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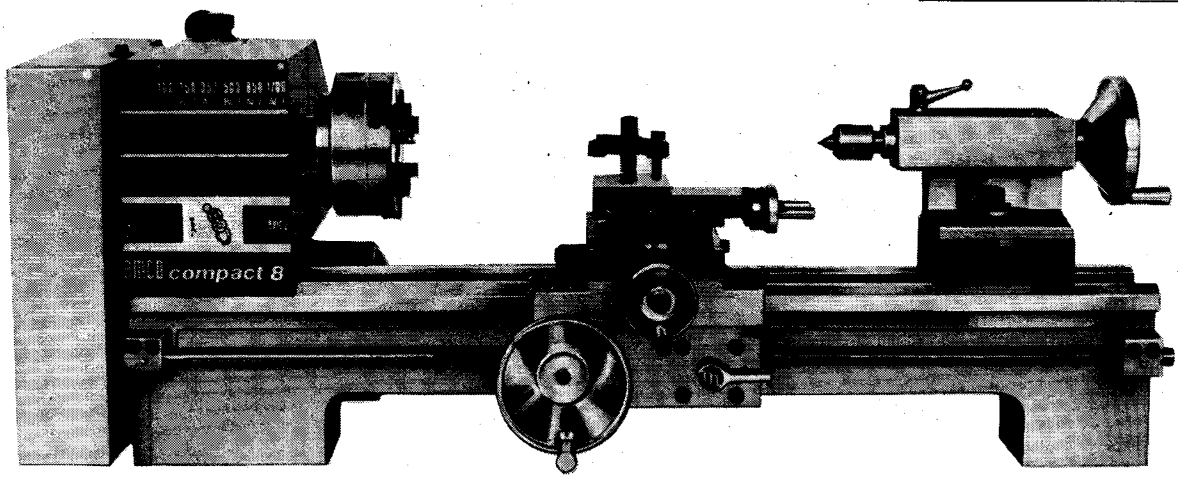

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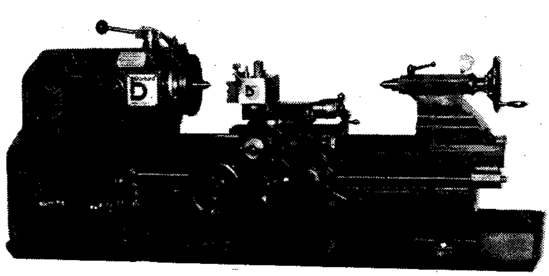

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7 October 1977

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COVER PICTURE

"Nellie" — an old steam engine now on display at the Industrial Museum, Moorside Mills, Bradford.
Photo by Clifford Robinson.

NEXT ISSUE

Rex Tingey describes a Vertical Unimat.

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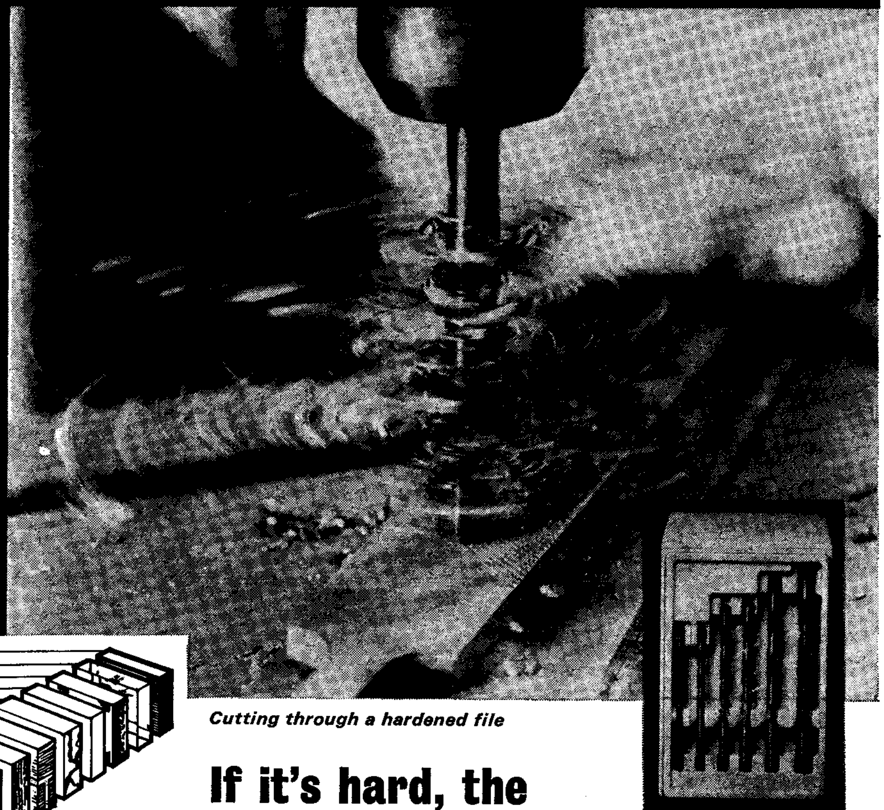
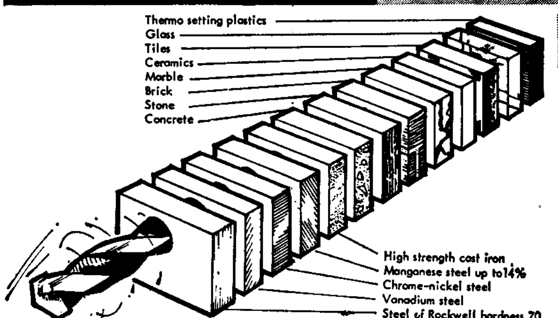


Cutting through a hardened file



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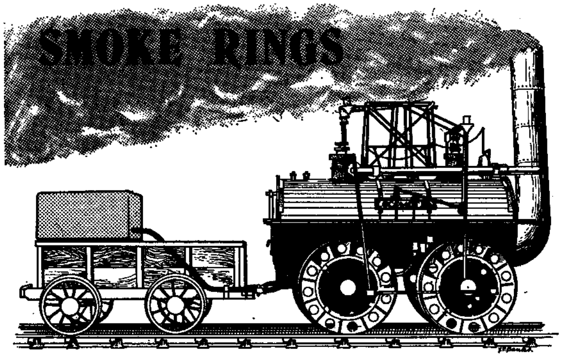


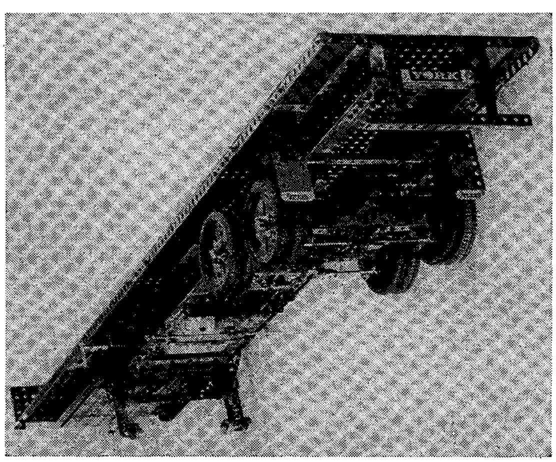
A Commentary by the Editor

Toys and Hobbies Exhibition

Make a note in the diary for 20 to 25 March 1978 when the Toys and Hobbies Exhibition will be held in the Granby Halls, Leicester. In case you haven't yet looked that far ahead, these dates correspond with Easter and the Exhibition will also open on Good Friday and Easter Saturday, the last two days of the show. Times of opening are from 2 p.m. until 10 p.m. Operational railway layouts are included in the many forms of leisure activities on display and personalities from the sporting entertainment professions will be around to sign autographs.

Building a trailer in Meccano

Alf Dean, a retired haulier from Gosforth, has just completed a one tenth scale model of a York SL Teamster platform trailer using Meccano parts. The model, which incorporates fully operational landing gear and Hobo lifting axle suspension, contains 3000 nuts and bolts, 1500 other components, and took over 500 hours to build. To finish it off, Mr. Dean intends to construct a tractor unit with engine, gear box, and differential all working. Hopefully, Model Engineer will also be able to publish details of that.



Cyanoacrylates Again

A somewhat misleading item of information regarding cyanoacrylate adhesives appeared in M.A.P.'s quarterly trade newspaper, *Model Hobby Trader*, summer edition. The article more or less stated the same facts that appeared in *M.E.* "Smoke Rings" on 19 August but added that the antidote and solvent for these adhesives is Nitro Methane, known to model makers as an additive for fuel. Unfortunately, anyone reading the article may be misled into thinking that cyanoacrylate adhesive in the eye should be neutralised by the use of this liquid, which is certainly NOT the case as anyone who may have accidentally splashed Nitro Methane into the eye will know. In fact the eye has its own protection and apart from washing well with warm water, no other treatment should be necessary. However, prevention is always the best cure and *M.E.* cannot emphasise enough the care which should be exercised when using this adhesive.

Exhibition of Rail Art

Anyone in the vicinity of Messrs. Locke & England Fine Art Galleries on the Parade, Leamington Spa, between 4 and 19 November, should pay a visit to Railart '77, the first National Exhibition of Railway Art. The event is organised by The Midland Area Group of the Wight Locomotive Society in commemoration of the Silver Jubilee of H.M. Queen Elizabeth II and the proceeds will go to the World Wildlife Fund. Among the artists whose work will be appearing are David Shepherd, Terence Cuneo, David Weston, George F. Heiron and C. Hamilton Ellis.

Railway Calendar

Leighton Buzzard Narrow Gauge Railway Society Ltd. has, for the first time, brought out a calendar depicting, as one would expect, scenes from the railway, both of steam and diesel traction. Copies of the 1978 calendar are now available, price 30p (40p with post and packing).

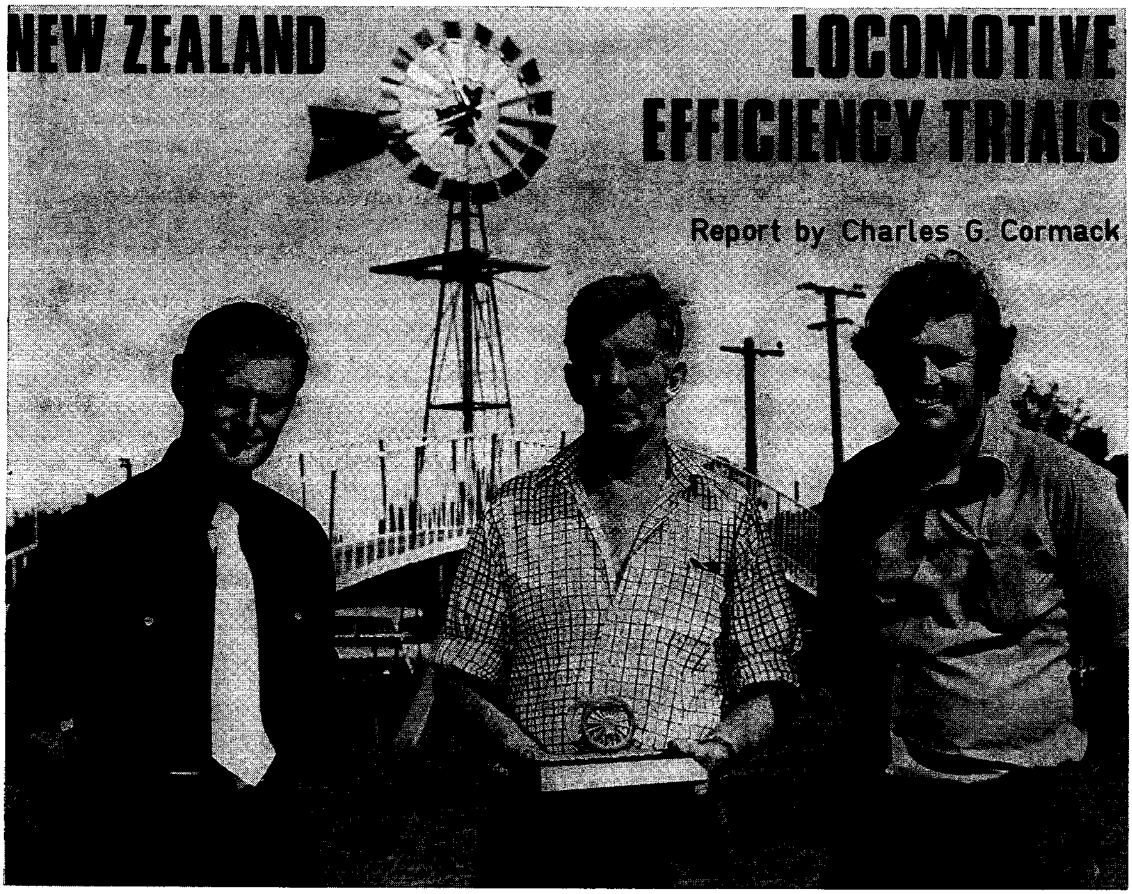
Marshall Portable Engine

In "Smoke Rings", 19 August issue, it was erroneously implied that the article and drawings for the above engine, commenced by the late Bill Hughes in July 1976, were to be completed by Mr. R. Kibbey who has completed a model of the engine from sketches and photographs of the full-size engine.

Mr. Kibbey, in fact, is supplying his own sketches to Messrs. Arnold Throp, Ivan Law and Peter Southworth who will produce working drawings for availability from Historic Steam of Beighton, Sheffield. The serial will be continued by Mr. Arnold Throp and the first instalment will be published in the very near future. *Model Engineer* apologises for any misunderstanding the previous article may have caused.

NEW ZEALAND LOCOMOTIVE EFFICIENCY TRIALS

Report by Charles G. Cormack



Trials winner Jim Shipman with Van Cormack the runner-up and Bob Bell (left) who took 4th place and won the Concours d'Elegance.

THE 1977 New Zealand Locomotive Efficiency Trials were run by the Canterbury Society of Model & Experimental Engineers at Christchurch on 12 and 13 March. The weather treated us well on both days and entrants came from as far afield as Nelson in the North and Dunedin in the South.

New Zealand hasn't got the population to bring a new crop of entrants each year, but we did have a few, and for the regular entrants it was a happy reunion. The Trials have the good effect of keeping the various clubs in touch with one another. Catering is an important part of these functions, and this was taken care of by Mr. and Mrs. Colin Brittenden with a willing band of helpers. A social function was held on the Saturday evening and prizegiving took place following the Sunday lunch.

Previous trials have included a number of novelty events. This year it was decided to lengthen the efficiency run from 15 to 20 minutes and eliminate the novelty events except for the three-minute slow run and the Concours d'Elegance. Trials organising was in the capable hands of Allan Orwin and a small committee and the Concours judging was done by Allan Johnson from Dunedin and Les Holdaway from Blenheim; this was a difficult job well done.

Section One—Efficiency Test

We haven't got around to building a dynamometer car in New Zealand yet and the rules for the Efficiency run were as in previous years using the formula taken from *Model Engineer* of 17 February 1959—

$$\frac{\textit{Total Weight Hauled (lb.)} \times \textit{No. Laps} \times 10}{\textit{Weight of Fuel Used (oz.)}}$$

Steam was to be raised to 30 p.s.i. using charcoal, after which the engines' own blower must be used, using fuel from the allotted supply. This is "Raycarbo", a semi-carbonised coal with a calorific value of 12,800 B.T.U. per lb. The contestant was to run for 20 minutes with a load of his own choice, after which the fuel is weighed and distance counted to the nearest 1/10 lap. The contestant may run for two laps without his full load, without losing points. Note—this rule has prevailed since the first trials in 1971. Some contestants run light for the first two laps while others prefer to load up at the start and get on with the job without losing time by stopping to load up.

Section Two—3 Minute Slow Run

Maximum points 100. The shortest distance run in three minutes wins, using throttle only, no brakes allowed. If the engine stops the competitor is out.

Section Three—Concours d'Elegance

Contestants are judged both before and after their run and points are allocated for appearance and tidiness of both locomotive and driver. The Christchurch track is 472 ft. per lap with rails for 5 in., 3½ in. and 2½ in. gauge rolling stock. There are three 90° bends and one "S" bend, all 35 ft. radius. There is a rise of a few inches through the "S" bend and a fall through the station.

Run No. 1. First man away was Bill Downing from the Otago club, Dunedin, with his 3½ in. gauge 4-8-4 *Uranus,* originally built by Bill Jackson of Christchurch. Bill didn't get very far before coming to a stop with low steam pressure. He said his grate was choked. The "Raycarbo" fuel we use comes from the North Island, it is an excellent fuel for small locos but contains a lot of fines and we have been using a finer screen lately, so we tipped all the carefully weighed coal back in the bin and got out our old screen to get the next contestant steamed up and promised Bill a re-run later.

Run No. 2. A newcomer to the Christchurch track was Dave Ward from Dunedin with his 2½ in. gauge American type Freelance Pacific. Dave started away with three adults making a total of 616 lb. He ran 24 laps in a fast, no trouble run using 18.55 oz. of fuel, which was to finish in 12th place. In the three-minute slow run he came third with a distance of 72 ft. 3 in.

A small group of spectators followed each loco as they made their slow runs. A smooth, sensitive regulator and reasonably good valve timing is essential in this event. Surprisingly, the smaller locos seemed to be more docile than the big ones.

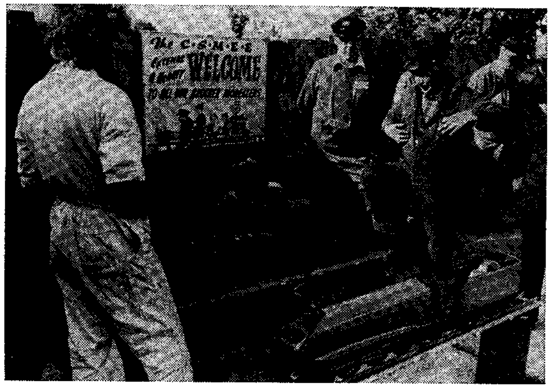
Run No. 3. Peter Holdaway from Blenheim with his 2½ in. gauge 4-6-2 N.Z.R. AB is no stranger to the Christchurch track and with a total of 670 lb. ran 24.4 laps and on 21.8 oz. of fuel to make 13th place. He had one stop with a derailed trailer, otherwise it was a good run. He won first place in the three-minute slow run with a distance of 64 ft. 0½ in. Driver and engine were well turned out and came third in the Concours.

Bill Downing and son, Colin, with "Uranus".

Run No. 4. Tom Mountford was the first trials competitor from the Timaru club and it was his first go at competition driving. His 2½ in. gauge *Fayette* is older than the writer's and has done a lot of running. Tom had a lot of slipping trouble and shed one passenger, then with a load of two adults totalling 417 lb. he completed 16.4 laps using 16.4 oz. of fuel to finish in 15th place. On the slow run he travelled 111 ft. 11⅜ in. to make seventh place.

Run No. 5. John McGhee from the Otago club with his 3½ in. *Juliet* made this run with three adults totalling 644 lb., a comfortable load for the *Juliet.* Apart from one derailment of the trailer it was a no-trouble run, in fact second fastest run of the day totalling 25.6 laps using 14.89 oz. of fuel and finishing in ninth place. On the slow run John travelled 89 ft. 11 in. to take fifth place.

Run No. 6. Bill McGhee, father of John, was driving his 5 in. G. & S.W. 0-6-0 tank. This is a beautiful piece of craftsmanship and was winner of the 1976 trials. Bill started away with 12 adults on four trailers but had severe slipping trouble. He cut the load down to nine adults on three trailers totalling 1858 lb. and ran 13.1 laps. Having watched this loco on its winning run at Dunedin it was disappointing to see it finish in eighth place. He finished ninth in the slow run with a distance of 283 ft. 1½ in.



Bill and John McGhee inspect D. Renshaw's "Grange".

Run No. 7. Stewart Andrew made this run driving Jim Shipman's 5 in. gauge 0-6-0 *Simplex* and was the first home club member to run. This is another beautifully finished loco and ran second at Dunedin last year. The load was 13 adults totalling 2,680 lb. This was a good run with speed increasing as the run progressed. *Simplex* burned 31.01 oz. of fuel for 17.3 laps to finish fifth. *Simplex* stopped on the slow run.

Run No. 8. Gerry Marshall was a member of the Blenheim club when he first ran his 5 in. gauge 1½ in. scale 4-6-4 N.Z.R. WW tank loco at the Christchurch trials in 1974 and won first place. He is now living in Christchurch and when he gets his new home fixed up the WW will get some needed attention. However, after a good start with 12 adults and 2495 lb. total the WW ran 21.9 laps on 42.47 oz. of fuel to finish seventh. The WW stopped on the slow run.

Run No. 9. Lindsay Downing is a member of the Otago club and his well-finished 5 in. gauge 0-6-0 *Simplex* is a regular entrant at trials. With well-controlled slip he made a good steady run with a load of 13 adults totalling 2599 lb.; he ran 18.3 laps on 24.9 oz. of fuel. When his score went on the board with 4150 points better than the previous best it made a few eyes pop and one wondered if the longer running time this year was favouring the bigger locos; however, more was to come and Lindsay finished in third place. *Simplex* stopped in the slow run.

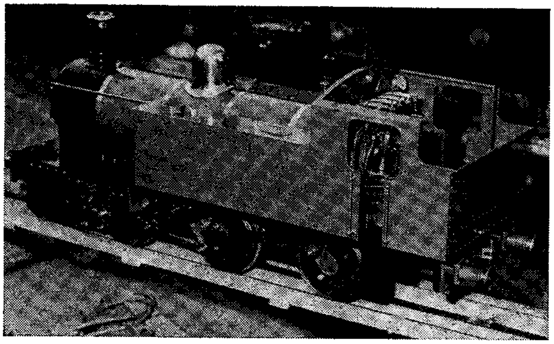
Run No. 10. Stan Vernon with his 3½ in. gauge *P. V. Baker,* now over a quarter of a century old, took a comfortable load of four adults totalling 811 lb. He ran a steady 18.9 laps on 16.93 oz. of fuel to finish in 11th place. His slow run tally was 167 ft. 3 in. which gave him sixth place.

Run No. 11. Bill Downing made his re-run with his 3½ in. gauge 4-8-4 *Uranus.* With five adults *Uranus* did 14.1 laps with the 795 lb. with a fair amount of slipping. It could be that those eight small wheels are carrying some weight which should be on the drivers as the 3½ in. gauge locos that ran before and after carried heavier loads and ran more laps. *Uranus* burned 24.27 oz. of fuel and finished 14th. In the slow run *Uranus* travelled 246 ft. 5 in., finishing tenth.

Run No. 12. Bob Bell from the Otago club is well known around South Island tracks. His 3½ in. gauge *Mallard,* originally built by the late Bill Cleine of Timaru, has previously had derailing troubles on the Christchurch track. However, Bob has got that problem sorted out and made the best 3½ in. gauge run of the day. With six adults totalling 1166 lb. he did 21.2 laps non-stop on 15.8 oz. of fuel to take fourth place. In the slow run he was sixth with 111 ft. 0 in. Driver and loco were immaculately turned out and were placed first in the Concours.

Run No. 13. Perhaps No. 13 is an unlucky number for it just wasn't Derek Renshaw's day. He is a member of the Nelson club and travelled 540 miles to compete in the trials. I saw his 3½ in. gauge Great Western *Grange* running on the Blenheim track and was very impressed by its sleek performance and regarded it as a dark horse for the trials. Derek started off with six adults on two trailers but just couldn't get any pace. The load was reduced to four adults totalling 738 lb. but he still had severe slipping and gave up after 6.3 laps. There was a very rigid coupling link between trailer and tender; it was pulling on an angle and may have had something to do with the problem. The track was good at this stage and the 3½ in. gauge runs before and after were fast. The *Grange* had used 10.97 oz. of fuel and this put him in 16th place. In the slow run he stopped so we

Bill McGhee, last year's winner, tops up his G. & S.W.R. Tank with water.



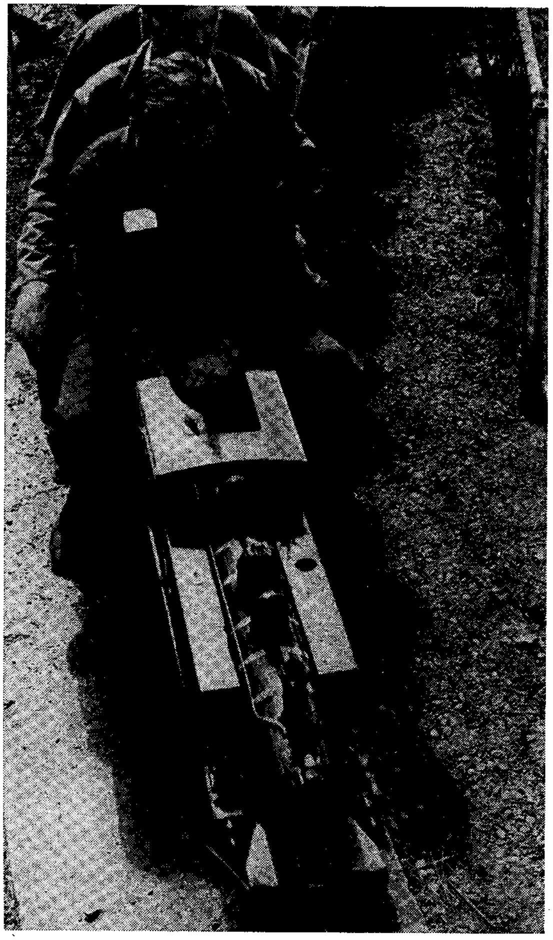
can only say—better luck next time, Derek; the *Grange* was fourth in the Concours.

Run No. 14. Murray Brown from Blenheim made the first run on the Sunday morning with his 3½ in. gauge *Juliet.* Starting slowly, his speed increased and with a load of three adults totalling 689 lb. he ran 20.1 laps non-stop using 12.7 oz. of fuel to finish in tenth place. This was a very good effort considering he was driving with a very painful and heavily bandaged hand. He then went on to take second place in the slow run with a distance of 72 ft. 1 in.

Run No. 15. This run was awaited with great interest as Jim Shipman's 5 in. gauge *Simplex* is now well run in and Jim had had time to learn just how to handle it; and with all the weight concentrated on the drivers a *Simplex* is hard to beat in any case. With 12 adults on four trailers totalling 2380 lb. Jim got the load under way smartly and worked up a pace. Passengers on this trip were made to lean in on the curves. A trailer derailment spoilt an otherwise perfect run but *Simplex* got under way again and the score went on the board with an unbeatable lead of 6521 points over Lindsay Downing's sister *Simplex.* 23.3 laps were run on 21.55 oz. of fuel to gain a well deserved first place in the 1977 Trials. *Simplex* was ninth in the slow run with 200 ft. 0½ in.

Run No. 16. The writer's 12-year-old 2½ in. gauge *Fayette* with son, Ian, driving was next on the track. With 1,430 miles on the counter a complete overhaul is called for but will have to wait until her new stablemate in the shape of a 3½ in. gauge *Britannia* comes alive. A few urgent jobs were attended to meantime. Ian wanted to take a 700 lb. load, so, as passengers, Stewart Andrew and I each nursed a 20 lb. concrete building block. With a total of 691 lb. *Fayette* went on to run fastest laps of the day with the lever one notch off middle using 8.32 oz. of fuel for 26 laps to finish second between the two *Simplexes*. *Fayette* was fourth in the slow run with 82 ft. 1 in. and second in the Concours.

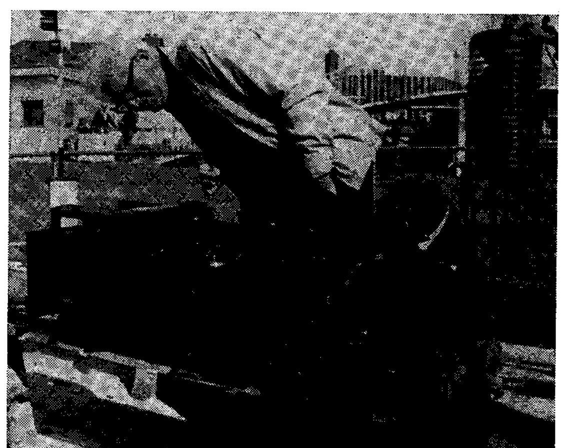
Continued on page 1099



Top left: Jim Shipman's winning "Simplex".

Above: Gerry Marshall with his 4-6-4 N.Z.R. WW.

Below: U.K. visitor, Monty Wells, studies the 1974 winner, Gerry Marshall's N.Z.R. WW.



A COMPRESSION IGNITION ENGINE

In the late 1940s, small "diesel-type" engines made an appearance, competing with the petrol engines which were already popular. This article describes a 1.25cc engine designed and built by Mr. C. C. Whitehead. No castings are necessary.

THE LITTLE ENGINE described herein is interesting for two reasons. Firstly, it was made before any information on the design of such engines was available in this country, so that there was a certain amount of experimentation by the writer before the final design was arrived at. Secondly, this particular design seems to be very efficient, in comparison with some later commercial designs, in regard to the matter of fuel consumption. There are also some controversial points in the design, though the actual model itself operates very well indeed, and is easy to start.

The engine is $\frac{3}{8}$ in. bore by $\frac{5}{8}$ in. stroke, with variable compression, and drives an airscrew of $9\frac{1}{2}$ in. dia. by 5 in. pitch at between 3000 and 6000 r.p.m.: weight, complete, 5 oz.

There is no difficult soldering or brazing work to be done in the fabrication and assembly, though the whole of the components were machined and/or filed out of the solid, as no castings were available. The latter procedure is not quite so arduous as it sounds, since with these small engines the amount of metal to be removed is not great, and the most difficult part to shape is the crankcase, which is made of soft material.

Having no previous information or experience available as a guide, the writer assumed that a design which was virtually a scaled down version of a normal two-stroke engine would be satisfactory.

Since the compression ratio must be high, it meant a deflectorless piston, so the prototype was the "Villiers" four-port engine, but with the port shapes modified. There are thus two transfer and two exhaust ports.

The first part to be tackled was the crank-case, made out of a piece of 2 in. dia. aluminium rod, 2 in. long. (A casting would be used now.) A diameter was scribed after the rod had been faced, and a centre-punch mark made $\frac{1}{4}$ in. off the centre of the diameter.

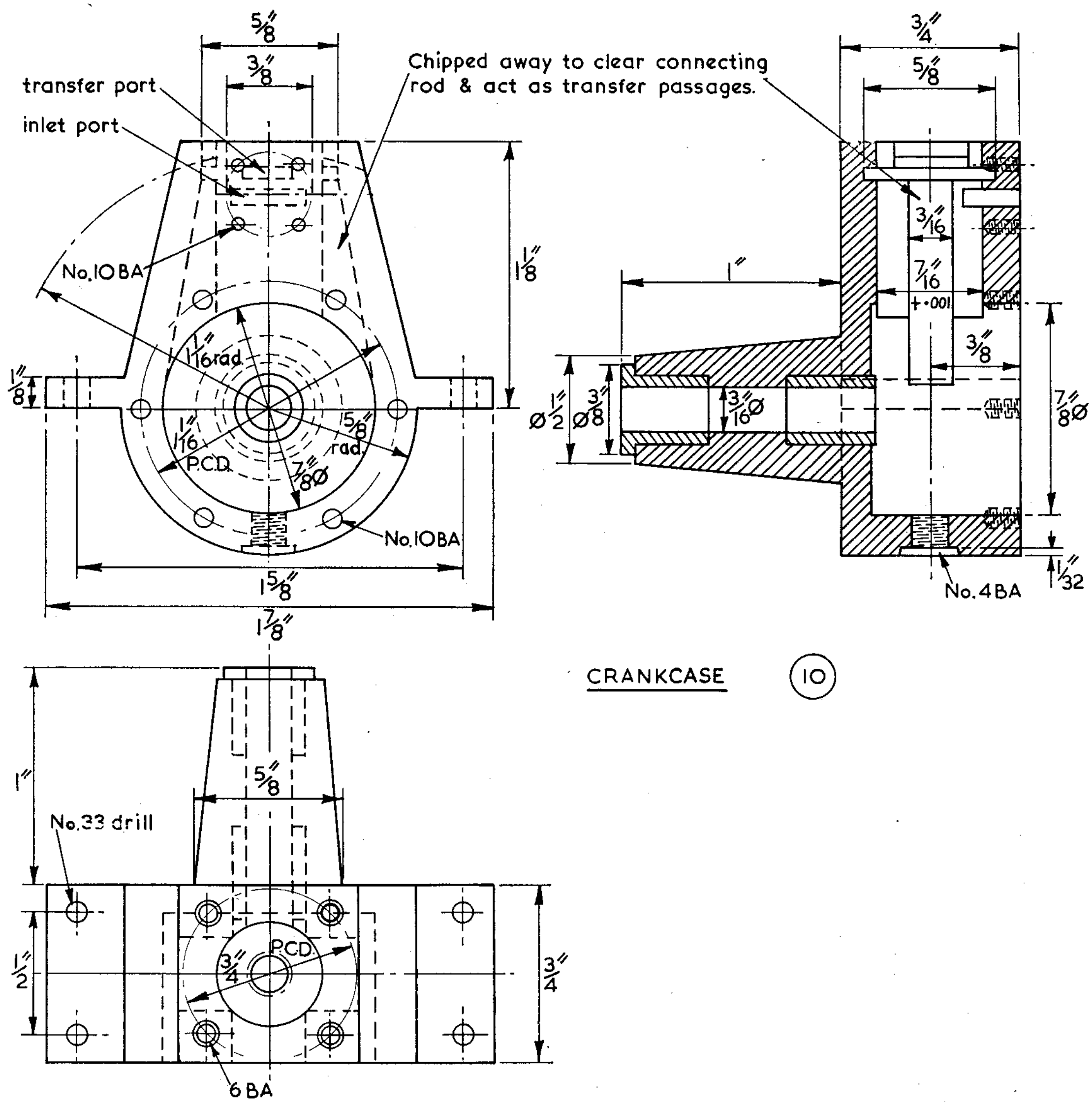
Mounting the rod in an independent-jaw chuck, and using the mark as centre, the crank-case well is bored out, and the housing for the crankshaft journals. Mounting the piece upon a brass mandrel turned to fit the well, the outside of the crankshaft journal housing is turned, and also the part of the exhaust-ports where they pierce the crankcase.

The mandrel is now mounted upon an angle-plate and the piece carefully aligned so that the axis of the crankcase well is on the centre-line of the lathe, so that a hole drilled from the back centre will meet the crankcase precisely. Such a hole is now drilled into the crankcase well, and reamed to 7/16 in. dia. Then with a fine, square-tipped boring tool, the transfer channel is bored out, 1/16 in. broad by 3/32 in. deep. The seating for the cylinder liner is faced off true.

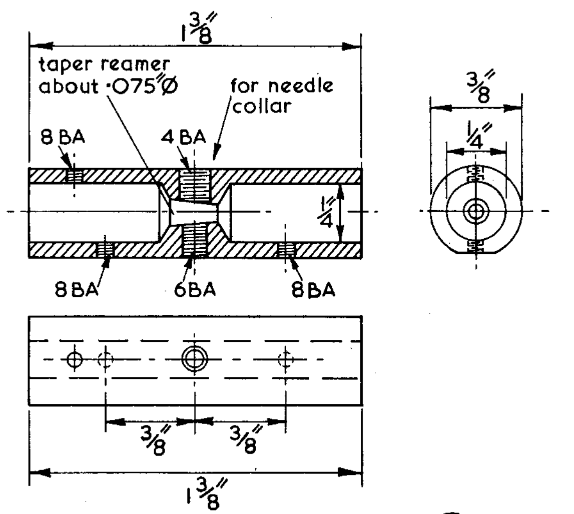
Taking the piece out of the lathe, the outline of the crankcase outside profile is scribed on the faces, and the metal removed to this profile by any convenient means. (The writer used the file.) The crankcase job is completed by drilling the fixing-bolt holes in the lugs, the six holes for the crank-case cover, four for the inlet spigot, and three close together for the inlet port, the latter finished to the proper size and shape with a Swiss file. It is convenient, but not essential, to drill and tap (4 BA) a hole in the bottom of the crankcase for a drain-plug, a 4 BA brass cheese-headed screw, $\frac{1}{8}$ in. under the head.

The channels forming the connections between the transfer port channel and the crankcase, and at the same time the clearance spaces for the connecting rod, are carefully chiselled out with a cold chisel of $\frac{1}{8}$ in. face, and finished with a draw scraper.

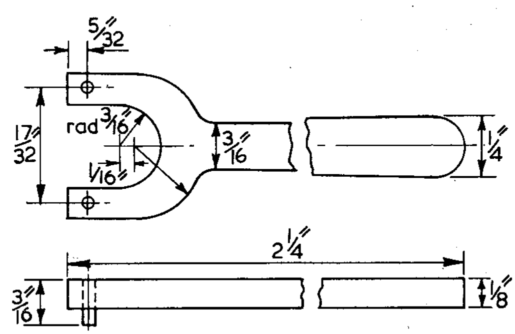
The crankcase cover is a straightforward job of turning on a piece of aluminium rod, $1\frac{3}{8}$ in. dia. It is best to leave the fixing-holes in the crankcase until those in the cover have been drilled, when



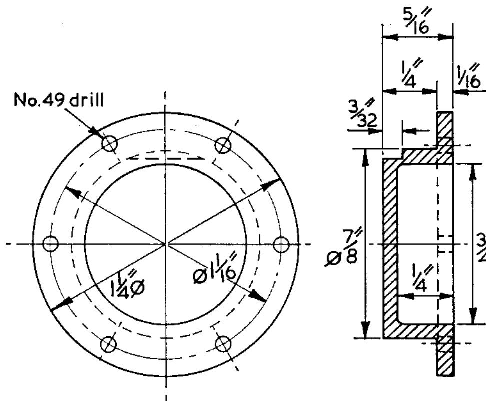
CRANKCASE (10)



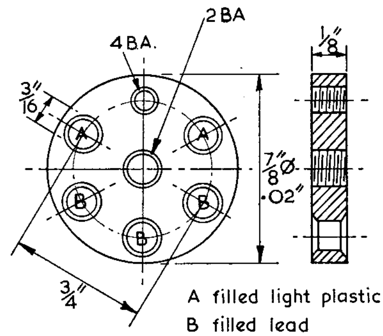
CARBURETTOR CHOKE TUBE (16)



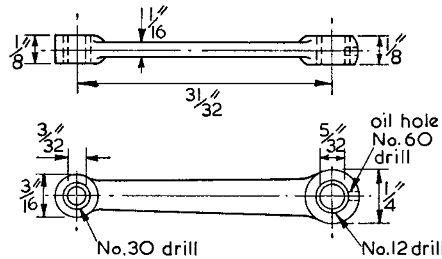
C–SPANNER (24)



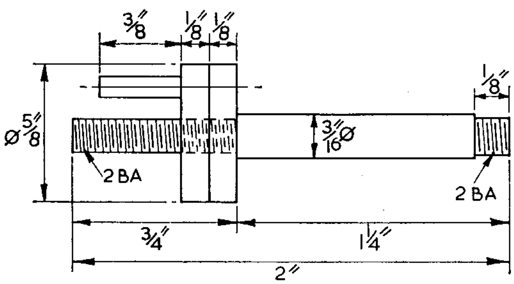
CRANKCASE COVER (9)



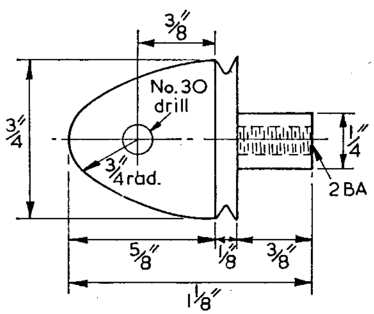
FLYWHEEL (13)



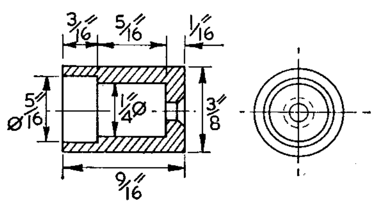
CONNECTING ROD (14)



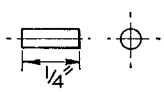
CRANKSHAFT (11)



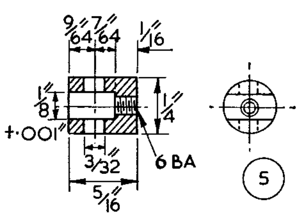
SPINNER (22)



PISTON (4)

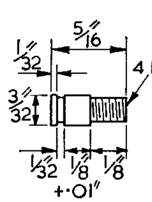


GUDGEON PIN (6)



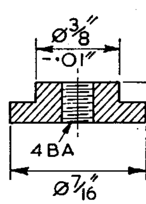
(5)

GUDGEON PIN BEARING



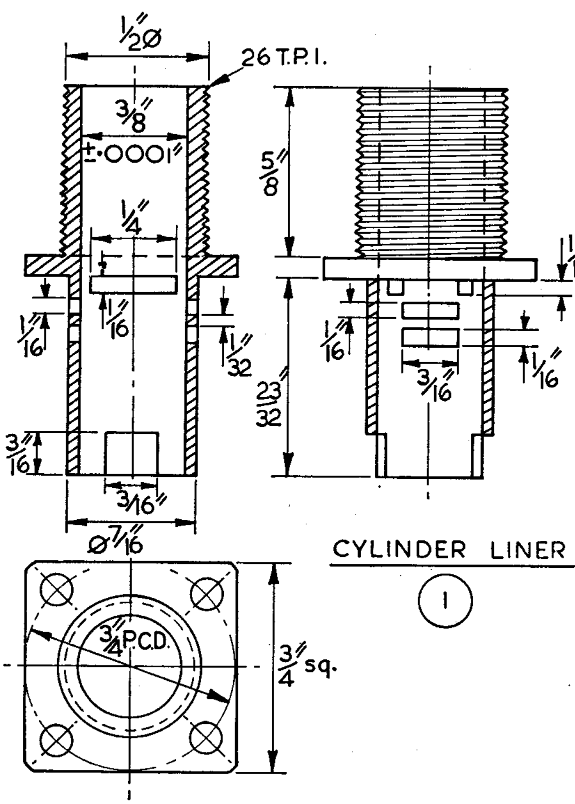
(12)

CRANKPIN



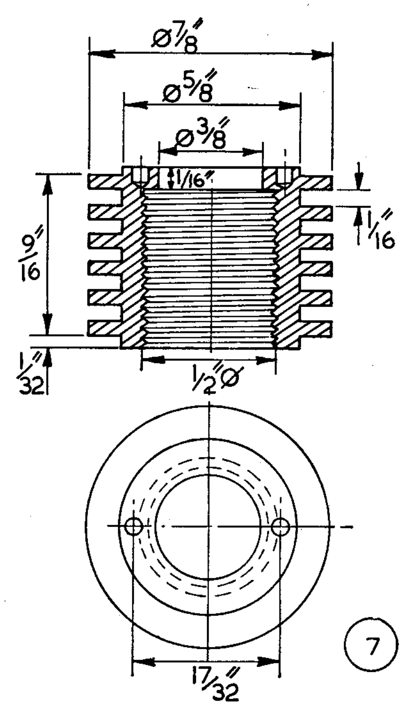
(8)

"DIESEL" CYLINDER HEAD



CYLINDER LINER

1



CYLINDER COVER
(RADIATOR)

the cover can be put in place and used as a jig, not forgetting to make a couple of coincident centre-punch dots on cover and case as "fitting marks". The latter remarks also apply to the inlet spigot, turned out of ½ in. dia. aluminium rod.

The cylinder cover is turned from ⅛ in. dia. aluminium rod, bored and tapped ½ in., 26 t.p.i. (See later on cylinder liner.) Likewise the "spinner" (if required, if the engine is used for model aircraft).

In the writer's model, the flywheel, crankshaft and crankpin were all turned separately, screwed and brazed together, but they can with advantage be turned integrally out of the solid, ⅞ in. dia. silver steel.

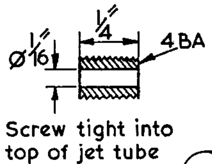
The outer locating nuts for the crankshaft are turned out of ⅝ in. dia. mild steel.

Main crankshaft bearing bushes are of phosphor bronze as are also the big- and little-end bushes. (This is a controversial point in design.)

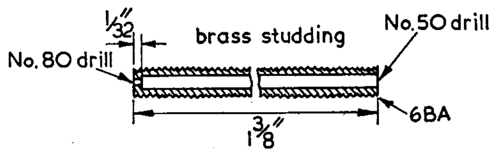
The cylinder liner is of "K.E. 805" steel, turned from 1 in. dia. rod. This is best turned in collets, except that the initial roughing out can be done in a 3-jaw chuck. Alternatively, the "blank" for the cylinder cover could be bored and tapped first, before turning the outside, and used as a jig for boring and finishing the cylinder liner. Rough turn the outside of the liner, and screw the upper end to fit the cover. If using the cover as a jig, screw the externally roughed liner into the cover in place in the chuck. Finish the outside of the liner, and drill and ream or bore the bore to within about .001 in. of the finished size. Get a smooth surface on the finishing cut, it will save a lot of work with the lap, later on. Cut and file the flange square, and drill the holes for the fixing bolts. Using the liner as a jig, mark and drill the holes in the crankcase facing for the holding-down bolts. Fit the liner on the crankcase, with the bolts, and using the ports in the crankcase as jigs, drill and file out to shape the inlet and exhaust ports.

Removing the liner from the crankcase, mark out the position of the transfer ports (this needs some care), drill and finish them to size. Likewise finish the skirt of the liner.

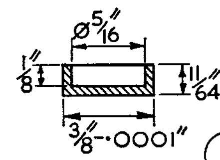
Now make up the expanding lap, and with a little No. 600 flour emery and oil, start to lap out the liner. Commence the job in the lathe, and don't start with the lap set too tight, or it will bind as soon as it heats up. As soon as the toolmarks are lapped out, take the liner out of the lathe, and finish the lapping job by hand (this is



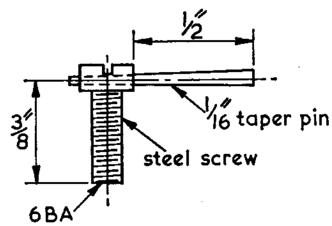
NEEDLE COLLAR (18)



CARBURETTOR JET (17)



CONTRA PISTON (2)



ADJUSTER (3)

rather tedious, but is essential, if the bore is to be truly parallel and dead smooth). Work the lap in and out with a "figure-of-eight" screwing motion, and turn it end-for-end frequently, re-adjusting the lap by screwing up the end-nut as soon as a little slackness develops. When finished, rinse the bore out with petrol. Then rinse the lap well, and finish the lapping in the same way with a little metal-polish. Rinse the liner again. The bore should look like a mirror when the liner is held up to the light.

The piston needs to be either made of mild steel or cast-iron and case-hardened, or it can be made of carbon or K.E. steel (same as the liner) and hardened. The writer found the latter more satisfactory, from the point of view of wear. Remember, it is the *hardest* member that wears more quickly, and it is easier to replace the piston than the liner. Turn it a little oversize, and harden or case-harden. Then mount it on a mandrel in the lathe and lap it. Unfortunately, it *must* be hardened first, on account of the danger of distortion. The writer lapped the piston by mounting a piece of fine carborundum stone ("Turkey slip") in the tool-rest and with the liberal application of oil and *light* pressure with a high lathe-speed working it backwards and forwards along the surface until the piston was a push-fit in the liner. If the mandrel is a piece of $\frac{3}{8}$ in. brass rod, eased down by a few thou, it can be used as a handle for the final lapping in the cylinder bore, using metal-polish (*not* emery or carborundum) and plenty of oil. Clean and rinse both thoroughly afterwards.

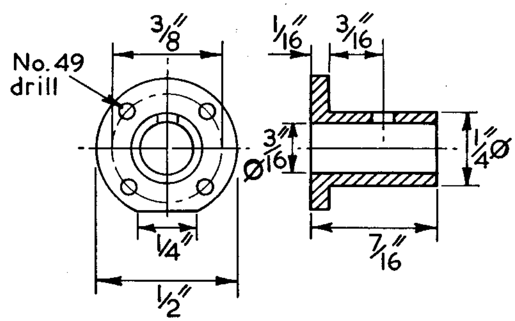
The connecting-rod is made of $\frac{1}{8}$ in. steel sheet (gauge plate), drilling the holes first, then mounting on mandrels in the lathe (of 3/16 in. and $\frac{1}{8}$ in. dia., respectively) to turn the web and bosses. Then the connecting rod is hardened and tempered (deep blue) in a sand-bath. The bushes are then turned about .0003 in. oversize on the outside diameter, and the same amount undersize on the inside diameter, and forced into place, *carefully*, between the smooth faces of a parallel clamp or vice. Then ream out the bushes to size, after drilling the oil-hole in the big-end.

The gudgeon-pin is a length of 3/32 in. silver steel rod carefully lapped to fit the small-end bush.

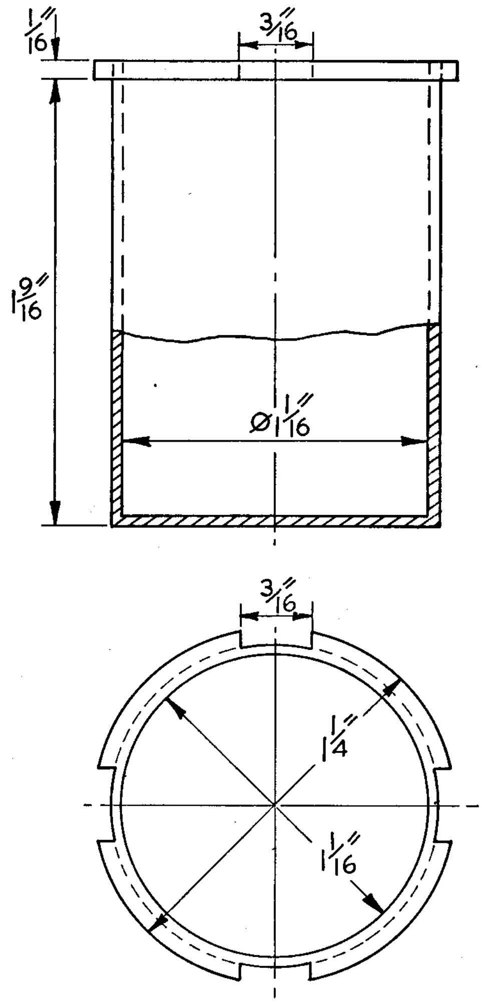
The gudgeon-pin bearer is of phosphor bronze (cast-iron would be as good). In case of any slight error in cutting the ports in the liner, a suitable washer can be inserted between the underside of the piston head and the gudgeon-pin bearer, or a little metal faced off the top face of the bearer, whichever is applicable. The bearer is fixed in the piston by means of a No. 6 BA countersunk-headed steel screw through the piston crown, the hole in which is countersunk so that the head of the screw lies flush, or slightly recessed. (To ensure gas-tightness, use a thin paper washer between the bearer and piston, and smear the screw with a little gasket compound before assembling.)

The contra-piston is made of the same material as the piston, but since there is little or no relative movement between it and the liner, it need not be hardened, though it must be lapped to size just as carefully as the piston.

The "diesel head" is made of phosphor bronze ($\frac{1}{2}$ in. rod) with a 4 BA cheese-headed steel compression screw. A handle is provided by a piece of

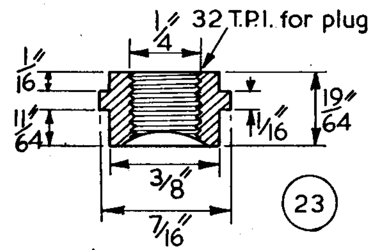


INLET SPIGOT 15

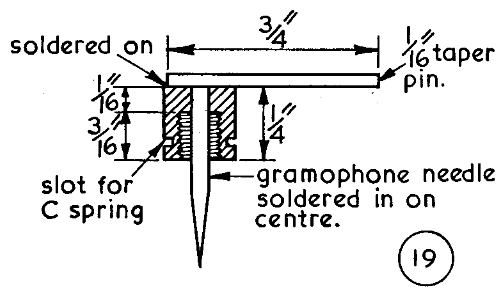


CARBURETTOR BODY

(FUEL TANK) 21



PETROL or "GLOPLUG" HEAD 23



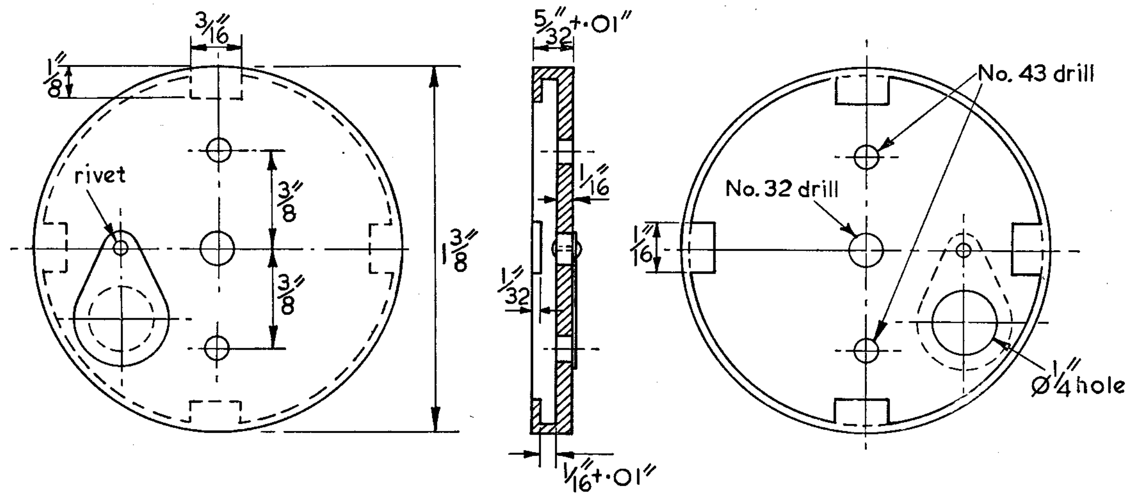
CARBURETTOR NEEDLE 19

$\frac{1}{8}$ in. taper pin through the head, and a spring washer under the head to steady the screw.

The carburettor choke tube is of $\frac{3}{8}$ in. dia. aluminium rod. The jet was made from a piece of 3/32 in. outside diameter brass tube, sweated into a hole drilled into the head of a No. 6 BA brass screw.

The screw is drilled from head to shank with a No. 50 drill. The head end of the hole is opened out to fit the 3/32 in. tube (about 3/32 in. deep). The writer used a piece of No. 6 BA studding, drilled through with a No. 50 drill, as a piece of 3/32 in. tube was not available at the time. The final part of the hole in the screw, to form the jet itself, is drilled through with a No. 80 drill (this is the last 1/32 in. of the hole). The jet needle is a miniature gramophone needle ("Silent Stylus") soldered into the hollow nut, which carries a spring clip of piano wire as a steady for the "throttle". A 1/32 in. taper pin soldered to the top of the nut forms the handle for adjustment.

The lid of the fuel chamber, upon which the



CARBURETTOR COVER (20)

choke-tube is mounted, is turned from either a piece of 1⅜ in. dia. aluminium tube, or 3/16 in. aluminium sheet. The filler hole cover is cut with scissors from a piece of No. 30 s.w.g. phosphor bronze sheet, and riveted in place with a 1/16 in. brass rivet. The fuel chamber itself was turned from a piece of 1¼ in. dia. "Perspex" rod, and the four lugs filed out from the flange left after turning. It is secured in place by the four lugs bent inwards from the flange of the cover.

A No. 8 BA brass screw, with a spring washer under the head, secures the choke tube onto the spigot on the engine, engaging with corresponding holes in the spigot, according to in what position it is desired to have the engine (i.e. running the engine upright, inverted, or on its side).

Lacking any experience with "diesel" engines, the writer made up an alternative "petrol head", to give a compression ratio of about 6 to 1, and take a ¼ in. miniature sparking plug or the new "Glowplug". However, the performance and starting qualities of the engine, not to mention the overall power-to-weight ratio, were so superior when operated as a "diesel" that the use of the "petrol head" was discontinued, though as a "marine" engine, where the weight is not so important, the slower speed and "gentler" action of the petrol version is conducive to longer life.

On final assembly, the inlet spigot is fixed on the crankcase in its proper position over the inlet port by means of four No. 8 BA cheese-headed steel screws. The piston, gudgeon-pin bearer, gudgeon-pin and connecting rod are assembled.

The main crankshaft bearing bushes, turned out of 5/16 in. phosphor bronze rod, are forced into place in their housings, and reamered through. The crankshaft, with flywheel and crankpin assembly, is carefully lapped to size, put in place, and secured with the locating nuts.

There is a little wangle necessary here in assembly. Fix the big-end in place with the piano-wire circlip *before* fitting the cylinder liner. Fix the liner in place, after lubricating, by sliding it over the piston and bolting in place with the four No. 6 BA cheese-headed steel screws. Put a few drops of oil in the crankcase, and bolt the cover on. Put the contra-piston in place and screw the cylinder cover on, with the "diesel" head in place. Putting on the carburettor, a rubber washer, cut from a piece of ¼ in. internal diameter rubber tube, is first threaded on the inlet spigot, as a seal. This also prevents the vibration from loosening the fitting.

For a start, commence with a fuel composed of equal parts of light lubricating oil ("Castrol XL") or castor oil, *medicinal* paraffin, and *ethyl* ether. This is a good standard fuel, which suits all engines of this type.

Having filled the container, fitted the airscrew or flywheel and mounted the engine on a suitable test stand, make sure that the compression screw is retracted sufficiently to allow the contra-piston to rise to the top of the liner under compression. Open the throttle a couple of turns, place the finger over the inlet pipe, and give the engine a couple of turns to flood it. You can tell by the difference in the sound of the suction whether or not the engine is drawing fuel.

Then give the propeller a smart flick round, over the top-dead-centre, with the finger. Screw the compression-screw down *cautiously,* a quarter of a turn at a time, until the engine fires. Adjust the throttle in an attempt to get the engine to fire regularly. If it fails to do so, it is probably because more compression is needed. Adjust this by ¼ turn, and try again. The engine will now probably run more or less regularly. If the exhaust is a bit smoky, and the engine is inclined to misfire, the mixture is too rich, so screw down the throttle. Throttle and compression settings are to some degree interdependent: both have to be adjusted to give full power and smooth running. If the engine starts to "knock" (and you will be left in no doubt of this by the sound, which can be really alarming if it is really bad) the compression ratio is too high, and the compression screw must be turned anti-clockwise until the engine is running smoothly. With the right fuel, there is a considerable range of speed and power available by adjustment of the compression, between the points where knocking sets in, on the one hand, and misfiring on the other.

Having found the right running adjustments, *don't omit to mark the positions, or make a note of, the right settings of compression screw and throttle.* This is the "running position". Pay just as much attention to the right position of the controls for *starting,* which adjustments *may* (but need not necessarily) be different from the running adjustments. These settings are only applicable to *the particular fuel used,* and may again be different for a change of fuel.

With these little engines, it is essential to use an excess of oil in the fuel, so that when running they tend to dribble oil from the exhaust. Otherwise the exhaust is perfectly clean, without a trace of smoke, when running properly. Any smell or smoke indicates an over-rich mixture.

One marked advantage of these little engines, when operated as "diesels", is that they will run, without any fuss or re-adjustment, in either direction of rotation. (Though don't forget to see that the airscrew, if used, is fitted in the proper manner, according to the direction of rotation desired.)

Since the ether is the most expensive element in the fuel, it is worth while to try to reduce the proportion of this constituent. A mixture of 25 per cent each of ether and lubricating oil, with 50 per cent paraffin, has been used with success. For initial trials, unless you have had previous experience with these engines, the "1/3, 1/3, 1/3" mixture is the safest to start with. If there is much initial difficulty in starting, up to 50 per cent of ether may be used, but the engine is very prone to knock on this mixture.

Editor's note: Experienced model engineers using internal combustion engines will know that this is not a "diesel" engine in the true sense of the word but a "compression-ignition". Beginners wishing to build an engine of this type will probably buy a can of ready-mixed diesel fuel rather than obtain the ingredients listed above. Also, since this article was written, the demands of local councils regarding the use of miniature engines have hardened and it will be necessary to fit some form of silencer to the exhaust. For boat use, it is now customary to use water cooling which replaces the finned head by a water jacket having an inlet and outlet for the flow of water. For an airscrew-driven hydroplane, however, air cooling is quite acceptable.

NEW ZEALAND LOCOMOTIVE EFFICIENCY TRIALS—*continued from page 1091*

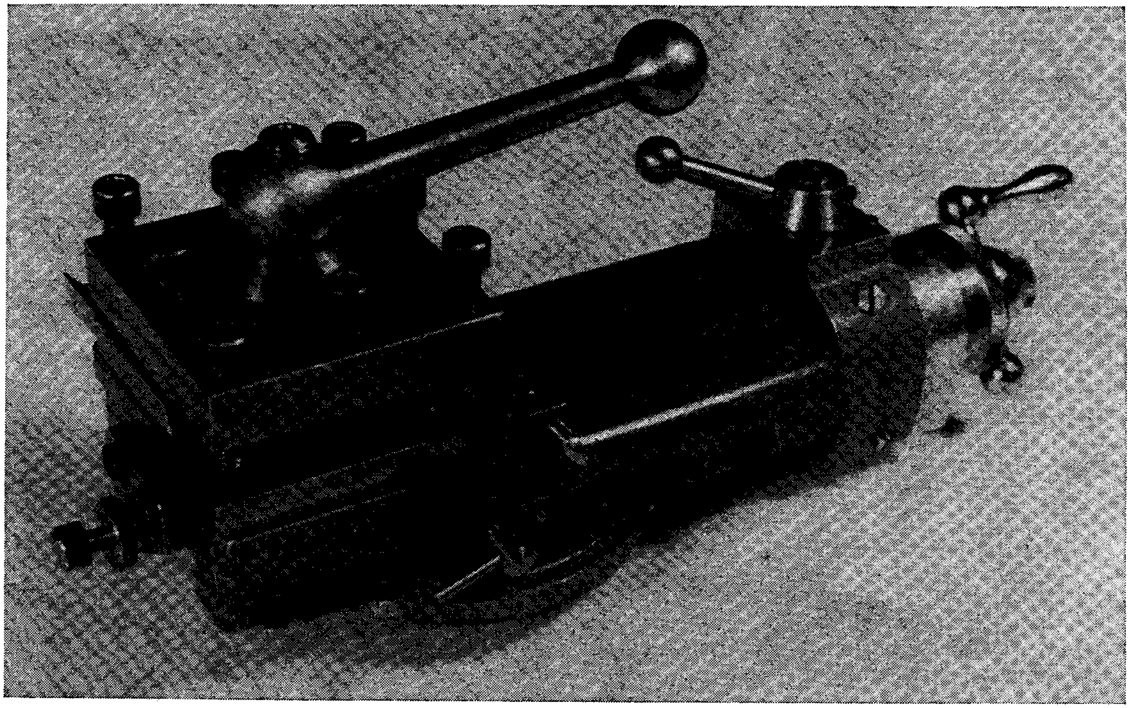
Run No. 17. Colin, son of Bill Downing, made this run with the 3½ in. gauge *Uranus.* Colin started away with seven adults totally weighing 1430 lb. and made a steady run of 18.3 laps on 18.38 oz. of fuel to finish in sixth place. *Uranus* stopped on the slow run.

Run No. 18. Allan Orwin, the trials' organiser, is also caretaker of the club 5 in. gauge 4-6-0 *Springbok.* He expressed a wish to have a run under trial conditions if there was time at the end of the trials. There was, and *Springbok* was steamed up. Allan is no stranger to steam as his father was a driver on British Rail and as there has never been a *Springbok* in the New Zealand Trials, the run was watched with interest. He took the heaviest load of the event with 15 adults totalling 2926 lb. and made a good run of 18.2 laps on 29.56 oz. of fuel which, had the run been official, would have taken fourth place. *Springbok* was built over a long period by club members.

Since the annual Efficiency Trials were launched by the Otago Model Engineering Society Inc. at Dunedin back in 1971, the function has become one of the main events of the year and has done much to improve driving skills and foster interest.

So far all the New Zealand Trials have been held in the South Island, which claims no monopoly of good locomotives. It is unfortunate that the North and South Islands are separated by the often boisterous Cook Strait and no matter in which Island the Trials are held, the sea crossing will always be a time-consuming and expensive excursion for competitors from the other Island.

The 1978 Trials will be held at Blenheim and as the nearest seaport at Picton is only seventeen miles from Blenheim it would be good to see even a small contingent from the North Island.



RETRACTING TOOLS

George Thomas, having completed his popular article on setting-up aids, now turns his attention to another useful item for the lathe.

ARISING OUT OF earlier correspondence in "Postbag", Mr. E. H. Jeynes in "Jeynes' Corner" (6 May, p. 521) made reference to devices for withdrawing the tool at the end of the thread when screw-cutting and remarked that he could not see much advantage in their use and that they "would be of no earthly use when cutting internal threads". There was a time when I had never used one either but I had seen them being used by skilled turners on high-class lathes and, for a long time, I had a hankering after one.

As I could see very little chance of incorporating one of the more conventional forms of withdrawal mechanism in the cross-slide of my lathe, I made, eventually, an accessory to fit into the square turret. In this, the screw-cutting tool is carried by a slide moving in dovetail guides and controlled by a cam. There is an adjustable positive stop in the forward direction which makes contact with a hardened button just as the cam is on dead-centre. A spring plunger assists the withdrawal which needs only the flick of a finger on the control knob. The return of the tool to its original position is effected with great accuracy and much more quickly than would be possible if the tool had been withdrawn and returned by a feed-screw.

Left: Top slide with retracting mechanism.

Below right: Geared-screw top-slide with larger dial and new feed screw arrangements on cross-slide.

Below: A view of the retracting toolholder for use in the square turret.

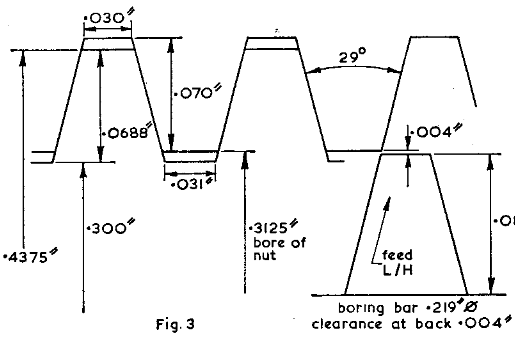
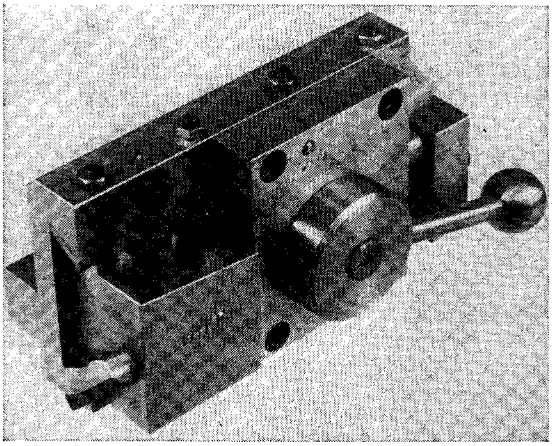
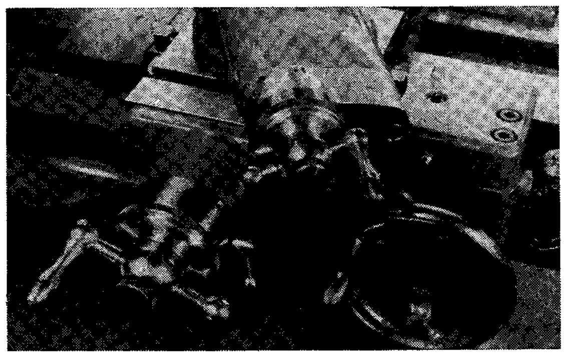


Fig. 3





FOR SCREWCUTTING

At about the same time that this little device was made I had a major session with micrometer collars which ultimately involved the incorporation of a gear drive to the top-slide screw. The actual drawings of this were made to while away the time on a ship ploughing a groove across the Pacific Ocean and after the interest in grass skirts had grown a little thin. So it happened that I had the drawings with me in New Zealand and showed them to Jack Radford who afterwards produced his own version with three gears and so retained the original screw and nut. I preferred two gears and a new L/H screw and nut.

One day, in one of my more lucid moments, it occurred to me that the existence of the gear drive to the screw would enable me to build a relatively simple withdrawal mechanism into the top-slide, so I purchased from Myford a pair of finish-machined castings for a new top-slide and got down to business. On the right in the photograph can be seen the large diameter micrometer collar ($1\frac{1}{2}$ in. dia.) graduated in thous and free running (no friction device) which is locked by a knurled knob in the centre of the ball handle.

The fiduciary line is engraved on a L.A. member which contains the pair of gears. Between this and the top-slide casting is a mild steel block which, when stripped down, looks like a piece of Gruyère cheese. This contains the withdrawal mechanism which is operated by the short handle on the top. Adjustments, each with its own lock, are provided at four different points and these take care of the initial assembly and also compensate for wear but, so far, none has taken place. On flipping the handle backwards, the slide carrying the tool is withdrawn 5/32 in. which is quite sufficient for all practical purposes—it is the depth of a $4\frac{1}{4}$ t.p.i. acme thread. When the slide is in the normal (forward, or cutting) position, the mechanism is clamped up rigidly and it is returned to this position, exactly, every time.

This slide, though the handiest device imaginable for external screw-cutting, was still not the answer to internal work because the movement for the cutting operation, in which position it is positively located and locked, is in the wrong direction—or so I thought. But this is another example of what the psychologists term a mental blockage. By long habit and custom we feed a tool *away* for external work except when parting off with a rear tool-post. Internal screw-cutting is carried out by feeding *towards* ourselves. Came another moment of revelation; why not turn the screw-cutting tool over so that it is upside down and faces the rear of the bore? The directions of rotation and travel will remain the same but the feed will be *away* as with external screw-cutting so one would be able to read the micrometer collar the correct way instead of subtracting for each successive cut and the retracting machinism could be used. Only one snag remained; the 5/32 in. withdrawal motion might be too much and foul up the tool in the bore when working in a cramped space. This was overcome by adding a plate and adjustable stop as seen on the extreme left. This can be set to limit the retracting motion and so prevent the back of the tool from rubbing against the bore when it is withdrawn. It should be clear that with this stop in use the withdrawal motion will increase as the depth of cut is increased. The stop need not be permanently attached to the slide as it is only required in rather special circumstances.

Using this slide, I have cut a third feed-screw nut in about one-third of the time taken for each of the previous two. Owing to the very small diametral clearances, the tool had to be positioned almost as accurately for withdrawal as for cutting. This slide looked after everything automatically. One might claim that, the tool being upside down, the chips will fall away better than when the tool is in the conventional position.

Another photograph shows a geared-screw top-slide with large micrometer collar and a new form of cross-slide collar about 2 in. dia. and reading tenths on a vernier scale. This feed-screw is provided with a lock which is a most handy feature as it prevents accidental movement of the screw, and pre-loaded needle-roller thrust bearings which, although virtually frictionless, eliminate end-play.

Cutting a 16 D.P. (5.093 t.p.i.) worm using the retracting tool-holder.

Mr. Jeynes mentioned also the use of a "chasing bar" for finishing screw threads by chasing after screw-cutting and supposed that I had one and used it. I can imagine only one circumstance in which I would use a chaser on a screw-cut thread and that is if the work had been removed from the lathe and subsequently the thread was found to be too tight to fit the mating part. It is impossible to replace work in these circumstances with sufficient accuracy to enable a fine cut to be taken and, in the absence of suitable dies, it would have to be chased. I would never dream of applying a chaser to a screw-cut thread otherwise, because I feel that it could do nothing but damage it. There is obviously a difference of opinion here and it could very well be a matter of scale—E.H.J. is, no doubt, thinking in terms of the screws he has cut in the past whereas I work mainly in the 20 to 60 range. On a good lathe such as a Myford Super 7, especially with a few refinements added, such threads can be cut with precision—the last half-thou cut is the one which tells and gives a close fit in the screw-thread gauge. I have not the skill to control a hand-chaser within such limits and some of the work I do is far too small for chasing.

Note: The drawing, showing a cross-section through the mating threads of a 7/16 in. x 10 t.p.i. Acme screw and nut, illustrates clearly how little room is available for the screw-cutting tool, .004 in. on each side—not allowing for any burr thrown up from the cutting operation. The original Myford screws are ⅜ in. x 10 and it was decided that nuts in G.M. or P.B. would be virtually impossible to cut as the shank of the tool would be no more than about 5/32 in. dia. It was for this reason that the size was increased to 7/16 in. which not only makes the screw-cutting possible but gives the added bonus of increased bearing area on the threads and a smaller helix angle which reduces any tendency for the screw to shift under interrupted cuts.

It would be possible, by adjusting some of the dimensions, to help the screw-cutting. A reduction of the clearance at the tops of the threads (about .007 in. as drawn) and a slight truncation of the thread would combine to allow a slightly larger bar diameter but I have now made four nuts to the drawing dimensions and can regard the job as routine.

Note that, the screw being left-handed, the top-slide is slewed round so that the tool is fed towards the tailstock, i.e. against the cut.

George Thomas describes his cross-slide micrometer collars in the special workshop issue planned for 4 November.—Ed.

"GREENE KING"

Martin Evans continues with the description of a 3$\frac{1}{2}$ in. gauge locomotive based on the Southern Railway S.15 class

Part VI

From page 993

WE COME NOW to that evergreen bone of contention—Walschaerts valve gear. I should think that beginners must by now be thoroughly confused as to the best way to design a Walschaerts valve gear, what with Dr. Burrows' mathematics and Don Ashton's long practical experience; which would be a pity as the working out of this gear is a fascinating exercise. I hope though that readers will not misunderstand me—I have every respect for the views of both these gentlemen, even though my own approach to the problem may be somewhat more mundane.

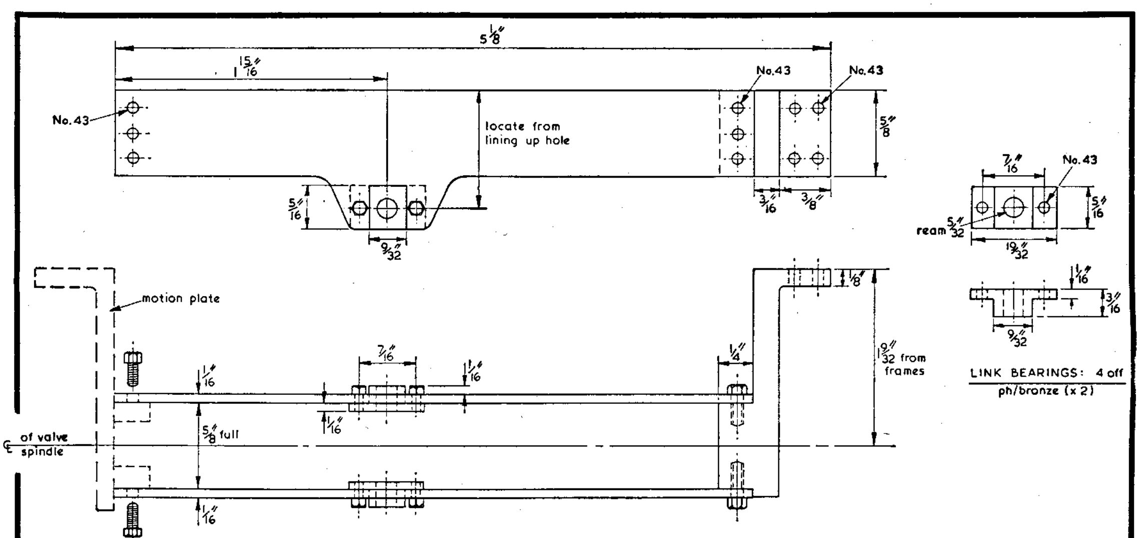
Readers who have followed the arguments over the design of Walschaerts gear will remember that it all started through criticism of what has come to be called the "Greenly" method, where the travel of the valve spindle is taken as provided by the return crank (or eccentric) on the driving crankpin. It is accepted that where the gear is for the operation of external admission valves (nearly always, but not necessarily, slide valves), the Greenly method gives a certain amount of overtravel to the valves; but calculations of gears of typical modern design, where the lap of the valve is approximately equal to the port opening in full gear, show that with inside admission piston valves, the Greenly method is very nearly correct.

It may well be asked why it is that thousands of model locomotives with Walschaerts valve gear and slide valves, and in scales from 7 mm. to 2 in. to the foot, designed according to the Greenly principles, are apparently very successful. I would say that this is because a certain amount of overtravel of the slide valves in full gear is no real disadvantage in practice, provided that the proportions of the other parts of the valve gear are correct, particularly the combination lever and anchor link. This does not necessarily mean that the die-block is going to foul the ends of the curved slot in the expansion link or that the valve is likely to strike the steam chest at each end of its travel.

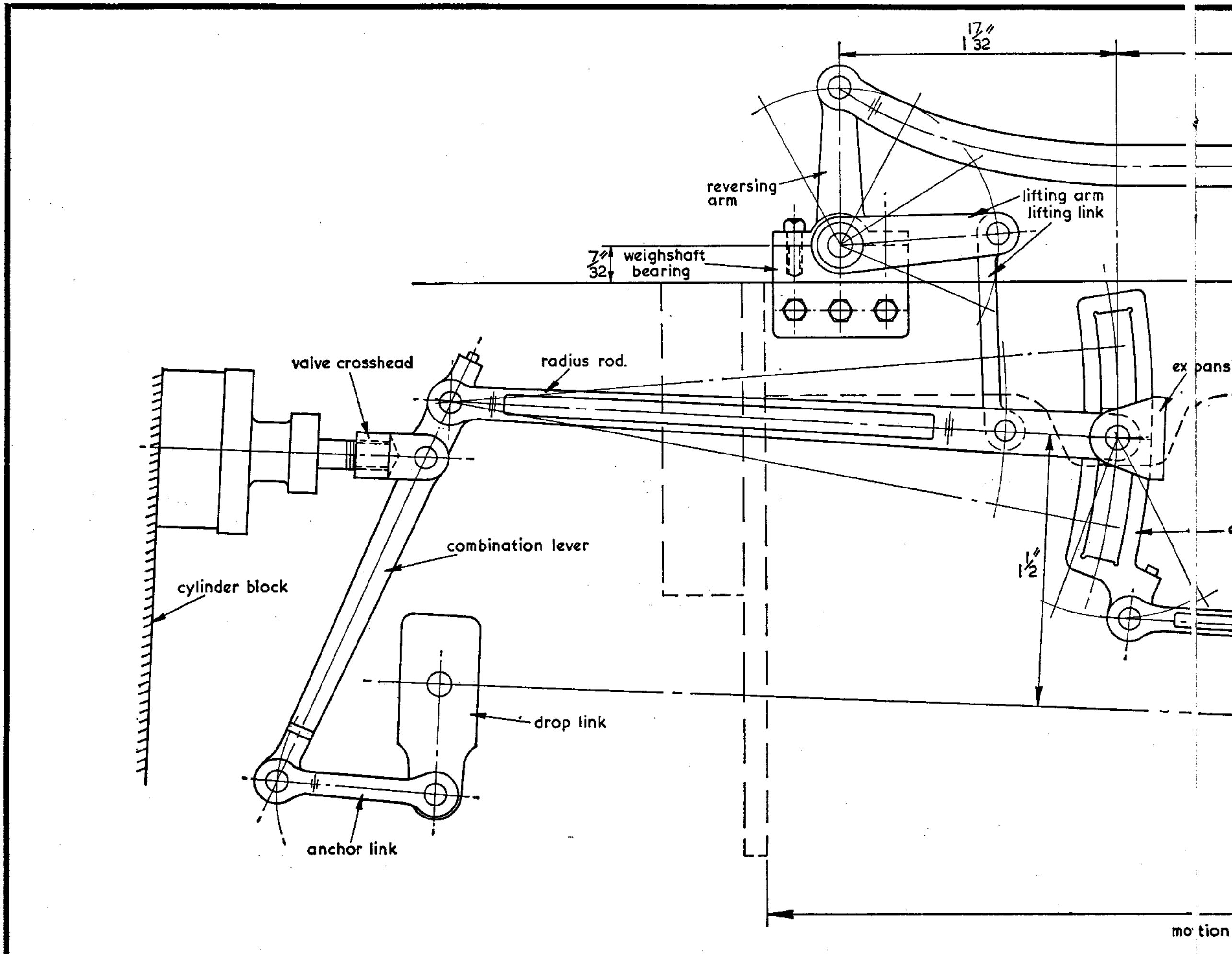
Deferring movement decision

In my view, the cab reverser movement should be settled after the other parts of the valve gear have been assembled, and in this way, the full gear positions can very easily be determined so that the die-block has a reasonable amount of clearance in its slot, and as for the valve movement, no self-respecting cylinder will be designed with so little clearance in the steam chest that it is likely to be fouled by the valve at the full gear positions.

Another point—a well designed and well made model locomotive, in any scale, should be capable



LINK FRAMEWORK & LINK BEARINGS: (x 2)



GENERAL ARRANGEMENT OF VAL VE

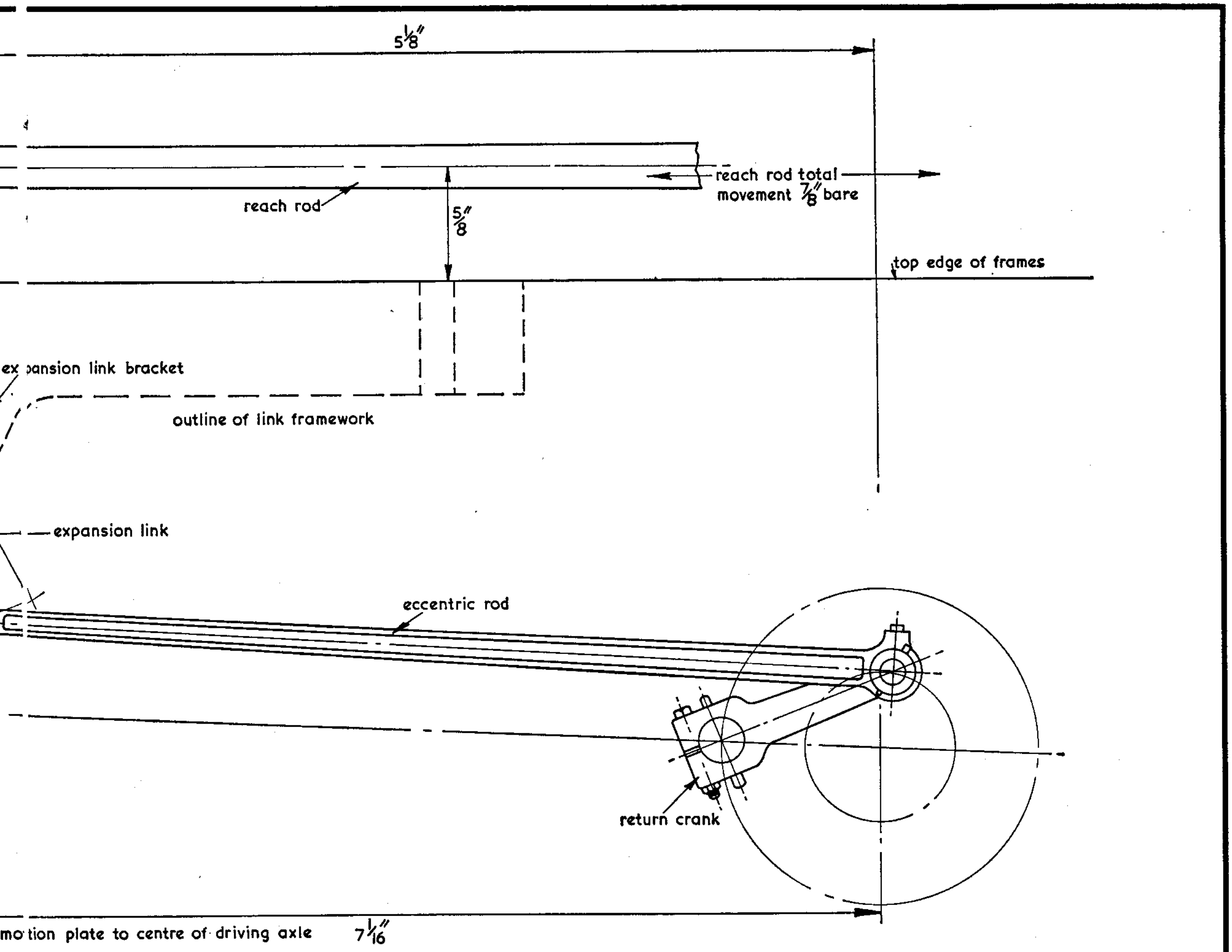
of being "notched up" as soon as it has its train properly under way, in which case any over-travel of the valves will immediately disappear.

No doubt Henry Greenly took into account that not all model engineers had height gauges, or even knew how to use them, and in the making of the expansion link, he preferred to allow the builder a certain amount of latitude as far as working clearance for the die-block is concerned.

Risk of fouling

For beginners' benefit, I should explain that in full gear, the die-block in Walschaerts and similar gears must be well clear of the end of the curved slot, otherwise it will foul when the link starts to swing, being constrained by the lifting arm; this is especially so with the slide type of reversing as used by the later L.N.E.R. and L.M.S. locomotives, and Great Western four-cylinder engines. It is also more pronounced with short radius rods (which of course means small radius expansion links) and with excessive angular movement of the link itself. Those who have made locomotives with Walschaerts gear, particularly those with the three-piece Gresley type of expansion link, will, I am sure, appreciate this point. No matter how accurate the design of the gear, if sufficient working clearance is not provided for the die-block in its slot, the accuracy of the gear as a whole goes out of the window!

Now for the Walschaerts gear for *Greene King*! This is based on typical modern proportions, the lap being made equal to the port opening in full gear, which also coincides with the width of the steam port, viz. 0.110 in., the full gear valve travel being 0.440 in. This, scaled up to full size, would



VALVE GEAR: L.H.S. (connecting rod omitted) (x 2)

represent a travel of 7.04 in., rather more than *Greene King* in fact (6.125 in.).

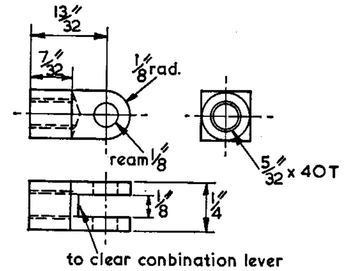
I am not now a believer in very much lead, so long as steam pipes and passages are of respectable cross-section, and also that the steam chest is of reasonable volume, so I have fixed the lead at 10 thou. Cylinder clearances have also been cut to the minimum practical at 1/32 in. plus the thickness of any gasket used, which may be from 1/64 in. to 1/32 in., making the total clearance between 3/64 in. and 1/16 in.

Builders will notice that my drawing of the general arrangement of the valve gear looks slightly different to the gear drawn on the side elevation of the complete locomotive (pages 510-511, 6 May). This is because I found that I was able to arrange the expansion link centre higher than I first thought, at 1½ in. from the cylinder centre-line, which as mentioned earlier, is at an angle of 1 in 24.

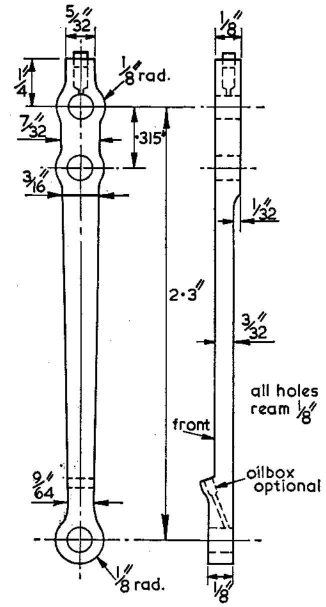
The valve gear is a typical L.S.W. type, with link suspension by a swinging lever ahead of the link centre, so that the reach rod is in the backward position for forward gear! However, this arrangement works well enough, provided that sufficient clearance is allowed for the swing of the expansion link top front corner, as the expansion link is of course in the same horizontal plane as the lifting link.

Further design points

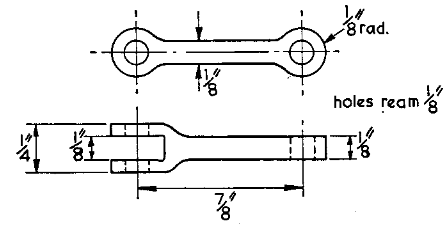
Incidentally, this valve gear is anything but symmetrical, as the radius rod is not by any means parallel to the horizontal centre-line of the motion when in mid-gear, nor is the lifting arm parallel to the radius rod when the latter is in the mid-gear



VALVE CROSSHEAD: b.m.s. c/harden (x 2)



COMBINATION LEVER: b.m.s. c/harden (x 2)



ANCHOR LINK: b.m.s. case hd (x 2)

position. Finally, the reversing arm is not at right-angles to the lifting arm, but is at right-angles to the horizontal—in other words, it is vertical to rail level when in mid-gear! However, after some time on the drawing board, with the gear at twice full size, the final proportions turned out quite well. The odd movement of the reach rod can be overcome quite easily, by using a right-hand screw in the cab reverser, so that the wheel is turned clockwise for forward running.

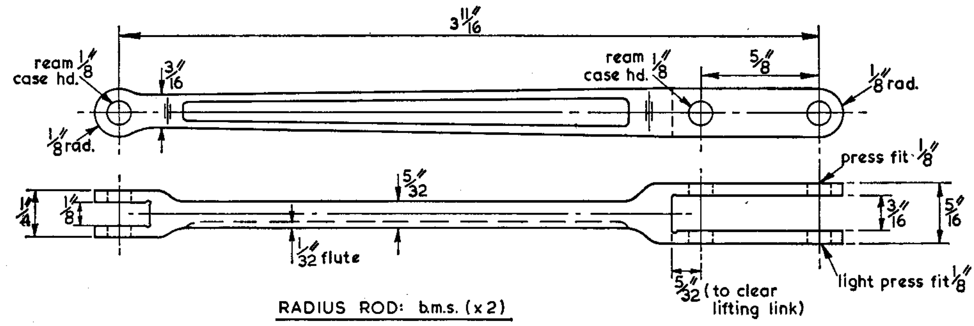
Coming now to some of the components of the valve gear, I don't need to say anything about the valve crosshead, as this is extremely simple. The combination lever, too, is very simple, being cut from $\frac{1}{4}$ in. x $\frac{1}{8}$ in. b.m.s., unless the bottom oil-box is required, in which case something rather thicker will be needed. Note that the combination lever is recessed by 1/32 in. at the back, to give a little more clearance between it and the slide bars. All holes are reamed and case-hardened, though phos/bronze bushes make a better job for those who don't mind the extra work.

The anchor link is also quite simple, being forked to fit around the bottom pinhole of the combination lever. Again, both pinholes are reamed $\frac{1}{8}$ in. dia. Somewhat more work is required for the radius rods, as these are cut from 5/16 in. x $\frac{1}{4}$ in. b.m.s., the expansion link end being slotted out 3/16 in. wide to take both the bottom lug of the lifting link, and the die-block. The front end is forked to embrace the top pinhole of the combination lever. Note that the holes for the die-block are made for a press-fitted pin, flush on each side, so one hole may be drilled with a No. 31 drill, and the other drilled the same size, but eased out very slightly with a reamer, or a home-made D-bit of, say, 0.124 in. dia.

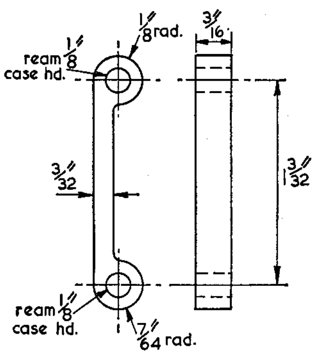
Both the lifting link and the lifting arm are simple components; the latter fits on the end of the weighshaft, so is reamed a larger diameter, at 3/16 in. The framework which supports the expansion link is rather like that fitted to the "Royal Scots". The rear bracket should be a casting for preference, having lugs cast on as shown, for bolting to the frame, the two link bearing plates, which are made from 1/16 in. steel, being bolted to the forward facing lug by three 8 BA bolts each. At the front end, these plates are bolted to the rearward facing lugs on the motion plate. Builders should aim to get these plates a full $\frac{5}{8}$ in. apart, so if the front lugs have already been machined to exactly $\frac{5}{8}$ in. apart, it may be worth while inserting a shim of brass or steel on the outer side. Ten thou would be ample. This gives us a shade more working clearance for the expansion link.

The expansion link bearings are rectangular in shape, for a change. Drawn phos/bronze or gun-metal can be used here. These bearings are drilled and reamed 5/32 in. dia. for the expansion link trunnion pins, and they are bolted on the inside of the bearing plates by two 8 BA bolts each. These must not protrude through on the inside, but they should be strong enough for the purpose, nevertheless.

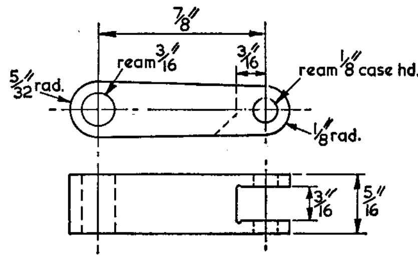
To be continued



RADIUS ROD: b.m.s. (x 2)



LIFTING LINK: b.m.s. (x 2)



LIFTING ARM: b.m.s. (x 2)

Screw Couplings

by B. Waite

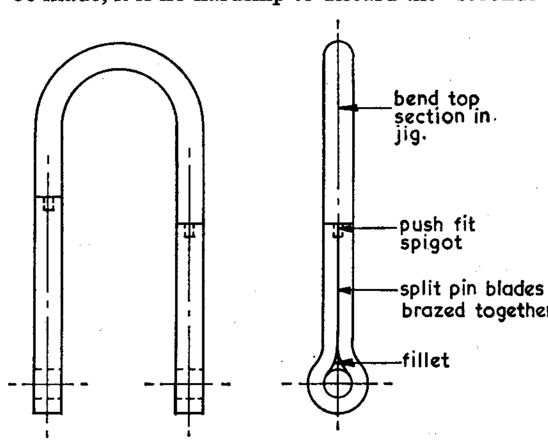
I HAVE EXPERIENCED some difficulty in fabricating shackles for a screw coupling and have adopted the following method which avoids some of the problems and may be of interest.

My own shackles, which are for 3½ in. gauge, comprise three parts as shown on the enclosed drawing. The top curved section is a short length of cycle spoke with spigots turned on each end. This is bent to a U-shape in a jig in the usual way. The two lower sections incorporating the "eyes" are split pins. The blades of the pins are brazed together and the pins, cut to the correct length, are drilled to receive the spigots as a push fit, the whole assembly being brazed together and filed and polished.

The advantages of this method are as follows:

1. The "eyes" are preformed perfectly symmetrical and do not require drilling.
2. Bending does not have to be accurate (i.e. symmetrical) since the pins can be cut to suit and adjusted to the correct position before brazing.
3. The "eyes" can be rotated on their axes ensuring that they are parallel to each other and perpendicular to the plane of the shackle.

I have found the method to be quick and easy and the components can be made in batches. Several shackles can be made in one go and the best pair can be selected from a batch for the fabrication of the complete coupling. Due to the ease and speed with which these small items can be made, it is no hardship to discard the "seconds".



SHACKLE FOR SCREW LINK COUPLING 3½"/5"G

A Light Compound Steam Tractor

at 2 in. Scale

Part IV

by John Haining

From page 985

THE COMPOUND CYLINDERS of the prototype are 4½ and 7½ in. bore x 8 in. stroke, with slide valves on the outside. The cylinder casting is in one piece, the curved lower face fitting direct on to the top outer surface of the boiler barrel, the cylinder block bottom flange being attached to the boiler shell with twelve ¾ in. dia. cone neck bolts, cone and head inside the boiler shell, and no internal reinforcing plate being necessary. Steam passes from the boiler direct to the cylinder jacketing and then up into the top steam cavity or dome, thence via the regulator into the H.P. valve chest—a fairly typical cylinder layout and not too difficult to produce in small casting form or as a fabrication in mild steel.

Unfortunately it is not possible, for obvious reasons, to follow the same method of attaching the cylinder casting to the boiler shell with bolts, in a model, owing to the impossibility of obtaining hand-access to the inside of the boiler except during assembly of the boiler itself, prior to fitting the front tubeplate. If anyone wants to adopt this method of assembly instead of the more usual one of drilling and tapping the boiler shell and reinforcing plate for studs or set screws, don't forget that you will be faced with silver-soldering the tubeplate into the boiler with a casting already attached. And, more important still, once the boiler is assembled completely there is no way of removing the cylinders, unless you have drilled and tapped the holes through the shell and screwed the setscrews through from the inside—a finicky job, in my opinion, and hardly worth the slight saving of material caused by omitting the reinforcing plate inside the shell. Also, to remove the casting from setscrews protruding through the shell raises difficulties unless the holes in the cylinder block lower flange are slotted sufficiently to clear the angular positioning of the screws.

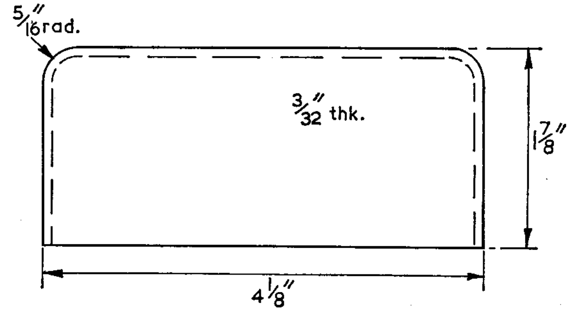
Keeping strictly to scale, the compound cylinder sizes for this 2 in. scale model work out at ¾ in. dia. H.P., 1¼ in. dia. L.P. and 1⅜ in. stroke, but in my opinion the ratio of H.P./L.P. cylinder bore areas would be a little too high and the stroke too short if these were adhered to, so cylinder dimensions have been made ¾ in. dia. H.P., 1 1/16 in. stroke. These give respective cylinder bore areas of .4418 sq. in. and .8866 sq. in., a ratio of just over 2:1, which should ensure a lively blast from L.P. exhaust into the chimney throughout the running range. These bore sizes fit in quite well with the method of getting steam from the boiler up to the dome, and leave the cylinder block correct in its *external* dimensioning and appearance.

It is quite impractical in two-inch scale to attempt to reproduce the full-size method of steam jacketing, with the complex coring which would be necessary in a casting, so steam transfer has to be via a vertical drilled passageway upwards between the cylinder bores.

As an alternative, however, I have designed a cylinder layout which conforms exactly to external appearances but consists of two simple H.P. cylinders of slightly smaller area, namely 15/16 in. dia., which lend themselves to a less complicated method of steam distribution, feeding steam straight to both valve chests from the top dome, instead of to the H.P. chest only, with H.P. exhaust to L.P. valve chest, right across the cylinder block.

In any case the exhaust note of a small steam tractor is always rather more fussy than that of a bigger engine and the difference between the exhaust beat of a compound and that of the two-cylinder layout should be hardly noticeable in small scale.

The area of each cylinder is .6903 sq. in., the two totalling 1.3806 sq. in. compared with the 1.3284 sq. in. area of H.P. and L.P. on the compound version—the latter being the effective area of the compound cylinder worked "double-high" with live steam at a boiler pressure being admitted to both valve chests via a starting valve.



CROSS PLATE: 1 off b.m.s.

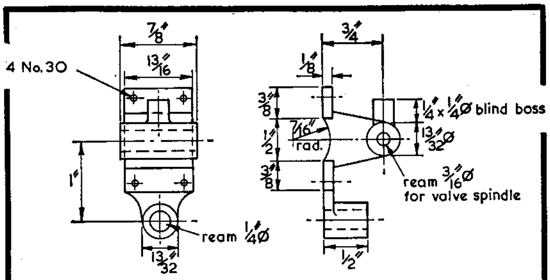
Described in the preceding article.

Cylinder bores in the full-size casting are of the semi-blind type, both bores being open at the front (chimney end) but closed at the crankshaft end except for a 4¾ in. dia. hole into which fits the spigoted end of both trunk guides. Piston rod glands are thus carried in the forward end of the trunk guide and not on the back face of the cylinder casting itself. Studying the Ransomes drawings of over half a century ago it is interesting to note that the holes in both the cylinder back facings and the trunk guide nose spigots themselves are simply dimensioned "4¾ inches diameter"—no tolerances, limits, or notes calling for the spigot to be a push fit in the back facing hole, or stressing the need for concentricity and squareness to the centreline. In view of this, one wonders what the craftsmen of those days would make of the metricated drawings of today, whose message to the man at the bench is sometimes almost totally hidden beneath a rash of complex B.S. 308 symbols all requiring interpretation before the simplest machining operation can be commenced.

Ransomes steam tractors, in common with their traction engines, all had cylinder castings which, although fully steam jacketed around the cylinder bores, were unusual in as much as steam was taken from the boiler into the cylinder casting via a cast-iron elbow bolting to a facing on the boiler top at the crankshaft end of the cylinders. The saddle of the cylinder casting thus presented an unbroken face to the boiler top, without the usual steam passage through to the jacketing. A facing low down on the back of the casting, between the cylinder bores, connected with the cast elbow which itself had a small boss for fitting a relief valve if required (this *was* required by certain overseas customers or their insurers), and a second boss on the right-hand side was for steam connections to a water lifter on the belly tank.

Advantage and disadvantage

A big advantage of this method of steam transfer from boiler to cylinder was that the joint between boiler and cylinder casting did not have to be steam tight. A slight disadvantage was the necessity for both the cylinder flange face and the elbow joint face to exactly match, allowing for a joint thickness on the elbow facing, otherwise leaking or even broken flange facings could occur. Another characteristic feature of the full-size engine is that the H.P. and L.P. valve chests and their covers are offset slightly forward of the transverse centreline. This is to allow for the blind, or rather semi-blind back end of each cylinder bore, and is covered on the two-inch scale version by simply moving the valve chest covers forward slightly, but leaving the steam ports equi-spaced about the centreline.



VALVE SPINDLE GUIDES: 2 off GM

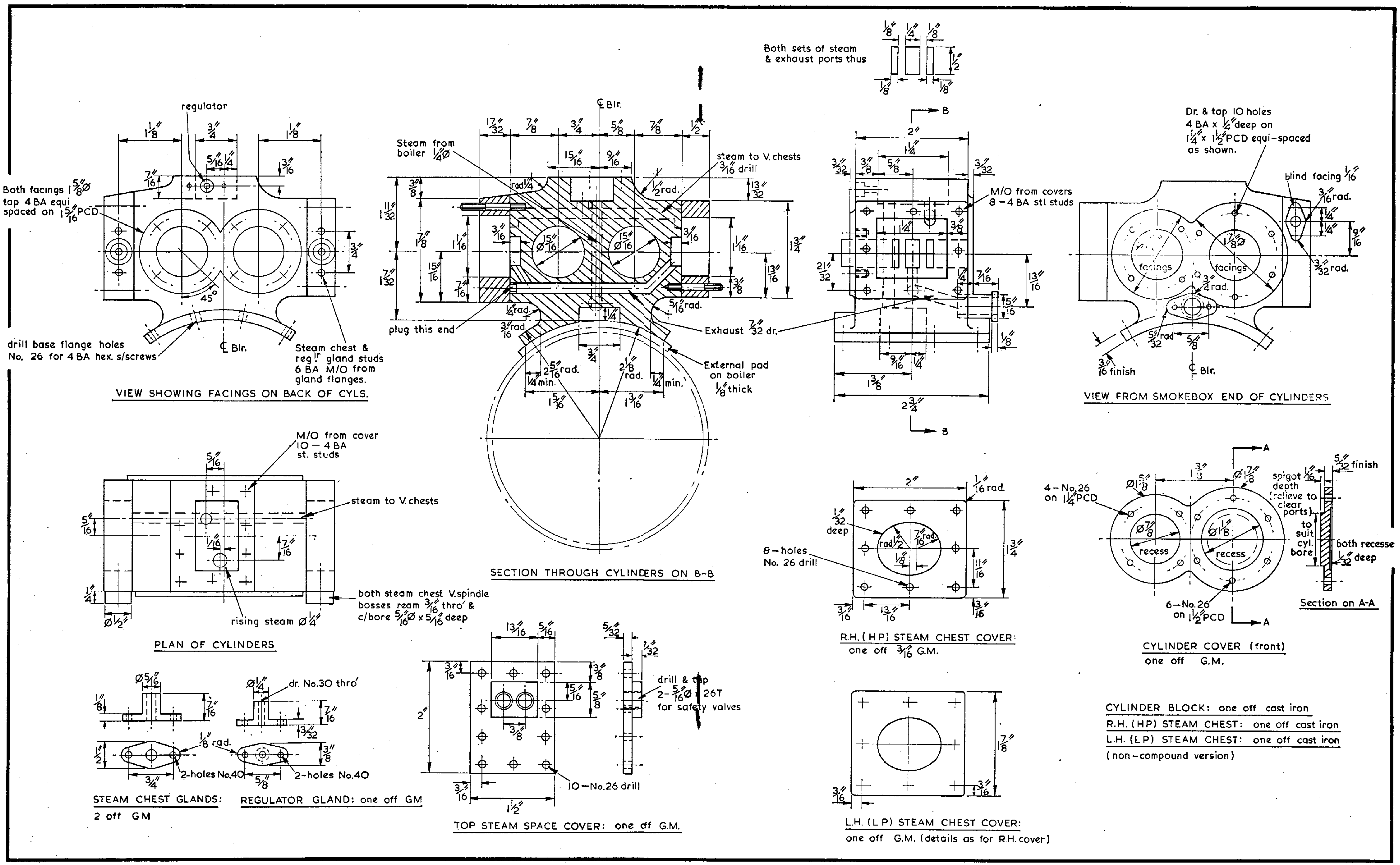
The full-size cylinder castings had a small boss drilled and tapered ⅜ B.S.P. above each steam chest for a displacement lubricator to be fitted each side. A relief valve screwed into a boss on the front of the L.P. valve chest, with its vent pipe led into the chimney—not a pretty sight!

A bigger circular facing at the rear end of the H.P. chest top face was for mounting a "gardner" governor and a note on the maker's drawing calls for this to be cast blank unless specifically ordered to be tapped and faced.

Safety valves were fitted well forward on the top facing cover, placed transversely. So much for the main features of the big job, the external dimensions and centre distances of which have been reproduced in the two-inch scale cylinder casting, but with the minimum constructional modifications necessary to the small scale. The cylinder bores I have mentioned already; to simplify construction—and machining—I have continued the cylinder bores right through from front to back, instead of sticking to the semi-blind arrangement of the prototype. The trunk guide flange, spigoted to fit into the bore, with no external appearance differences at all, is an easier boring operation as the tool can be taken through from front to back in one operation in each bore.

For ease of machining both H.P. and L.P. valve chests are separate castings, attached to the main casting by studs which also secure the covers in place. Personally I find it easier to bore cylinder blocks on a faceplate rather than use a toolbar, with the casting mounted on the cross-slide; after positioning the casting on the faceplate centrally for the first bore, pack it out so that it is at least ¼ in. away from the plate, so that the tool can run clean through the full length of each bore in turn.

First of all, however, to enable the casting to be mounted for machining it must have one true face; in this case the L.P. port face is the best, as it is a large face area. Clamp the casting to the lathe saddle with the big port face towards the headstock, and using a flycutter obtain the cut by moving the saddle towards the headstock, and the feed by the cross-slide handwheel.



Both sets of steam & exhaust ports thus
regulator
Both facings 1 5/8 Ø tap 4 BA equi spaced on 1 5/16 PCD
drill base flange holes No. 26 for 4 BA hex. s/screws
℄ Blr.
Steam chest & reg.r gland studs 6 BA M/O from gland flanges.
VIEW SHOWING FACINGS ON BACK OF CYLS.
Steam from boiler 1/4 Ø
steam to V. chests 3/16 drill
plug this end
Exhaust 7/32 dr.
External pad on boiler 1/8 thick
SECTION THROUGH CYLINDERS ON B-B
M/O from covers 8 – 4 BA stl. studs
Dr. & tap 10 holes 4 BA x 1/4 deep on 1 1/4 x 1 1/2 PCD equi-spaced as shown.
blind facing 1/16
facings
3/16 finish
VIEW FROM SMOKEBOX END OF CYLINDERS
M/O from cover 10 – 4 BA st. studs
steam to V. chests
both steam chest V. spindle bosses ream 3/16 thro' & c/bore 5/16 Ø x 5/16 deep
rising steam Ø 1/4
PLAN OF CYLINDERS
8 – holes No. 26 drill
1/32 deep
R.H. (HP) STEAM CHEST COVER: one off 3/16 G.M.
4 – No. 26 on 1 1/4 PCD
spigot 1/16 depth (relieve to clear ports)
to suit cyl. bore
recess
both recesses 1/32 deep
6 – No. 26 on 1 1/2 PCD
5/32 finish
Section on A-A
CYLINDER COVER (front) one off G.M.
dr. No. 30 thro'
1/8 rad.
2-holes No. 40
STEAM CHEST GLANDS: 2 off GM
REGULATOR GLAND: one off GM
drill & tap 2 – 5/16 Ø x 26T for safety valves
10 – No. 26 drill
TOP STEAM SPACE COVER: one off G.M.
L.H. (LP) STEAM CHEST COVER: one off G.M. (details as for R.H. cover)
CYLINDER BLOCK: one off cast iron
R.H. (HP) STEAM CHEST: one off cast iron
L.H. (LP) STEAM CHEST: one off cast iron
(non-compound version)

Having obtained one good machined face as a datum, mount the casting on this, on an angle plate bolted to the faceplate, and set-up for boring each bore in turn, moving the casting on to the headstock centreline for each one.

Fly-cut each end-face in turn either with the cylinders mounted on the saddle, or machine them in the same operation as the bores, when on the faceplate. Cutting the parts should be left until all the other operations are complete.

To machine the 2$\frac{1}{8}$ in. radius on the underside of the cylinder saddle, I found it easier to mount the casting on steel packing, on its side, using a bar and flycutter held in the chuck and moving the saddle forward to cut. Anyone with a bigger lathe may prefer to use a faceplate with the casting mounted opposite a suitable counterweight.

Difficulty of assembly

Despite the Ransomes method of getting steam from boiler to cylinder jacketing via an external elbow I have not used this method on the model mainly because of the disadvantage I mentioned plus the additional one of extreme fiddliness—a very small elbow and eight nuts which are not exactly easy to get at. If anyone wants to add an external elbow to follow the prototype in absolute detail, the sketch taken from Ransomes' drawing shows what the job looked like.

One or two other makers used a somewhat similar method of a self-contained cylinder casting fed by an external steam pipe, but preference was usually given to a pipe rather than a casting, so that the cylinder beds down firmly on the boiler and the pipe takes up any slight misalignment, impossible to achieve with rigid cast-iron connections.

Steam and exhaust passages should not present any great difficulty on the casting as they are all pretty straightforward to drill or mill, and there is not a shortage of metal around the bores. In fact, if anyone wants to enlarge their cylinder bores to 1 in. dia. in order to use Stuart Turner piston rings instead of graphited packings, they can do so, with care.

Now that the engine can really be said to be under way, I should mention that the photographs accompanying articles will be from two sources, those illustrating the full-size engine will be supplied by the Institute of Agricultural History at Reading, which is also supplying me with prints of the original maker's drawings, and those illustrating the model and its component parts will be by Bryan Morgan, who has also recently completed a full series of photographs of my 3 in. scale model of the one and only Suffolk Winchmaster steam tractor. Kits of material for construction of the boiler and all castings for *Clopton* are being supplied by Locoparts of Avonmouth, to my drawings as they appear.

Subsequent to the publication of the first article of this series I received a most welcome and informative letter from Mr. Gordon Limb of Romsley who many visitors to the late Eric Middleton's Steam Parties at Hartlebury will remember as driver of the Foden tractor *Matilda.*

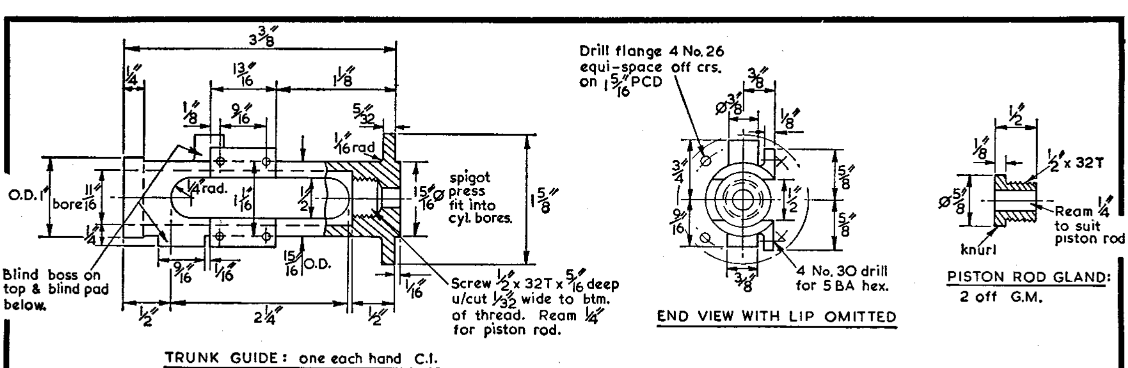
Mr. Limb, himself the owner of one of these tractors, has supplied me with some interesting information on the breed, for which I am most grateful.

Forty-eight were built, of which five survive, numbers 23266, 36220, 39088, 39127 and 39149. All these differ in some details.

Prototype differences

The engine depicted in the works photograph illustrating my opening article, No. 20047, the prototype of the class, was broken up without being sold. This engine differed from subsequent engines in that the rear wheel spokes were riveted to a single tee ring. Later examples had double tee rings in orthodox traction engine fashion. Also the pump was attached to the left-hand hornplate instead of being fitted between flywheel and belly-tank as on later engines.

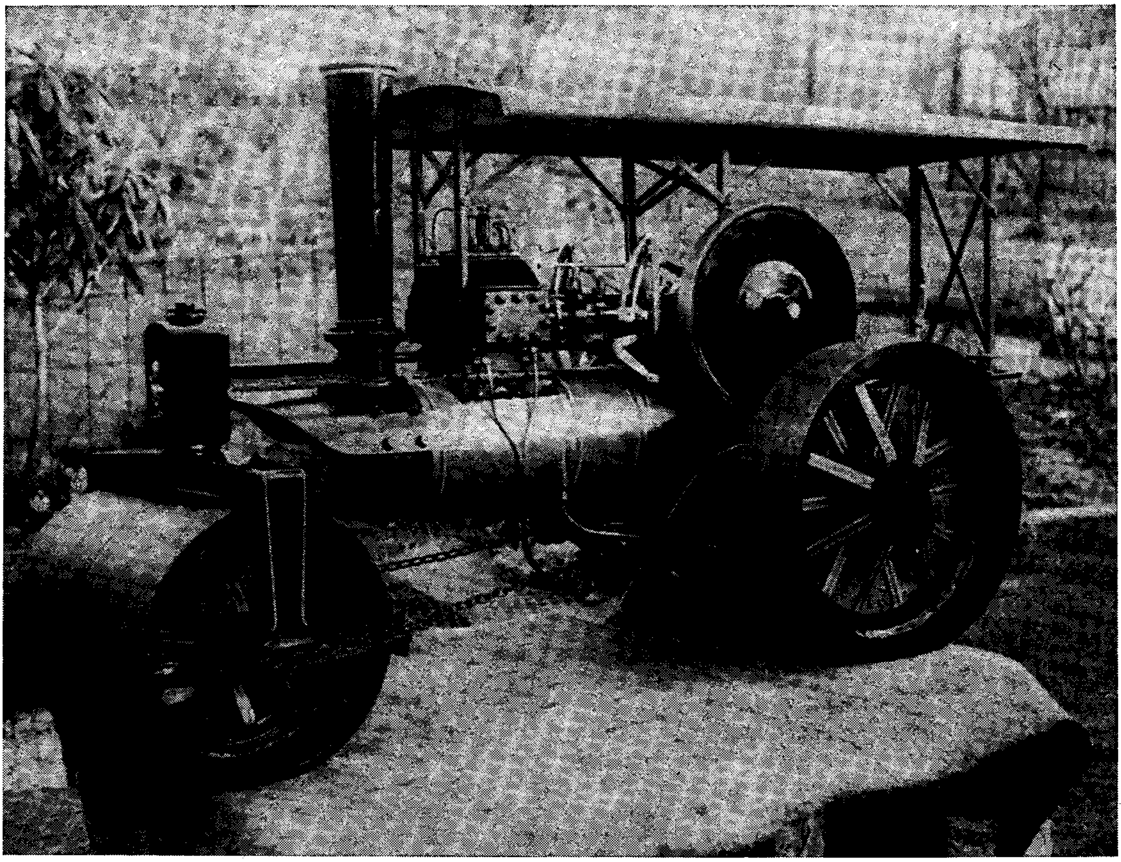
Continued on page 1121



TRUNK GUIDE: one each hand C.I.

END VIEW WITH LIP OMITTED

PISTON ROD GLAND: 2 off G.M.



AVELING & PORTER ROAD ROLLER

by M. E. Sparkes

HAVING JUST COMPLETED and test run a 5 in. gauge *Simplex,* I was at a loss as what to make for my next model. While reading *Model Engineer* I saw advertised the commencement of a construction series for a 2 in. scale Aveling & Porter road roller. At that time I was helping a fellow Club member to renovate a 13-ton single-cylinder Aveling & Porter Road Roller very similar in outline to the model described.

As the articles progressed, I read, noted and started to obtain some of the necessary materials to start construction. From the onset I decided that being a new model, not many castings would be available so pre-fabrication would have to be the order of the day. Later on in the construction series Mr. C. R. Tyler of Reading did produce a list of castings, but my course was set.

The construction of the boiler progressed with no major snags. To fit the check valve and pump bosses, clamps were made to make sure they were square to both axes before silver soldering into position.

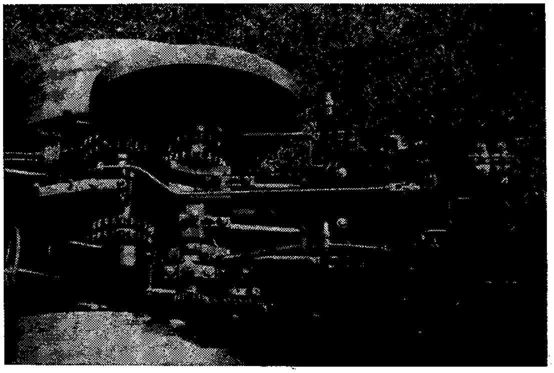
A card template was now made and used to cut the front of the boiler barrel to give the smokebox shape. The boiler was finished and tested to 200 p.s.i. hydraulic. Work now started on the steering saddle. This was rolled from a piece of 3/16 in. m.s. plate and duly shaped, the steering head being pre-fabricated from mild steel. To enable the slot for the fork pin to be made, the head was constructed of four pieces of mild steel, being a front and back plate of the outline shape and a piece either side the thickness of the slot, so that when welded together outside, no work was required inside the slot.

The chimney was rolled up and mounting bosses made and fitted to the saddle. Next came the construction of the steering fork. Again this was constructed from a kit of parts, welded up and finally shaped. The chain shoe, being of curved angle, was again constructed rather than trying to bend angle.

The drawing for the horn plates called for 3/32 in. m.s. sheet. A plea on the next Club Night "Has anyone got a piece to spare?" proved positive in the true club fashion, and the said material was handed over, and construction commenced.

The various bearing brackets and support ribs being made and silver soldered into position, they were duly bolted to the boiler sides, and it really looked like a roller. It was at this point that the decision whether or not to fit all dummy rivets was to be made. This decision was quite easy; my wife said "Put all the rivets in everywhere, it will take longer", so some 120 or so rivets were fitted in each horn plate.

The next item of construction being the cylinders, I blindly followed the author's words and music, the cylinder block being made from mild steel and the H.P. and L.P. bores bored in. Then came the drilling of the steamways between the two cylinders to allow steam from the boiler to steam dome, but all went well. Again the steam chests were pre-fabricated, and then the subsequent cutting of all portways and steam passages continued to a satisfactory conclusion. The cylinder covers, being of awkward shape, were prefabricated. The front cover was shaped and the centres were bored out to ½ in., brass turned to the diameter of each bore, then turned down to ½ in. and silver soldered into position. This then positively located the cover into position and enabled the marking-off of the cylinder studs. The rear cover was constructed the same way, so enabling a locating boss for the crosshead guide. The crosshead guides and valve spindle guides were next constructed from various bits and pieces from the scrap bin and fitted.



The crossheads were firstly turned to size and fitted to the guides, then the sides were milled down to give the correct thickness and finally the recess was cut in to enable the conrod to fit, using the vertical slide and an end mill. The pistons were next turned to size and "O" ring grooves cut in and the rods fitted. Finally the whole cylinder block assembly was built up and looked quite realistic.

The cylinder mounting saddle was pre-fabricated to give the correct height to the cylinders; when constructed it was bolted to the boiler and sealed.

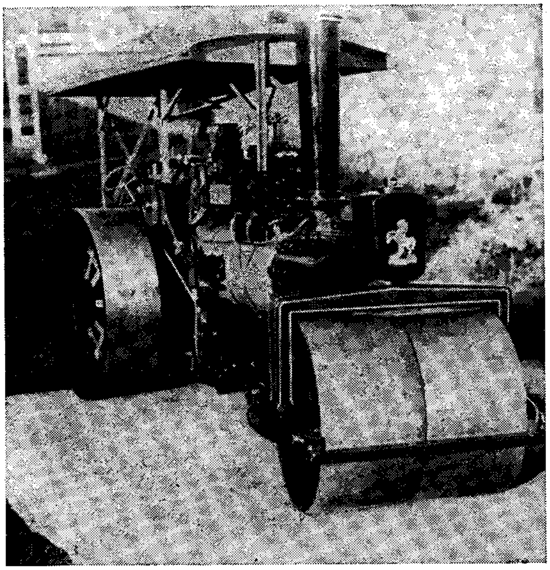
Next came the construction of the crankshaft. Again the author's words and music on the prefabrication left no stone unturned and so far no problems have arisen under steaming.

Now with the cylinders mounted and the crankshaft in position the manufacture of the con rods was uppermost in my mind. Again I waited for the delivery of *Model Engineer* with the relevant article and drawings. Rods were made and fitted, and now the crankshaft actually drove the pistons—it was all working.

At this point the decision of what material to make the flywheel had to be made. I decided to make a pattern. It was my first attempt, I may add, but with the aid and advice of another old Club member, the pattern was made and delivered to the foundry, and lo and behold they cast my flywheel. I used aluminium for the flywheel and this has proved successful under steaming conditions.

The construction and erection of the valve gear was now the next item on the list, and on erecting I found that certain measurements were adrift.

Taking new measurements, new links were made and the motion functioned. At this point some correspondence between the author and myself took place, as I was rather ahead of the published articles, and a quick and concise reply on how the valve link connected to the valve spindle allowed construction to continue to completion.



The combined pump and clack was again fabricated using a piece of $1\frac{1}{2}$ in. dia. brass rod, faced in the lathe, and then the portways machined in and finally shaped. The pump cylinder was constructed and brazed to the pump body. The bore was increased to 5/16 in. dia. but under steaming conditions I feel that even $\frac{3}{8}$ in. dia. may be required. At the base of the pump on the pump side of the clack I have fitted a small priming valve; this is to ensure the pump is primed before operation, and also as the pump is fitted directly onto the boiler side it gets very hot and has small passageways to check that when under steam the water is not flashing off to steam.

The next article provided the drawings of both front and rear rolls. At this point I wondered how I would make them. They called for cast iron castings, so away with the tools, on with the thinking cap, and various ideas were expounded and ruled out of hand. Again it was left to prefabricate, so a visit to the local scrap yard proved very rewarding. The front hubs were turned up from $1\frac{1}{2}$ in. dia. mild steel, bored and bushed as per drawing. The front rolls were constructed from 6 in. dia. BSP sockets, $\frac{1}{4}$ in. m.s. plate rolled around the outside, and seal welded on both circumferences. A ring of $\frac{1}{2}$ in. thick mild steel was welded into position to form the "tee" rim and the roll finally machined on both internal and external faces. The spokes were made from $\frac{3}{8}$ in. dia. x $\frac{1}{8}$ in. bright mild strip, and duly bent to shape. A jig board was then made to hold the roll rim and the hub in their correct positions, the spokes were then fitted, and in taking off the jig the rolls ran true.

The rear roll hubs were made from three pieces of mild steel shaped and bored for the axle. They were then welded up together, set up in a 4-jaw chuck, the bore opened out for bushing, and the spoke recess machined.

The hind roll rims were constructed from $\frac{1}{2}$ in. thick mild steel strip rolled and welded into a ring and a ring welded inside to simulate the "tee" rim. They were machined on both external and internal faces. Then came the arduous task of making the rear spokes, but armed with a new blade in the hacksaw, new files and a rag to mop up the sweat, with a few encouraging words the job was completed.

The jig used to construct the front rolls was modified and the rear rolls were duly assembled and came off quite true.

With the rolls now fitted, it looked the part and the urge to see it completed became stronger every day. The next step in construction was the addition of the gearing to convert reciprocal motion of the pistons to rotary motion at the wheels via the crankshaft. The blanks were duly machined to size, until I came to the final drive; this was to be 7 in. O.D. with 54 teeth. Again the blank was fabricated, bored and bushed, and turned to size. All the gear blanks were duly cut on a gear shaper, thanks to a very kind friend. Also at the same time the worm and wheel were made for the steering. When they returned from the gear cutters they were assembled, and when tested ran very smoothly, with no appreciable high spots. When under steam, it sounded like the full-size engine.

A brake drum was now called for to enable the hind rolls to be located in their final position on the rear axle. The drum was turned up from a piece of 3 in. dia. mild steel, an oval drive boss shaped and bored, and welded to the drum. Another part complete.

Next on the construction list was the tender. I decided to use 1/16 in. copper sheet throughout, to permit the largest size water tank, and for ease of construction. The side plates were cut and flanged and the dummy rivets fitted; the manhole is not dummy. A wood former the correct thickness of the tender inside measurement was made to hold the tender square while the wrapper sheet was silver soldered in several positions; it was then riveted completely, and finally to make watertight, a run of silver solder was applied to the joint. Next the coal bunker parting plate and tank top were fitted and the tank completed, the front plate being silver soldered into position. The water filler was fitted and also the draw bar. The 3/16 in. half-round edging on top of the tender was made from a length of 3/16 in. copper tube filed to half thickness and finally soft soldered into position. A drain plug was fitted to enable the tender to be drained.

Continued on page 1117

JEYNES' CORNER

Some Notes on Manually Operated Pumps

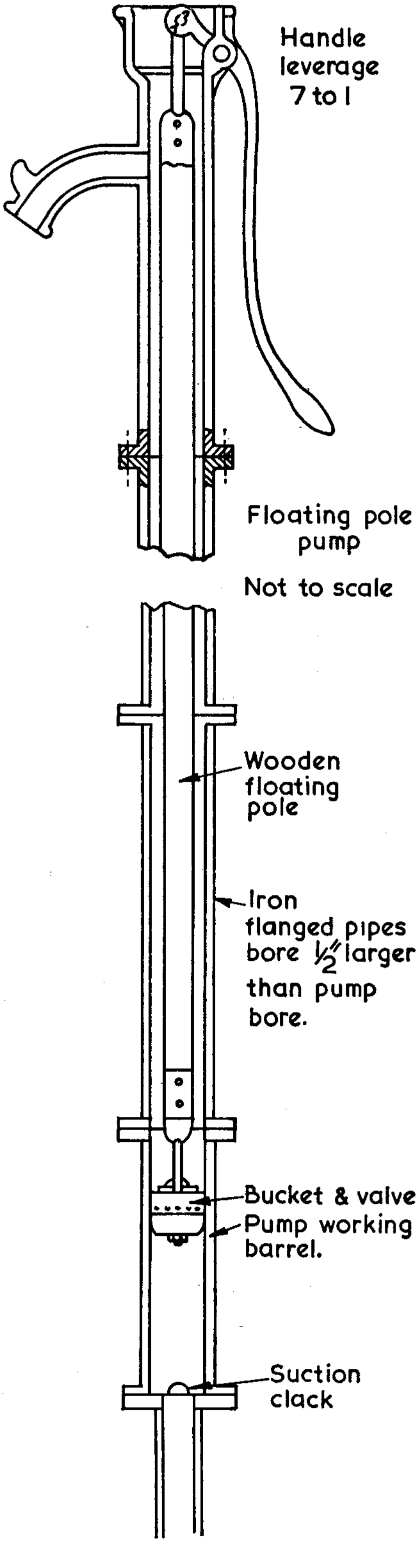
SINCE MY SERIES of articles on manually operated pumps appeared, I have had considerable correspondence with users and prospective users of this type of domestic pump. Many readers appear to live in outlying districts, far from the water and electricity mains; often without any prospect of the advent of either. One or two of my correspondents had installed a windmill to pump water, while many others had put in internal combustion engines to drive their pumps: in the latter cases, some had put in an engine large enough to provide light as well.

The purport of most of the letters I received was on the subject of the size of suitable pumps to install, should their usual source of power fail, so that the domestic supply of water could be maintained by manual operation. One or two however enquired about the floating pole pumps I had mentioned, suitable for shallow wells, and I herewith give a rough sketch of one, and would mention that, should the water be known to cause rapid deterioration of iron, gunmetal fittings should be used, at least on the lower end of the pole. It will be noticed that owing to the long pole between bucket and handle, it is not necessary to fit any kind of parallel motion, such as the rocking standard. By studying the sketch, it can be seen that the pole and bucket can be withdrawn for inspection or repair, without having to dismantle the pump, except to remove the handle.

Many of these existing pumps are of considerable age, and in some cases the occupants of properties have thought of purchasing a new pump, say a 4 in. bore to replace a 3 in.; thinking to reduce the pumping time. If the pump is worked by hand this is a great mistake, as if the pump is a lift and force pump of the type generally in use to fill roof tanks, it will probably make the work so much harder, that much less water will be lifted in a longer time, previously the pump being worked by one person, it might now require two to work the pump continuously.

The average country house of two storeys with roof tanks, and a water level in a well 30 feet below ground, requires a pump capable of a 60 feet total lift. Now the average man can exert a force on a pump handle of about 25 lb. continuously, and looking at the old-time pumpman's pump barrel table it will be seen that a 3 in. bore pump requires a force of 30 lb. to be exerted for a 60-foot lift. This would be too hard work for a female member of the household.

Now to the mathematics of it. Say a 4 in. pump had been considered, I previously mentioned that the average man can exert a force of 25 lb. on a pump handle continuously; with a leverage of 6 to 1 this becomes 150 lb. Now take the area of the 4 in. bucket (using the old-time calculation, multiply half the circumference by half the diameter), it is seen that the area is roughly 12 square inches (I would say that multiplying the square of the bucket diameter by .7854 might be said to be more accurate). This 12 square inches has the pressure of a column of water 60 feet high upon and below it (the whole having to be moved with each stroke), which amounts to roughly 360 lb., not to mention friction on bends, pipe skin effect, etc., so it can be seen that it would be impossible for an average man to work this size of pump continuously.



It will be noticed in the pump barrel table given here (which I copied from my grandfather's copper-plate handwriting) how the theoretical pressure on the foot valve mounts up, as the lift becomes greater. Where a pump is hard working, the work can be made much easier by the fitting of a crankshaft with a heavy flywheel, especially if this can be geared up, so that it can act as an accumulator of power, absorbing it on the down stroke, and giving it out on the up stroke. No more power is gained, but the work will be much easier. The fitting of air chambers will also make the work easier, and the flow of water more continuous, besides easing the wear of valves.

To conclude, I would say to the "Do it Yourself" men: never enter a well, even a shallow one, without lowering a lighted candle down to water level; if it is repeatedly extinguished, it is unsafe to enter. The foul air can be expelled usually by lowering a glowing brazier on a chain, the heated air rising and fresh air entering.

Old-time Pump Man's Table for Pump Barrel Size

A	B	C	D	E	F
10	6	1381	20	4.33	
15	5½	1161	25	6.49	
20	5	959	28	8.66	Too hard for continuous working.
25	4½	777	28	10.82	Too hard for continuous working.
30	4	614	27	12.99	
35	3½	470	24	15.16	
40	3½	470	27	17.32	
45	3½	470	31	19.49	Too hard for continuous working.
50	3	346	25	21.65	
55	3	346	28	23.82	Too hard for continuous working.
60	3	346	30	25.99	Too hard for continuous working.
65	3	346	33	28.15	Too hard for continuous working.
70	2½	240	24	30.32	
75	2½	240	26	32.48	
80	2½	240	28	34.65	Too hard for continuous working.
85	2½	240	31	36.82	Too hard for continuous working.
90	2½	240	33	39.98	Too hard for continuous working.
95	2	154	21	41.15	
100	2	154	22	43.31	

Where noted "too hard for continuous working", fit next size smaller pump.

A. Total height of water lift in feet.
B. Pump bore in inches.
C. Estimated gallons per hour raised at 25 strokes per minute.
D. Pressure in pounds required to be exerted on pump handle. 6 to 1 ratio.
E. Theoretical pressure in pounds per square inch on footvalve.
F. Practical notes on working, based on average man power.

Note: For ordinary calculations the atmospheric pressure is taken at 15 lb. for convenience sake in mental calculations, etc. Actually the pressure varies with the state of the barometer, and altitude.

AVELING & PORTER ROAD ROLLER—*Continued from page 1115*

Provisions at this stage for brake gear and water supply cock supports were made. Various other loose ends were now connected up, i.e. regulator spindle, exhaust blast pipe and all the plumbing.

At this stage the roller was air tested and ticked over like a sewing machine at about 50 p.s.i. of air. Next came the fitting of the steering gear, as it was now easier to roll the roller on its rolls than carry it; the only omission from the drawing was not to fit a gear casing around the steering worm wheel.

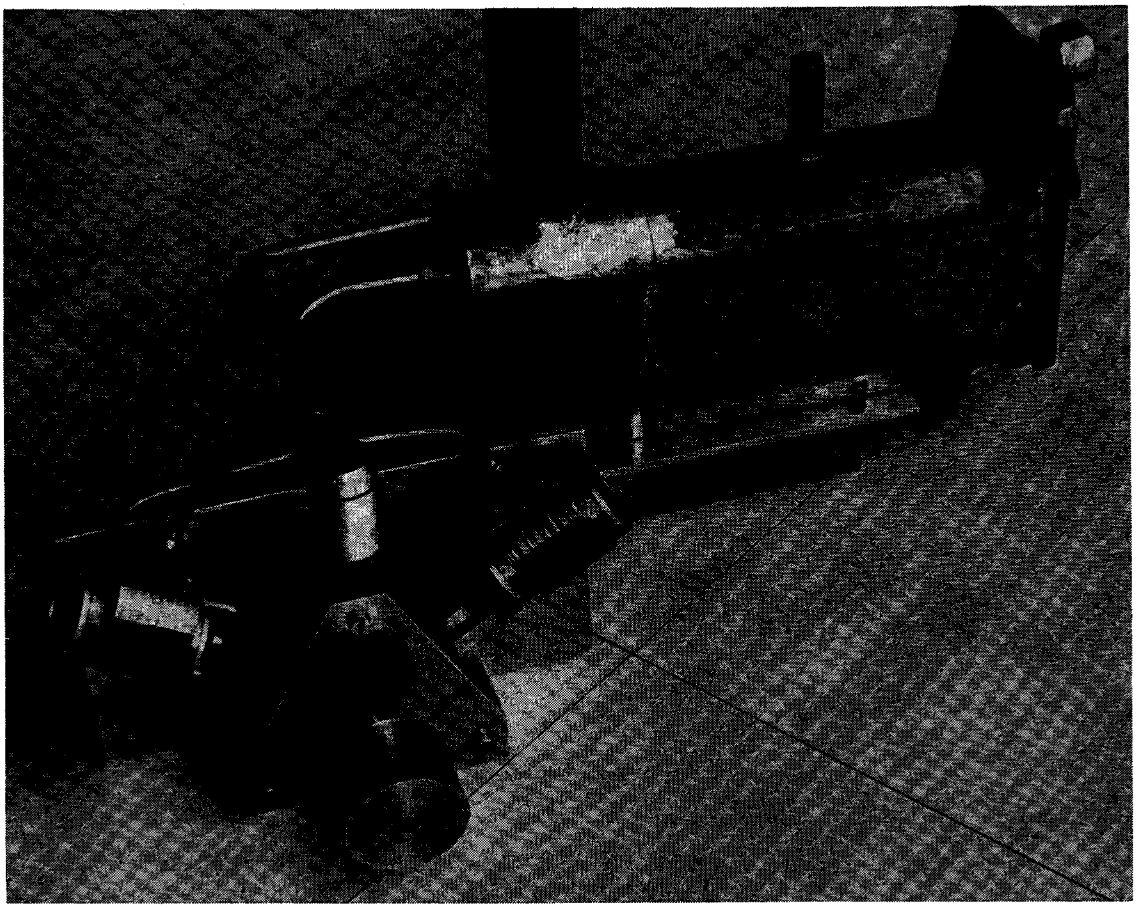
The actual steering chain is a commercially-obtainable plug chain which does not look too out of scale and so far appears quite strong enough.

The lubricator was next on the agenda and the design and construction was very good. Though larger than life, it does not look out of place, the drive of the lubricator being taken from the water pump eccentric sleeve bolting face. The grate and ash pan were duly made and fitted, leaving only the canopy to make and fit. This was made from 1/16 in. aluminium sheet, the guttering being shaped around a 5/16 in. dia. m.s. rod. The strengthening rods were then fitted.

The canopy standards were to be of ⅜ in. x ¼ in. channel. None was available so strips of 1/16 in. brass were cut, annealed and formed in a plate bender and finally shaped around a piece of 5/16 in. square key steel.

With the canopy now complete and fitted, only the trade plate casting on the cylinder and the "Invicta" emblem remained to finish the model.

In closing, my thanks go to John Haining, the author, for his clear, concise articles and drawings and prompt replies to my letters when all was not well; to Mr. John Stannard, the roller owner who allowed me to climb over and literally take to pieces his full-size roller for information; to all my colleagues of the Romford Model Engineer Club who gave encouragement and advice when asked for; and also to Mr. Dave Bateman for the photographs.

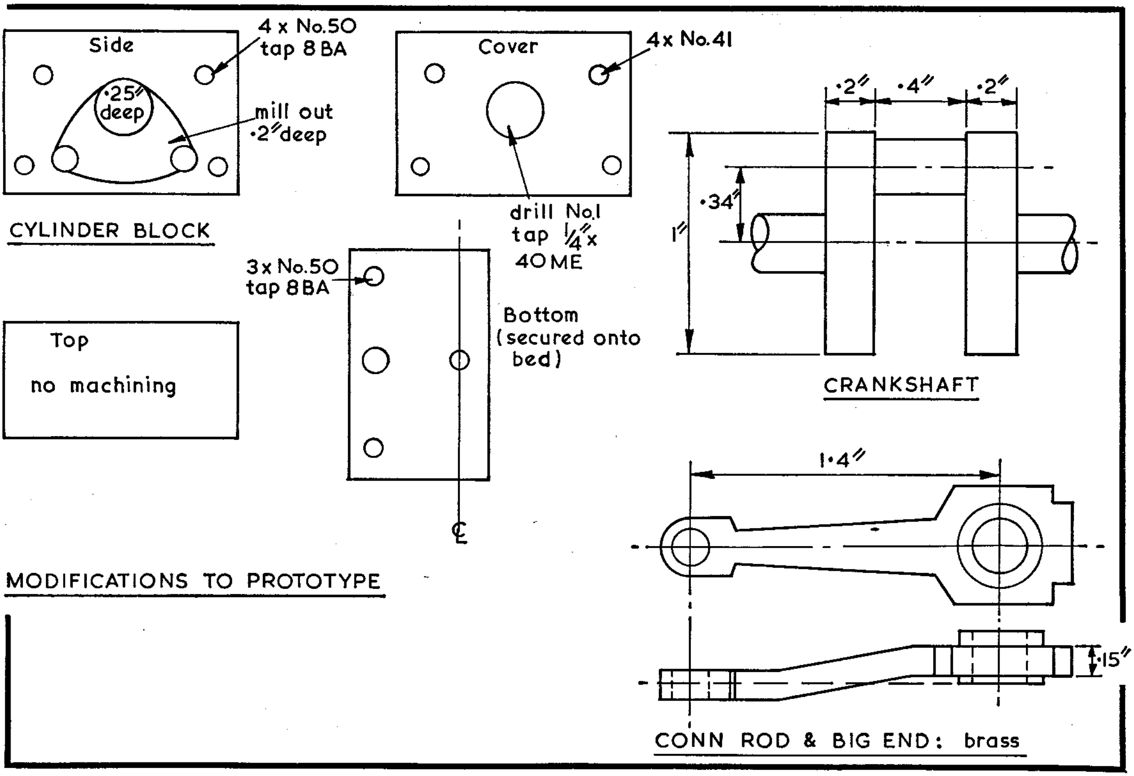


A V-TWIN VALVELESS STEAM ENGINE

R. L. Tingey concludes his description of this interesting engine by giving constructional details

THE CYLINDER BLOCKS are much simplified, with no lubricator, regulator, exhaust passage or safety valve, just a hole for the cylinder, and steamways to two faces. With two basic units to hand (one left and one right) they are fitted to the vertical alloy bed. A front plate is supported by three pillars. The front plate and the bed are drilled out, while clamped together, for the pillars and the bushes for the crankshaft. The three pillars are flycut in the lathe while clamped together, to get them square and the right length. All positions are scribed on the vertical bed as shown, using the extremes on the throw to position the units on the scribed angles, with the hole on the centre line of the exhaust face of the cylinder block being used to position each unit.

The crankshaft is made as before, but with slightly larger webs to take the longer throw, and a longer crankpin for the dual big ends. No trouble should be experienced in brazing this if the flat is cut on the piece for the web after drilling and before slicing through; the crankshaft sits on the now two flats for brazing up, all in line.



The connecting rods are made from 1/8 in. b.m.s., by hand, after drilling the big and small ends. They are then bent up in a vice before fitting the big end brasses.

The big end brasses are turned down from ⅝ in. phosphor bronze. Cut a piece about 1½ in. long, saw down into the end ½ in., then cut one half out. File the cut flats to perfection and Comsol solder the half back into place, which will be a little displaced, before turning down the two brasses on the lathe, drilling the hole 6 mm. Ream out to ¼ in. only after the brasses are in the big ends, and before melting the Comsol. Run the fitted brasses together on the crankshaft, using plenty of Brasso, to run them in.

Make all the other bits and pieces and assemble (including the displacement lubricator, which works a treat). Everything should feel very tight, so run in a little, with "3-in-1" everywhere, on the Unimat; listen for squeals and groans while running-in quite slowly, and ease any tight motion fittings.

Running In

Fit a nice heavy flywheel and give a pneumatic run on an air compressor at about 50 psi, fill the lubricator with "3-in-1", and, after a few minutes of assisted tick over, if all is well, it will begin to show signs of life and run quite fast throwing oil and air from the exhaust left open at the back of the bed. The pressure can be gradually reduced until the engine will run well at about 35 psi. Refill the lubricator and let the engine tick over for an hour or so to run it well in before applying steam. When the engine feels to have an easy cycle fit a collar each side of the shaft, and the correct flywheel.

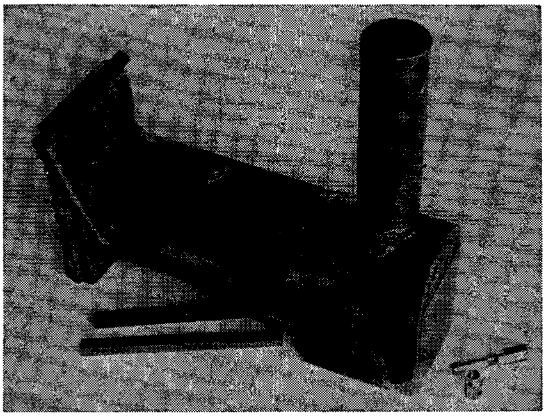
Before running with steam refill the lubricator with Valvata, and oil all moving parts with a thicker oil than the "3-in-1". The lubricator, when full, has space enough above its feed hole to lubricate by gravity the two engine units plus a little back to the regulator, which is warming up at the smokebox end of the boiler.

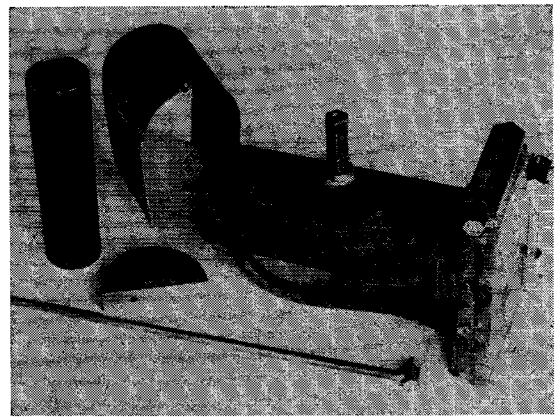
Under steam the engine runs well from about 30 psi at all speeds with good regulation, up to about 50 p.s.i., which is the maximum steam pressure so far obtained on this boiler.

The Boiler

The little boiler I made for this job has several interesting features built into a brass block, mounted at the smokebox end.

The boiler has a 5 in. long, 2 in. dia. copper shell, and has two water tubes. The backhead, with the usual water and steam gauges, incorporates a dome milled from hexagon brass, from which the steam is taken through the fire-space to the smokebox and into a thick brass block mounted right at the front.

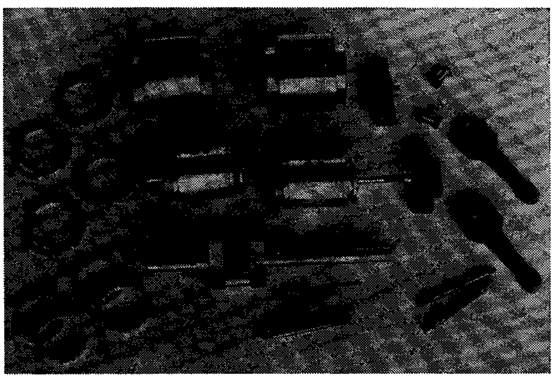




Top, left and right: The boiler under construction showing all necessary parts.

Left: The main components of the two engine units.

Below: Flycutting the three clamped-up pillars.



The steam passes into a piston type regulator in the block, which is at smokebox heat, and should cause little condensation. The mainstay of the boiler protrudes into the smokebox area and has two untidy plates of 16 s.w.g. copper fixed to it to extract more heat from the fumes before they go up the chimney.

The exhaust is brought back to the block at the smokebox end to an exhaust nozzle, blowing up the chimney. The exhaust tube in the block has a large hole opening into a sealed tank beneath the block. This tank catches most of the condensate which blows out of the exhaust otherwise, and, the tank being at smokebox heat, it converts the condensate back to steam and this blows out of the chimney instead, providing a blower effect. At the end of a run, upon cooling down, the tank gets quite full of water, which provides steam blow when heating up on the next run.

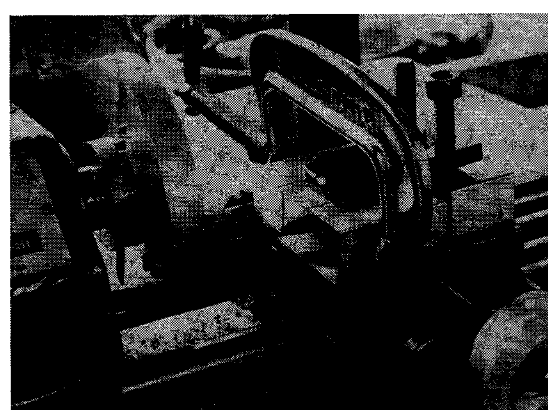
The boiler has a mounting pad on its backhead for a water feed pump.

The lubricator is made from a $\frac{3}{4}$ in. dia. piece of aluminium alloy bored 10 mm., 20 mm. deep, with a hole drilled in the side, No. 1, just touching into the bore and tapped $\frac{1}{4}$ in. x 40 M.E., to be suspended from the fourth end of an "X"- piece taking the steam to the two units. The lid is made from similar material and fitted with a hallite gasket, the lid is coarse threaded into the body. After a good run it will be full of water with a skim of oil on top, just as it should be.

In Conclusion

The engine will self start from any position on opening the regulator, providing the steam pressure is sufficient. To change the direction of rotation the flywheel needs to be given a half turn in the required direction. Remember that if the engine and a boiler are fitted below decks in a boat a supply of air is required for the fire, and, for prolonged running, a supply of water will be needed for the boiler via a feed pump.

At the moment I am finishing off the little traction engine, and have started on the drawings and details which may appear herein. I have in mind a larger version of the single unit which I intend to run as a single cylinder vertical engine, just to prove that a larger version will work as well, even against gravity.



Light Steam Tractor—*Continued from page 1112*

All engines had a relief-valve, as I have already mentioned, set horizontally on the L.P. valve chest to blow off at 100 p.s.i. into the chimney, and light springs were fitted above the boiler clack valves to return them smartly to their seats. Speeds on the road were about 10 m.p.h. on steel strakes and 15 m.p.h. on rubbers, the rather high gearing making the job of getting away under load on a slope a bit tricky, and, conversely, reversing the engine didn't retard its progress much! Rear wheel strakes were ½ in. apart except on 39149 which has a wider gap; the other three are mounted on rubbers.

Numbers 23266 and 36220 have oval maker's nameplate on valve-chest covers, the others having the R.S.J. monogram. Gardner governors were fitted except to No. 23266 which has a Pickering governor. Although most of the survivors have wooden canopy roofs, the originals had felt roofs on rafters, and Mr. Limb quotes a farmer telling him that they could always tell if it was the Ransomes engine coming to thresh by the felt flapping up and down as it crossed the field!

Despite any apparent shortcomings in the construction of the canopy, older employees of Orwell Works always maintained that the standard of workmanship on Ransomes engines of all types was far higher than found on some other makes, a fact I can confirm from my apprentice days in a small country works undertaking, among a variety of other steam work, overhaul and repair of traction engines.

To be continued

CLUB DIARY

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

OCTOBER

7 **Models Progress,** Foxhole Community Hall, Paignton, Devon.
7 **Brighton & Hove.** Club Auction.
7 **Lincoln M.E.S.** Monthly Meeting. Unitarian Chapel, High Street, Lincoln. 7.30 p.m.
7 **Rochdale S.M.E.E.** Annual General Meeting. Technical College, Rochdale. 7.30 p.m.
7 **Stockport & District S.M.E.** Bits and Pieces. The Parish Hall, Church Road, Cheadle, Cheshire. 8 p.m.
7 **Romford Model Engineering Club.** Competition Night. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch Essex. 8 p.m.
7 **Ickenham & District S.M.E.** Club Auction. Rear of Coach and Horses, Ickenham. 8 p.m.
8/9/15/16 **Norwich & District S.M.E.** Invitation from John Bilton of The Poplars, Tivetshall St. Margaret, Norwich—locos will be in steam on his 7¼" gauge railway.
8 **M.E.S. of Northern Ireland.** Monthly Meeting. Strathern Hotel, Holywood, Co. Down. 3 p.m.
9 **Harlington Locomotive Society.** High Street, Harlington. 2 to 6 p.m. Public Open Day.
9 **Harrow & Wembley S.M.E.** Public Running. Roxbourne Park, Field End Road, Eastcote. 2 p.m.
9 **Northampton S.M.E.** The Society will hold its Members' Cup Trial in Delapre Park, London Road, Northampton. Starting at 10 a.m.
9 **Bracknell Railway Society.** Public operation of Jocks Lane track, Bracknell, Berks. 3 p.m. to 6 p.m.
10 **Wirral M.E.S.** Traction engine evening. Victory Hall, Upton. 7.30 p.m.
10 **Bedford M.E.S.** Clock Making.
10 **Clyde Shiplovers' & Model Making Society.** Visit to new shipping hall, Museum of Transport, 25 Albert Drive.
10 **King's Lynn & District S.M.E.** Monthly Meeting. St. James School, London Road, King's Lynn. 7.45 p.m.
10 & 24 **Peterborough Society of Model & Experimental Engineers.** Meeting at Clubhouse, Lincoln Road, 7.30 p.m.
11 **Guildford M.E.S.** Executive committee meeting.
11 **Romney Marsh Model Engineering Society.** Film Night "E for Experimental" Church Hall, New Romney. 7.30 p.m.
11–15 **Derby S.M.E.E.** Model Engineering Exhibition. Queen's Hall, London Road, Derby. 9.30 a.m. to 9 p.m.
12 **Norwich & District S.M.E.** Bring and Buy Auction.
12 **Harrow & Wembley S.M.E.** Loco Meeting. St. Andrews Church Hall, Malvern Avenue, South Harrow. 7.45 p.m.
12 **Southampton & District S.M.E.** A. C. Sterndale experiences at Swindon Loco Works. To be held at Atherley Bowling Club, Hill Lane, Southampton. 8 p.m.
13 **Leyland, Preston and District S.M.E.** Meeting. Roebuck Hotel, Leyland.
14 **Ickenham & District S.M.E.** General Interest Nights. Rear of Coach and Horses, Ickenham.
14 **Polegate M.E.C.** Annual General Meeting.
14 **Tonbridge M.E.S.** Jubilee Year Dinner. Bligh's Hotel, Sevenoaks, 7.30 for 8 p.m. £4 each.
14 **Melbourne S.M.E.E.** Reproducing Old Clocks. D. Batten. 92 Wills Street, Glen Iris. 8 p.m.
15 **Society of Model and Experimental Engineers.** Studio visit—Photographic methods for model engineering.
16 **King's Lynn & District S.M.E.** Final round inter club competition at Standground (Peterborough). 10 a.m.—functional and scale steering.
15/22 **Pontins National Model Makers Festival** at Brean Sands, Burnham-on-Sea, Somerset.
15/16 **Papplewick Pumping Station.** 1884 Watt beam engines in steam. Details from: G. P. Barnes, 16 Arthur Street, off Waverley Street, Nottingham.
16 **Worcester and District S.M.E.** Public Running Day. 3½" and 5" elevated and 3½",5",7¼" ground level tracks. Waverley St. Digils. 2.30 p.m.
16 **King's Lynn & District S.M.E.** Public Running. Walks Track, London Road, King's Lynn. 2 to 5 p.m.
17 **Wigan & District M.E.S.** Meeting in Co-operative Guild Room, Thompson Street, Whelley. 7.15 p.m.
17 **North Wales MES.** Meeting at Penrhyn New Hall, Penrhyn Bay, Llandudno 7.30 p.m.
18 **Sutton Coldfield & North Birmingham M.E.S.** Auction.
19 **Guildford M.E.S.** Bits and Pieces competition.
19 **British Rail Staff Association Club.** St. Vincent Street, Ladywood, Birmingham. 7.45 p.m. Mr. Relph—lecture—remote control steam locos.
19 **Bristol Soc. of Model & Experimental Engineers.** Hot air engines described by E. Chapman.
20 **Hull S.M.E.** "The Experiences & Tribulations of a Boiler Inspector"—talk by Mr. W. Rooke. Trades & Labour Club (Room 3), Beverley Road, Hull. 7.45 p.m.
20 **Nottingham S.M.E.E.** Festiniog Railways into the 80's. Mr. G. Caddy. The Friends' Meeting House, Clarendon St. Nottingham. 7.30 p.m.
21 **Brighton & Hove Society.** The Pullman Car Co., talk.
21 **Rochdale S.M.E.E.** Mr. V. Beswick: Swing Boats. Rochdale Technical College. 7.30 p.m.
21 **Stockport & District S.M.E.** Mr. F. Hulley—Talk, illustrated with slides. The Parish Hall, Church Road, Cheadle, Cheshire. 8 p.m.
21 **Ickenham & District S.M.E.** General Interest Night. Rear of Coach and Horses, Ickenham.
21 **Romford Model Engineering Club.** Talk or Films. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch, Essex. 8 p.m.
23 **Harlington Locomotive Society.** High Street, Harlington, Middx. 2 to 6 p.m. Public Open Day.
21/22/23 **The Elizabethan Railway Soc.** Annual Exhibition at St. Michael's Church Hall, Outram Street, Sutton-in-Ashfield, Notts. Friday 6.30 to 9.30 p.m., Saturday 10 a.m. to 9 p.m., Sunday 10 a.m. to 5 p.m. Details from P. Wright, 15 Sandhurst Avenue, Mansfield, Notts.
22/23 **Urmston & District Model Engineering Society Ltd.** Models Exhibition. Flixton Secondary School for Girls, Flixton Road, Flixton, Manchester.
22 **G.E.C. M.E.S.** Copsewood, Coventry. Bonfire Night and Night Run. All visitors welcome from 2 p.m. "Hot Dogs" and refreshments available. Drivers: Don't forget your red rear lamps!
22/23 **Hanwell & District Model Society.** Model Exhibition—22nd 2 to 8 p.m., 23rd 10 a.m. to 7 p.m. Hanwell Community Centre, Westcott Crescent, London W7
23 **Harrow & Wembley S.M.E.** Public Running. Roxbourne Park, Field End Road, Eastcote. 2 p.m.
24 **Bedford M.E.S.** Informal Meeting—Restoration of Brough Superior Motorcycles.
24 **Clyde Shiplovers' & Model Makers' Society.** Model makers discussion night.
25 **Romney Marsh Model Engineering Society.** Bits and pieces evening. Church Hall, New Romney. 7.30 p.m.
26 **Birmingham Society of Model Engineers Ltd.** Illshaw Heath—35 mm slide comp. Bring along your best six slides.
26 **Harrow & Wembley S.M.E.** Film Night. St Andrews Church Hall, Malvern Avenue, South Harrow. 7.45 p.m.
26–29 **Ilford & West Essex Model Railway Club.** Ilford Town Hall, Ilford High Road.
27 **Leyland, Preston and District S.M.E.** Meeting. Roebuck Hotel, Leyland.
28 **Ickenham & District S.M.E.** 16 mm. Films. Rear of Coach and Horses, Ickenham. 8 p.m.
29 **North London S.M.E.** Club Hallowe'en Party—Colney Heath.
29 **Romney Marsh Model Engineering Society.** Portable track at Canterbury (in aid of Cathedral Appeal).
29 **Society of Model & Experimental Engineers.** Informal Meeting—Loco Topics.

HORSE-DRAWN VEHICLES

Bernard B. Murdock concludes his articles on these fascinating vehicles by discussing the finishing of a model and explaining the right terminology

Part II *From page 998*

LAMPS CAN BE MADE from sheet brass, or even tinplate, although brass is best, while thin sheet copper is finest of all as it is so easily flanged, etc. The glasses of lamps, of course, can be formed of perspex, and many such lamps, even the cheapest types, ordinary van lamps, had bevelled glasses to them.

The painting of such models is an art in itself which not all modellers can tackle confidently, but, as ever, practice makes perfect. Thin coats of paint, with every coat well rubbed down before another coat is put on, is one of the secrets of a fine finish, while naturally every little imperfection in a surface must be filled up before any of the paint is applied. Wet-or-dry paper, used on those final coats, is one of the coachpainter's secrets, even for the in-between rubbing of those last coats of the palest copal varnish. While speaking of varnish, it is best to avoid polyurethane as it dries far too quickly, so stick to the kinds sold for model-work, which dries at a sensible speed.

However, that is all I am saying about painting now; maybe, another article can be the source of some of the real gen later on. In these mechanical times, there are few people who really know the correct terms of the wagon and coachbuilder, so here are the basic ones, for interest.

Firstly, a cart, while often being a horse-drawn vehicle, is certainly not the term used to denote all such vehicles; although there are many people who will use the word to describe any horse-drawn vehicle, even a coach at times, which is surely pure sacrilege.

A true cart is only a two-wheeled vehicle, not necessarily animal-drawn, either, as hand-barrows, trucks, etc., are all of the true genus cart, while it may perhaps be argued that even a bicycle is a form of cart, albeit, with wheels in tandem. Thus, farm tumbrils, Scotch carts, etc., are truly carts, whereas farm wagons, with four wheels, are just that—wagons, as are other types with no head, or roof, and an open body. Flat vehicles, such as a coal trolley, are thus, trolleys, while in the Midlands, Lancs., Yorks., etc., such are referred to by the age-old name of rully, and in the south, are equally correctly termed lorries, even lurries, or drays.

What's in a name?

Those types with a head, or superstructure, are, nowadays, loosely called vans, which subdivide into tilt-vans, or covered wagons, and those with a solid head are also vans, but usually box-vans, to distinguish the actual types. At one time, any vehicle with four wheels, with or without sides and without a head, was referred to as a van. There are also, of course, two-wheeled vans, which are quite correctly termed thus, while they are equally carts. Such nomenclature is probably misleading to the layman, but so, often, is it to even the expert in the field! A float is, correctly, a low-hung two-wheeled vehicle, not just a vehicle, of any type, to carry milk! The original term described those beautiful little carts of that low-hung type used by almost every dairyman in the past to deliver milk, and the term has simply come to be associated with present-day milk vehicles. But there are other types of floats, as well as the milk variety; even some few carriages are actually floats, while the well-known Pickering floats, which are either used for trade purposes or as a handy carriage, or runabout, are a case in point. But a true milk float was specially designed for that purpose, and what pretty little things they were, often with brightly-polished brass rails to their sides, to say nothing of that big churn, also of brilliantly-polished brass. The coming of the bottled milk made such little beauties largely obsolete, but not always, as there were quite a number of them, in the later years, which carried the bottles, such as those built for the Burnley Co-operative Society, in Lancs., as late as the 1930 period, which had solid-rubber tyres, like many carriages. All floats, *A view of a "Warner" pattern wheel with a cast-iron collar shrunk on to the centre part of the nave. Note the chamfering of the frame members, for decoration and weight saving.*

correctly, are only horse-drawn vehicles. But, if you set out to build a milk-float, do not put one of those china models of a Shire in her shafts, as such big horses never pulled milk floats! Only cobs, or ponies, the smaller types of draught horses, were ever in those vehicles. And, while mentioning those china models, the sets of harness, said to be perfectly authentic, are often certainly not; they are usually only passable. Have a look at a full-size set and you will see what I mean. At least such harness will need a lot of adjustments before it will satisfy any true enthusiast who knows what is required!

Making the horse

I carve my model horses from chipboard which I laminate into blocks of pre-shaped sections, and then shape up with a rasp, which makes a fine and accurate job, too. Also, horses are not highly glossy, like those china models, but have a sheen, which, in a model, can be exactly simulated by using matt-type undercoat paint, or even some emulsion, which, on chipboard, acts as a first-rate filler for the surface, as well as producing a natural semi-gloss to simulate the coat of the animal.

Finally, a few more words about wheels. Most farm wagons have 12 spokes in their front wheels, and 14 in the hinds, which looks just right. The carts usually had 14 in their wheels, for only 12 looks too few. Small-wheeled vehicles, such as trolleys, those with four equal-sized wheels, almost without exception have 12 spokes in their wheels, which, again, looks exactly right for such wheels. There are many types of wagon, also vans, carriages, etc., which have 12 spokes in front and 14 behind, especially the heavy wagons, etc., while many more have 14 in front and 16 in the hinds. Note that, to get a truly balanced effect in any vehicle's appearance, there should be those proportional numbers of spokes to the wheels, or two more in the hinds than in the fronts. It is not completely the rule, but variations were usually the result of some wheels having been changed at some time. Most caravans, almost universally in fact, had the "12 in front, 14 behind" ruling, although, where in the uncommon cases of equal-sized wheels, there were 12 at both ends, of course.

Very rarely indeed were the spoke-numbers I quote ever exceeded although there were some of the London pair-horse omnibuses which had 16 in the front and 18 in their hind wheels, which certainly made those wheels look too crowded, and really spoilt their appearance; they were usually of the artillery pattern, by the way.

The best-looking horse buses were those with either the most-common sets of spoking, which I will term "12 and 14" for ease, or those with 14 and 16. However, attention to such points of detail will ensure that a model of a horse-drawn vehicle is really authentic; such fine itemising will be really worthwhile!

A helping hand

I can always be contacted via the Editor of this magazine, so, if any modelmakers are desirous of getting into touch with me over details of horse-drawn vehicles, I am at their service. The tremendous growth of interest in this branch of the hobby has been truly astounding in the last few years, which is exceptionally gratifying to me as I have been almost all my life with such vehicles, and still am, and it gives me enormous pleasure to see such interest, which, somehow, I always knew would come, one day. It is a peculiar trait of human character to take greater interest in anything that has suffered an eclipse, for some reason.

REPLACING A MILL ENGINE CRANKPIN IN SITU

by A. Haworth

SOME FORTY-FIVE YEARS AGO, in the 1930s, I received a call from a cotton mill in a N.E. Lancs. cotton weaving town. The complaint was that the engine's crankpin was running very hot.

The engine was known to me as a horizontal tandem compound of some 500-600 i.h.p. and typical of its time. Arrangements were made to visit the engine room shortly before stopping time on that day. On arrival at the mill the writer found that the crankpin was extremely hot with a cold water service playing on the pin. It was decided to keep running to the end of the shift. Meanwhile it was asked if any work of any sort had been done at this end of the engine or indeed, anywhere on the engine recently. The answer was no.

Upon shutting the engine down and allowing the pin to cool off, an examination was made. The crankpin brasses appeared to be in one piece without any undue movement, although somewhat tight on the pin. The wedge adjusting gear behind the brasses was also in order. The connecting rod also appeared to be in line.

Attention next turned to the pin itself. This was mild steel and six inches across its working diameter. As was the usual custom, this was shrunk into a slab crank with a dowel about 1½ in. dia. driven in such that half the dowel was in the crank and held in the pin, from the back of the crank. It has never yet been satisfactorily explained to me what the purpose of this dowel is, since if the shrink fit is holding, then no load of any kind is transmitted to the dowel. I believe that this was a contribution to the policy of "belt and braces" so beloved of engineers of the past.

However, to return to the pin. A closer examination soon showed that the back of the pin in the crank was depressed by ¼ in. below the face of the crank, and consequently protruding ¼ in. from the face of the crank on the opposite side! This proved beyond doubt that the pin was loose in the eye of the crank and was moving transversely, thus forcing the crank collar against the brasses.

A discussion then took place between myself and the directors of the mill as to the possible repair. I had already decided that the only repair was a new crankpin and brasses, and this was agreed. It was decided not to run the engine until this was done.

A start was made immediately. First the connecting-rod was removed. A fully dimensional sketch was then made of the crankpin and the brasses, together with any necessary pin-gauges. It should be said here that it was the common practice in those days to make pin gauges when "measuring up", especially that of interlocking components. The gauge consisted of a suitable length of black mild steel about ⅜ in. dia. and ground down to a point at each end. This was then filed down to its correct dimension and became a fixed micrometer length of that desired. The sketches and gauges were then forwarded to the works for a start to be made on the brasses and the rough machining of the crankpin.

We now returned to the engine. The next step was to remove the crankpin. Since we did not know the degree of looseness between crank and pin, a decision was made to try and remove the pin in the cold condition; that is, without the application of any heat. The manner of doing this was as follows: a six-foot length of six-inch diameter steel bar, commonly called a "tup", is suspended on chains from the crane hook and in line with the crankpin. A suitable drift is interposed between the tup and the pin and the tup started swinging, applying heavy blows to the end of the pin.

After many hours of this treatment it was obvious that the pin was beginning to come. It was also evident that the surface steel of the pin was beginning to "pick-up" the surface steel of the crank-eye. Since there was an interference fit between crank and eye, this was hardly surprising. This occurrence, however, necessitated a rebore of the crank eye itself, which would in any case have been necessary, since a loose pin invariably results in a loss of roundness in the eye.

Once the old pin was removed, preparations were made for the re-boring of the crank-eye. The diameter of the bore of the eye was 7½ in. and a choice of a suitable portable boring bar was made. This bar was 4 in. dia. and about six-foot long. In a groove in and running down the centre of the bar is the lead or feed screw. This was about ¾ in. dia. with a square thread about ¼ in. pitch protruding from the bar at one end. On this end was fitted a train of gears to give a fine feed to this screw at every rev. and driven by a sun and planet gear by a weight. On the boring bar itself was a boring head which engaged with the feed screw via a nut, and itself traverses along the bar. In this head the boring tool was secured. The whole bar and head is threaded through the eye and held in bearings which are bolted to the main engine bed via packings, etc. The non-gear end of the bar is fitted with a suitable belt pulley and driven from a portable steam engine bolted down to the engine room floor.

A minimum of metal is removed from the crank-eye at a fine feed. It should be noted that the main engine is scotched and held fast whilst reboring is taking place.

Shrink allowance

After finish boring had been done, an accurate pin gauge was made of the bore. In those days the usual shrink allowance was .001 in. per inch or slightly less, in this case a total of .007 in. The pin gauge was sent to the works, where .007 in. would be added to this to finish machine the shrink fit diameter. The pin would therefore be .007 in. larger in diameter than the eye in which it is to fit. The eye had therefore to be expanded .007 in.-plus by the application of heat. An accurate pin gauge was made of the shrink diameter and returned with the new pin. This gauge will become apparent later. The new pin after finish machining would be accurately bedded to the new brasses and the whole returned to the mill.

Arrangements now had to be made to shrink the crank on to the pin. The gear employed to accomplish this was known to us as a "Wells Light", which was in effect a very large blow-lamp consisting of a circular steel tank about 18 in. dia. and about 2 ft. 6 in. high, filled with paraffin. This was pumped up by a hand pump on the tank to a pressure of about 100 p.s.i. (There was a pressure gauge on the tank.) The paraffin was then led through armoured hoses to the burners, of which I think there were three. These burners were capable of throwing a flame six-foot long by about one-foot diameter! I do not know the temperature of these flames but I do know they were able to bring a steel crank 12 in. thick to a red heat in about an hour! The pressure in the tank was constantly kept up by hand pumping.

Fitting the pin

Before commencing operations on the crank, the pin was suspended on a light chain sling by a crane opposite the crank-eye, and sufficiently far away not to be affected by the heat. The burners were then set up to play on the crank-eye and asbestos sheets sited at strategic points to direct the heat away from the bottom end of the crank which was also shrunk onto the shaft. A bucket of cold water was placed in a convenient position in which to dip the crank-eye pin gauge held in tongs. If the crank-eye bore would allow the pin gauge to enter it would also allow the crankpin! Next a stop was fitted to the back of the crank to prevent the crankpin from going in too far. The burners were lit, and the crankpin doused periodically with cold water.

In about an hour or so the top end of the crank was glowing a dull red; the moment of truth. The gauge was held in the tongs, dipped in the bucket, and offered to the crank-eye. It entered, and one end travelled 4 or 5 in. circumferentially round the bore. This was it! The burners were quickly turned off and the crankpin, suspended on its crane hook, was quickly traversed towards the crank. This was no moment for indecision. The crankpin entered and was quickly rammed home against the top. A sigh of relief rippled around the engine room, and a few of the labourers spat on the sizzling crank for luck, as was the custom. All the load was removed from the crane. Since the crank and its pin would not be touched again for 24 hours the time had now arrived to repair to the local hostelry across the road for a well-earned pint.

We returned to the mill the following day to replace the connecting rod and the new crankpin brasses. These were adjusted slightly on the slack side to be finely adjusted after running for a few days. The engine was finally barred round by hand and found to be perfectly free. Upon steaming the new brasses were found to run slightly warm for a few days. The engine ran for a further thirty years without trouble.

New Club in Tasmania

Yet another club has been formed "down under", this time in Hobart, Tasmania. Although the formation was, technically, over two years ago, starting with a bare plot of land, the club, The Hobart Miniature Steam Locomotive Society, has now reached the stage of having 450 feet of track for $3\frac{1}{2}$ and 5 in. gauge. Only three Tiches and one Maisie are steaming at present but more are on the way. *M.E.* hopes to bring further details as they become available. The secretary is Mr. D. G. Cook, 6 Leyden Avenue, Seven Mile Beach, 7170, Tasmania.

Guest Speaker in Birmingham

The Birmingham Society of Model Engineers has a special guest speaker on 19 October. He is Mr. R. J. K. Relph of Truro who has spent many years experimenting with indoor steam locos in gauge "O". Mr. Relph uses a form of remote control in the operation of his track. Interested readers are welcome to attend what must be a very interesting talk and demonstration. The event is to be held at the British Rail Staff Association Club, St. Vincent Street, Ladywood, Birmingham, at 7.45 p.m.

Norwich City College

Norwich and District Society of Model Engineers tells us that the City College is to hold evening classes for model engineers starting on 20 September. Those in the area may yet be able to enrol even though this is a little late. The club has been active this year with public running afternoons at Eaton Park Track on 3 July, 17 July and 7 August. On 11 July, there was a talk by Dick Stockings about his life with B.R. diesels, and on 10 August, Mr. Malcolm Woodward of Microflame (UK) Ltd. gave a talk on gas blowlamps and torches.

Busy Year at Brighton

Brighton & Hove Society of Miniature Locomotive Engineers have been round the clubs as well as holding the usual home runs. The club visited Southampton for the Spring Open Day, went on an inter-club trip to Maidstone, attended the summer Southern Federation Rally at Oxford, and paid a visit to the Harrow and Wembley Club on its Open Day at Roxbourne Park. Looking at the "Diary" the club still has an interesting programme to finish before the end of the year.

CLUB NEWS

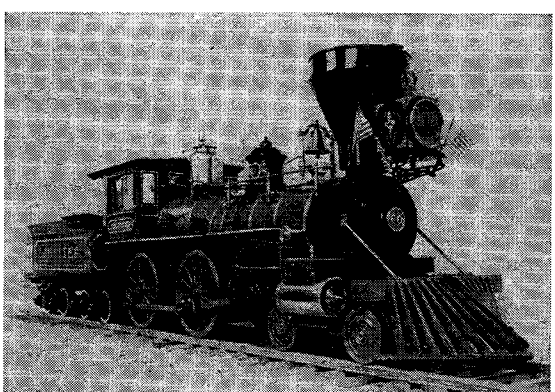
Club Diary appears on page 1121

Model Traction Engines

The 10th Model Traction Engine Rally and the annual Model Engineering Exhibition were successfully held by the Guildford M.E.S. on 16 and 17 July despite all the warnings handed out by the met. office. It is fortunate that the forecast, though accurate, was a sufficient number of hours out in its timing—long enough to give everyone a pleasant week-end. *Model Engineer* will be publishing a report on this event in the near future.

Wigan Meeting

Roy Amsbury travelled from Derby to the Wigan & District M.E.S. on 23 July to give a talk on small locomotive fittings. He took two locos, a G.W.R. 2-6-2T and a Caledonian 2-4-0, which he ran on the Wigan track the following day.



One Way to Catch a Shark

The Steam Locomotive Society of Victoria sends us an interesting anecdote in its journal *Big Wheel News*. It refers to an incident which happened—albeit not recently — at Pretty Beach, on Bristol Water, near Sydney, when a 5 ft. 6 in. steam-powered boat belonging to a Mr. Needham was attacked and demolished by a 14 ft. shark. The explosion of the 12 in. x 6 in. boiler was heard from the beach and, not surprisingly, the shark was never seen again!

Visitor to North London S.M.E.

At the October General Meeting of the North London S.M.E. the guest speaker will be Mr. W. F. Cooper from Gloucester, who was an apprentice with the Eastleigh Loco Works in 1915. Mr. Cooper left in 1934 to become, eventually, Chief Draughtsman at the Ordnance Survey Office at Southampton. He will talk about "Locomotives and the men who made them at Eastleigh". A recent "work-in-progress" evening produced some very interesting projects including a five-cylinder radial engine by Mr. L. Mason—a $7\frac{1}{2}$ cc. design which the staff of *M.E.* also had the privilege of seeing in August. An advantage of having so many sections in the one Society is that a wide variety of models and engineering projects can be displayed. It is also quite common for members to share their activities so that as one country member pointed out, when the pond is out of commission and no boats in operation, they can always go back to Keston Common with their radio-controlled tanks, cars, and motor-cycle combinations.

Peter Olds, president of Model Engineers & Live Steamers Association, Maryborough, Queensland, built this 5 in. gauge Central Pacific "Jupiter". See Club News, page 1053.

Post Bag

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

Walschaerts' Valve Gear

SIR,—The latest article on Walschaerts' valve gear by Dr. F. Burrows interested me greatly, for it would appear that the expressions that he now presents for the mathematical derivation of the expansion link-return crank mechanism at last concur with the accepted (not "traditional") precips as indicated by Messrs. Ashton, Holmes, Rowley and Ewins. I cannot claim a lengthy association with the valve gears' geometric requirements, but as a result of careful briefing I have been able to produce a set of equations that enable a correct layout to be determined by calculation alone, once the three independent variables are given.

These equations were determined by simple trigonometrical analysis, and I would suggest that they provide a more easily used (and a more elegant) answer to the problem. The equations are tabulated herewith; the notation can be understood by reference to the diagram Fig. 1. I have indicated when an equation bears a comparison with those of Dr. Burrows' article in *M.E.* of 19 August.

The independent variables are d, c and Ø, where:
d = distance, axle centre to expansion link trunnion.
c = radius described by expansion link tailpin.
Ø = half allowable angle of expansion link swing.
(these are given as D, R and $Ø_1$ in the article)

Return crank throw, q, is given by:

$$q = \frac{d^2 + c^2}{\sqrt{d.c.\sin Ø}}$$ (see 7.L.2)

Eccentric rod length, t, is given by:

$$t = \sin\beta\sqrt{d^2 + c^2}$$ (see 10.L.2)

$$\text{where } \cos\beta = \frac{d.c.}{\sqrt{d^2 + c^2}\,(1 + \cos Ø)}$$ (the stage required at 8.L.2)

The "backset angle", Θ, is given by:

$$\Theta = \mu - \beta$$ (see 9.L.2)

$$\text{where } \tan\mu = \frac{L}{H}$$

The "inclination angle", ψ, is given by:

$$\psi = 90° - (\mu + \delta)$$ (see 4.L.2)

$$\text{where } \tan\delta = \frac{c.\sin\beta}{d - c.\cos\beta}$$

and the return crank setting (γ) will be:
$90° + \psi$ for inside admission, or
$90° - \psi$ for outside admission

The return crank centres are found using the cosine rule:

$$= z\sqrt{q^2 + R^2 - 2.q.R.\cos\chi}$$

If the radius rod is inclined at an angle γ from the centre line of motion then the "backset angle" must be increased by this amount, i.e.

$$\alpha = \mu - \beta + \gamma$$

The values determined by using the above equations provide answers that satisfy the valve gear layouts that I have been able to inspect of some L.M.S. and B.R. locomotives, and would therefore also seem to satisfy the design office practices that have been used in the locomotive manufacturing industry in the past. If the mathematical proof of the above work is required I should be pleased to furnish it.

Axminster, Devon. A. Gettings

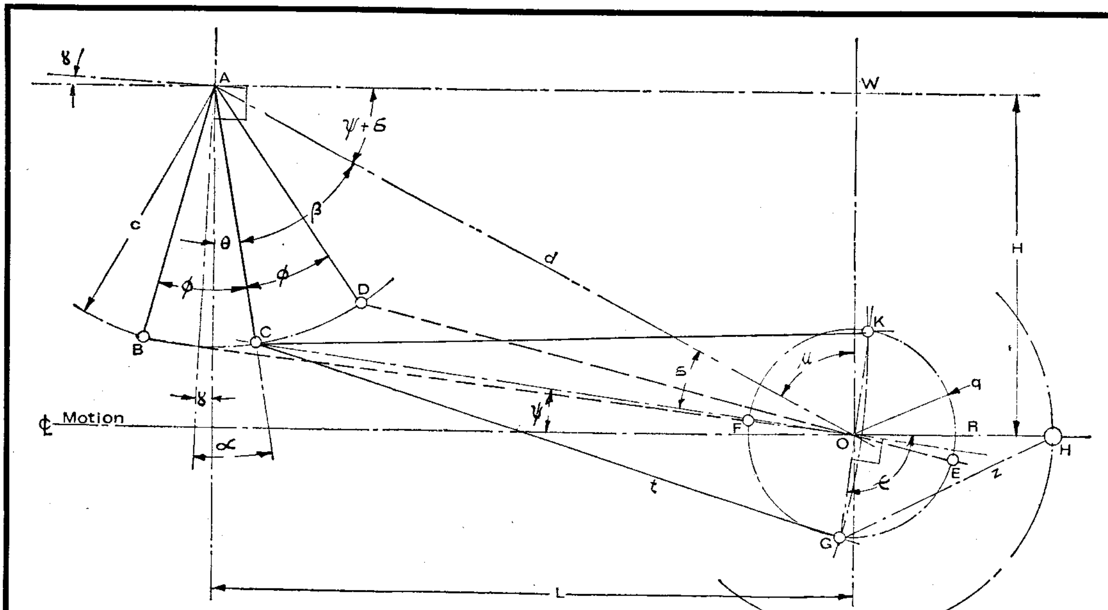


Fig 1 - Expansion Link and Return Crank Line Diagram

Setting-up aids

SIR,—Being now retired, at the age of 68, I have "M.E." recollections dating as far back as 1914, when Percival Marshall and George Gentry both "lived" at Farringdon Road. The latter, a most informed gentleman indeed, ran a column and workshop, under the title "Lessons from the Laboratory".

I mention this, as in 1977 this is my first entry to your correspondence columns, being prompted by your very able contributor, Mr. George Thomas, in his current article on setting-up aids. I have an edge finder, made by Offen and Co. Ltd., which I have had for many years and enclose a list of some of the precision toolmaking aids made by them, which Mr. Thomas will find of interest. I have no connection with them, except as a very satisfied user of their products, their internal micrometers being sensitive enough to "feel" to tenths in a good bore.

The edge finder is provided with two probes, both 0.200 in. dia., with spring-loaded ball ends, as Mr. Thomas has described, one a cylinder, but the other a sphere. Both will run off a plane surface although the cylinder is intended for use on cylindrical objects. A little thought about the geometry will show that the ball will run true whatever the relationship with the machine spindle. The cylindrical probe, when "out" with the spindle to the extent of 0.042 in. or 2 degrees (which should not be tolerated anyway), gives a line contact error of 0.0001 in. only. A section of the cylinder at this point becomes an ellipse, with a minor axis of 0.2000 in. and major axis 0.2001 in. An interesting point, I believe mentioned by Offen, is that one's eye can detect run-off within micrometric limits at the point of contact.

I note that Mr. Thomas, in his latest article, refers to the "Verdict" lever type ball-ended indicator (I believe preceded by the Starrett "Last Word" Indicator of this design) and I agree with him about its usefulness. With a suitable shank lined up with the machine spindle, the probe will sense-out a surface, either plane or curved, by partial rotation, when the pointer will rock either side of its zero setting. A workpiece of known dimensions may thus be set at a required relationship with the spindle, using the machine's own feed screw.

Finally, for many years past, I have seen many references to the use of the top-slide in an angular setting, when screwcutting on the lathe, some users having gone to the trouble of calculating and producing tables of figures for this purpose. The object of this offset is to avoid feeding a vee tool cutting on both flanks into the work. Why not, as I do, when using the cross-slide for feeding the tool into cut, leave the top-slide parallel to the bed and, from its initial zero setting, for each thou of cross-slide advance, move the top-slide just half a thou? Thus, the trailing flank of the tool cutting edge takes but a scrape cut, compared with main cutting edge, which may be provided with suitable rake. Incidentally, in all my engineering career not once did I encounter another person who was familiar with this dodge.

Ealing, London. L. F. White

SIR,—I first saw the EF described by George Thomas in *M.E.* 3567, 5-18 August, at the Machine Tool Exhibition, Olympia 1956, and was fascinated with its antics and accuracy. It is uncanny to watch.

Being at that time an instructor of a workshop course evening class, I decided to try and make one to interest and instruct the students. It was and is yet entirely successful, repeating well within .00025 in.

My main point in writing this letter is to say that the original firm's, and my own, feeler end is barrel shaped and suggest with all due respect to G.T. that this might have some slight advantage over the cylindrical end (see Fig. 4).

This in my case was done by first roughing to shape and size whilst soft and lapping after hardening. I decided on a 5/16 in. radius and pressed a ⅝ in. dia. steel ball between two pieces of lead in the vice. Using these as a lap, the feeler end was finally made .2 in. diameter.

George Thomas will probably mention that the EF will only work in one direction of rotation. (At least mine will.)

I usually demonstrate on the lathe and if an angle plate is mounted on the cross-slide the angle plate must be fed towards the EF from the back. May I also stress the advice of G.T. as regards the many advantages of leaving a workpiece on the parent bar as long as possible. This makes further machining so simple in many cases. A simple case is a collar, say, for a spindle. If this is turned and drilled and reamered and left on the bar, the cross hole normally required is easily dealt with before being firstly parted off complete.

Horwich, Lancs. W. H. Balshaw

Boring Tools

SIR,—Re George H. Thomas's articles on "Boring Tools", which I have found very helpful, he mentions on page 731 that he has never found a definition of a D-bit, nor seen it mentioned except in *Model Engineer,* and knowing that many model engineers are members of the Society of Ornamental Turners, I waited with interest for replies from some of my learned colleagues from this Society, but without result.

The "bible" of ornamental turners is *Turning and Mechanical Manipulation* by Holtzappfel, a work in five volumes, the first of which appeared in 1846. On reading through Vol 2 I found D-bits described as cylinder bits, and even sketches of expanding cylinder bits, or half-round bits, all described as "producing accurate cylindrical holes".

Further research in Vol. 4, page 311, produced directions for making and using cylinder bits, or half-round bits, and on page 363 is the comment "the hole is broached out to size with the slightly tapered D-broach".

From these, it is obvious that the half-round bit is of considerable antiquity, research on expanding half-round bits being carried out by quite a few firms, including Holtzappfel and Maudsley.

I regret I cannot ascertain when the actual name "D-bit" became common, but it must have been around the time of Vol. 4 being published, my Vol. 4 being dated 1879.

If any model engineer wishes to expand his hobby, I would recommend him to read Holtzappfel, particularly Vol. 5.

Some public libraries have a reprint of this book, and if he has sufficient interest in this branch of turning, the Society of Ornamental Turners will help to further his knowledge.

Much of the special apparatus used by ornamental turners is well within the scope of our readers to make. I myself use an ordinary screw-cutting Boby lathe, as I could not hope to afford a Holtzappfel or similar lathe specially made for ornamental turning, and with patience and ingenuity, two of the necessary qualities for any model engineer, I find I can enjoy both model engineering and ornamental turning.

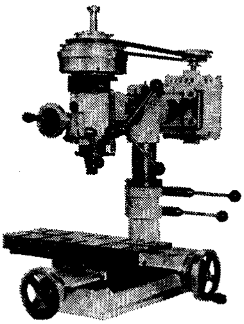
Alness, Rosshire. A. G. Fraser

Barnes Lathe

SIR,—I wonder if I could ask for help through *Model Engineer*? I have a very old Barnes lathe, as illustrated in a line-drawing in the *M.E. Lathe Manual*, by E. Westbury.

The bracket to hold the stud for screwcutting is missing; I would be very grateful if any reader of *M.E.* who owns one of these lathes would be willing to send me a drawing of this part so that I can make one.

Bristol. J. Pritchard



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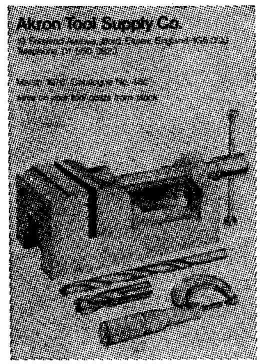

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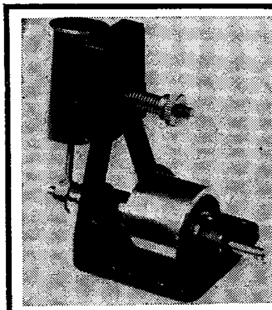

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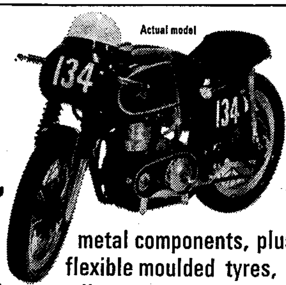

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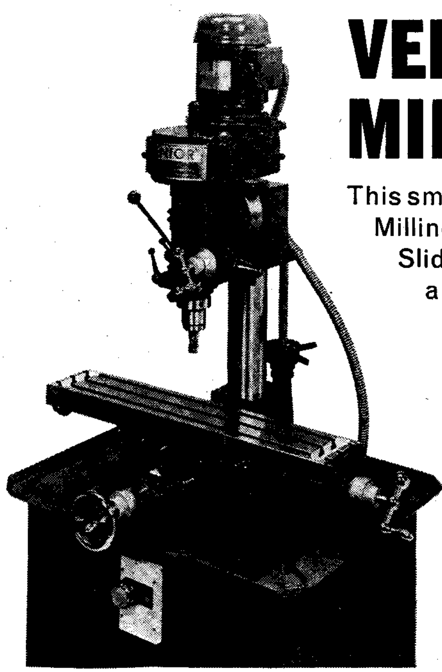

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