinion arbors there is the choice of using silver steel or piano wire obtainable from Model and Mechanical Supplies, King's Road, St. Leonards-on-Sea. It is sold in a few diameters up to ⅛ in. and in 3 ft lengths.

Centre pinion arbor

A piece of steel rod, say, ⅛ in. dia is cut to a length of 3¾ in. Chuck truly and turn a cone centre at each end. To digress for a moment, for small diameter turning operations it is strongly recommended that the hand rest and graver be used for general work of this type; a graver 3/16 in. square is very suitable and it can be held in one or two positions on the hand rest, Fig. 3, No 2 shows the point being used for cutting. The graver can also be laid on its side on the rest which is useful for finishing and removing ridges left after using the point.

Although it is generally accepted that the graver should be tempered to a straw colour I find it much better to leave it dead hard. In using the point of the graver for the first time it will probably break off, but after a little practice this difficulty will be overcome. For cutting clean shoulders to the pivots a narrow chisel-shaped graver will be found ideal. Referring to Fig. 3, No 3 this is a filing rest, the stalk is made to fit the hand rest in the socket. The roller should be of dead hard steel. No 4 is a miniature catch plate and driving pin made to fit a lathe mandrel centre; the small centre is made from a standard taper pin and a reamer can be obtained to match the taper pin for reaming the hole in the lathe centre.

Small hollow centres are required for turning the pivots as in Fig. 3, No 5. No 6 is used for finishing the ends of the pivots later. A miniature carrier will be required: although these can be purchased, a makeshift one is very easily made in a few minutes from a scrap of brass and an 8 BA cheesehead screw. Fig. 3, No 4a shows what is required.

Now mount the pinion arbor between centres and turn down to the diameters shown in Fig. 3, No 1. We need not keep exactly to these dimensions. I have yet to come across two hand-made clocks seemingly identical in which the parts are interchangeable. The pinion head can either be a press fit on the arbor or taper fitted; if taper fitting is adopted the hole in the pinion head should be slightly tapered with a broach and the pinion arbor turned to fit it: the graver is the tool for this.

It should be noted that the distance between the motion plates is a full 2⅛ in., whereas the shoulders of the pivots should be a bare 2⅛ in. apart, so as to have a little end shake: this is essential. It is a good plan to pivot the arbors after the wheels have been fitted to the collets. The centre wheel is fitted to the step turned on the end of the side of the bobbin. It should fit closely up to a shoulder and is secured with three 14 BA screws threaded into the side of the bobbin. Care is needed here that the screwed holes do not foul any of the ends of the rounds. It will now be seen that no retaining cap is needed for this pinion as the hub of the wheel itself forms the cap.

Beyond the front pivot shoulder will be seen another shoulder formed to locate the friction spring to the minute wheel of the motion work; this should not be made until the train wheels have been planted in the motion plates.

The third wheel and pinion

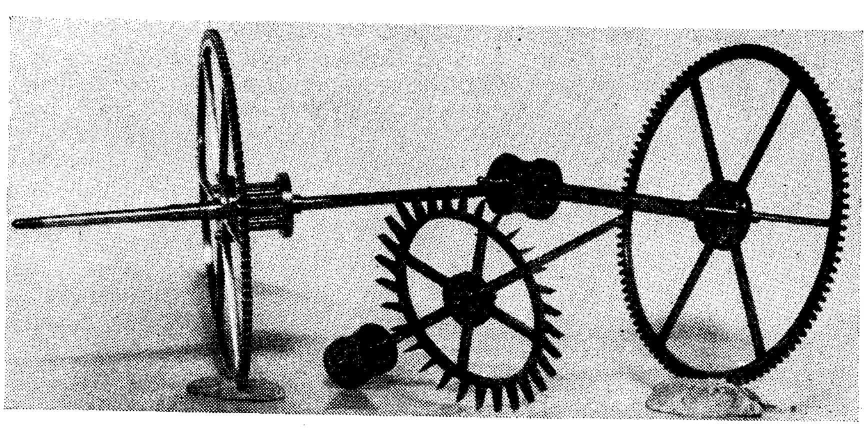
Fig. 7, Nos 1 and 2. The pinion arbor is machined in the same way as the centre arbor; the pinion head in this case is fitted to the end of the pinion arbor and has a cap fitted to the outer side of the bobbin to retain the rounds in position. The wheel is mounted on a collet at the opposite end of the pinion head. This collet for fixing the third wheel should next be made; it can be roughed out from a piece of ½ in. round brass rod in the self-centring chuck, the hole drilled for a press fit, taper fit or a soft soldered fit to the pinion arbor. The seating to fit the wheel must be turned after the collet has been fixed to the pivot arbor, as in the case of the centre wheel it is secured to the collet with three 14 BA screws.

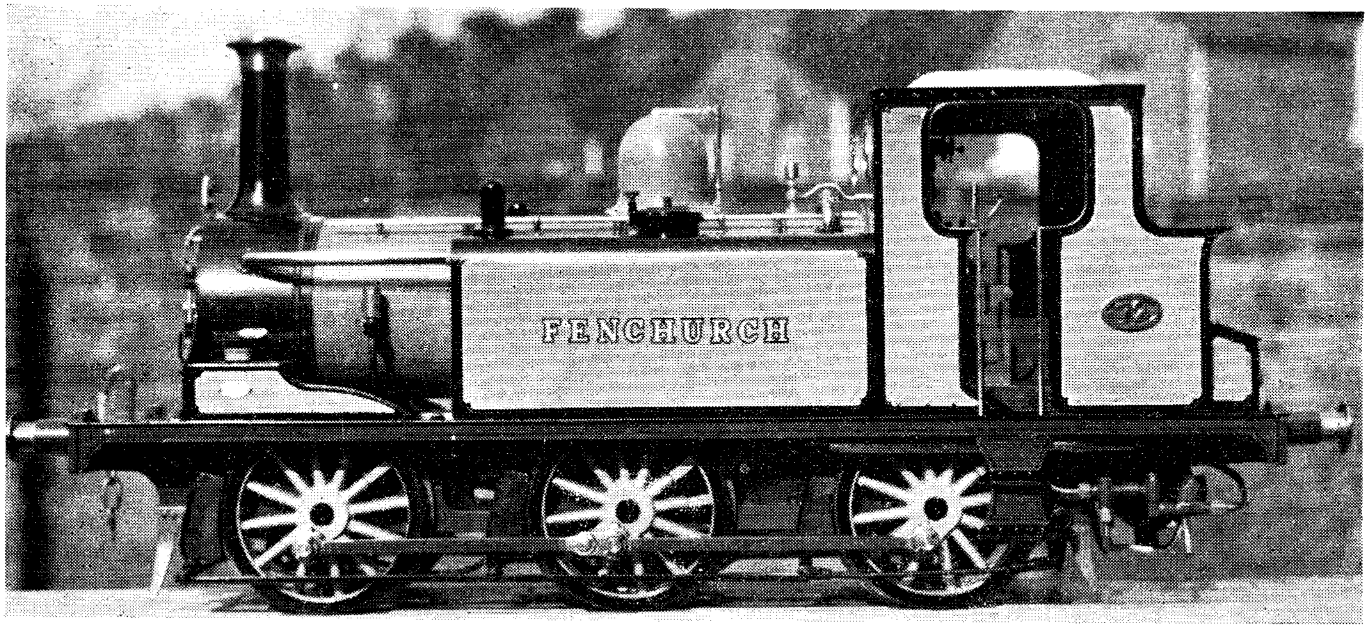
The escape wheel and pinion

Fig. 8, Nos 1 and 2. In this case the pinion head is fitted to the end of the pinion arbor; the arbor itself can be made from a piece of blue pivot steel. The cap for retaining the rounds is fitted to the outer side of the bobbin. The approximate diameter of the sides of the bobbin is ⅜ in. and the hole in the escape wheel is 11/64 in.. Three 14 BA screws fix the wheel to the collet and as this pinion arbor is rather slender, some form of back stay should be used.

To be continued.

Centre, third and escapement wheels and pinions.





A BRIGHTON TERRIER FOR 5 in. GAUGE

Based partly on the ME design and built by R. W. Fenwick

THIS engine is not an exact copy of Martin Evans' *Boxhill*, published in *Model Engineer*, but some of the essential parts were made to that design, such as the frames which were cut from black iron plate. I find this quite suitable and easy to obtain and it does not have so much spring in it as bright mild steel.

The cylinders and valve gear were made strictly to the drawings and apart from making one or two adjustments for " near-misses " between the moving parts in the cramped space between the frames, they presented no trouble until the time for valve setting came. I then had to buy a small electric torch with a pre-focus bulb that would shine a spot light through a small hole in the valve chest so that the valve events could be seen.

The cylinders, wheels and hornblocks were castings purchased from an ME advertiser. The reason why I did not follow the ME design for *Boxhill* was that I had got ahead of the serial and obtained the dimensions for the cab, tanks, chimney, etc., from measuring the outline drawing published in the first *Boxhill* article; it proved interesting to compare the sizes that I had made these parts when the dimensions were finally published, none differed very much!

The chimney was turned and bored from a solid piece of iron scrap, the cap being copper-plated to a depth that would allow some polishing before it wore off. The dome was turned from dural bar and finished turned with a wood chisel held by hand. A large safety valve is fitted in the dome, the spring balance valves being dummies.

The boiler differs from *Boxhill*, the barrels being slightly thicker and the front tubeplate is set further back to give more room in the smokebox. Also the superheater has been omitted: this I have found to be a mistake, and one day I will fit the engine with a superheater, for I feel sure that I can notice the difference on this engine compared with my other superheated locomotives if only for a less misty view ahead when running on a damp summer's evening.

Aiming for more room in the smokebox, I dispensed with the usual crossbar and made the bar removable; it is supported by the pull of the dart. The crossbar has a tapped hole through the centre and to replace it a rod is passed down the chimney and screwed a couple of turns in the crossbar, the bar is then held by the rod, the door closed, the dart engaged and drawn tight, when the rod is unscrewed.

I have departed from a true LBSCR *Terrier* footplate arrangement of controls and tried to make these of a size and in a position to suit my personal requirements. The regulator is of the push-pull plug type, I find this type to be very simple and trouble-free and by using the backhead gland nut to provide friction on the rod to prevent uncontrolled movement, the balancing spring can be dispensed with.

The remainder of the backhead fittings are of the LBSCR type: before they were fitted, a cardboard backhead was made and the fittings mounted on this to position them for clearance and ease of handling.

A feature of the full-size *Terriers* is the Westinghouse brake pump on the right-hand cab side; this I have tried to represent by a Weir donkey pump. It was made to a drawing by LBSC published in ME, during the 1930's. The pump works perfectly; it has been the cause of overfilling the boiler on several occasions when it has been accidently left ticking away when running, for from the driving position the only sign that the pump is working comes from the exhaust which discharges from under the footplate edge just under the pump.

With the addition of the displacement lubricator, boiler clack and air release valve for the donkey pump in the cab, the usual side-hinged firehole door could not be fitted. So a drop-down door is used, held in position by a small chain. Coal jamming the bottom hinge is taken care of by sweeping out with a 1 in. paint brush.

The mechanical lubricator

I was able to fit the mechanical lubricator for the cylinders in the toolbox at the rear of the bunker by making a second partition in the box for the oil and another for the pump. The ratchet arm passes through a slot cut in the footplating and is operated from an eccentric on the rear axle. The toolbox is made of brass with removable lid, the brass is covered with thin wooden veneer to represent a timber box.

The side tanks hold a small amount of water and are connected by balancing pipes under the footplate each side to a small tender tank which contains the hand pump. Owing to lack of space I fitted a vertical plunger pump; this was a mistake. It has proved only of use when the engine is stationary; if used in an emergency whilst the engine is running the fore and aft rocking movement that the pump produces on the engine can easily derail it.

Connected to the tender tank is a small cylindrical tank and this supplies the injector, donkey pump and axle pump; it also has a connection for a rubber hose from an auxiliary water tank that I carry on the driving truck. The cab roof is made of wood and is in two halves, the join being covered by a metal strip. A screw-down hand brake is fitted with wooden brake blocks: these were a trouble to fit as I found it difficult to allow for the positions of the wheels in relation to the blocks whilst the wheels were moving up and down under the control of the springs.

The injector is LBSC pattern of which I have made several successful examples; this particular one, in spite of repeated attention, still dribbles.

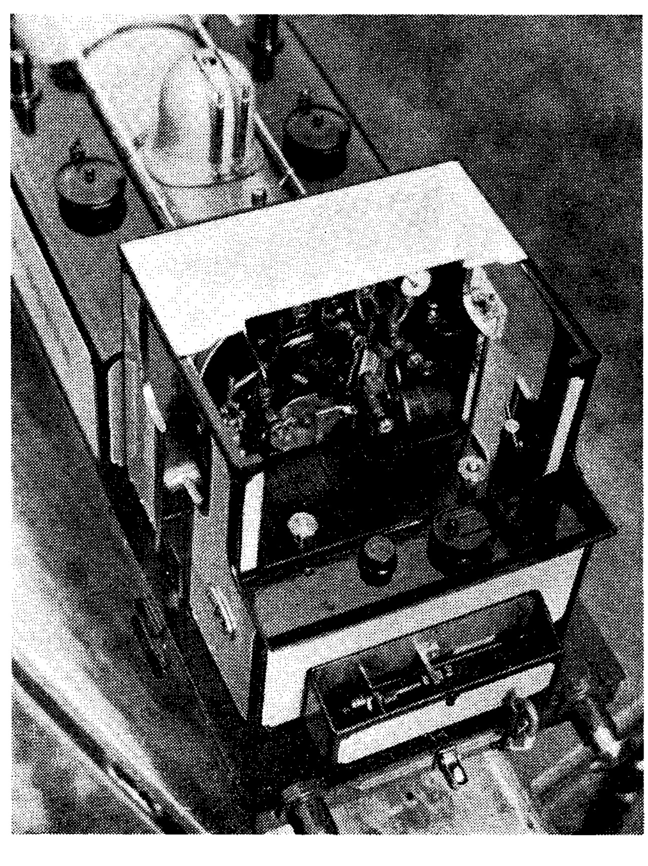
The paint used is Valspar, three coats and one of varnish, mainly to protect the lining which is poster paint and took nearly as long to apply as it did to build the engine. The most suitable transfers that I could obtain were used for the name, but I had to leave a discrepancy in the first letter which should have been larger than the remainder. Construction time was just under 12 months: the engine has turned out to be quite a success by my standards, and apart from the boiler priming badly at first has been quite satisfactory.

The model is finished in the full Stroudley livery

Having a fairly intimate experience of the full-size *Fenchurch* now in working retirement, I sometimes think that the little engine has the same hollow bark from her chimney, she certainly has the same clatter from her reversing lever!

Once again, my thanks to Martin Evans and LBSC for the help and inspiration their articles have given me. ■

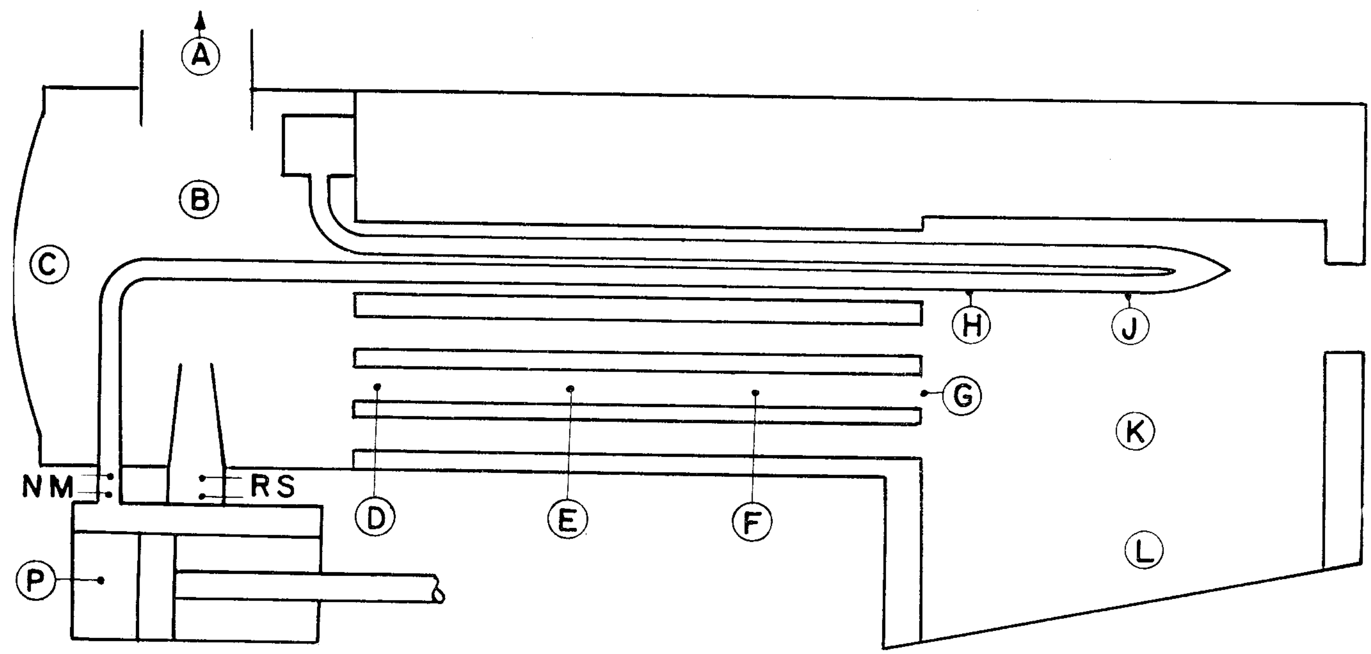
A neat and well-filled cab: half the roof can be removed for driving.



Testing a Locomotive Boiler

by J. Ewins

Continued from page 325



		Test No. 1 (no load)	Test No. 2	Test No. 3
Speed ...		400 r.p.m. (6.5 m.p.h.)	400 r.p.m. (6.5 m.p.h.)	400 r.p.m. (6.5 m.p.h.)
Tractive Force ...		Zero lb.	7 lb.	30 lb.
D.B.H.P. ...		Zero	0.125	0.525
Heat Generated ...		290 B.T.U./min. 100%	445 B.T.U./min. 100%	455 B.T.U./min. 100%
Heat Transferred in Firetubes ...		74 „ „ 25%	83 „ „ 19%	124 „ „ 27%
Heat Rejected to Smokebox ...		38 „ „ 13%	42 „ „ 9%	77 „ „ 17%
Heat Transferred in Firebox (by difference)		178 „ „ 62%	320 „ „ 72%	254 „ „ 56%
Overall Thermal Efficiency ...		Zero %	1.19%	4.9%
Coal Consumption ...		—lb./D.B.H.P.—hr.	15 lb./D.B.H.P.—hr.	3.9 lb./D.B.H.P.—hr.
Grate Loading ...		—D.B.H.P./sq. ft.	0.9 D.B.H.P./sq. ft.	3.8 D.B.H.P./sq. ft.
Rate of Flow of Flue Gas	Recorded at A	6.7 cubic ft./minute	7.28 cubic ft./minute	10.8 cubic ft./minute
Flue Gas Analysis	„ „ B	CO_2 10%, O_2 9%, CO 0.5%	CO_2 13.5%, O_2 3.5%, CO .5%	CO_2 9%, O_2 10%, CO 1%
Smokebox Vacuum	„ „ C	0.3 in. water	0.35 in. water	0.6 in. water
Temperature in Firetube	„ „ D	360 F.	370 F.	430 F.
„ „ „	„ „ E	490 F.	410 F.	690 F.
„ „ „	„ „ F	550 F.	570 F.	760 F.
„ „ „	„ „ G	950 F.	980 F.	1070 F.
Superheater Temperature	„ „ H	800 F.	980 F.	1570 F.
„ „	„ „ J	850 F.	1570 F.	1460 F.
Firebox Vacuum	„ „ K	0.05 in. water	0.15 in. water	0.3 in. water
Fire Bed Temperature	„ „ L	2120 F.	2840 F.	2912 F.
Steam Chest Pressure	„ „ M	6 lb./in. sq.	11.5 lb./in. sq.	41 lb./in. sq.
Steam Temperature	„ „ N	500 F.	620 F.	595 F.
Cylinder Temperature	„ „ P	250 F.	275 F.	295 F.
Exhaust Back Pressure	„ „ R	0.18 lb./sq. in.	0.22 lb./sq. in.	0.9 lb./sq. in.
Exhaust Temperature	„ „ S	310 F.	325 F.	350 F.
Superheat		270 F.	378 F.	307 F.

The above tables were inadvertantly omitted from Mr. Ewins' articles in our issues of March 18 *and April* 1. *Our apologies to the author*—EDITOR.

MOGUL

Some notes on a 7¼ in. gauge Great Western 2-6-0

Part II *Continued from page* 412

by K. E. Wilson

I decided to try a more "built-in" regulator than the usual pattern, just for experiment. The final design is shown in Fig. 1, and needs some explanation. The general construction is clear, but items A and B are not quite so obvious.

A is a banjo bolt (see inset sketch); with the main vertical pipe taking steam to the superheater; whilst the one leading off at 22 deg. is connected to the snifting valve.

B is a special bolt, drilled up the centre, and having an annular groove in it near the head. This groove connects to the central hole by a cross-hole. Steam from the boiler therefore passes through the port, up the central hole, through the cross-hole and round the groove, finally going down to the wet header. The joint round the banjo A is made with red hermetite, obtainable in tubes from any garage. Incidentally, in all my drawings I am being sparse with dimensions, but am including a scale so that all measurements can be obtained.

A light spring is placed round the rod so as to bear on the front collar to hold the disc lightly against the portface. These collars are pinned to the rod during assembly; their position being obtained by trying on the job. The regulator disc can be marked out after drilling the ports and fitting the pin that limits travel; then if you run out slightly with the drill, the block can still be used by making the disc to suit. The square hole should not be a tight fit on the rod, but left slightly sloppy to allow the disc to seat firmly on the portface.

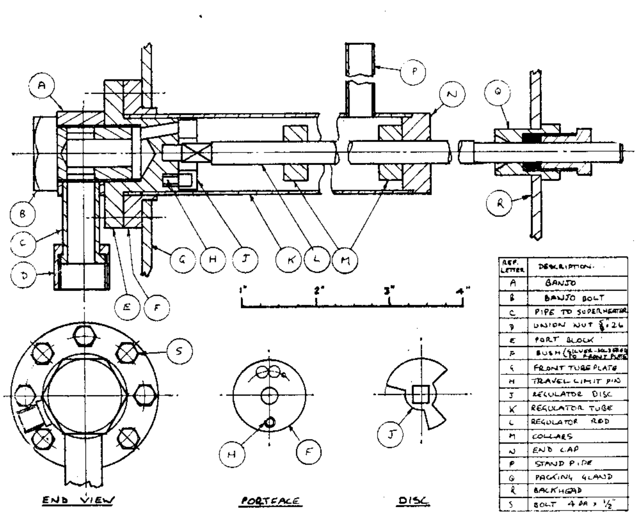
When assembling the outside of the regulator, silver solder together items N-P-K, then just before inserting the front tubeplate into the boiler, pass the regulator through the hole in the tubeplate and silver solder the bush E on to the end. Brazing is better for this job, as you don't want it to melt off while doing the tubeplate. Then assemble the tubeplate in the boiler in the usual way, and fit a long temporary stay through the bush E right down to the packing gland on the regulator; a nut on each end will keep it secure. Don't forget to make a stepped bush for the front end of this stay to locate it in the centre of bush E; then the stay will hold the whole thing in line during the final brazing operation.

Steam is collected from the point where Churchward collected his; i.e. the front top corners of the firebox. True, he had two pipes (one to each corner), but one does quite well. Regulator lubrication is taken care of by a small standpipe just below the duplex safety-valve, this pipe is not shown in the drawings. It should in theory have a little cap on it to stop water getting in during surges, but I have tested the regulator as shown and had no trouble. Digressing for a moment, it is this practice of actually trying things out to see what *should* happen which has led to the tremendous progress that has been made in miniature locomotives over the last forty years. Prior to about 1924, there were perhaps only one or two 3½ in. gauge locomotives in existence that could haul a living load, and certainly everybody *knew* that it was impossible for a 2½ in.!

Superheater

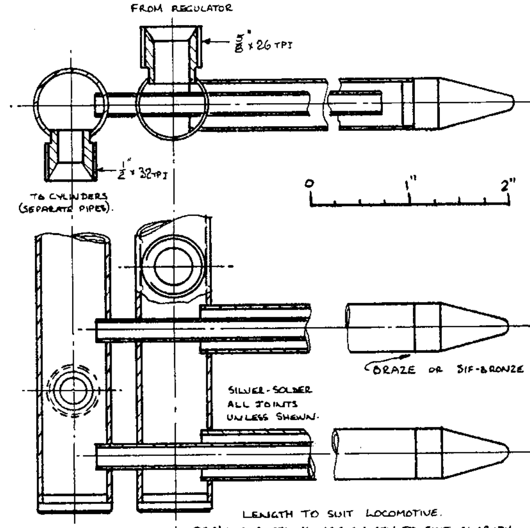
This design of superheater was, I believe, first described in ME last year. It was suggested to me that I make my Mogul's superheater to the same basic idea; being interested in trying things out, I drew up and constructed that shown in Fig. 2. I would have preferred to make the inner tube $\frac{5}{16}$ in. dia., but this size was not obtainable at the time.

I toyed with the idea of making the outer shell detachable by a ½ in. × 40 in. thread, but decided against it as I find

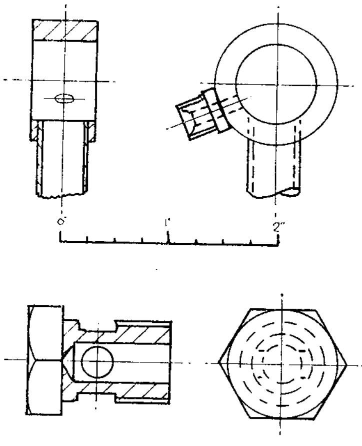


REF. LETTER	DESCRIPTION
A	BANJO
B	BANJO BOLT
C	PIPE TO SUPERHEATER
D	UNION NUT ⅝"×26
E	PORT BLOCK
F	BUSH (SILVER-SOLDERED TO FRONT PLATE)
G	FRONT TUBE PLATE
H	TRAVEL LIMIT PIN
J	REGULATOR DISC
K	REGULATOR TUBE
L	REGULATOR ROD
M	COLLARS
N	END CAP
P	STAND PIPE
Q	PACKING GLAND
R	BACKHEAD
S	BOLT 4 BA × ½"

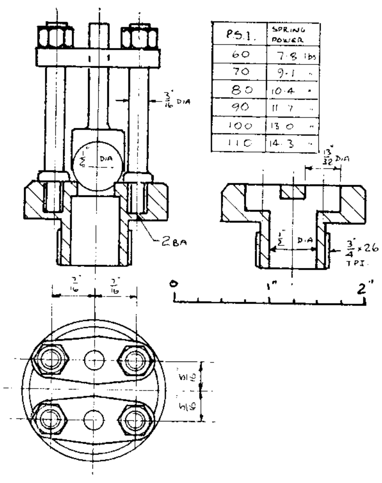
REGULATOR FIG. 1



SUPERHEATER FIG 2

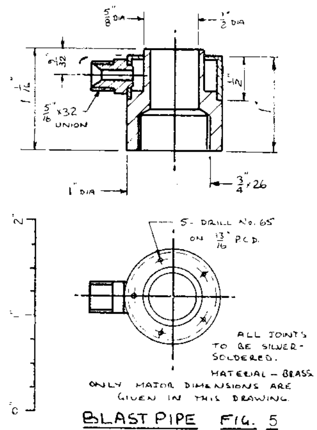


BANJO BODY & BOLT. FIG 1A.



P.S.I.	SPRING POWER
60	7·8 lbs
70	9·1 "
80	10·4 "
90	11 7 "
100	13 0 "
110	14 3 "

"DUPLEX" SAFETY VALVE FIG. 3



BLAST PIPE FIG. 5

that screwed fittings in the corrosive and erosive conditions in the smokebox quickly cause any thread to "fuse up" and be most difficult to remove.

As I see it, the advantages of the style of superheater are as follows:—

(a) Less blocking of the flue tube, so that not only can more hot gases get through, but fewer cinders are likely to get trapped and block the tube entirely.

(b) The spearhead is far easier to make, also the outer case can be renewed; this being the only part likely to wear.

(c) There is no awkward return block to make with its tricky drilled passages.

Against this must be set:

(d) Slightly more difficult to make the header tubes, as these must be drilled very accurately to permit the inner tubes to line up.

(e) With the direction of steam flow as shown, the heating might be slightly less efficient than the usual design. In actual fact, the steam will pass fairly slowly through the first (outer) tube, and then more quickly through the inner. Some of the heat in the steam as it goes out will, of course, be transferred to the incoming steam, but in practice a steady state will be reached shortly after opening the regulator.

I have no doubt that the theorists will heartily disagree with the direction of steam flow, but since we are heating the steam rather than letting it expand, the usual laws of thermodynamics apply somewhat differently. Anyway, it works in practice and is much easier to connect up. Reliability and ease of maintenance count for far more than theoretical efficiency when it comes to locomotives, thus I consider the method shown has no real arguments against it.

My superheater was made entirely from stainless steel; the spearheads were sifbronzed, and the rest "easyflowed" using the special flux for stainless steel. The ordinary grade will *not* do; even with the correct grade, extra care is needed, but the results are worth it. I always try to arrange the superheater to come out of the engine as easily as possible: experience tells! The undoing of three unions and the swivelling of the two steam pipes to the cylinders allow the whole assembly to be drawn out.

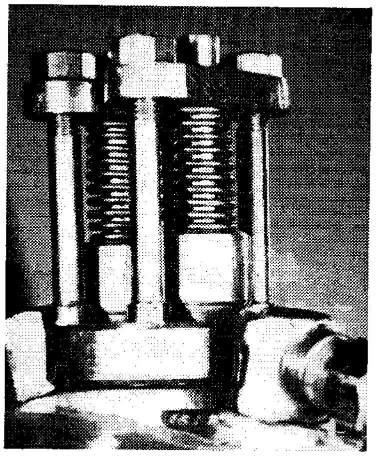
Safety valve

I always like a big safety valve; all the boilers that I have built produced plenty of steam and there must be a way of releasing it. It is not easy, however, to get a good valve without going to an outsize in holes in the boiler; but Fig. 3 shows a good way out of the difficulty. The construction should be clear from the drawings; and Fig. 4 shows the actual valve nestling between the two feed clacks. Incidentally, I do not put clack-valves up here, my clacks are fitted just after the injector. The two separate valves should be set at different pressures, one at working pressure and one at about 6 p.s.i. higher.

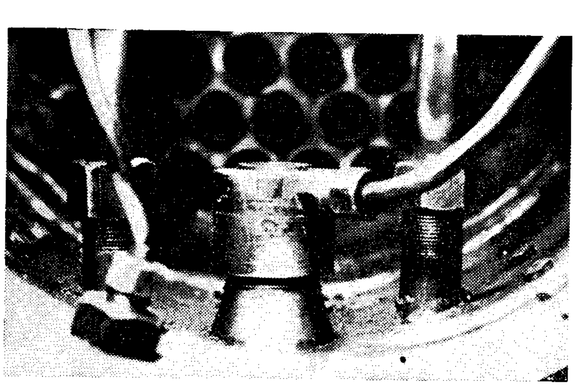
Of course, the standard safety-valve casing is fitted over the valve and will direct the escaping steam upwards; without it I find that the steam shoots up until it strikes the top plate and then spews out sideways.

Continued on page 463

Right, Fig. 4: The duplex safety-valve



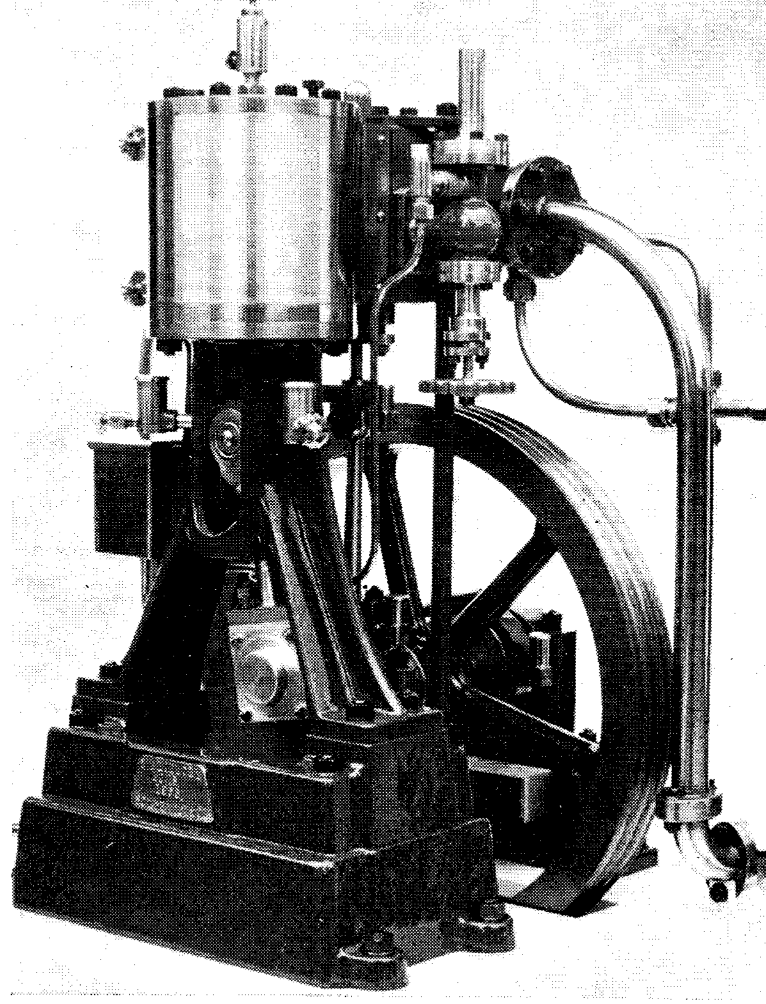
Below, Fig. 6: Fittings inside the smokebox



A FINE VERTICAL ENGINE

by

Anthony Beaumont



I USED the basic castings of the Stuart No 4 steam engine and the 7 in. flywheel castings from their beam engine to build my working vertical engine.

In common with some of my other small engines made for prolonged working under load, this present design incorporates a ball-bearing crankshaft, and in addition there are ballraces at the crankhead and crosshead bearings. I also made a ballrace type of pump eccentric strap, but discarded it as being somewhat large because of the necessity of using the only narrow large-diameter race available.

The main bearings are 12 mm. bore double row, self-aligning and are pressed in cast dural housings, mounted on pedestals of the same metal; much of this material came from an old mallet head of " scrap " origin, and numerous small blowholes required filling later. These bearings are grease-packed and have close-fitting bolt-on covers secured by 10 BA studs and nuts.

The machining of this type of crankshaft, although basically a simple straight shaft, requires careful finishing to micrometer on 6 diameters—2 for bearing journals, 2 for eccentrics, flywheel and the shoulder for the crank disc. I increased the shaft diameter towards the centre, the flywheel fitting on the maximum diameter; thus assembly takes place from the centre outwards.

I machined the connecting rod from solid mild steel $1\frac{1}{8}$ in. dia., and pressed in a pair of rigid sealed $\frac{1}{4}$ in. bore ballraces for the crosshead pin bearing. The bolt-on crank head bearing contains an 8 mm. bore DRSA ballrace pressed in a mild steel housing. The complete connecting rod occupied me for eleven evenings, and was finished entirely as a turning, boring and milling operation. I secured the crankhead bearing on its pin by a $\frac{3}{8}$ in. × 40 t.p.i. nut, pinching the inner race against the crankpin shoulder. This nut is covered by a dural grease cover and 10 BA studs and nuts.

The crankpin itself is a press fit in the $2\frac{1}{4}$ in. × $\frac{5}{16}$ in. disc, and is again secured by a thin nut behind. The crank disc is secured on its shaft by a press fit and a taper key.

In keeping with my usual practice, I hand-lapped the gunmetal cylinder and cast-iron trunk guide to the closest possible limits. In fact, the mild steel crosshead will not enter its guide unless it is greased first, and I have proved that wear on these two important components is virtually nil even after long hard duty when care is used in initial precise fitting.

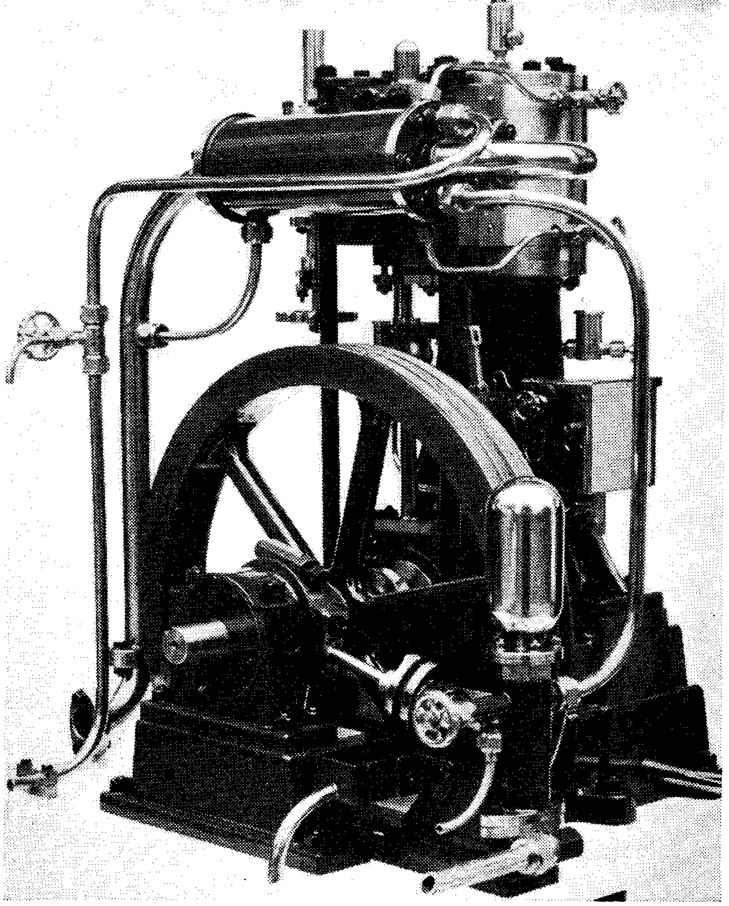
The complete cylinder, valve chest, covers and piston are gunmetal to avoid any rust worries. I like to have my cylinders cast solid on the port face, so that ports can be precisely milled out, which is hardly possible when cast-in ports are cleaned up parallel. In this case the steam passages are four $\frac{1}{8}$ in. dia. holes at each end. I fitted a silicone-rubber O-ring to the piston, and I can recommend this procedure as superior to the usual packing. Any desired ring compression can be obtained by varying the depth of the piston groove.

The cylinder is $1\frac{1}{2}$ in. bore × $1\frac{5}{16}$ in. stroke, the stroke being greater by $\frac{1}{16}$ in. than Stuart's design. The eccentric rod is machined from mild steel, foot, rod and spherical head. Incidentally, the simple ball-turning lathe attachment described in ME some years ago is of great value in model steam work, and I have made a very satisfactory set of railing stanchions with its aid.

The valve rod head of mild steel has a generous $\frac{3}{16}$ in. dia. bearing, and the eccentric rod head is bronze bushed to suit. The mild steel pin is case-hardened. I attached the nickel silver operating arm for the lubricator drive to the valve rod head by 10 BA studs, which are duplicated on the opposite side of the valve head for possible valve adjustment.

The stainless steel valve rod is $\frac{1}{8}$ in. dia., screwed 60 t.p.i. for the valve nut, hence a half-turn will give 1/120 in. adjustment. I made the internal steam chest guide $\frac{3}{32}$ in. dia., and therefore, changed Stuart's rather heavy $\frac{3}{16}$ in. valve rod design.

Stuart Turner's drawings for the No 9 (horizontal) and this No 4 engine, show different lengths for the valve on the same port dimensions, the No 4, giving a later cut-off. I compromised here, and arranged the valve events to give



a 77 deg. cut-off as measured by a protractor at the crank pin on both strokes.

The main stop valve has $\frac{1}{4}$ in. clear steamways, and I machined it from solid $\frac{3}{4}$ in. dia. bar. The two 90 deg. exits are silver soldered in the main body. The bolted flange carrying the $\frac{5}{16}$ in. × 26 t.p.i. main steam valve is attached by four 8 BA studs. I made the spindle from $\frac{1}{8}$ in. dia. stainless steel to which the main screwed part is silver soldered. As a change from cutting the spoked handwheels from the solid, I built them up by silver soldering six separate spokes to hub and rim, previously drilled by using the lathe mandrel dividing attachment. This method gives a neater job than the solid type, but it is important to select a drill diameter an easy fit for the spoke material. I used clock pinion wire in different sizes for these jobs.

I cut the eccentric straps from solid b.m.s. $\frac{1}{4}$ in. thick, and lined them with gunmetal brasses $\frac{1}{16}$ in. thick, sweated in with soft solder as a ring and parted with a jeweller's saw at the joint faces of the steel straps.

The well-proved LBSC type of mechanical lubricator has a $\frac{3}{32}$ in. dia. piston and a 40 tooth ratchet wheel. A 50 tooth wheel was tried first, but appeared to deliver insufficient oil at the cylinder wall opposite the steam ports. The ratchet gear pawls are case-hardened and the hairpin springs are stainless steel. I have a Clarkson 45 deg. milling cutter, bought for machining lubricator ratchet wheels. I cut about 3 in. of b.m.s. rod at one " go " and this provides a number of wheels when sections are sawn off by a thin-blade hand saw to save parting-off waste.

There are six other lubricators on the engine. The pair on the trunk have adjustable needle valves, and the three on eccentrics and valve crosshead have a slow feed via No 60 drill oilways. The top cylinder cover lubricator is really unnecessary, being more ornamental than useful, although it has a screw on the cap.

Reverting to the cylinder description, I made the piston and rod assembly by the shouldered spigot and nut method, which has much to recommend it when compared to the more or less permanent screw-on method where the piston cannot be removed from its rod via the open cylinder top. Although I have not included a pair of blind tapped holes in the upper or outer face of the piston, such holes would enable the piston to be removed easily in conjunction with a small lifting bar drilled to suit the tapped holes.

The remaining principal accessories are the drum type feed-water heater and the boiler feed pump. I made the heater from brass tube with bolt-on end covers fixed by fourteen 7 BA studs and nuts. The pipe fittings are silver soldered, and the turned ends are rebated and soldered to the drum with " Comsol " silver alloy. The $\frac{1}{4}$ in. dia. heating coil makes a hairpin loop in the drum and connects to the $\frac{3}{16}$ in. dia. pump delivery line and by-pass valve. All the copper pipes are thin wall (20 and 22 s.w.g.) and were filled with Cerrobend after annealing, and bent by rough and ready hand methods by mallet and vice work. A former was turned for the 180 deg. bend in the $\frac{7}{16}$ in. dia. exhaust pipe from cylinder to feed-heater. I may remind inexperienced users of Cerrobend pipe filler, that it is essential to quench the hot filler in the pipe immediately, otherwise a brittle structure develops, and subsequent bending operations will crack the filler and kink or wrinkle the pipe. Straight pieces of pipe could have been used if the feed-heater had been placed elsewhere, but I like to see a few small radius bends in the pipework if they can be made to a perfectly even cross-section.

I fabricated the pump from brass and gunmetal bar and rod in ten pieces. The pump ram is arranged desaxé to the line of thrust of the operating rod, so that the latter is in line with the ram midway in the delivery stroke. I consider that this offset design is insufficiently used in pumps, as it greatly relieves side thrust on the gland. I have pivoted the pump rod inside the hollow $\frac{3}{8}$ in. plunger at a point which is always inside the pump barrel. Only a small bearing is possible internally, but it is flooded with oil in the hollow ram. This pivot also gives less angularity of pump rod where a compact design is required. The lower valve box is studded to the valve chamber and gives access to the $\frac{1}{4}$ in. dia. stainless steel ball valve, duplicated in the upper or delivery valve. The upper $\frac{3}{8}$ in. × 26 t.p.i. fitting carries a large size in air vessels and a dummy bolted flange fitting. The air vessel prevents all valve hammer and general " water knock " in the delivery side. A release valve is fitted under the air vessel, but is not required to start the pump.

All unwanted drips and drains in a working model should be controlled and gathered to one or two points so that mess is avoided, the engine then resembles a large version in use and not a dribbling toy operating in ever-spreading pools of emulsified oil and water—definitely not an attraction in public display!

I have made a false dural plate base to the crank pit and this plate slopes towards an outlet pipe to carry waste clear of the plinth to a suitable small container. Two narrow brass trays are supported on brackets, and are situated under each eccentric. There is, of course, no oil running from the main bearings. A small drip tray under the pump gland collects the odd leak here which is piped away clear of the base. I have not fitted an O-ring to the pump, and it would be unwise to tighten the gland to prevent all leakage on the grounds of excessive friction and power required to operate the pump.

A pair of column supports may be noticed from the valve chest top to the engine baseplate. I included this to stiffen the trunk guide against the slight side thrust imposed on it by the disc crank design. At full output with about 45 lb. per sq. in. a slight whip could be seen, although no binding took place in the motion work because of the self-aligning trunk-head ballrace. Cast-iron will bend!

The engine baseplate is ¼ in. dural 8 in. × 7½ in. which is boxed up by ⅜ in. square × 1¼ in. high dural columns connected by 1/16 in. dural plates, one of which is cut away to allow the triple 3/16 in. round plastic driving belts to emerge from beneath the flywheel. This type of belt drive is very efficient and grips well, besides having easily made and silent joints, and I have found that it drives my 6 v. 5 amp. dynamo without any trouble.

The engine and plinth are finished in Valspar paint and I took care to rub down the parts to show a final gloss of a reasonable exhibition standard. The plinth is cream, and the main castings of the engine are dark green BS-074 shade, which I found has to be ordered through a stockist. The disc crank, eccentric straps and main valve body are red. The cylinder lagging is stainless steel, grained finished with medium emery cloth, and covers the felt insulation.

I oil-blackened all stud ends and nuts after polishing them. Purists may criticize my design as being out of line with steam work of the period which the engine represents, but I have had quite enough experience of dismantling models to take up wear in plain bearings to wish to repeat this procedure on my present engines. True scale may be the only answer when museum pieces are concerned, but hard work demands a different approach.

My test figures for this engine do not show its full potential because I have only the small boiler of my generating set (previously described in ME) with which to steam the No 4.

Here are the results: Boiler—water tube, drum size 11 in. × 3 in. Firing—twin silent Primus paraffin "Picnic" burners. Time of test—1 hour's running (not including steam raising from cold. Time from cold to dynamo cutting in—5 min. Pressure maintained throughout run 44 lb. per sq. in. with feed water pumped by engine. Temperature of feed water—approx. 180 deg. F. Temperature of boiler steam superheat—approximately 320 deg F. (soft solder bead just plastic). Water used including starting from cold—9 pints. Paraffin used—1⅛ pints. Cylinder oil approximately ¾ cu. in. Engine speed approximately 500 r.p.m. as measured by mechanical lubricator wheel. Dynamo output eighteen 6 v. .3 amp. bulbs fully run (approximately 30 watt.).

These output figures exceed those of my twin vertical 1 in. × 1 in. generating engine by some 50 per cent, using the same boiler and firing apparatus, but the boiler is now pressed to its limit.

A direct-coupled alternator would be an interesting generator for this engine. Perhaps some electrical experts can suggest a suitable commercial item.

I have fitted a paraffin hand pump to my fuel container and also a glass gauge. Generating runs of very long duration can now be made on my original set, and air pressure on the fuel kept constant by pumping in paraffin to maintain a steady state. The air pump is used only for starting. ■

MOGUL *(Continued from page 460)*

Having found out that the usual bent-ring-of-copper-tube blower is easily damaged when cleaning the flues, I now make the type shown in Fig. 5 and 6. I fitted one to my *King* about eight years ago, and have not had to touch it since.

The fitting is made out of three parts only, simple turning jobs, and then silver soldered up and fitted. The "line-up" of the jets is "built in" and remains constant. The dimensions shown are for 7¼ in. gauge, but by reducing sizes generally the blastpipe will fit any locomotive down to 2½ in. gauge. I have not the slightest doubt that the number and size of holes are all wrong, but as made and fitted I can assure anyone that it certainly draws the fire up.

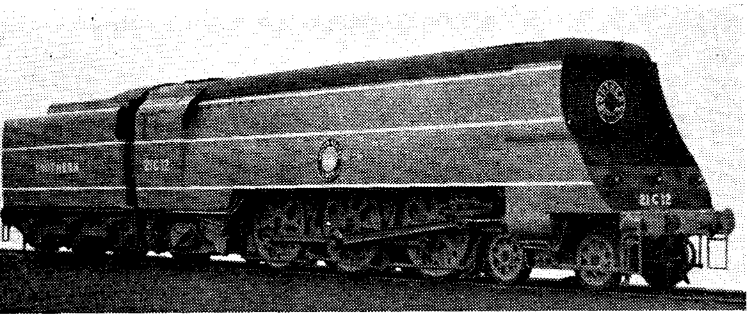
The first steam test

On Sunday, February 13, we duly arrived at the Malden Society's 7¼ in. gauge track at Thames Ditton, being allowed to try the locomotive out by kind permission of the Society. We lost no time in unloading and raising steam. I did not time this operation, but it was pretty quick, and we had no snags. I drove the locomotive back on to the main line (chopping up numerous twigs with the driving wheels) and then started.

Calamity! The pony truck would just *not* stay on; so we had to run back into the steaming bay just by the shed. Now this is where the doctrine of "easy dismantling" paid off hand-over-fist; to the surprise of everybody present I just put my hand under the front buffer beam, withdrew two small split cotters (3/32 in. dia.) and then lifted the front of the engine about 2 in. The truck dropped clean out and was pulled away. In fact, searching around for some spacers to boost the springs took as long as the entire repair. After re-assembly, the first trip round the track took place. I found in the cold weather that it was very difficult to see ahead, the exhaust steam was aimed "just right." We derailed once more (probably a twig) but then no more trouble; and while a friend had a lap (he ran round in reverse) we got out a train of three trucks. This was rapidly loaded, and the locomotive backed on. Toot on the whistle, and then away she went. I was terribly disappointed by the poor performance and acceleration until someone discovered that the train's power brakes were full on! Not at full pressure, but quite enough to spoil results. The interesting thing here is that at no time was there any trace of wheelspin; with a rather high TE of 212 lb. (I am not sure yet of the adhesive weight) I would have expected some, but only at one time during the day's run did she slip; and that was on a patch of water with the train's brakes full on at full pressure. One in the eye for the low TE—heavy locomotive brigade! As a matter of interest, I have found (by actually driving one) that even so perfect an engine as a GWR Castle is very easy to slip *running light* if one is too generous with regulator opening; yet I do not think that anyone in their right minds would say that the Castle should be "weakened!"

Speed and acceleration are all present, but I find that the injectors are a little too fierce to feed the boiler whilst actually running; the delivery cones are drilled No 55, and it sure puts the water in! I shall experiment with a slightly smaller set of cones, then use one injector (large) for filling up while stationary, and the other (small) for running.

Due to an internal failure in the cyclometer, I was unable to get the exact distance covered, but a good estimate would be about 15 miles. *To be continued.*



BULLEID: LAST GIANT OF STEAM

K. N. Harris discusses the recent biography of Mr O. V. S. Bulleid

I HAVE recently read, with great pleasure and not a little profit, Sean Day Lewis's book bearing the above title, and I can strongly recommend it to all interested in locomotives and locomotive Engineers. Not very many men are honoured in their own lifetime by a full-scale biography, and of these, few can have had a better biographer.

Mr Lewis specifically states that he is not in any sense an engineer but, nevertheless, he hardly ever puts a foot wrong on technical matters. It is evident from his acknowledgements, which occupy a page and a half, that he has been to immense trouble over his sources of information, and in verifying his references.

Whilst obviously and admittedly a wholehearted admirer of Mr Bulleid, he stops well short of uncritical adulation.

The story of the Bulleid " Pacifics " and of the " Leader " class has never previously been so fully told, and it is the first time that I have ever seen anything in print about Mr Bulleid's outstanding work in Ireland for C.I.E.

The book abounds in what " Readers Digest " calls " quotable quotes," many of which bring out Mr Bulleid's sardonic sense of humour. I must content myself with two. On being told of some half-baked sneers at his Q.1's (0-6-0 Express Goods) Mr Bulleid quoted an Arab proverb, which most admirably fits the case: " The dogs bark, the caravan proceeds on its way." On another occasion, summing up the evidence of two drivers who had been involved in a collision (in Ireland), he said: " I have investigated this collision carefully, and from what I hear, both of you must have been stationary at the time of the crash." !

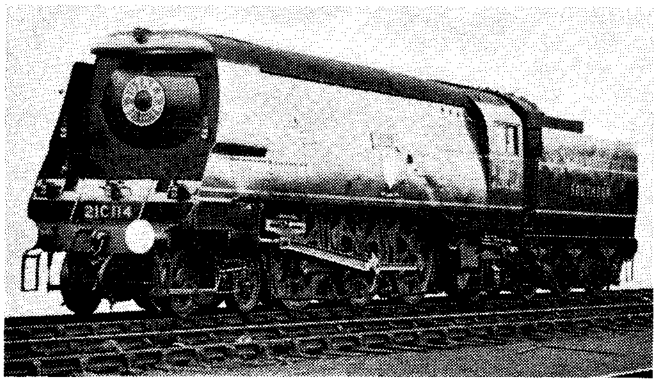
Mr Day Lewis quotes a comment of the late E. L. Ahrons about the leisurely speed of the Brighton Expresses (?) in Stroudley's day: " It is better to be a dead mackerel on the LNWR than a live first-class passenger on the Brighton." This arose from the fact that some of the fish trains on the former were timed between Tebay and Preston faster than the Brighton " City Limited " (then the fastest train on that line) with a booked speed of only 46.6 m.p.h. ! (Period 1883).

In 1905 *The Times* pointed out that as the South was unable to compete with the North in the matter of speed, they had apparently decided to set up unbreakable " go-slow " records.

Again and again in this book, the point is emphasised that, had it not been for the hide-bound conservatism, not to say obscurantism, of British locomotive engineers in general, of all grades from top to bottom, the demise of the steam locomotive might well have been postponed for quite a few years. Few people would be found who admired the appearance of the Q.1's, but the engines were designed to meet very difficult conditions of material and labour supply, and whatever one may think of their outward appearance, they were functionally excellent engines. It is not so many years ago

Below, right: Bulleid's first design, 0-6-0 Q.1. class.

Below: One of the " West Country " class.



that I saw one of them at the head of "The Thanet Belle," and on passenger work in general they were quite capable of running at speeds up to 75 m.p.h. when necessary. Because, however, their appearance was unorthodox, they, and their designer, immediately became the targets for every sort of irrelevant jibe and sneer, from people whose qualifications to criticise existed largely in their own over-vivid and quite undisciplined imaginations. On the basis of "handsome is as handsome does," they not only completely justified themselves but confirmed their designer's great abilities.

No fair-minded individual could read this book without coming to the conclusion that Mr Bulleid is a great and highly original locomotive engineer. I am certain in my own mind that the almost pathological hatred of his work stems primarily from its originality, for, to his critics, any slightest departure from orthodoxy, either mechanical or visual, or from the sacred Stephensonian tradition was anathema and not to be tolerated at any price. Well, these troglodytic gentry prevailed and now the steam locomotive has joined the Great Auk and the Dodo, and will very soon be only a museum piece. In perhaps twenty or thirty years, when modern locomotive history assumes its proper perspective, I would hazard the opinion that the name of Bulleid will take a high and honoured place amongst the British Locomotive Engineers of the 20th century.

"Bulleid, Last Giant of Steam" is a book to buy and keep, and to dip into again and again to fill a leisure hour. The unprejudiced will, I think, agree that the title is apt.

D. W. Greenslade completes his description of a model Motor Ship

Continued from page 415

The Thrige electric windlass and the Wardhill pattern cable stoppers were made from similar materials to the crane. There are four wire reels made from aluminium, cut out with a fretsaw to make the 'A' frames and base, and the round discs of the reels. The reels are dowels and the spindle and crank handles are made from brass pins.

There is a ladder on the front of this deck house, and two fuse boxes. The ship's bell is fitted on the front of the deck house.

Just behind the jackstaff in the bow is a small square hatch to reach the fore peak. Three roller fairleads are mounted on the forecastle bulwarks, and there are twin roller fairleads fixed to the aft deck, on both sides. To gain access to the forecastle there are two companion ways with sliding hatches in front of the superstructure.

A large mushroom-topped vent is mounted on the centreline just forward of the front bridge, and there is a smaller mushroom vent in front of the windlass. Another vent with a cowl top is fixed on the starboard side at the after corner of the fore deck house. A spare bower anchor is stowed on the starboard side of this deck close to the bridge front, and a spare stream anchor is carried on the port side opposite.

The ports are brass, supplied by Bonds; they are let in flush with the side of the hull. Short lengths of brass tubing were also let in to the hull to make the outlet pipes.

The model is powered by a 12 v. shunt-wound Mersey Marine "Navigator" electric motor, driving a 2 in. dia. four-bladed brass propeller. It is coupled to the shaft with a universal coupling. Electric current is provided by a 12 v. 5 amp-hour Exide accumulator, actually two 6 v. cells wired in series: they weigh 7 lb. 2 oz.

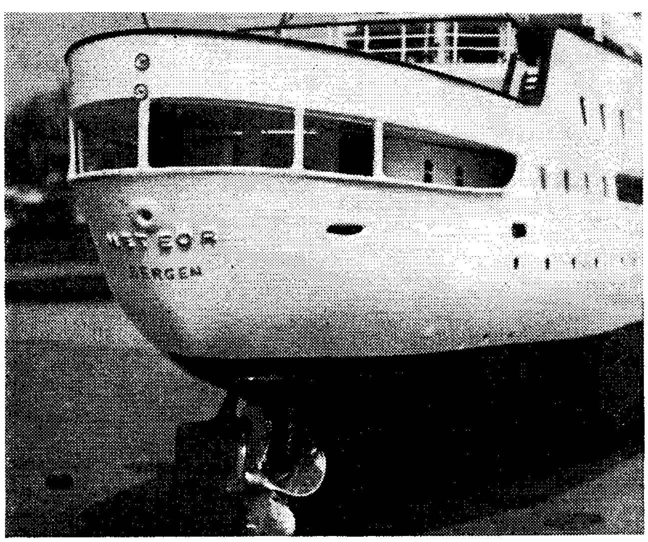
The brass stern tube is filled with vaseline for lubrication and to keep the water out. It was filled by melting some vaseline in a tin, and sucking it up by using the stern tube as a straw!

For ballast I melted some scrap lead, and cast it into blocks about 4 in. × 3 in. × 3/8 in., using aluminium cigarette tins as a mould. The lead does not stick to aluminium. The ballast is positioned in the bottom of the hull by trial and error at the pondside, then screwed down.

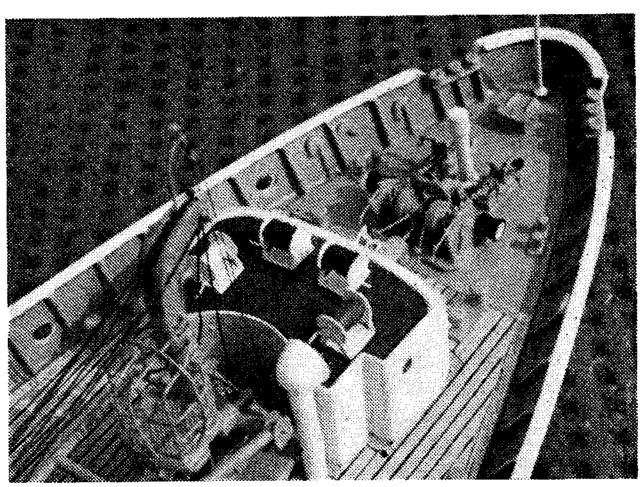
The model has a good turn of speed, and performs well on the water.

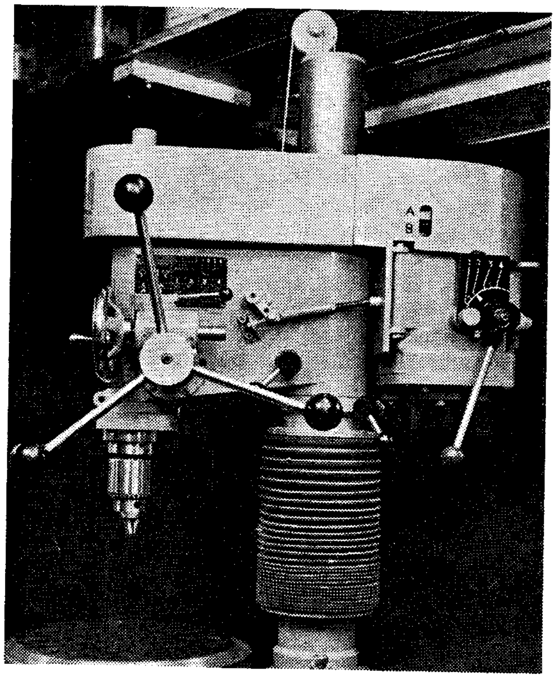
Building the *Meteor* has been an enjoyable task, one that has kept me out of mischief for two winters; all the work was done at home on the kitchen table; it was great fun. ■

Below: A stern view of the model, showing the four-bladed screw.



Below: The windlass can be seen in the bows.





A PILLAR DRILLING MACHINE

built by B. Hatfield

Part Two: *Continued from page 397*

THE shaper did a good job: to get the correct spacing for the teeth, I clamped a dial gauge on to the shaper and was able to cut two teeth at a time before the gauge had to be moved and zeroed. My photograph shows a dummy run on a bit of scrap bar, the dial gauge can be seen in the background.

The splines on the spindle, four in number, were cut on the milling machine and at the same set-up a piece of silver steel was also splined, the reason for which I will explain. It was my intention to make with the silver steel a broach to cut the internal splines to engage with the splines on the spindle. I had never made a spline-cutting broach before so I was in the dark except for what could be gleaned from text books.

The piece of silver steel was fluted in the miller and then mounted in the lathe to be turned to a long taper and gashed to form teeth; a small portion was left parallel at the small end to act as a pilot. It was then hardened and tempered in accordance to the right colour for broaching tools. A piece of 1 in. dia. bar was bored to the root size of the splines and as much surplus metal as possible was removed (to try and make things easier for my broach) with an end mill.

I was now all set to push the broach through, making, I hoped, a set of splines that would mesh perfectly with the spindle. The broach and the component were mounted in a large fly-press and I started pressing it through: all seemed to be going well for a while, but then the broach started breaking up to the accompaniment of loud cracking and crunching noises. There was nothing that could be done; if I had pulled the broach out, it would have broken all the teeth off, so I carried on and pushed it right through. The broach came out minus some of its teeth, which were embedded in the walls of the component; all was lost, and an alternative had to be found.

I suppose that the moral of the story is " don't try to carry out specialised machining operations with no experience."

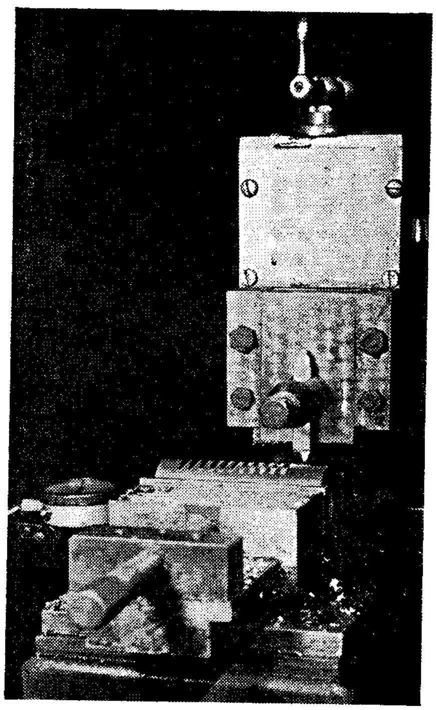
As an alternative to the broach method of forming splines, I built up the component by brazing four involute-shaped pieces of mild steel into four slots in a 1 in. dia. tube, and as the finished item worked all right it seemed to be a suitable method of construction.

The countershaft assembly (Fig. 8) was next on the list, this being fairly straightforward work, consisting of bits of steel plate to from brackets, etc., on which to mount the motor and gearbox. The whole of the countershaft assembly is pivoted so that belt changing and adjustment is facilitated between the spindle and gearbox.

The motor ($\frac{1}{2}$ h.p. s.p. 1425 r.p.m.) is mounted on a secondary countershaft which in turn pivots on the main countershaft, again to facilitate belt changing and adjustment. I find that most of my drilling can be done using the gearbox alone to alter the speeds; however, when I find it necessary to use a very low or very high speed, it is a simple matter to move one or the other of the belts to gain the required ratio.

The gearbox is, in fact, a motor-cycle gearbox given to me by a friend who is a keen motor-cycle enthusiast, his workshop usually contains many old gearboxes, engines, frames, etc. I was, one day, moaning to him that I could not find a suitable gearbox for

Below: Cutting the teeth in the rack.



the drill I was making; he dived under the bench and came out with a dirty looking lump of aluminium, which he said was a gearbox. It was originally fitted to a very early 250 c.c. Triumph. I must say that at first I was not keen to use a cast-off motor-cycle gearbox on my new drill, however, I took it home and stripped it down and found it was a beautifully made little thing which had hardly any visible wear, save for one ball-race and one bronze bush, which I renewed.

I removed the outer casting containing the kick-start mechanism and blanked it off with a piece of ¼ in. aluminium plate; I also sawed off a few lugs and projections and then mounted the two sets of two-step pulleys on the input and output shafts. By now the gearbox had taken on quite a different appearance and after a coat of priming paint I was very pleased with it indeed, for it seemed to have quite a neat appearance. The countershaft was next mounted on the drill and after buying two belts I was able to have a trial run.

As readers will know, the first trial run is always accompanied with much pleasure, as we see months' of work spring into life and run according to plan. I stood staring and listening at my part-finished machine with great satisfaction; the gearbox made much less noise than I expected, and the motor seemed to be boss of the job. I had some fears that the gearbox, being built for a 2½ h.p. motor-cycle, would absorb too much power from the ½ h.p. motor and cause it to overheat. I later found that the motor provided enough power at all speeds, with drills up to ⅞ in. dia. without overheating.

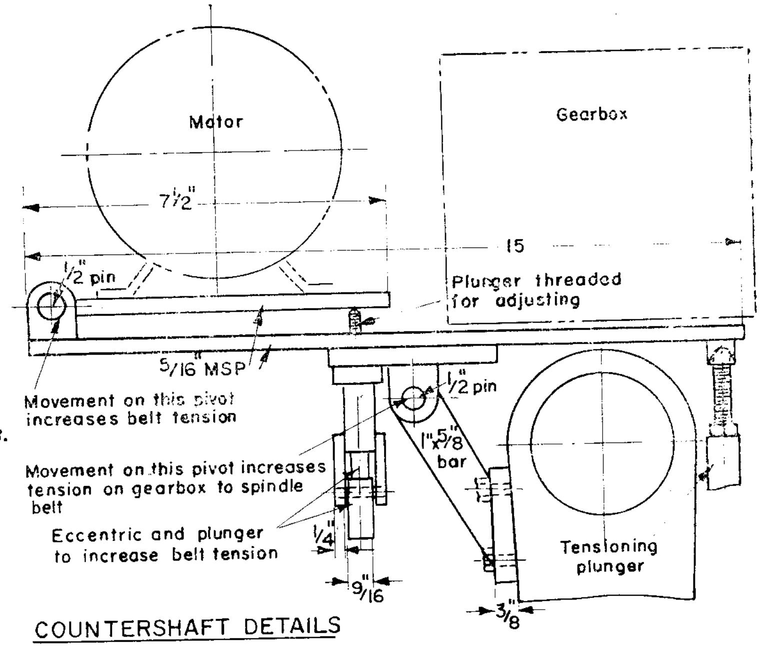
A counterweight in the column is suspended on a ⅛ in. dia. stranded steel cable which runs via three pulleys to the quill. The weight is just enough to hold the quill in any position.

The bellows, of course, prevent the ingress of grit and small swarf on to the column and also seems to prevent rust during the "rusting season." Should it be necessary to lower the table to an extent greater than the extension of the bellows, the housing can be temporarily released from the table allowing the table to drop right down on to the baseplate. The top housing for the bellows clamps to the column and takes some of the weight of the whole of the top assembly of the machine, supplementing the transverse pinch bolt in the headstock.

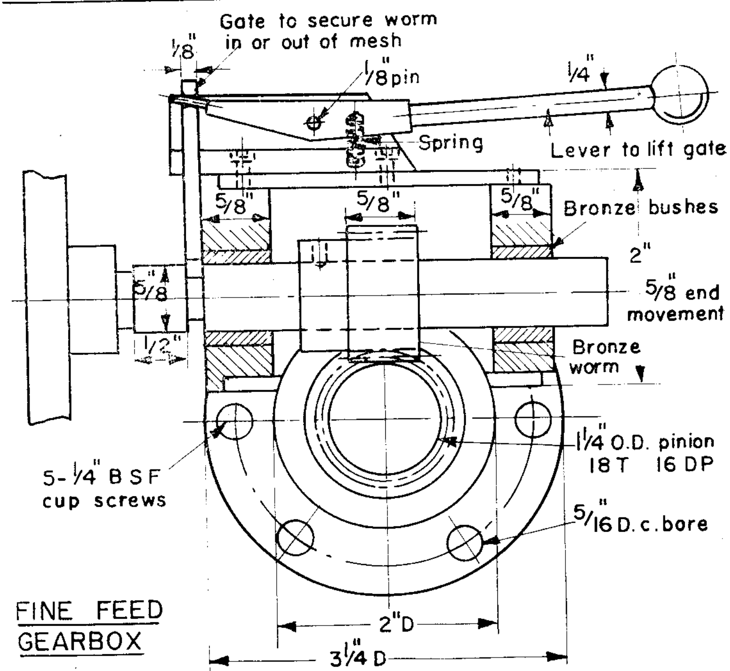
The machine was now nearing completion. There remained to make only a few odds and ends, belt guards, etc., and also to paint the whole machine. I put on one coat of primer and three coats of Valspar enamel, rubbed down between each coat.

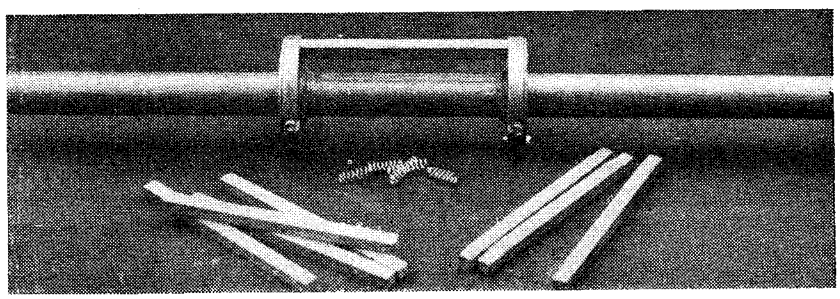
The machine has been in use now for several months and functions very well; in fact, I must say that I am very pleased with it indeed and I think it will serve me well for many years. ■

Right: Fig. 8.

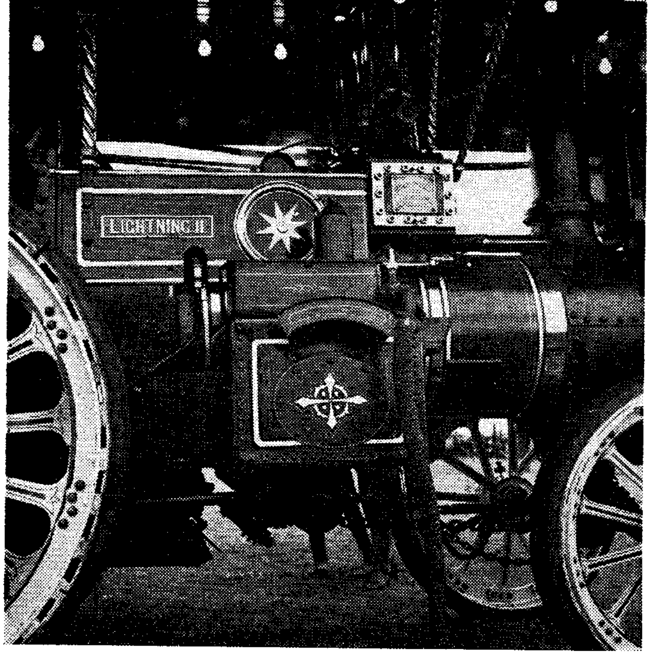


Centre Right: Fig. 9.





Bottom Right: The expanding lap, with cutters and springs.



Jeynes' Corner

A commentary on current topics

E. H. Jeynes writes about old engines

I WAS interested to read Mr William Oswald's notes on steam on the Scottish Fairgrounds. Had I spent my boyhood in Kirkcaldy at the same time as Mr Oswald, he would have had company in his runs beside the traction engines and showmen's road locomotives; as a small boy I ran many miles beside traction engines. I could keep up with the threshing sets and rollers, but the showmen's and road haulage engines soon left me behind, and there were no buses to ride home on in those days.

On a visit to some engine-owning relatives at the age of seven, I steered a traction engine down the deeply-rutted lane to the yard; of course the ruts guided the engine, but I was unaware of this at the time, then and there I determind to be an engine driver; I fulfilled this ambition years later.

Mr Oswald touches upon the gleaming brasswork on showman's engines seen at Rallies, saying few of them were like this during their working lives: this may be so of the Scottish engines, many of these were I believe converted haulier's and ex-Government road locomotives. Here in England, I have always known the brasswork polished; Burrells' seemed to cater more for the showmen in this direction than the other engine builders. Burrell No 2894 *The Pride of Worcester* even had the steering shaft encased in spiral brass tube.

I agree that quite a number of conversions to showman's type have been very much overdone, some quite garish. I have seen engines fitted with dynamo perch, full length awning, plenty of polished brasswork, but no belly tank; not much use for a real travelling showman. Some of the brasswork seen at Rallies reveals to the practiced eye that it is only polished once or twice a year, only the continuous loving care bestowed by the real engineman can match the splendid sheen of the old showmen's engines of days gone by. At every water-lift stop, after the fire was cleaned, out came the cotton-waste, and always a rub down at night, no matter how late, while the oil was still warm.

These old engines were not kept in cotton-wool either, they had to work for their keep; I can recall prodigious efforts put forward by both men and engines, a thirty-six hour shift was not unknown. I particularly remember an 8 h.p. engine, carrying its own load, and that of another engine which had broken down; of course she could not have started both the rides simultaneously, and admittedly the lights dimmed badly every time either was started; the driving belt suffered badly and could not have stood another night of it.

I have travelled many miles with just the lighting Mr Oswald describes, a couple of hurricane lamps slung from the front axle, this was about the best lighting for travelling in fog: if you had a leaky gland, you created your own private fog under the canopy. If the fog was not so dense, you could see your mate walking in front with a hurricane lamp all right, but if thick it meant off the road on to the verge, hoping you could get off again afterwards. For long distance travelling a pair of Ducellior acetylene lamps provided light enough for fast travelling at night, but unfortunately the water in the lamps sometimes froze; a separate generator was fitted in a warmer place, and rubber tubes connected to the lamps.

This brought another trouble: the swinging of the tubing was apt to cut the supply of gas, so copper tube was fitted with rubber connections. One day I had to remove the copper tube for some reason and was coiling it carefully up to avoid damage, when quite a violent detonation took place in the tubing. Apparently the flow of gas through the hot copper tube had deposited something akin to fulminate of mercury.

Reverting to brasswork again, I notice in the latest photograph of *Carry On* the regulator rod is encased in spiral tube; whether this was fitted by Openshaws on conversion, by Codonas in Scotland, or by McDermott in Ireland I could not say, and regarding the Foster type dynamo perch, I notice Mr Oswald's picture of the Burrell *King of the Road* also shows another of these brackets: Fowler No 14952 *Goliath* is also fitted with the same type; I have wondered if they were really Foster brackets, or were fabricated by the firm who converted these engines.

Mr Oswald also mentions Fowler No 10328 built for John Wilson; this was the engine mentioned in my notes on February 18, which after carrying away the parapet of Wooler river bridge, hung with one front wheel over, one rear wheel on the brink, suspended by the drawbar. Mr Arnold Wood of Huddersfield kindly sent me a photograph of the engine in this predicament. As the name of Wilson is just discernible on the tarpaulin sheets, the name of the engine would at that time be *Dawn of the Century*. Henry Irvin, on acquiring this engine, changed her name to *One of the Best*, and later back to its former name according to Mr Oswald's notes.

When Mr W. J. Hughes described the Rally at Pickering, he mentioned "a lovely Burrell" powering the mammoth Gavioli organ; I enclose an amidship view of the engine doing just that job. This engine, Burrell No 3526 owned by Dick Preston of Potto, is an example of showmen's refined taste in decoration, plenty of brass, but blended unobtrusively into the maker's design. The engine has powered the Gavioli for some years. ■

Gordon Rosekilly

talks about the

DOBLE STEAM CAR

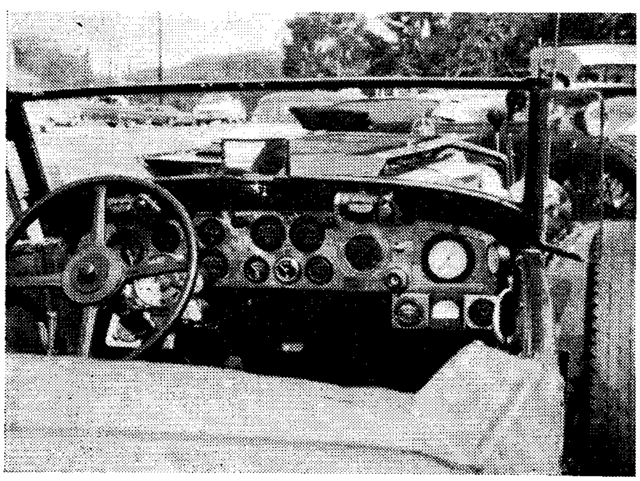
THE Doble Company ended up in Oakland, California in 1929, with the Model E steam car. This was just about the latest thing in steam cars, and is, to this day, still ahead of all others known—and, in fact, the one we are writing about will easily keep up in 65 m.p.h. traffic, can accelerate up to 90 with no trouble, and if conditions permit, it can hit 120 m.p.h.

This particular car is by no means as originally built. It was a 1924 model, and has been changed for the better in many particulars. The engine and running gear remain the same, but the boiler, the burner, and allied parts are much more modern. The end result is that this particular car is generally regarded as the complete answer to the steam car and its problems.

The boiler is made of $\frac{5}{8}$ in. dia. steel tubing, wound in pancake coils, with a single cylindrical coil for some distance down from the top. The burner is in the top of the case, with the exhaust coming out at the bottom, where it is led towards the rear of the car. The efficiency of the boiler is so high, that with poor fuel containing too great a proportion of impurities such as sulphur or vanadium, the bottom coil will clog with the condensed particles. A good washing with a hose will free this up, but the fuel has to be very poor before this will happen.

At the other end of the boiler, steam is produced at 1,300 lb. p.s.i. and 750 deg. F. The burner, in the centre top of the casing, is air atomising, the 20 lb. air pressure being supplied by a Quincy air compressor, seen in one of my photographs. This is motor driven. The burner is ignited by a spark coil and igniter—something like a long spark plug. Ignition is immediate on turning the switch and steam is raised in a very few minutes from stone cold—usually enough pressure remains so that the car will move.

The driver has plenty of instruments to watch.

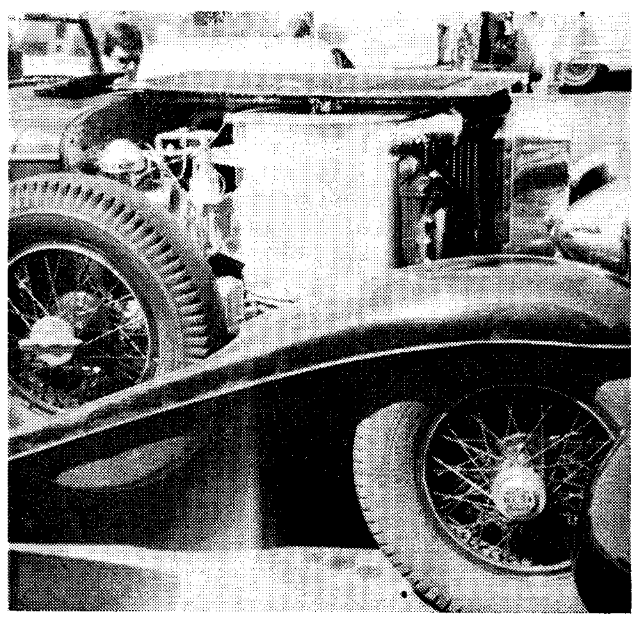


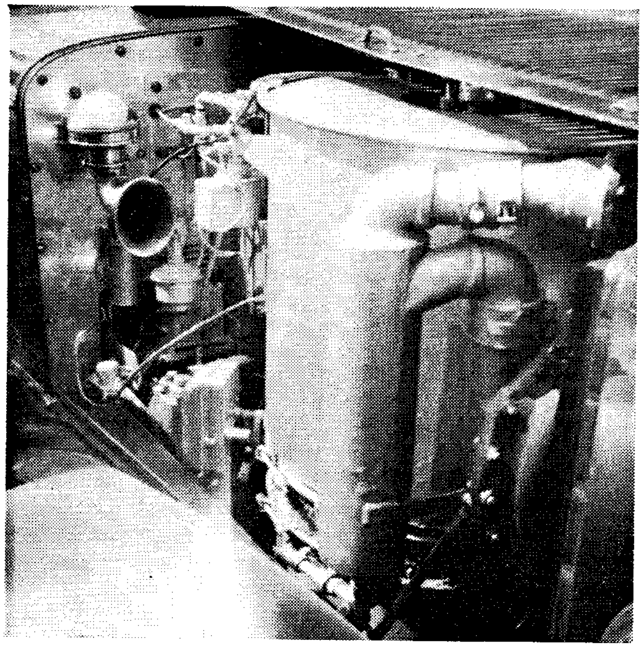
It has been said that with this type of boiler, the top coils can be red hot and the bottom coils full of water and cold. However, this has been overcome by fitting a water spray to the upper portion of the coils, so that the coils are cooled and do not get too hot. Even if, running on the road, the upper portion should become too hot, this spray comes into action and if too much heat continues the burner will shut off. Once the car is moving, there is fast circulation of water and fast generation of steam.

The interesting thing about this, is that in the operation of the car on the road, up to 65 miles per hour uphill, the boiler will make more steam than is required and the burner will cut off at high pressure, coming on again as the pressure drops, the range being 1,300 lb. off, 1,200 lb. on, and the temperature 750 deg.

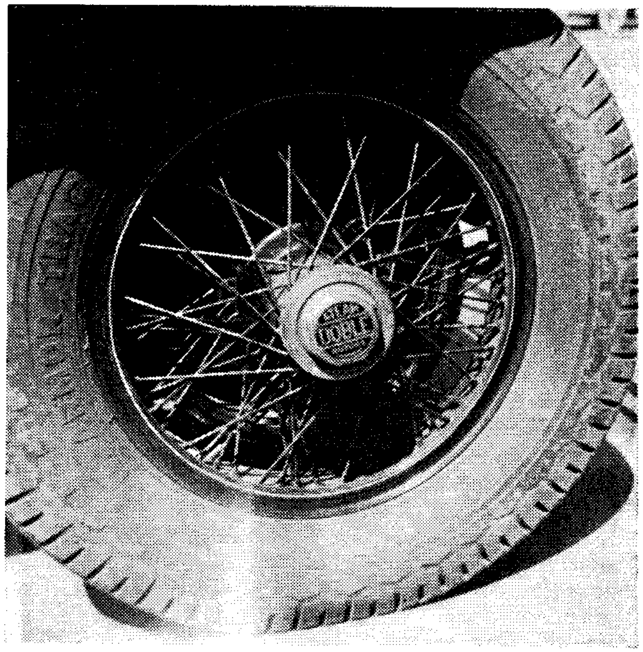
Remarkably, running at 65 m.p.h., the engine itself will only be using steam at 100 lb. pressure and 690 deg.—it will be throttled back to that extent! As can be seen in the

In this view, the boiler can be seen.





The air compressor for the burner can be here, just to the left of the boiler.



This Doble weighs 6,000 lb. and runs on 700 × 20 tyres.

photographs, the dashboard is loaded with instruments and these figures are obtained from the average of many runs.

The exhaust steam goes through an oil separator, and to two low-pressure turbines. One drives the fan, the other drives a battery-charging generator, similar to a petrol car. There is a storage battery for lights and auxiliary power.

One of the remarkable Doble features was a combined unit generator, "starter" water pump and lube oil pump. The speedometer drive was also taken from this unit. The entire unit was driven from the engine, being connected directly to the rear axle, ratio 38 to 58. There was a free-wheel device in this, allowing the "starter" to run the water and lube oil pump and get the burner going, with the car stationary.

A low pressure turbine drive to the generator is an obvious improvement and it really works.

This adds up to *using* the exhaust steam, which is otherwise wasted. The condenser (radiator) will have a "vacuum" of 8 in. water gauge, with the car running. Very little water is actually used in running and 17 gallons are carried anyway. The condenser water coming back to the boiler is about 120 deg.

The burner air is pre-heated by circulating it around the boiler casing, just as is done in full-sized boilers at the present time. The end result is smokeless combustion—and more important—smog-free combustion. Almost any fuel can be used, but normally No 2 diesel oil is the fuel, 10 miles per gallon US is obtained; and this for a car weighing over 6,000 lb.

If there is any steam in the boiler—that is, if the car has been used recently, the starting process is much faster than a petrol car, in that all you have to do is get in and step on it—it goes. No clutch, no gearshift, no starter, none of the usual things to do.

As for running, it is used almost every day in heavy traffic, it has made runs of 800 miles in each direction to meets and competitions—it is just a first-class road car. A car cannot run fast if it does not have proper wheels, tyres, brakes, steering, a rigid frame, and comfortable bodywork. The tyres are 700 × 20; 8 ply.

Operation is by three pedals, somewhat like a standard car, with the exception that the left or "clutch" pedal in this car, controls the forward, reverse and neutral position of the valve gear, with intermediate points for "notching up" or expansive working. The engine is a four cylinder double acting, with two high pressure and two low pressure cylinders. The central pedal is the brake, the right-hand pedal the accelerator.

One of the really impressive stunts they used to do with these cars was to put the front wheels against a 12 in. × 12 in. timber, and just crack the steam valve a little. Eventually the car would ride right up on the blocks. For sheer torque, its tremendous. Another stunt was to go up a hill backwards, faster than competitors could go up forwards. This must have been very humiliating!

The radiator and headlights are nickel silver—not plated but solid metal. The whole car just speaks of absolute top quality all through. It was expensive when new—it is still worth whatever they ask for it, and they are not asking . . . it just is not for sale at any price. ▣

POSTBAG—*continued from next page.*
my own case, I use a nominal 150 mfd motor start capacitor. It will be found that the motor revolves very briskly, and with considerable power. The direction of rotation can be reversed by reversing any two connections. The motor can be run on about 75 v. for short periods to obtain greater power.

It is obviously not worth while using one of these devices as a motor unless it can be obtained cheaply; but in my part of the world, they are obtainable for 10s., at which price they are excellent value.

Dorchester. M. C. MATTHEWS.

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.

The new *Model Engineer*

SIR,—May I add my somewhat belated congratulations on the new *Model Engineer* and particularly of the policy laid down in your editorial of April 1, of allowing and even encouraging constructive criticism of designs put forward by your contributors.

Those who criticise should, I think, remember that model engineers differ widely in their requirements and it is good that all types should be catered for. There is a need for both the simple practical designs of LBSC and also for the more technical approach of Mr K. N. Harris. Long may they both continue.

I am glad to see that Chuck seems to have been retired. Those who require this sort of thing would seem to be well catered for in childrens' comics and certain sections of the daily press. I trust that in his well-earned retirement Terry Aspin may find more time to devote to his experiments with small i.c. engines and to writing some articles on them for ME.

Esher. W. J. THOMPSON.

"Chuck" has not been retired—he is having a rest!—EDITOR.

Corliss engine

SIR,—I have been following with great interest the correspondence on Corliss Engines.

I feel that Mr King (April 1) must have made an inadvertent mistake in stating that Hick Hargreaves were making Corliss engines prior to 1863. In 1933, the firm's centenary year, they issued a booklet in which they stated that they introduced the Inglis and Spencer gear into this country in 1864, and I do not think that they manufactured other types of gear before this date.

I certainly never heard of anything prior to the Inglis and Spencer gear which was still being made by Hick Hargreaves when I joined the company as an apprentice in 1920. Of course, by then the tendency was for all the new engines to be fitted with what was known as the "Crab Claw" gear which was thought to be an improvement on the Inglis and Spencer gear.

Incidentally, a potted history of Hick Hargreaves & Co. appeared in an article written by the late Alfred W. Marshall and published in ME 16 April, 1936, the title of the article being "Models of a Beam Engine and Steam Turbine" in which the subject of the Corliss valve gear is introduced.

In the April 1 issue, Mr Beaumont of King's Lynn says he does not have the opportunity of speaking with another model engineer from one year to another. Well, what about it Beaumont. King's Lynn is only 34 miles from Peterborough so can we not arrange a meeting?

Peterborough. J. DENTON.

SIR,—My very mild criticism of the habit which so many people have of calling any engine which has four separate valves per cylinder and a trip gear, a Corliss engine, seems to have so upset Mr W. J. Hughes that he feels he must defend it. He and Mr Coey have thought up a most ingenious and fantastic excuse for applying it to the Lilleshall engine.

The drop valve is essentially a poppet valve, in fact, when applied to locomotives it is generally so termed, while the Corliss valve is a slide valve, having a curved face which works backwards and forwards on a curved port face, the admission valves being usually controlled by a trip gear as is also usually the case with the drop valve. The original Corliss engine of 1840 employed four flat-faced slide valves, but on the 1850 design Corliss introduced the very distinctive face valve ever since known by his name. The balanced drop valve originated, I believe, on the early single-acting Cornish beam engines where all these valves, steam, equilibrium and exhaust valves, were usually operated by a form of trip gear.

I have never been to New York or much farther east than Port Said, but from my early schooldays I have been familiar with both Corliss and drop valve engines and a lifetime devoted to engineering has not diminished my interest in them, which I think is more to the point in this case.

Making a poppet valve slightly rotate every time it lifts does not bring it in any possible way nearer to a sliding Corliss valve, however desirable such a movement may be to the poppet valve. The popular mistake is easily accounted for in the way mentioned in my first sentence and I have known it made by first-class engineers who were unfamiliar with this class of engine, but a closer examination quickly shows the inherent difference.

It is rather a shattering thought to me that Mr Hughes found it necessary to defend such a common mistake in such a way.

Shotesham All Saints. GEOFFREY K. KING.

Synchros

SIR,—With reference to Mr Jeynes' comments on synchros, it is, in fact, possible to use these as two phase motors off the single phase supply.

The first requirement is to short circuit the rotor connections. This can be done by connecting a stout wire across the rotor terminals externally, but is better done by dismantling the machine, and short-circuiting the slip rings on the armature. Care must be taken not to upset the dynamic balance while doing this. A piece of heavy wire about 18 gauge wound firmly round the slip rings and soldered to them will do the trick. The brush gear can then be removed.

This having been done, it is only necessary to connect a 50 v. supply to two terminals, and a large capacitor of not less than 25 mfd between the third terminal and either of the first two. The capacitor must be able to withstand about 200 v. d.c. and can advantageously be a starting capacitor such as is used with a capacitor-start motor. In

Continued on preceding page.

LBSC replies to his critics

SIR,—Even a criminal in the dock at the Old Bailey has a right to be heard in his or her own defence, and I now claim that right. Also, it is well known that all successful persons have enemies; prejudice and jealousy being among the world's greatest curses. I have had my share of both. Nuff sed—now let us get down to facts.

Steam cars

If those who adversely criticised my article on steam cars, will take the trouble to consult Thomas S. Derr's book on *The Modern Steam Car and its Background*, they will find confirmation of every point that I raised, also plenty of illustrations of steam car components, including the cross-drum water-tube boiler. They will also learn that the first automobile ever to climb Mt. Washington in U.S.A. was a Stanley steamer with cylinders 2½ in. × 3½ in., which makes the statement that my proposed 1914 engine with 2 in. × 3 in. cylinders would not develop one dog-power, appear not only irresponsible, but utterly ridiculous. Mr Derr is an eminent engineer with full knowledge of the subject on which he writes.

Hackfly

In the very first column of my analysis of this design, I distinctly stated that I had no intention of "guying" the designer, who apparently believed he was doing a good job, but just lacked designing experience. I honestly believed that; and it has grieved me very much indeed that not only Mr Turpin himself, but others whose letters have been published, apparently deliberately ignored my disclaimer, and accused me of personally attacking the designer. If I upset Mr Turpin's feelings, I apologise to him here and now for so doing, but I don't think he should have gone so far as to accuse me of being bigoted, and so on. I expected that he would take up the points that I raised, and give his own explanation of them. Any full-size locomotive engineer would fully endorse the faults that I pointed out; and my criticism was constructive, inasmuch as I explained how the engine might be made to work successfully, even to giving a drawing of a suitable boiler. Personal abuse is a poor reward for my endeavour to save folk from wasting their time and money, only to be disappointed with the result.

Valve gears

If Mr Holcroft, or any of the eminent C.M.E.'s who took an interest in my work, and gave me much valuable information had discovered any faults in my valve gear designs, I should have been very grateful, and immediately proceeded to rectify such faults; but in common with many readers who follow my notes and have built successful locomotives to my designs, I do not recognise K. N. Harris's claim to be an expert on valve gears. One very good reason is his intense admiration of the Greenly versions. Now Greenly stated *in the columns of the journal*, that "expansion in small locomotive cylinders is all rubbish," and arranged his valve gears to suit that idea. Engines built to his design used an abnormal quantity of steam, and suffered from excessive back pressure. I am in a position to know that, from the number of Greenly jobs that I have converted and made efficient.

My valve gears are based on full-size practice, incorporating lead, early cut-off, expansive working, and a free exhaust. I make certain modifications to suit the small size of the locomotives, such modifications being the result of actual experimenting *on the track*; not merely on paper. The significant part about the whole business of K. N. Harris and his "revisions" is just this—that it is many years since my original designs were published, scores of successful locomotives have been built from them (my correspondence tells a tale!) and it is only now, that they are alleged to be faulty. Incidentally, K. N. Harris designed a water-gauge fitting, illustrated and described in this journal, in which the glass tube was clamped *at the ends*, so that expansion of the tube was impossible; yet the old driver who first showed me how to fit a gauge glass about 70 years ago, stressed the point that the glass must be free to expand!

Finally, may I state that my one aim is—and always has been— to help readers build locomotives that will do a real job of work in a really efficient way, and build them in the easiest possible way at that. Proof that I know my job is evidenced by the 23 engines in my stud (my latest, the SR 4-6-0, has now joined the others) and my lifetime's experience is at the disposal of all to whom it may be useful. Can I offer more than that?

South Croydon. LBSC.

I must correct LBSC on one point—It is not "only now" that the designs in question are alleged to be faulty. For many years, complaints were received by ME that certain of our locomotive drawings contained errors, and in particular the book on MAISIE, *in which most unfortunately a serious error occurred in the boiler dimensions. As regards the valve gears of* MAID OF KENT *and* SPEEDY, *Mr K. N. Harris was commissioned by our previous Editor, Mr Leslie Howard, to re-design them, because of complaints received.*
—EDITOR.

Steam engine design

SIR,—In ME January 21, Mr K. N. Harris made statements concerning the thermodynamics of steam engines which I regard as misleading. My letter on the subject appeared on March 4. It was written on the assumption that there would be a reply. Mr Harris has not replied and the matter is left in a rather untidy state. I would like to rectify this and bring out a point which would have emerged if Mr Harris could have been drawn into discussion.

There is something in what Mr Harris says, but only at low pressures. He made no such qualification and clearly thinks his ideas hold good at any pressure. Mr Keiller's locomotives use a boiler pressure of 150 lb. per sq. in. Inspiration was also drawn from the pressures found in i.c. engines—i.e. anything up to 1,000 lb. per sq. in.

As Mr Harris well knows, my interest in his grasp of thermodynamics derives from his summary dismissal of the considerable amount of development work now being done on full-size piston-engined steam plant, as instanced by his letter on December 15. I had hoped to provide a strictly technical discussion on thermodynamics during the course of which it might become apparent that Mr Harris's judgements on such matters are not necessarily final.

When I saw Mr Harris's statement, I saw that I could set up a diametrically opposing case with complete accuracy, provided that I qualified it against use at low pressures. Since Mr Harris declines, it is up to me to point out the limitations of my own case, particularly with regard to model steam locomotives. The first qualification is the stipulation of a high degree of superheat, without which the losses due to the throttling process need added consideration. Second is the stipulation of a severely limited expansion ratio and the effect of this is perhaps not so obvious. With exhaust to atmosphere, conventional expansion ratios are more or less adequate for pressure below 100 lb. per sq. in. At such pressures my case should be modified and more attention paid to keeping admission pressure close to boiler pressure.

I hope I have corrected any wrong impression I might have given with my earlier letter.

Whitefield, Manchester. JOHN CROSSLEY.

Boiler tests

SIR,—I must congratulate you on the recent composition and production of *Model Engineer*. I am primarily a locomotive enthusiast, but am also interested in most aspects of engineering and I find the present mixture is excellent.

I have been extremely interested in the article by Mr J. Ewins on "Testing a Locomotive Boiler." His writing certainly shows an unusually thoughtful and thorough approach to the problem and I offer him my most sincere congratulations on his work. I hope the following comments may be useful.

It seems to me that the curves shown in Fig. 1 are inconsistent, despite the explanation given under the heading "Heat Transfer." The curves for zero horse power and 0.79 h.p. appear to agree with each other, but it is very unusual indeed for the centre curve of any group of three to lie as far from parallel with the others as does the curve for 0.39 h.p. I am sorry that the actual test readings have not been presented to the reader. (They are on page 458 of this issue.—Editor). I should like to know how many thermocouples were used by Mr Ewins and exactly where they were situated and how they were mounted, particularly in the flue tubes.

I was very surprised by the statement that the specific heats of carbon dioxide and air are 0.201 and 0.237 respectively. Specific heats of gases rise considerably with increasing temperature. For the range of temperatures recorded by Mr Ewins the following figures would be more appropriate:

Carbon dioxide: 0.239 at 400 deg. F rising to 0.297 at 1,400 deg F.

Air: 0.245 and 0.274 at the above temperatures.

Nitrogen: 0.252 and 0.280 at the same temperatures

Nevertheless, these figures do not invalidate Mr Ewins' statement that combining the results will lead to negligible error.

I was somewhat shaken by Mr Ewins' remark that more than 80 per cent of the heat transfer in the tubes takes place in the first ⅓ of their length. I expect many other readers felt the same way, but I can assure them that if the curves of Fig. 1 are correct, then Mr Ewins is not exaggerating.

One important factor which Mr Ewins has not mentioned in his discussion of boiler water capacity is the question of where to introduce the feed water. Mr Ewins asks, "What is to be gained by cutting down the barrel and tube length" and goes on to suggest that the major gain would be a reduction of water capacity where it cannot obtain its share of heat directly from a heating surface. But just *what* does one gain by this? I can see no real disadvantage in heating the water by condensing steam from the space above. After all, the efficiency of steam power stations is improved by feed heating, where the feed water is heated by the condensation of steam tapped from the turbine. I know the parallel is not exact, but it bears consideration. Furthermore, the feed water has to enter the boiler somewhere; the colder the point at which it enters the better it will be for the boiler.

The sudden injection of relatively cold water on to a hot firebox or combustion chamber wall could lead to rapid cracking of the plates, whereas injection at the front end of the boiler enables the water to warm up gradually as it flows towards the firebox, to replace the water evaporated in that region. I should hasten to point out that I am not suggesting that Mr Ewins would be so naive as to arrange his boiler feed straight on to the firebox, but someone with less experience might be tempted to experiment in a manner which could lead to disaster. The risks arising from injecting cold water into a really hot part of the boiler cannot be over-estimated.

I should also mention, for the benefit of those who have never seen inside a locomotive boiler, that external appearances can be misleading. I refer, of course, to those engines, particularly ex-LNER, in which the clackboxes are on the back of the firebox. The water is not sprayed straight on to the top of the firebox but is carried over it in pipes, which lead into long, open troughs, which terminate well towards the front tubeplate.

Redcar. W. F. GLASSPOOLE.

Oil burners

SIR,—Mr P. A. Warholm is interested, with many other people, in the use of waste oil for his domestic heating. The answer is that there is no domestic oil burner which will burn waste engine oil. The only burner that would burn it at all, so far as I am aware, was one produced for garages by Johnson Starley Ltd. of Northampton, which required connection to the garage compressed air system and was of the "throw in a flaming rag and regulate manually" type. It is just possible that some of the bigger industrial burners, such as the horizontal rotary cup type might deal with it, but since the minimum output is several times the probable maximum required by Mr Warholm and the cost of the burner probably far more than the cost of his present heating system, I think it can be ruled out.

There are other problems attached to burning waste oil such as the necessity for a system of settling tanks to extract the solid material, and the fact that the calorific value of waste oil is probably down to about half that of normal heating fuel. This means that the quantity he would require would be fairly considerable, perhaps as much as 1,500-1,600 gallons per year, and the efficiency of the boiler would be pretty low. It is in any case an uphill job to get a sensible efficiency out of a solid fuel conversion. However, if Mr Warholm decides that he would still like to burn oil, but of the conventional fuel type, provided he instals a purpose-made burner unit, he will still be able to run his system at a lower cost than that of any other fuel, including solid.

While dealing with oil burners, I will be interested to know if anyone has made an oil burner similar to full-size, i.e., air jet, steam jet or pressure jet as distinct from the normal blowlamp type.

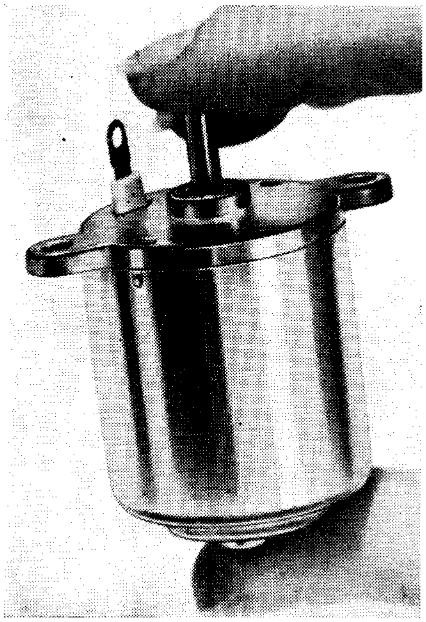
May I say that I think *Model Engineer* has improved tremendously over the last few issues. I for one am happy to see a variety of opinions expressed, for in this way one's knowledge becomes far wider.

Ware, Herts. D. H. ROBINSON.

Lathe aprons

SIR,—I always read "Jeynes' Corner" with pleasure and profit, and generally with agreement. However, I do not agree about the position of the saddle-traverse wheel on a

Continued on page 476.



Around the TRADE

New miniature electric motors

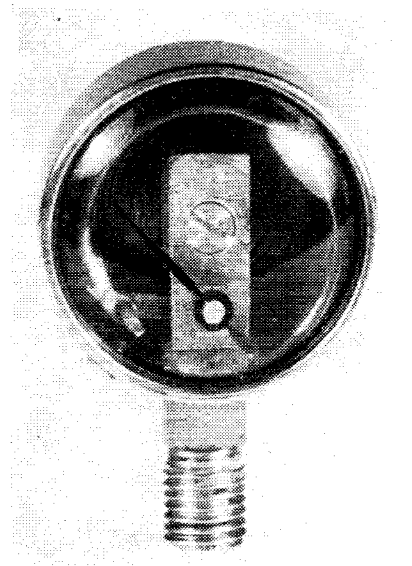
The well-known firm of Plessey are to make a new range of miniature electric motors. There will be nine basic types in this range, covering power inputs from 1 to over 100 watts, and D.C. voltages from 1¼ to 24. No-load speeds range from 1,600 to 20,000 r.p.m., stall torques from 0.5 to 100 inch-ounces, and rated torques from 0.2 to 30 inch-ounces.

With diameters from 1 in. to 3 in., the new Plessey motors should have an instant appeal to model engineers and model railwaymen. The motors are of advanced design with silver or copper graphite brushes. The shafts are of precision-ground steel working in properly lubricated sintered bronze-steel bearings, and the commutators are of silver-bearing hard copper, moulded with high-impact phenolic resin.

The new motors will be available from Plessey Components Ltd., Titchfield, Hants.

New model pressure gauges

We have recently received samples of some new steam pressure gauges now being made by F. S. Dinnis, of 3 Ward Avenue, Cowes, Isle of Wight. They are ¾ in. dia. and can be had for various pressures up to 180 lb. On test, one of these gauges proved entirely satisfactory, the recording hand returning to zero after use. It is neatly made and individually calibrated and represents good value at 40s.



Our picture shows the gauge with the dial removed.

Send news and notices to the CLUBMAN, Model Engineer, 13-35 Bridge Street, Hemel Hempstead, Herts.

CLUB NEWS

Peter Fagg's 5 in. gauge KING ARTHUR.

Southampton Open Day

Southampton & District S.M.E. held an open day on April 2, to mark the re-opening of their Riverside Park track for its fifth season. Visiting clubs were Andover, Bracknell, Brighton, Maidstone, Portsmouth, and Rugby. There was a record turnout of 23 visiting engines, in addition some of the Southampton engines were on display.

The largest locomotives running were the 5 in. gauge King Arthur belonging to Peter Fagg, Maidstone and the 5 in. gauge 2-6-2 of Mr O. Trott of Andover. Mr Jack Davies was there with his *Virginia* and *Consolidation*, recently described in ME. Mr D. W. Alford of Bracknell ran his just-completed GNR K2 2-6-0.

An unusual model seen in action was a steam crane for 3½ in. gauge track brought by Gordon Howell of Andover. This model now belongs to the Andover society.

Passenger hauling takes place on the Southampton track every Sunday until October, from 2.30 to dusk. Visitors are welcome and should note that the ground on which the track is situated (formerly Cobden Meadows) has now been named Riverside Park; access is from Manor Farm Road, Bitterne Park, Southampton.

Secretary: Mr D. Batt, 35 Aberdeen Road, St. Denys, Southampton.

News from Hitchin

The Annual General Meeting of the Hitchin & District M.E.C. was held on February 24; about 30 members were present. The Chairman and Treasurer were both re-elected, but a new secretary had to be appointed. It was decided to improve the permanent track, and to run a service at some local functions with the portable track. The club has a very active live steam section, and good workshop facilities. New members will be welcomed.

Secretary: Mr F. Henshaw, 26 Randles Hill, Stevenage, Herts.

New track at Chesterfield

During the past nine months, members of the Chesterfield M.E.S. have been constructing a new and ambitious track for $3\frac{1}{2}$ in. and 5 in. gauge locomotives. The track is being built in the grounds of the Brambling House School, thanks to the co-operation of the local authority. It will eventually extend to no less than 640 ft.

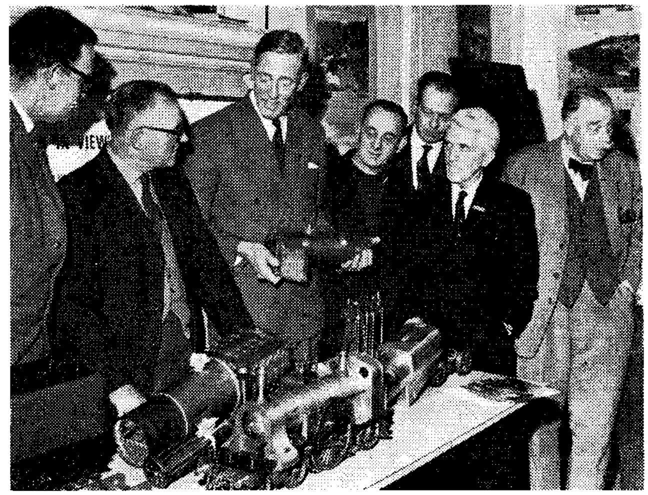
The site is well-wooded and there is a difference in level between the East and West ends of 3 ft. By excavating a cutting at one end, and building an embankment at the other, gradients have been kept down to 1 in 120. Construction consists of brick pillars with cast concrete cappings at 4 ft 6 in. centres. Flat steel bar $1\frac{1}{2}$ in. $\times$ $\frac{3}{8}$ in. is used for the rails, with spacers and tie bolts every 14 in. The rails were drilled and assembled in 18 ft lengths in the Club workshop using a standard radius of 40 ft for the curves. A set of three drilling jigs was made, in which the rails were assembled for drilling so as to achieve the correct radius. On the site the rails were clamped to the concrete cappings by holding down bolts with conveyor-belt rubber pads under the rails. This has made a quiet, smooth and robust track. A turntable is being constructed for the steaming bays, the pivot for this being a motor car back-axle assembly modified to carry the track where normally one of the wheels is bolted. The axle is embedded in concrete at the required height.

It is hoped that the track will be completed by Whitsun. Four locomotives have been completed, and a further 14 are under construction.

Secretary: Mr C. K. Lane, 125 Longedge Lane, Wingerworth, Chesterfield.

Martin Evans at Norwich

Martin Evans recently visited the Norwich Society, to give a talk on the design and construction of model locomotive boilers. Quite a large crowd of members and visitors from other clubs had an interesting two hours; Martin's talk being very well received, not to mention the interest shown in the boilers which he had brought with him. These included a boiler for his 5 in. gauge LBSCR Terrier tank locomotive, one for a 5 in. gauge "Firefly," and an entirely new design for the popular "Jubilee" tank locomotive.



CLUB DIARY

Dates must be sent at least four weeks before the event.

May 20 Rochdale SMEE. Springfield Park.
May 20 Brighton & Hove Society of Miniature Locomotive Engineers. Preserved locos (colour slides), by G. F. Collins. Elm Grove School, Elm Grove, Brighton. 8 p.m.
May 20 Greenwich & District Ship Model Society. Intermediate. Newton Room, Charlton House, Charlton, SE7. 8 p.m.
May 21 SMEE. Rummage sale.
May 21 Paddle Steamers Preservation Society. Rally of model paddle steamers. Prince of Wales Pond, Blackheath. 2 p.m.
May 21 Bournemouth & District SME. Visit to Southampton MES track, Cobden Meadows, Southampton. Track open 12 noon.
May 21 Swansea SME. Running day at Derwen Fawr.
May 21 SMEE. Rummage sale. Marshall House. 2.15 p.m.
May 21 Wigan MES. Meeting. Co-op Guild Room, Thompson Street, Whelley, Wigan. 7.15 p.m.
May 21/22 Birmingham SME. Visit by Leeds and Warrington Societies.
May 21/22 National Traction Engine Club. Farming Fair, Maidstone, Kent.
May 21/22 National Traction Engine Club. Traction Engine Rally. Wilsic Hall, Wadsworth, Doncaster.
May 22 Leeds MPBC. RC Regatta.
May 22 Liverpool MPBC. RC Speed, RC Steering and SR Regattas. Walton Hall Park Lake. 11 a.m.
May 22 Braintree MPBC. SR Regatta. Southchurch Park, Southend. 11 a.m.
May 22 Sussex Miniature Locomotive Society. Society visit to Romney Hythe and Dymchurch Light Railway.
May 22 Wigan MES. Regatta at Liverpool Walton Hall Park.
May 22 Woburn MHC. SP Regatta. Duncombes Beeches, Woburn Abbey. 11 a.m.
May 22 St Albans MES RC Steering Regatta. Lake Verulamium (small lake). 11 a.m.
May 23 Sutton Coldfield and North Birmingham MES. Open night.
May 25 Harrow & Wembley SME. Loco section meeting. Heathfield School, College Road, Harrow. 7.45 p.m.
May 28 National Traction Engine Club. Congleton (Cheshire), Carnival and Engine Parade.
May 28 National Traction Engine Club. Traction engine rally. Umberleigh, Barnstaple, Devon.
May 28 Keighley & Worth Valley Railway Preservation Society. "Steam Gala." Haworth Station. Locomotives and rolling stock on view. Museum open as usual. 2 p.m.
May 28/29/30. Birmingham SME. St Mellons annual rally.
May 28/29/30 National Traction Engine Club. Melton Mowbray Steam Fair and Engine Rally.
May 29 Wigan Model Engineering Society. Regatta at Manchester.
May 29 Harrow & Wembley SME. Track meeting. BRSA (LMR) Sports Ground, Headstone Lane, Harrow. 2.30 p.m.
May 29 Hull SME. Meeting at track in Goddard Avenue.
May 29 Norwich & District SME. 3 p.m.-5.30 p.m.
May 29 Wolverhampton MES. Members track day.
May 29/30 National Traction Engine Club. Traction engine rally. Revesby (Carrington Park), Boston, Lincs.
May 29/30. National Traction Engine Club Traction engine rally. Great Wymondley, Hitchin, Herts.
May 29/30 National Traction Engine Club. Traction engine rally. Beaulieu, Southampton.
May 29/30 National Traction Engine Club. Traction engine rally. Stanford Park, Rugby.
May 30 National Traction Engine Club. Newbury (Berks) Canal Fair and Engine Parade.
May 30 National Traction Engine Club. Traction Engine Rally. Madley, near Hereford.
May 30 National Traction Engine Club. Traction engine rally. Woodton, Bungay, Suffolk.
May 30 National Traction Engine Club. Traction engine rally. Elham, Canterbury, Kent.
May 30 Leicester Society of ME. Ordinary meeting. The Museum, New Walk, Leicester. 7.30 p.m.
May 30 Bourneville. Valley Pool, Pilot Event. RC Regatta.
May 30 The City of Leeds SMEE. Public running day (Whitsuntide holidays). Track superintendents: D. Thompson and G. Faulkes.
May 30 Malden & District SME. Track day (Whit Monday).
May 30 Wolverhampton MES. Kinver Carnival. WMES public running.
May 30 Brighton & Hove Society of Miniature Locomotive Engineers. Hove Park track day. Hove Park.
May 31 Chelmsford SME. Monthly meeting. Rev. Phillip Wright talks on traction engines.
June 1 Bristol SMEE. Modern Work Holding Techniques, by Mr C. Brownsell. Unitarian Hall, Lewins Mead, Bristol. 7.30.
June 2 Hull SME. Ships, by Mr K. Nicklas.
June 3 Rochdale SMEE. Lea Hall, Smith Street, Rochdale. 7.30 p.m.
June 3 Greenwich & District Ship Model Society. Intermediate. Newton Room, Charlton House, Charlton SE7. 8 p.m.
June 3 Brighton & Hove Society of Miniature Locomotive Engineers. Annual general meeting. Elm Grove School, Elm Grove, Brighton. 8 p.m.
June 4 Birmingham SME. Princess Alice Orphanage.
June 4 SMEE. Visit to Haywards Heath, Beechurst Track.
June 4 The City of Leeds SMEE. West Riding Small Locomotive Society's Rally.
June 4 Perth SMEE. Exhibition of models. Lesser City Hall, Perth. 10 a.m.-8 p.m.
June 4 Traction Engine Meet at Tinkers Park, Hadlow Down, near Uckfield, Sussex. (On B2012), gates open 2 p.m. In aid of Cancer Research.
June 4 Chelmsford SME. Portable track at Trueloves School Fete, Ingatestone.
June 4 Sussex Miniature Locomotive Society. Visit by SMEE.
June 4 National Traction Engine Club. Traction engine rally. Chandler's Ford, Eastleigh, Hants.
June 4/5 National Traction Engine Club. Crewe Engine and Car Rally.
June 5 Chester-Le-Street MES. Club invitation day. Riverside Park, Chester-Le-Street (off the A1). 10 a.m.
June 5 Guildford MES. Members track day. Stoke Park, Guildford.
June 5 Harrow & Wembley Society of Model Engineers. Pondside meeting. Rushgrove Park, Rushgrove Avenue, NW8. 10 a.m.
June 5 Rugby Society Model & Experimental Craftsmen. Open track day. 10.30 a.m.
June 5 Chelmsford SME. Public running at permanent track, Waterhouse Lane.
June 5 The City of Leeds SMEE. Blackgates, Tingely Cross Roads, near Leeds.
June 5 Malden & District Society of Model Engineers Ltd. Track day.
June 5 Victoria MSC. SP, SR Regattas. Victoria Park. 11 a.m.
June 5 MPBA. RC, SP, SR Regattas. Witton Lakes Birmingham.
June 6 Sutton Coldfield and North Birmingham MES. Workshop questions.
June 7 The City of Leeds SMEE. Talk by Mr T. O. Hunt on "Marine Engines." Salem Chapel. 7.30 p.m.
June 8 Harrow & Wembley Society of Model Engineers. Photo section outing.
June 10 Greenwich & Dist Ship Model Society. Tug *Turmoil*, by Mr Baines. Newton Room, Charlton House, Charlton, SE7. 8 p.m.

READERS' QUERIES

DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE

★ Queries must be within the scope of this journal and only one subject should be included in each letter.
★ Valuation of models or advice on selling cannot be undertaken.
★ Readers must send a stamped addressed envelope with each query and enclose a current query coupon from the last page of this issue.
★ Replies published are extracts from fuller answers sent through the post.
★ Mark envelopes "Query," Model Engineer, 13-35, Bridge St., Hemel Hempstead, Herts.

7¼ in. gauge Invicta

I am contemplating the construction of a 7¼ in. gauge locomotive, and would like to have your advice.

The locomotive is to be a 1½ in scale version of LBSC's *Invicta*. I have access to a suitable track and I think this engine would be reasonably portable and straightforward to make.

I am considering "doubling-up" on *all* dimensions, but realize the boiler would not stand this treatment and would like information as follows:

1. Number and diameter (and gauge) of flues.
2. Could the original superheater be retained with twice-diameter pipes and single flue, or a 7¼ in. gauge type with multi-elements and headers ?
3. Could the cylinder bores be increased to 1½ in. dia. (3½ in. gauge size 11/16 in.) as all the weight is available for adhesion ?
4. Is there an existing LBSC locomotive whose cylinder castings could be used ? (Casting length machined 3¼ in.).
5. Are there any other snags which could be expected. (The engine would be built primarily for novelty and not for hard work.)

I am also considering the building of a 1½ in. scale LNWR "Special Goods Tank" No 777 with 2-2-4-0 wheel arrangement. The drawings would be *Jeanie Deans* doubled-up. The middle cylinder would then have a bore of 3¾ in. (H.P. cyls. 1¾ in. dia.).

1. Is this feasible ?
2. Is there any means of obtaining a drawing, sketch or photograph from which measurements could be taken ?—G.F.P. (Ken).

▲ *It is difficult to advise on the number and diameter of the boiler tubes without seeing a rough sketch showing the shape of the firebox tubeplate and also the length between tubeplates. At a guess, we should think that ½ in. outside diameter tubes of 20 swg. thickness at ⅝ in. pitch would be suitable. Two superheater flues of about 1 in. diameter would be about right.*

Cylinders 1½ in. dia. are suggested; we do not know whether any suitable castings are available from the trade, but think that Kennions would have something you could use.

Regarding an LNWR Special Goods Tank locomotive, the cylinder arrangement could be roughly similar to "Jeanie Deans" doubled. The low pressure cylinder could be about 3¼ in. diameter. We see no reason why such a model should not be successful, and if you write to Mr. Wilson of the Public Relations and Publicity Department, British Railways London Midland Region, Euston House, London, N.W.1, you may be able to get sufficient of the full size drawings to enable you to make your 1½ in. scale drawings.

Armature winding

Could you please help me with this query?

I have an electric drill which I want to rewind to run off 230 v. a.c. 50 cycles.

It is a 2 pole motor, armature 2 in. dia. slots 2 in. long.

It has a 14 slot 28 segment commutator.

Could you please tell me the size of wire to use and the number of turns on the poles.—W.D., Ireland.

▲ *We suggest that you wind the field coils of your drill as follows: Each coil to have 400 turns of 31 s.w.g. "Lewmex," the two coils being wrapped with cotton tape and connected in series with each other so as to create poles of opposite polarity, and in series with the armature. The armature should have 14 coils each with 150 turns a centre loop being brought out at 75 turns for connection to the commutator and the gauge of wire should be .0076 (36 s.w.g.).*

Use a slot span of 1-7, and there will be four coil sides per slot, i.e., 300 conductors. With the armature placed so that slots 1 and 7 centres are equidistant from the centre of one pole face, number the commutator segment which lies nearest the centre of the pole number 2. All numbering is clockwise at the commutator end. For reversible operation connect the start of the coil in slots 1-7 to segment 1, the loop to segment 2, and the finish of the coil to segment 3. Connect the start of the coil in slots 2 and 8 to segments 3, the loop to segment 4, and the finish to segment 5, and so on.

The reason for the loop in the winding is that there should be as many coils on the armature as there are commutator bars. Thoroughly check and clean out the commutator bars for shorts between bars before winding. We would use a mains test lamp using two 100 watt lamps in parallel on a bar to bar test.

Scraping vee slides

I have just completed machining a set of castings for a hand shaping machine designed by Duplex and described in back numbers of *Model Engineer* which I do not possess.

Messrs Cowell of Watford, who supplied the castings, advise scraping the slides with the aid of a surface plate or a piece of plate glass and marking blue.

Does this also apply to the vee section of the slides which would appear to be very difficult to rub on a surface plate to find the "high spots." A little advice on the last item would be welcomed.—E.L.D., Romford.

▲ *In scraping the angular surfaces of dovetail or V slides, it is necessary to use accurate test strips of the appropriate angle section for checking the truth of the work. The strips may be machined from steel or cast-iron bars, and for toolroom work, they are usually finished by grinding, but careful scraping or lapping is satisfactory. In use, they are thinly coated with marking colour in the usual way.*

For scraping undercut angles, it is advisable to make a special flat scraper, with a very thin edge and bevelled sides like a paring chisel, in order to reach all parts of the surface without fouling the corners.

POSTBAG—*continued from page 473.*

lathe apron. This is, of course, an excellent example of one man's meat being another man's poison. The two lathes which I use most regularly, a 5 in. Adams-Pittler and a 90 mm. Boley (both screwcutting), both have their saddle traverse wheels to the right and I would on no account swop for the left-hand arrangement, chiefly because with this, your hand is nicely in line with the hot chips and cuttings coming away from the stock, which can make things distinctly uncomfortable. Like so many things in lathe design, it is largely a matter of personal preference. In a large lathe there is, no doubt, much to be said for the left-hand position, but with my lathes I use the hand traverse very largely for longitudinal feed, a thing unlikely in bigger machines, where it would only be used normally for preliminary location of the saddle before putting in the power traverse and applying the cut. For some years I frequently used a couple of American lathes, one a South Bend and the other of unknown make, both with left-hand positioned wheels, and I usually wore a thick glove on my left hand to protect it. So much depends on circumstances.

Rustington, W. Sussex. • K. N. HARRIS.

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WORKSHOP EQUIPMENT

Buck & Ryan for Lathes and Workshop Accessories, drilling machines, grinders, electric tools, surface plates, etc.—101, Tottenham Court Road, London, W.1. T/C

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Wanted. Myford Super 7 or ML7. Also Fobco drill.—H. BARR, "Chestnuts," Histons Hill, Codsall, Wolverhampton. LMN

Wanted. Myford Super Seven or ML7 lathe. Please state price required. Will collect up to 80 miles.—C. SCREEN, 1424, Leek Road, Abbey Hulton, S-O-T, Staffs. NO

Myford ML7 on stand complete with tools and many extras, £70.—24, Dryden Crescent, Stevenage. N

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Wanted. Amateur lathe owner requires practical instruction on working with lathe, preferably at weekends, from an interested expert. For particulars—Telephone: HOUnslow 3333 evenings only. NOP

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For Sale. Wallis & Steevens 5-ton steam tractor. View by appointment. For further details contact.—G. Lugg, Gore Farm, East Street, Billingshurst, Susses. Telephone: 2117. N

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Myford ML7, motorised, with 6" Burnerd "M" and 0-½" Jacobs chucks, D.T.1, swivelling vertical slide, machine vice, very little used. Offers to—Loy, 5, Mines Rescue Station, Winscales, Workington, Cumb. N

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For Sale. "Juliet" No. 2, frames cut out, cylinder, wheel castings, untouched, other items, etc., £6 10s. post paid.—Sherwen, 101, Main Street, Frizington, Cumbd. N

For Sale. 3½" "Maisie" chassis, 75 per cent. completed, £30 o.n.o. 2½" "Olympiade" chassis, wheels, cylinders, axle, pump, £10 o.n.o.—8A, Green End, Braughing, near Ware, Herts. NOP

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2" Scale, 5" gauge, narrow gauge 0-4-0 chassis, 1⅝" × 2¼" outside cylinders for Walschaerts V.G. (not fitted). Cylinders, rods, etc., machined, all heavy work finished, castings, materials, drawings to complete. First-class workmanship and detail, £60 near offer.—Bilton, Tibenham, Norfolk. NOR 82W. NO

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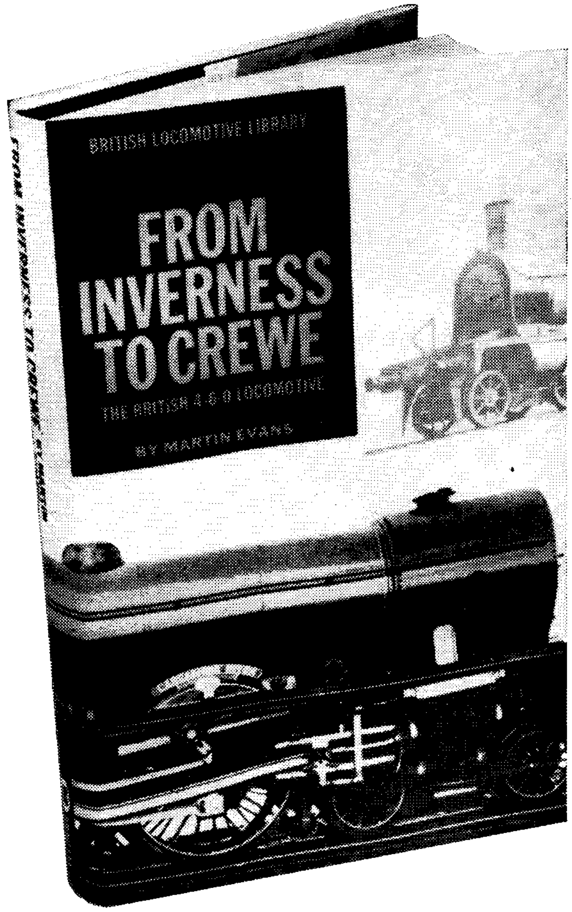

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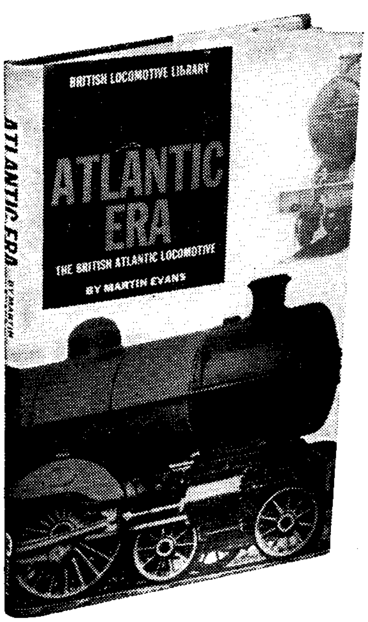

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