

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

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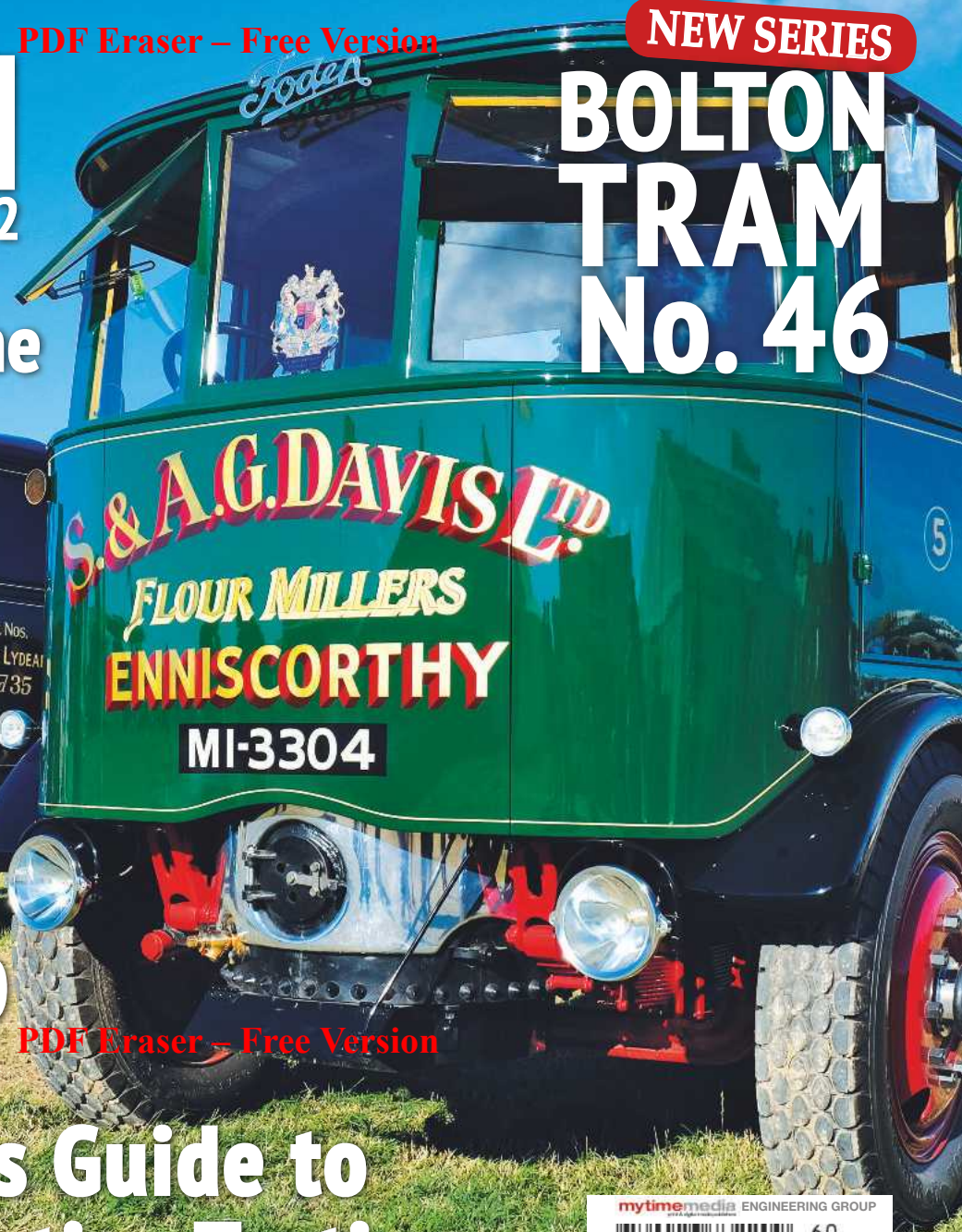
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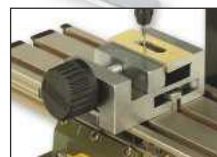
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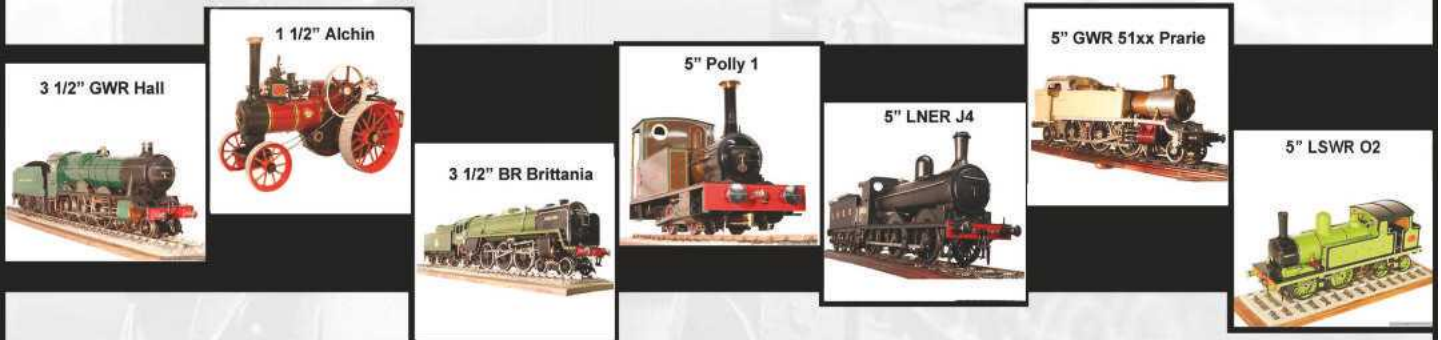
At the Great Dorset Steam Fair, 2016, the only two surviving Foden 'Speed' models were presented, beautifully restored by Mike Dreelan. Read about the pair, plus a unique scale model, in Martin Wallis' article on page 699. Photo courtesy of James Hamilton.

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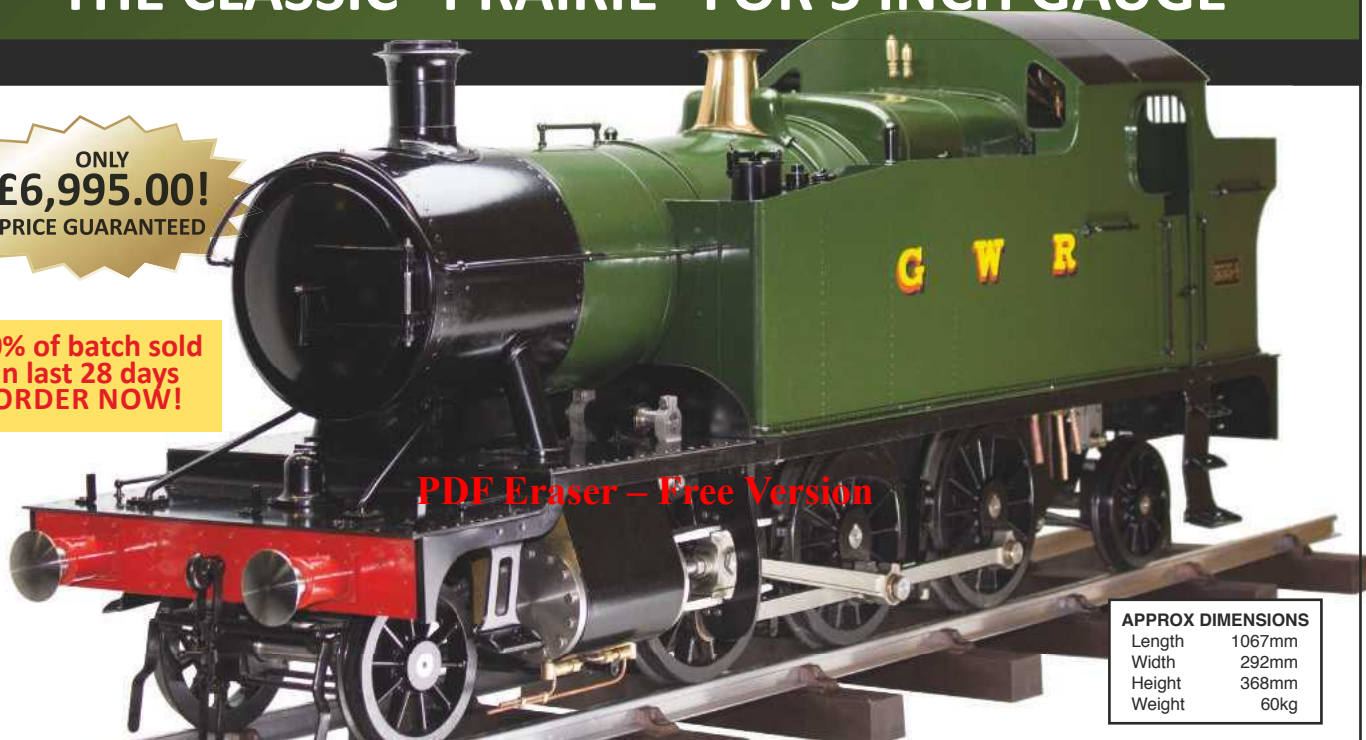
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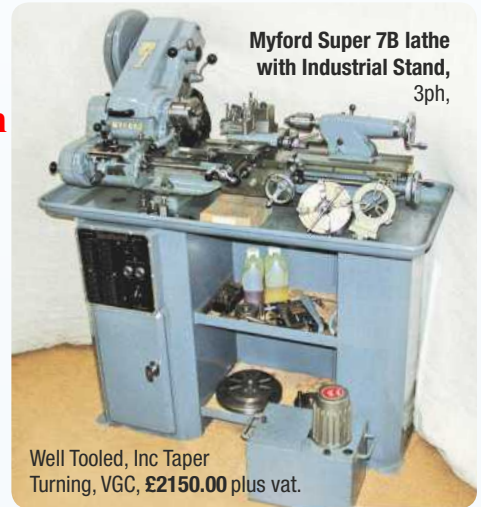
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A final word on safeguarding

Following on from the recent topic of safeguarding children and vulnerable people who visit our tracks on public running days (issue 4556, 17 March), I had an email from Jim Jennings, President of the Bradford Society, who advised me that they have a robust policy in place, one that is reviewed every two years and has been checked by experts in the field. The club would be happy to provide a copy of their policy to any club who feel it would be useful. To obtain a copy please contact the Editor in the first instance (details on page 683).



DIANE
CARNEY
Editor

Titanic Belfast

We had a few days away over Easter and, staying close to Stranraer, we decided to take a day trip across to Belfast. The sailings are frequent and simple to book and, for three of us and the car, it certainly didn't break the bank. I had never been all the way across the Irish Sea before - I usually don't get past Douglas - so it was a new experience. Part of the reason for making the effort was to visit the highly acclaimed exhibition, Titanic Belfast about which I had heard a lot of good

Northern Association Model Engineering Exhibition

I have been advised that the Northern Association of Model Engineers' exhibition organising group have decided that they will put on the show on a biennial basis in future. The next exhibition is therefore due to take place in the early Spring of 2018, at, I understand, the same venue.

Melton Mowbray Open Weekend

This annual event will take place over the weekend of 3/4 June 2017 at Whissendine Sports Club Ground, Melton Road, Whissendine LE15 7EU.

Over thirty miniature steam road vehicles - traction engines and wagons - will be in attendance ranging in size from 2 inch to 6 inch scale. The emphasis will be on engines working and giving demonstrations with some giving rides around the extensive grounds. One of the highlights of the weekend will be the road runs into the village; these start off at around lunchtime on both days. The parades are great opportunities to see engines working, particularly on the mile long up-hill return journey, and they are well supported by the villagers who always turn out in large numbers to give the event a great atmosphere.

The society's miniature railway tracks will also be busy giving rides throughout the weekend with visiting and members' locomotives. There will be an exhibition of model engineering and model aircraft and, following the success at last year's event, a much larger art and craft display.

Delicious home-made refreshments will be available throughout the weekend. Admission is free of charge so why not take the family along? This event is run by model engineers for model and steam enthusiasts and supports LOROS - Hospice Care for Leicestershire and Rutland.

www.mmmes.co.uk

reports. It certainly is an impressive display housed in a magnificent building that is designed to the same shape and proportions as the ship's bow and it's evident that a huge amount of money has been spent. Nine large, cleverly designed, interactive galleries tell the story of the city as it was at the turn of the 20th Century, the concept of the most luxurious liner ever to be built, the construction, the terrible disaster that befell the great ship, the aftermath and the discovery of the wreck. I could not help feeling, however, that the chance to shine a light on the magnificent engineering achievements has, however, been missed. The whole exhibition, understandably, focuses upon the human - the workforce, the grandeur of the accommodation, the terrible loss of life, the utter devastation - and it is all very well done and very moving in parts but in all the five floors there was but one photograph of one engine. I may have missed it, but I saw no reference to the

reciprocating engines being the largest ever installed in a ship. Nothing at all on how they were made or why they were designed as they were. It struck me as a sad, lost opportunity to feature British engineering history at its best or 'greatest', some might say. The presentation is, of course, titled '*Titanic*' so, to be fair, one would expect it to be all about that ship, but there were few references to the fact that there was a sister ship, *Olympic* that had a long and successful career and the museum has perpetuated the tendency to completely overlook the very existence of the poor old *Britannic* (it was mentioned briefly that she also sank). I would have like to have had time to visit the pump house adjacent to the *Titanic*'s dry dock where I think I might have *learned* more. My family tells me I am biased (i.e. not representative of the general public!) so don't let me put you off; if you haven't been, it really is worth a visit.

<http://titanicbelfast.com>

Ferrabee Pillar Engine, 1862

PART 2

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Anthony Mount continues his new construction series; an unusual stationary steam engine.



Continued from p.562
M.E. 4558, 14 April 2017

I was looking through some old technical books and came across an engine exhibited at the International Exhibition of 1862 (not to be confused with the Great Exhibition of 1851); I rather liked the look of it, thinking it would make an attractive model.

The flywheel

The first operation on the flywheel (**part 01, fig 7**) is to clean up all the inside edges on the spokes and inside edge of the rim. The casting, whilst nice and clean (sand blasted), did have a slight ridge where the two parts of the mould fit together but there was no off-setting as sometimes occurs when the pins in the mould boxes are worn.

Use round and half round files to achieve a smooth surface, watching especially the roots and junctions of the spokes to get nice intersections. Finish off the preparation by removing the sharp edges on all the spokes and inside edge of the rim. That's 36 sharp edges in total; ideally they need a slight

rounding to better retain the paint.

The flywheel is about 200mm (8 inches) diameter and you can see in **photo 3** that I have it mounted in a four jaw independent chuck. The chuck jaws fit nicely inside the rim so I was able to face off the outside edge of the rim, then face the edge and, with a boring type tool with an inward facing cutter (**photo 4**) I was able to face off the back edge as well, all at the one setting, which aids true running of the flywheel.

The cutter for machining the back face was a cut down carbide tipped parting tool bolted to the end of a piece of bar. By bolting on the cutter the other way round it was used for machining the annular passage in the cylinder.

For all the work on cast iron I used brazed carbide tipped tools as they take a

hammering on the skin of the cast iron and they can be reground which you cannot do with replaceable tipped tooling.

If your lathe is not big enough for a large four jaw chuck, then the flywheel can be mounted on the faceplate; with a 200mm (8 inch) diameter it is well within the capacity of the Myford 7 series lathes which can take 250mm (10 inches) in the gap.

The boss can now be faced off then centred and drilled through 9mm, finishing off with a small boring tool to achieve a very close fit on the crankshaft. Cast iron can be a bit strange when boring, as what at first seems a tight fit can become loose after you have pushed the crankshaft through a few times and pushed out the very fine dust coating the bore. So wipe out the bore before trying the crankshaft.



The flywheel casting mounted in a four jaw independent chuck.



Technique used to face the back edge without having to change the setting, ensuring a true running flywheel!

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Fig 8

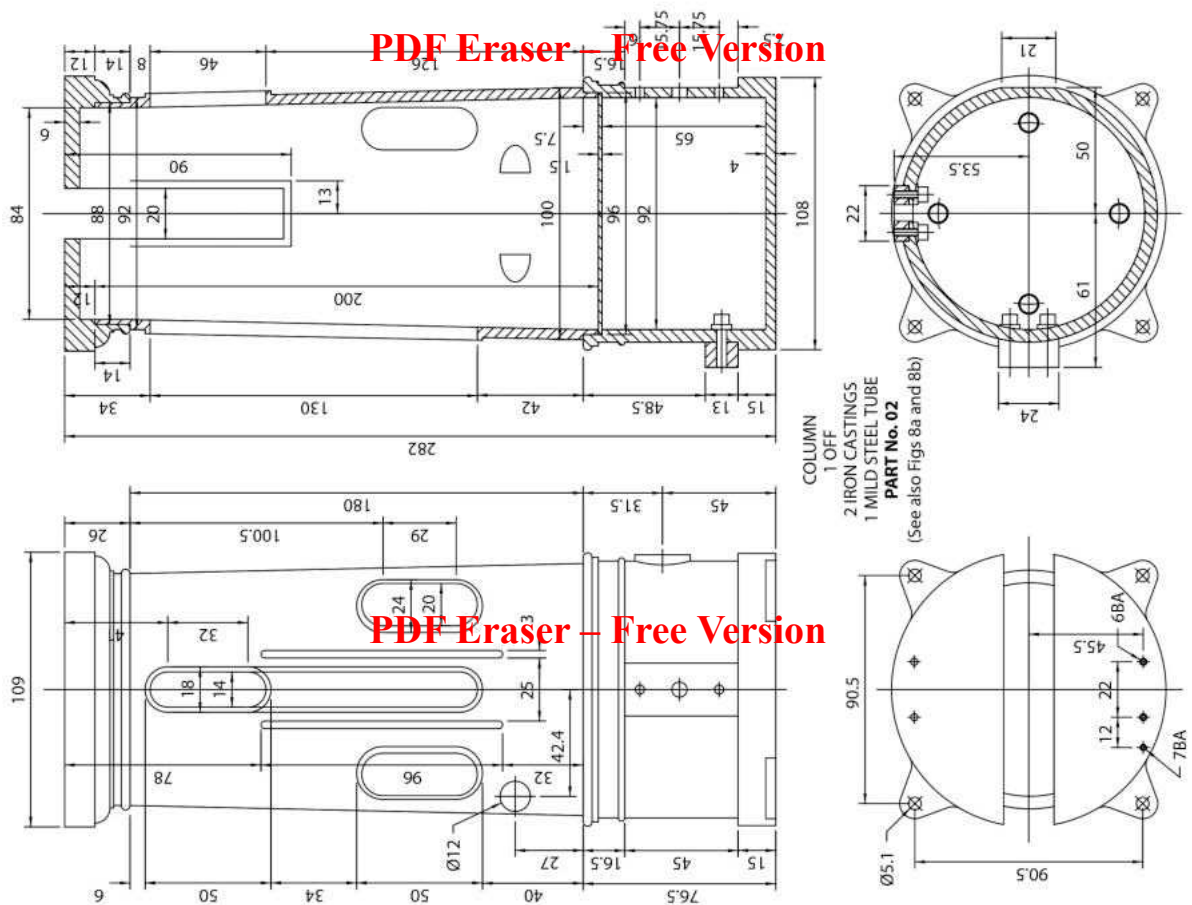


Fig 7

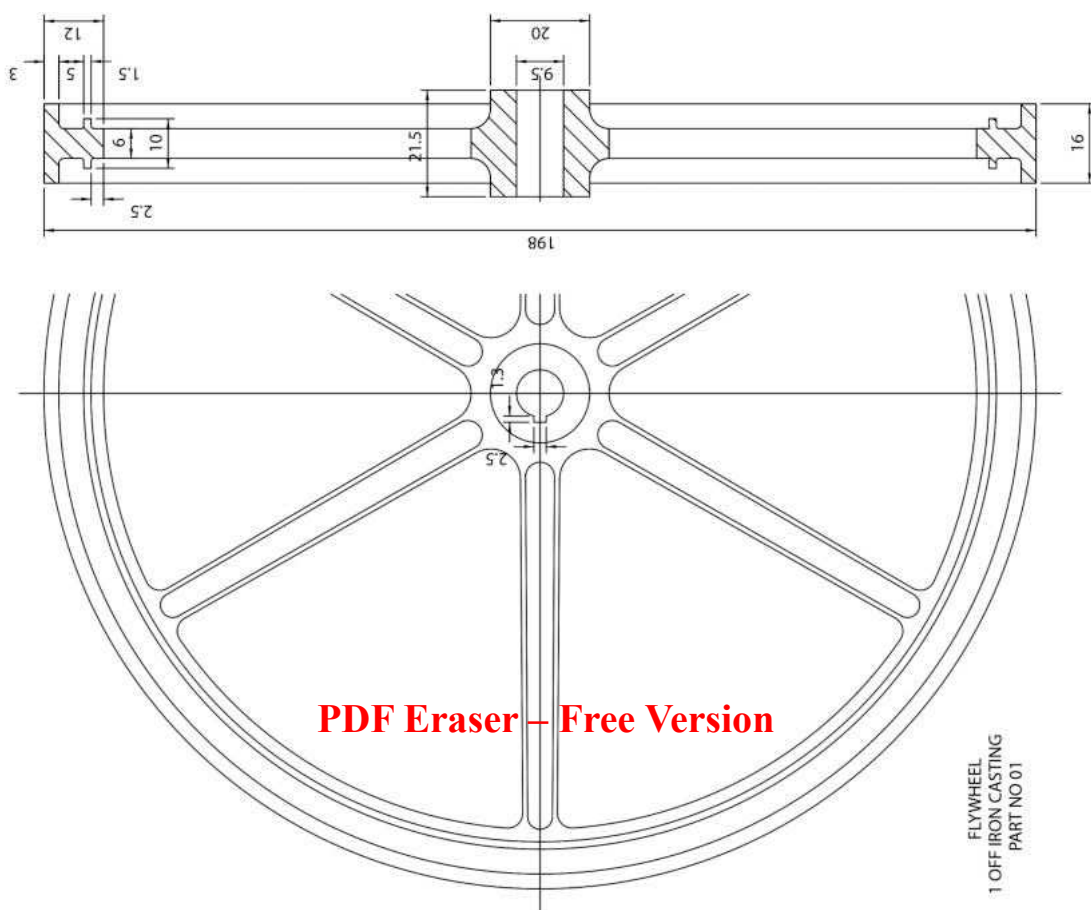


Fig 8b

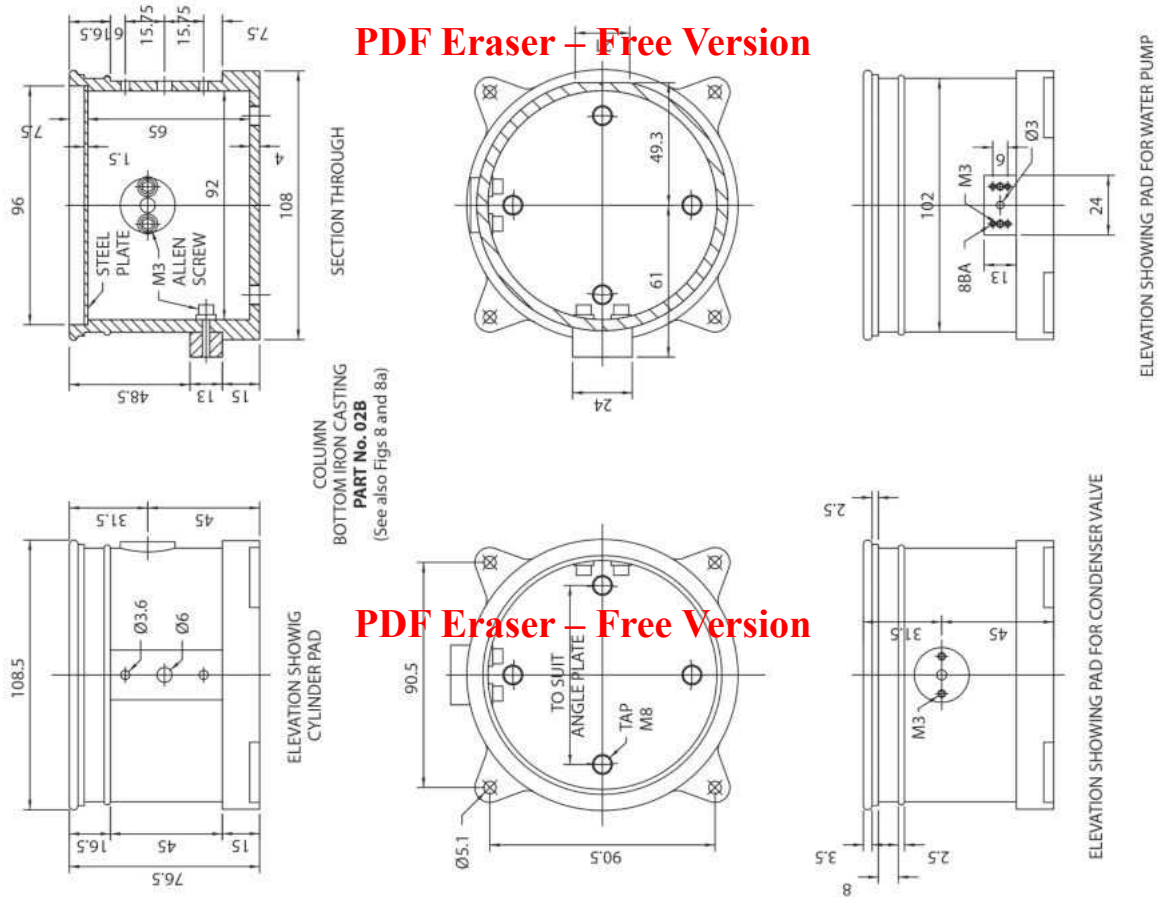
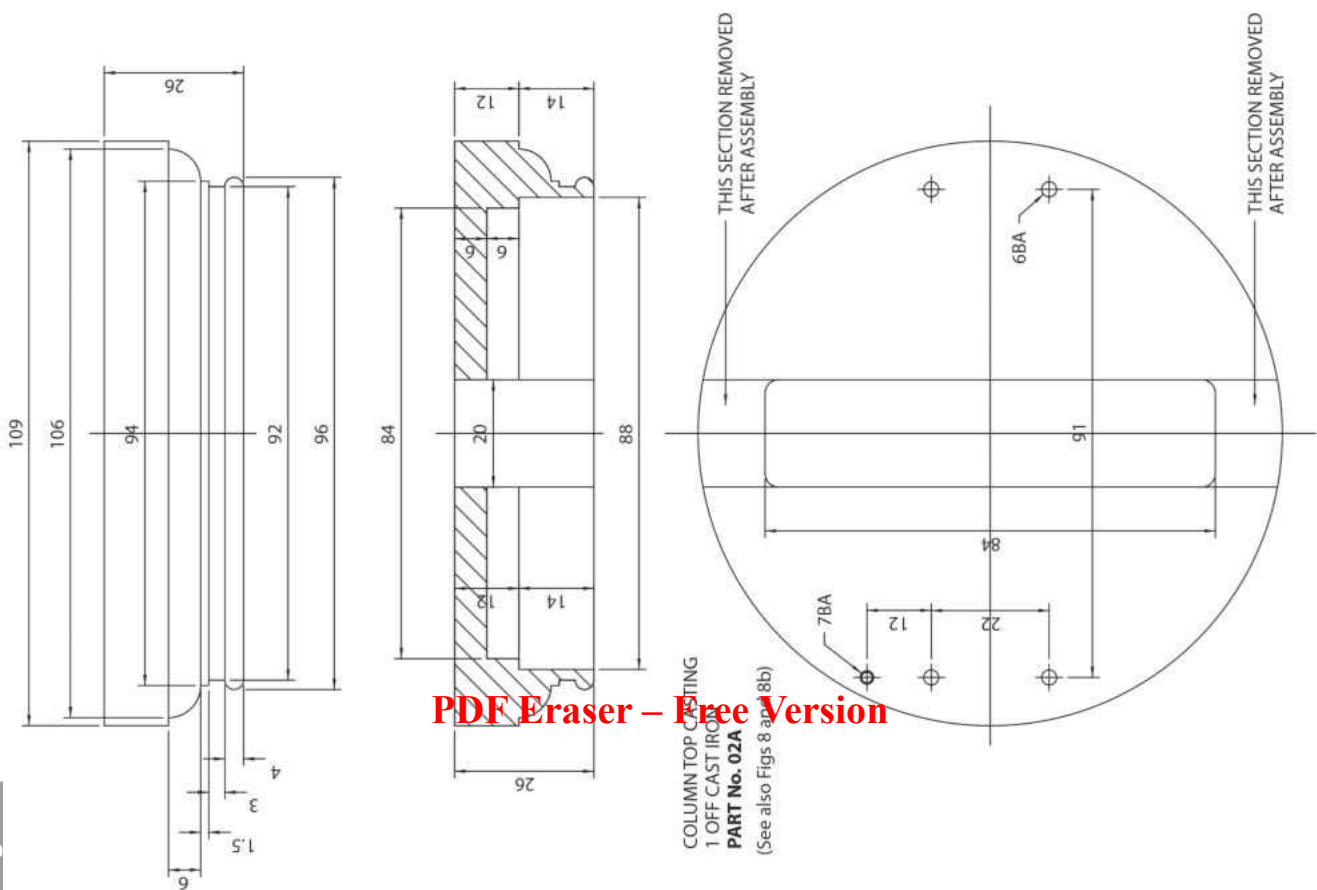


Fig 8a



Turn the flywheel around to face off the other side of the boss. As I had already faced off the back of the rim, I mounted the flywheel on an expanding arbor, just to clean up the boss.

Pillar (column)

The pillar or column (**part 02, figs 8, 8a and 8b**) is made up from four pieces: a top casting, central mild steel tube, bottom casting and a mild steel disk. The tube was a piece 102mm O/D by 81.2mm I/D. I went to my local structural steel works to obtain a piece as it's a standard size. A hardwood plug was made up and hammered into one end; the other end was supported by the four jaw independent chuck and the hardwood plug takes the tailstock centre.

Face off the end of the tube and turn down the registers each end that fit into the top and bottom castings. Set up the fixed steady on the machined bottom register and bore out to fit a previously machined mild steel stepped disc. This disc is furnished with a centre so can now be used to give tailstock support to the column for the outside taper to be machined, as shown in **photo 5**.

With the outside taper finished, the fixed steady can be used again for the boring out of the inside taper. As the column is quite long I came in from both ends to machine the internal taper; there is just too much overhang of the boring bar to go right through from one end. Just to show how impractical it was, photo 6 shows the huge amount of overhang of the boring bar for it to pass right through the column.

With the internal and external machining complete, a number of slots are required in the pillar. First, a cradle is needed to hold the pillar in the correct orientation; I used plywood as shown in the accompanying drawing. It consists of a 25mm thick base and two 50mm uprights. The uprights are angled so



5 Set up to machine the pillar. A hardwood plug takes the tailstock centre.



6 The overhang of the boring bar made machining the taper in one go impractical.



7 The slot machining cradle jig in use.



8 The set-up using angle plates. A three flute 6mm end mill with an extended cutting edge cut without deflection.

that the upper line of the pillar is parallel to the milling machine table. The uprights are screwed to the base from underneath.

A strip of wood, a close fit in the central Tee slot of the milling machine table, is screwed to the underside of the jig to keep it in line with the table. Tee nuts and studs each end bolt it to the table. Two long studs tie the two uprights together and lock the pillar in place, these need to be slackened off each time the column is indexed around.

The pillar has a stepped plate each end with spindles around which the pillar can revolve. The plates and spindles are locked to the pillar by an 8mm rod threaded each end which screws into the spindles, pulling the plates tight against the ends of the pillar.

There is a pin in each upright for the spindles and one is furnished with a 48 tooth gear which acts as an indexing device. A steel block adjacent has a screwed stop that engages with the gear teeth. The gear has a keyway,

being a change wheel, so a key is required in the spindle to lock the gear to the spindle.

To assemble the jig, screw one of the uprights to the jig base, slide in the column, add the other upright and screw this to the base. Add the gear and the indexing block, and then bolt the assembly to the milling machine table.

Photograph 7 shows the jig in use to machine a slot for the front brackets.

With an edge finder, locate a known diameter, then find the centre of the column; zero the dial and lock the slide. Starting with the top slot above the cylinder, find the centres of the radii and set the stops on the table. Drill through and open out to the required diameter, then, with a 4mm slot drill, make slots between the two holes and the waste material will drop out.

Make these slots undersize, as the repeated passes will create a poor finish to the edge of the slot, and then take a pass or passes to clean up the edges to a nice finish and to size.

Turn the column through 180 degrees and repeat the process, only this time the slot is much longer. Turn back to the first slot, then turn the column 45 degrees either side to form the lower slots. As these are a bit bigger I used a hole saw to cut the holes each end, following with the 4mm slot drill to cut away the waste material.

Reposition again at the first slot and then off-set the cutter to form the two slots for the slide bar brackets. They are 3mm wide; for jobs like these I like to use three flute FC3 cutters and only take shallow cuts as they are quite easily broken - and I usually, with these small cutters, cut from one end only, returning the cutter back before putting on another cut. These small cutters are apt to flex under cutting pressure.

The column is then turned through 90 degrees from the original slot for the cutting of the slot for the flywheel to pass through. A 4mm slot drill can be used for this job. Again, cut a little undersize to allow

for the edges to be cleaned up with the final pass or two.

At the bottom, on one side, a 12mm hole needs to be drilled for the rocker shaft support. This is a bit of a problem as the cut is against a curved side. I changed from the wooden jig to a couple of angle plates bolted to the milling machine table. Between these angle plates the column was sandwiched with a tie rod which passed right through the column and angle plates. Also, we now need to work from the centreline of the column, not the outer taper. This set-up is shown in **photo 8**.

Find the centreline and position to the correct orientation of the column. Then, with co-ordinates, find the centre of the hole. Instead of a centre drill I started the hole with a three flute 6mm end mill - one with an extended cutting edge that allows for a plunge cut - and this cut into the side of the curve without deflection.

I have, in the past when at exhibitions, bought long reach cutters and these proved very handy as they were just long enough to pass right through the column, saving having to turn it over and come in from both sides. Finally, a 12mm reamer was passed through to make sure a clean hole had been produced.

The top casting is a cast iron disc, set up in the four jaw independent chuck with the jaws gripping on the inside of the recess and set to run true. Face off and bring to finished diameter. Do not run too fast or you will blunt the cutter, even if it is a carbide one.

You can change to a self-centring chuck, reversing the casting and, with a boring tool, bore out the recess to fit the top of the column register. Then proceed to turn the moulding on the outside.

To make the machining of the flywheel cut-out easier later on, the milling machine can be used to cut a slot through the casting, leaving only a small amount either side to maintain the casting as a disc. The machining of the slot can be seen in **photo 9**.



Machining a slot at this stage will ease the later machining of the flywheel cut-out.

At the same set-up, the four 6BA holes for the bearing pedestals can be drilled, using co-ordinates from the centre of the disc to position the tapped holes. Another hole that can be drilled and tapped at the same time is the one for the governor lever column.

Fixing the top casting to the column does present a bit of a problem as once the flywheel slot is cut through, the disc becomes two halves. I wanted to avoid a soldering operation and decided to use an adhesive but I have found that many adhesives, though very strong in sheer, have a low peel strength; an accidental tap and the piece falls apart!

I found one adhesive (at Halfords in my case) that has worked well and that is Evostick Liquid Metal (usual disclaimer for both); it comes in a plastic tube the same size as a mastic applicator and needs the same mastic gun to use. It comes out just as mastic, a grey goo. I usually squeeze a little onto a piece of cardboard and apply it to the surface with a thin stick.

It is very messy to use but I found white spirit removes it while still soft. In this position, however, I was still not happy to use it on its own as it is subject to stress from the crankshaft so I drilled through the edge of the top casting, on the inside of the moulding; I used a 4mm FC3 cutter to counterbore through the moulding and then drilled through once a flat surface was available and tapped M3.

The casting was then fitted to the column and the tapped

holes spotted through and then drilled right through the column top edge. It was then possible to glue the top casting in position and use three screws from the inside of the column, each side, to pull all up tight. I used mushroom headed Allen screws. It was a bit fiddly working inside the column with a small Allen key but with a little patience the job was done. The counterbored holes in the top casting were filled with epoxy filler and filed flush. On painting all disappeared.

The assembly was then mounted between two angle plates bolted to the milling machine table and the remaining material removed with a slot drill to complete the slot for the flywheel. This operation is shown in **photo 10**.

While the adhesive was in use the opportunity was taken to apply the beads to the cut-outs in the column. The beads are supplied as laser cut in 1mm thick mild steel; they are attached to each other by

little lugs so first they are sawn apart and the lugs dressed flat.

They were fixed to the column with the same Evostick Liquid Metal adhesive, being held in place with masking tape while the adhesive cured. Like Mastic, it does not go hard but dries to a sort of hard rubber consistency.

I left it for 24 hours then scraped off any surplus and cleaned up the bead faces with abrasive paper, taking off the sharp edges. I was very pleased with the results; though only a narrow gluing area they were firmly attached. Once painted it all seemed as if one casting.

The bottom casting is another iron casting but a bit bigger. Use the independent four jaw chuck gripping on the inside edge of the cup. Centre, give tailstock support and face off as much of the bottom as the tool will reach (**photo 11**). When the rest of the machining is complete a tool with a trapezoidal shape can be used to go as close to the centre as



Using the angle plate set-up once again, the slot for the flywheel is cut.



Machining the bottom of the base casting.

practical and the last nib can be filed off.

Before that, however, the rest of the casting needs machining because of the lugs and the need for them to clear the toolpost. The tools will need to be overhanging the tool holder a bit more than is usual.

Use a cranked, R/H round nose tool and take off just enough at the bottom part of the body to have a clean surface all round, the round nose of the tool forming a nice junction with the lugs. I have shown the bottom diameter at 109mm but, unless your casting needs a lot of machining to clean it up, it can be left oversize once you have a clean surface and it will save removing a lot of metal between the lugs to bring it flush with the machined surface.

The rest of the body needs reducing in diameter to 102mm. First I took a cut all along with a knife tool, getting below the rough outer surface. Then, with a parting tool, I made a series of cuts almost to full depth to open out a gap, into which a knife tool could go to finish the main 45mm wide lower straight portion.

Then there's a 2.5mm wide bead, followed by another 8mm wide straight section; the bead was profiled freehand with the corners of the parting tool and finished to a round section with a file.

The casting was removed from the chuck and the sections between the lugs brought down to the same level as the machined lower band. This can be filed but if you have



Machining the base casting's inside locating recess.



The set-up for machining the base casting's cylinder flange seating.

The inside of the base casting does not need

machining as it is

hidden but I did run

the boring tool down

the inside to clean it up -

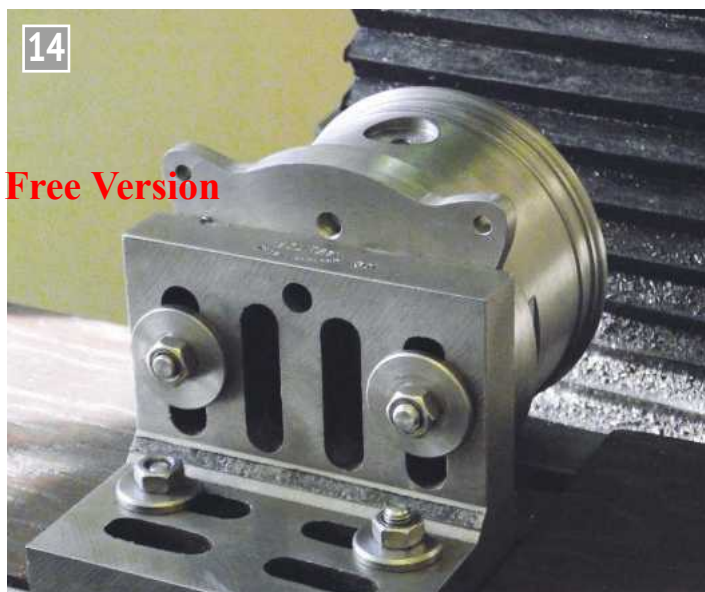
it seemed more

satisfying to do so.

the use of a 25mm vertical band sander, this will greatly help in removing the waste material, leaving only a little filing to create a nice finish.

The casting can now go back into the chuck, gripped by outside jaws on the base, and the top edge can be machined bringing to finished length. Then, with a boring tool, the recess can be made to take the register on the bottom of the mild steel column.

Machining the recess is shown



Having machined the spigot for the condenser valve flange.

in **photo 12**. This needs to be deeper than the length of the register to take account of the thickness of the cover plate.

The inside of the base casting does not need machining as it is hidden but I did run the boring tool down the inside to clean it up - it seemed more satisfying to do so.

There are four M8 holes shown in the bottom of the

casting. They serve two purposes; they are used to bolt the casting to an angle plate to machine the three location facets and when the engine is complete they provide an escape exit for the exhaust (as I doubt you will run the engine with a working condenser).

Bolt the casting to an angle plate on the milling machine, as shown in **photo 13** and after finding the centre of the base, drill the three fixing holes for the cylinder. Then, with an end mill, machine the flat seating for the cylinder flange.

Turn the casting around to machine the other seating for the pump and drill the pocket - as indicated in **photo 14** - that will receive the spigot for the condenser valve flange.

Finish off by cleaning up the lugs, drilling the fixing holes in the lugs and removing all sharp edges ready for painting.

●To be continued.

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If you don't want to miss an issue...





Martin Wallis looks at a pair of stunning restorations that came into public view in 2016 to much acclaim.



Foden

Speed 6 and Speed 12

2016 was indeed a classic year at the Great Dorset Steam Fair. The immaculate Burrell 7nhp DCC Road Locomotive, 3804

built in 1919, *Independence* made its first appearance since restoration - an engine which last steamed in 1946. The brand new Fowler Super Lion, *Onward* joined its sisters *Supreme* and *Lion*; the original engine named *Onward* was scrapped in the 1950s and has been re-created in a nut and bolt perfect replica by Dave Eves. Then, after incredible restorations, there were the Foden Speed 6 and the Foden Speed 12 belonging to Mike Dreelan, making their first appearances in preservation.

To avoid overloading my annual 'round up', Out and About 2016, your editor suggested the pair of full size Fodens, together with an excellent model of a Foden Speed 6, be given a few pages to themselves so here it is.

Foden's final steam wagon

The Speed 6 and Speed 12 steam wagons were Foden's final design of steam wagon and the most advanced steam wagon built by the company. Fodens of Sandbach in Cheshire, built 134 of them between 1930 and 1932 before the inevitable appeal of the diesel engine strangled the market.

The steam lorry design most associated with Foden were the overtypewagons (photo 1) where the cylinder and motion are mounted on top of a locomotive type boiler. The crankshaft is parallel to the back axle. The crank drives a second shaft through speed change gears, giving either two speeds or three speeds, and the second shaft drives the back axle via a chain. In the example in the photo,



An example of a Foden overtypewagon.

the end of the second shaft may be seen on top of the chassis channel and behind the hosepipe the chain drive to the back wheels. This was one of 76 wagons sold through William Adams in Sydney, Australia and then sold on new to New Zealand.

While a number of engine manufacturers made similar steam wagons, Foden's main competitor was the under-type Sentinel, fitted with a different boiler and engine configuration; an example currently undergoing restoration is shown in **photo 2**. A vertical boiler was employed with horizontal water tubes and the engine was mounted under the chassis, again with the crankshaft parallel to the back axle, the drive being either single (one chain) to the back axle where the differential fitted, or double (two chains) with the differential gears fitted inside the engine unit and thence a separate drive to each back wheel.

Foden's Pistol boiler

The 'Speed' series of Foden wagons used a locomotive type boiler but heavily modified (**fig 1**). It was fitted with water tubes rather than fire tubes and had a circular firebox. The boilers are sometimes described as a 'pistol' type due to their overall shape, the round firebox being the 'handle' of the pistol and the barrel usually being a similar diameter to the firebox. The working pressure is 275 psi and it had a heating surface of 82.5 square feet. Five vertical banks of 2 inch diameter water tubes followed by eleven vertical banks of 1 1/4 inch diameter water tubes were incorporated. The inner firebox was pressed into an irregular hexagon shape creating flats into which the tube holes were drilled and reamed. The steam is superheated, leaving the boiler at 600 degrees F. The boiler is fed with a mechanical pump and an injector.

The outer barrel was flanged outwards to meet the firebox end and secured with a ring



A 6 ton Super Sentinel waggon being rebuilt around the remains of a chassis which had been cut down to make a farm trailer.

of bolts. A similar ring of bolts secured the front of the inner firebox to the front of the outer barrel. With all the bolts removed the outer barrel could thus be removed, giving access to the ends of the water tubes so, when the need arises, maintenance or replacement could be undertaken. Unfortunately, for such maintenance, the boiler had to be removed from the chassis which was well over a day's work in itself.

The new boiler design did present Foden with some initial challenges, usually attributed to the then relatively new practice of electric welding. The inner and outer firebox casings were pressed and welded together. Being an essentially stayless design, the inner and outer shell should have been free to move during the working cycles of expansion/contraction but where the two components were punctured at the top for the firing chute, cracks sometimes formed in the welds causing jets of steam to issue which, obviously, was an unacceptable danger leading to withdrawal from use.

Engine and brakes

Power was provided by a twin cylinder, double acting, undertype engine, 5 inches bore by 7 inches stroke, mounted across the chassis (**photo 3**). The poppet valves had variable openings controlled by a sliding camshaft giving three forward cut-offs, neutral and reverse (**photo 4**). The engine drove through a two speed

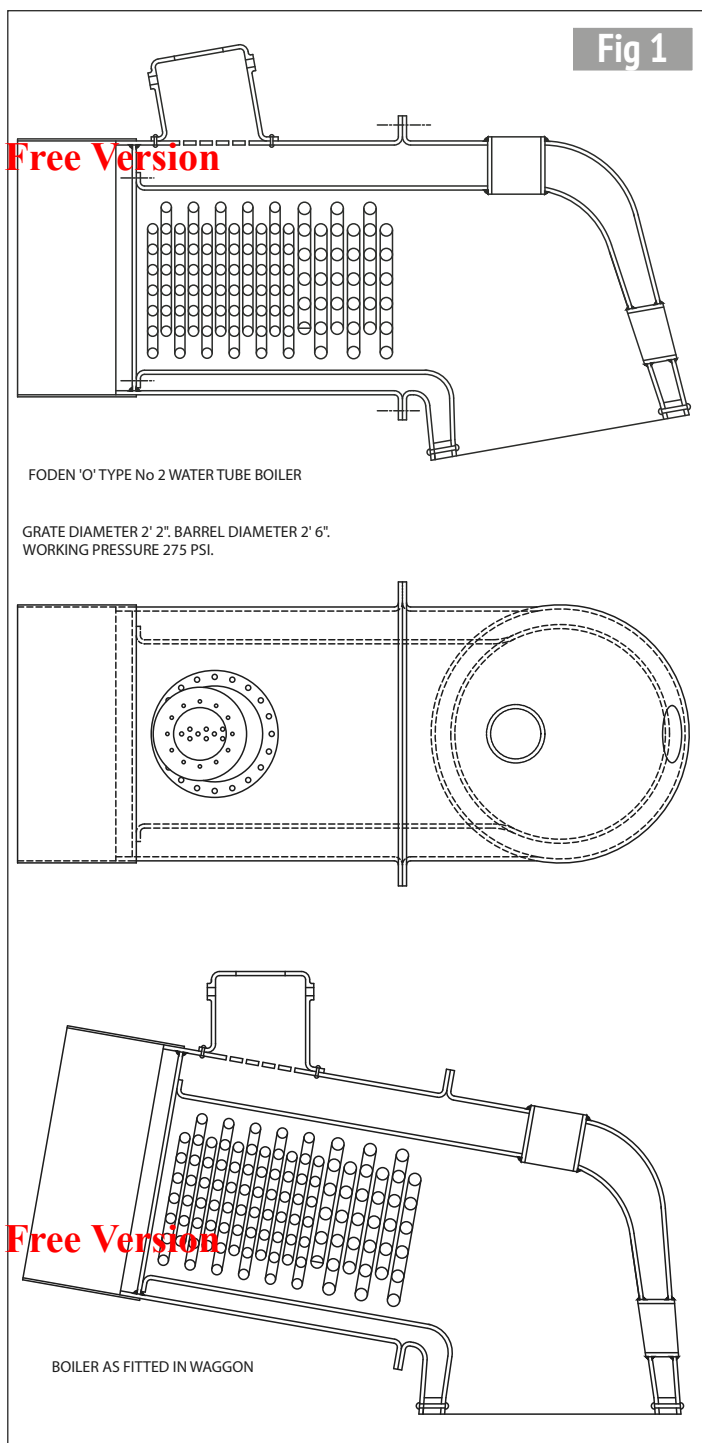


Fig 1

FODEN 'O' TYPE No 2 WATER TUBE BOILER

GRATE DIAMETER 2' 2". BARREL DIAMETER 2' 6".
WORKING PRESSURE 275 PSI.

BOILER AS FITTED IN WAGGON

gearbox and then directly drove a propeller shaft (**photo 5**) to an over-driving, bronze worm wheel differential on the back axle. Routine adjustments to the poppet valves were easy and most tasks in a major overhaul could be achieved with the engine remaining in the chassis.

The engine was made from the highest quality steels available at the time and aluminium alloy was used for the engine and gearbox casings (**photo 6**). At the maximum suggested rpm of 1,600 it developed over 100 BHP. Foden literature suggested a top road speed of 45 mph and an ability to climb a gradient of 1 in 3½ fully laden. While such claims were likely to be correct, the steam demands of the high speed engine would be great, leading to the inevitable suspicion that the boiler would be struggling to keep up over any prolonged period.

The brakes are internal, expanding in brake drums and available both with manual and steam operation, and both foot operated. All the wheels ran on roller bearings.

The two surviving wagons

Happily, two Foden 'Speed' lorries have survived into preservation, both being exhibited for the first time at the Great Dorset Steam Fair. The first, Foden Speed 6 (**photo 7**) was the 'O type' Steam Wagon, works number 13750.



The cylinder heads of the Speed 12; steam is admitted and exhausted with poppet valves.



The driver's controls; high and low gear on the left and 'cut-off' on the right.



Propeller shaft of the Speed 12.



Aluminium castings were used where possible.

It was supplied to Mr. W. J. King of Bishops Lydeard near Taunton, as a demonstrator. It was in commercial use until the start of the Second World War when it was laid up, becoming ever more derelict in a quarry until May 14th 1988 when it was part of the King

Sale when a number of Foden wagons and other engines were auctioned. The 'O type' was in a truly dreadful state after nearly 50 years out in the open. After the sale the wagon moved to Devon before being purchased by the current owner in 2007. The '6' in Speed

6 is the payload; six tons. 168 gallons of water is carried.

The second wagon, a Foden Speed 12 'Q type' is works number 13976, a large vehicle for its day (**photo 8**) at over 27 feet long and 7 feet 6 inches wide. The wheel base is 14 foot 3 inches and rear bogie



Foden Speed 6 'O Type' wagon completed in June 1930 and sold in July of the same year. Restored as a tipper.



Foden Speed 12 'Q Type' wagon completed in June 1931 and sold in May 1932.

centres are 4 feet. The turning circle was quite large at 56 feet, 6 feet larger than the 'O type'. 210 gallons of water is carried and the payload was 10/12 tons. The wagon was sold in 1932 to S. & A. G Davies of Enniscorthy, Ireland (photo 9) and made twice weekly journeys to Dublin. It was last taxed in 1945 and sold to Mr. Stacy, a local farmer, in 1947. The wagon was dismantled; the chassis was cut and the rear portion used as a farm trailer, the front axle sold to another farmer, the boiler used in a tannery and the water pump converted into a crop sprayer. Happily, in 1969 its life began anew when a syndicate of three preservationists located as many parts as they could and returned them to England. By the early 1970s the parts resided in Kent, thence passing through a few more owners – gaining a chassis from another Speed 12, works No. 13766 along the way – before being purchased by Mr. Dreelan who has completely restored it. **Photographs 10, 11, 12 and 13** give a good idea of the standard to which these restorations have been completed; 'immaculate' barely does them justice.

Norman Smedley's 3 inch model

Mr. Dreelan's full size engines were neatly matched in miniature by Norman



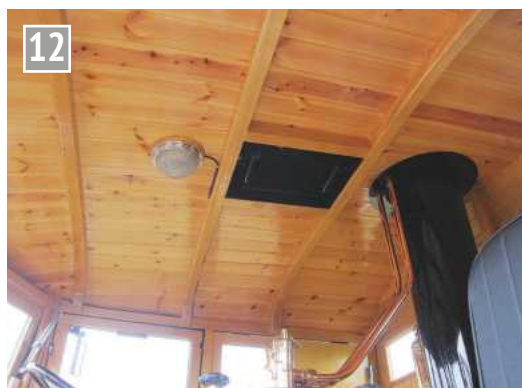
A beautifully sign written panel on the Speed 12.



The Speed 12 showing the forward of the pair of worm and wheel differential units on the back axles.



The fire hole door at the front is used for lighting up and raking the fire. When being driven, coal may be added from the cab via a top chute.



Cab roof; brand new and as yet untarnished by smoke!



Diver's view of the top of the boiler.



Norman Smedley's superb 3 inch scale Foden Speed 6. The cab is made from English ash and the roof and back panels from Oregon pine.



The framework is yet to be clad in aluminium sheet.

Smedley's superb 3 inch scale model Speed 6, to be found in the models tent (photos 14 and 15). The model was started in 1999 and has been exhibited quite a few times before but never fails to impress. It is being built from archive material, a few surviving Foden works drawings, some period photographs - where they still exist - and, in more recent years, measurements from Mr. Dreelan's Speed 6 in Aberdeen. The model so far represents 17 years' work.

The model is meticulous in every detail. For example, a mould was made for the manufacture of the tyres (photo 16). It has not only the correct tyre profile but also the correct tread pattern. The wheel rims, like the prototype, are split and turned from heat treated LM25 aluminium alloy castings. The crank case and two speed gearbox unit, together with the spiral drive housing for the cam shaft drive and water pump drive gearbox and crank case have been machined from solid



Detail of the back axle.

blocks of HE15 aluminium alloy, by 'hand' rather than CNC machined. The crankshaft is machined from a solid billet of EN24T. Photographs 17 and 18 show further details of this unique model.

My thanks to Messrs Dreelan and Smedley for their informative display boards from which much of the above text has been extracted.



The model's engine unit is nearing completion; compare this to the prototype in photo 3.



Cab controls and front axle details.

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- **Road Steam in Focus**
A handsome 4 inch Burrell traction engine
- **Old Engine Restoration**
The refurbishment of a stationary steam engine
- **Washington Locomotive:**
Part 2 of Jean-Louis Figureau's account
- **Workshop Extension:**
Mick Knights gets to grips with the building work
- **I Believe You Have A Lathe...**
Tales of impressing the locals!

Content may be subject to change.



ON SALE 26 MAY 2017

Ian Couchman describes the metal and woodwork techniques used in producing a model threshing machine.



Continued from p.303
M.E. 4554, 17 February 2017



The Tale of a 3 inch Scale Threshing Drum PART 9



First steps in making the cutter.



Off-set in the three jaw.



Turning the form of the cutter. This will be the tongue.



The cutters now notched.

On completing my 4 inch scale Ruston Proctor SD traction engine, I decided it needed some work to do so, after first completing a scratter mill, I then chose to make a threshing drum. Here I describe the combination of traditional and modern techniques used in its manufacture.

Cladding

Now for some cladding. The sides of the machine are covered with tongue and groove boards, set at 45 degrees, with the boards on the front section sloping from top centre to bottom front and the rear section sloping the other way. This braces the frame. Now, who stocks 1 x 3/16 inch tongue and groove boards? No - I thought not. Next job, then: make cutters for the router.

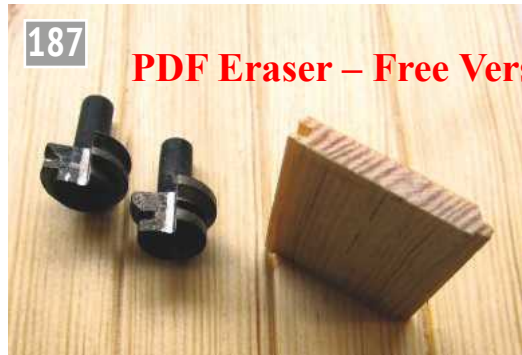
These were made from silver steel. First, the end $\frac{3}{4}$ inch was turned down to $\frac{1}{4}$ inch to suit the router chuck (**photo 183**). Then the part was cut to length plus a bit, reversed and chucked in a three jaw chuck with a piece of scrap under one jaw, off-setting the head of the embryonic cutter (**photo 184**). This will eventually give clearance to the cutting edge. Now the form of the cutter is turned (**photo 185**) - the photo showing the tongue cutter. Finally, the part is held in a chuck on the rotary table with the highest point being the bit with the greatest off-set (if that makes sense). The edge of an end mill is set at the centre of the chuck and a mark made on the work piece at the edge of the end mill. The part is rotated by the rake angle required and the cutter moved sideways to line up with the previously made mark. Then a simple notch is cut giving the cutters in **photo 186**. Hopefully the diagram at **fig 1** will make some sense of that! These were hardened and tempered and the results tested (**photo 187**).

Now, lots of blank boards were produced. First cut to a little over-size in thickness, then reduced to size in the thicknesser. Then, a simple job with the router and the new cutters and I was ready to clad! There's something over 50 metres of tongue and groove on this machine... **photo 188** shows the partly clad machine. The cladding was nailed in place, as per full size practice.

Pulleys and belts

There's loads of pulleys and belts on this thing! Pulleys were cast in bronze. **Photograph 189** shows the pattern, core box and core for the main drive pulley. **Photograph 190** shows the mold rammed up and the core in place, and **photo 191** shows a selection of the pulleys (there's twelve in all). Machining was straightforward turning, boring and broaching.

I put a crown on all the pulleys. Some say you should only crown one of a pair but I find it's best with both. I use



One tongue and one groove.



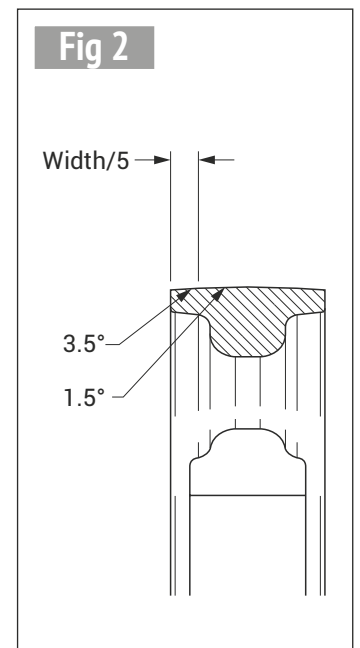
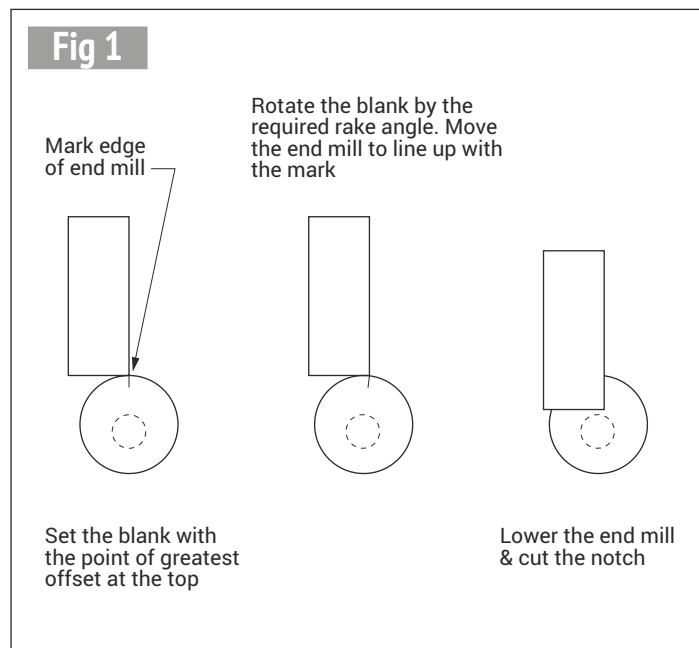
The partly clad threshing box.



Pattern, core box and core for the main drive pulley.



The mold rammed up and the core in place.



a simple method: first I face the pulley, then mark the face with a marker pen at width/5 intervals. Then I rotate the cross-slide by 1.5 degrees and skim the face until I get to the second mark from the side. Rotate the cross-slide 1.5 degrees the other way and repeat. Re-mark the outer two marks, which have now been machined off; rotate the cross-slide to 3.5 degrees and skim to the first mark. Repeat the other side (**fig 2**). You can then blend



A few of the twelve pulleys required.

the flat sections with a file or emery cloth but I leave them. After a few hours threshing, you won't see them anyway!

Belts (or straps, as Ransomes refer to them)

were made from fairly soft leather strip about 2-3mm thick. Search for leather strip on the Internet and you'll find a number of sources. I find softer leather rides better

on the pulleys than some of the harder leathers sold for belting. It will stretch, but if you give it a good pull before making the belts, it's not too bad and it's a simple job to

take a bit out to tighten a belt later.

Some lengths of leather have extra soft areas at the ends so it's best to check the strips and cut these bits off.

Here, then, is how I make my belts. I get a length of steel angle (drawn, with a nice sharp internal angle) and hold it in the vice. This is used as a guide to make sure the two parts of the belt are held in line during glueing. If they are not in line, the belt will tend to walk off of the pulley. I cut a scarf joint on the ends of the strip (after cutting to length) (**photos 192 and 193**) using a very sharp knife. One end is then clamped to the angle, using a block of wood to protect the leather (**photo 194**). The second end is then clamped in place (**photo 195**). Note the piece of silicon paper under the join, to stop the leather sticking to the angle. Now, one end of the joint is lifted and Cyanoacrylate glue is applied to the join. Then the end is pressed down, the silicon paper folded over and the joint is clamped (**photo 196**). After a few minutes, we have a nice new belt (**photo 197**)! I've used this technique for a number of years now and not had a belt failure (yet!).

The fans

The fans, again, were significantly different from the drawings, especially the first fan. The housing of this consists of a pair of end plates with grooves formed into them, which take a sheet steel wrapper. The whole assembly is held together with a number of bolts around the outside of the end plates, going between the two plates and clamping the lot together.

To produce these, I first printed a drawing (from the CAD drawing) 1:1 on sheets of paper, which were then stuck onto the blanks for the end plates (**photo 198**). This was used first to cut out the profile, then to centre punch the bolt holes, then finally to form the recesses for the wrapper. The forming was done in a rotary machine (another of those



Starting to make a scarf joint.



Two ends for joining.



The angle ensures perfect alignment.



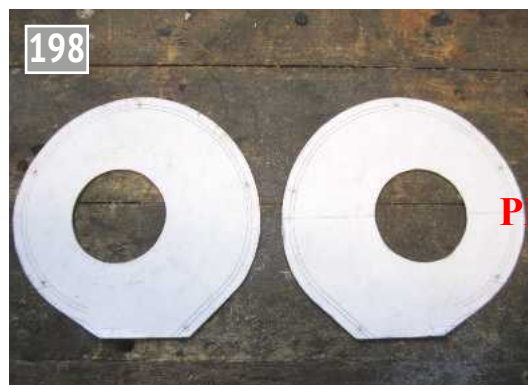
The adjoining end in position.



Clamping after applying adhesive.



A nice, new belt with a reliable join.



Paper templates for the end plates.



Forming the recess using a rotary machine.

tools you only use once in a blue moon, but pay their keep when you do need them!) as seen in **photo 199**. **Photograph 200** shows the (nearly) finished articles.

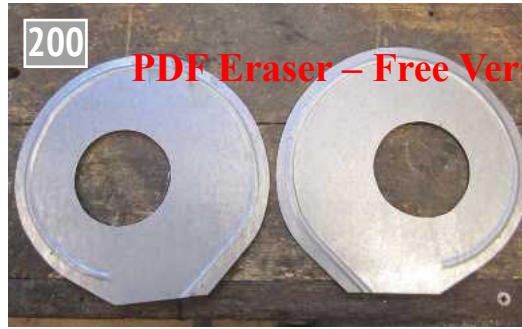
The rotor is a tricky little thing. It has five wooden blades held on arms cast into a hub. The arms were made by flattening the ends of pieces of round steel, bending to the appropriate angle and cutting to length. I printed a pattern which left impressions where the arms would go then assembled the flask ready for pouring (**photo 201**), resulting in the hubs in **photo 202**. **Photograph 203** shows the rotor in place, complete with blades, before the second end plate and the wrapper were fitted.

The second fan has a very similar (although smaller) rotor. The casing, however, is more conventional, with flanged end plates soldered to the wrapper. I didn't get any pictures of that...

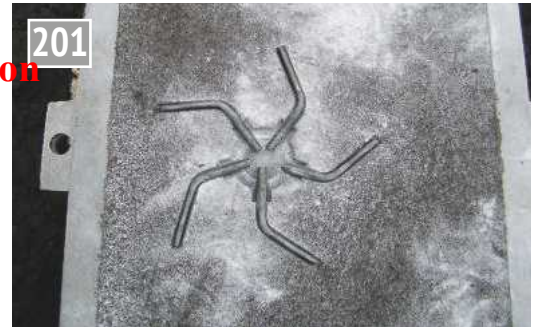
Assembly

We're now getting close to a finished machine! Now the beast was taken apart for painting. The colours used were Alpha red and Salmon pink, believed to be the colours used by Ransomes (or, at least, somewhere near...). I chose a matt finish as a gloss finish somehow looks wrong to me. Parts and assemblies were sprayed using an air brush. This worked well, although the layers were a little thin, so more coats were needed in some places.

In **photo 204**, we see the major parts laid out ready for assembly. **Photograph 205** has the upper shoe about to go in (here you can see the second dresser at the far end). Next it's the turn of the lower shoe (**photo 206**). You can see here the shaker crankshafts and bearings, temporarily held in place by battens. The shoe is fitted from below. In **photo 207** you can see the underside from the rear, with the bottom of the elevator, the first fan and the corn spouts visible. **Photograph 208** is taken from



The recesses fully formed.



Pattern for the fan rotor hub.



The cast hubs.



One end plate and the completed fan fitted.



A selection of main parts, painted and ready for assembly.



The upper shoe (left).



The lower shoe about to be placed in position.



The underside looking from the back end.



The underside looking from the front end.

the front and you can see the front axle assembly and, behind that, the opening from which the chaff is blown. Next the shakers are fitted (**photo 209**) and the concave is ready for fitting. Lastly, the drum is about to go in (**photo 210**).

The last parts were the top covers and the wind hood (the bit at the front where the straw comes out), which are seen under construction in **photo 211**, as well as the side boards. These had to be sign-written. I started by producing a stencil (the good old 3D printer again, **photo 212**). This was used to mark the outline of the text in pencil - you can just make it out in **photo 213**. The paint was applied, using a long sign-writer's brush and good sign-writer's paint (**photo 214**). I'm quite impressed with that!

●To be continued.



The shakers in position; the concave waiting ...



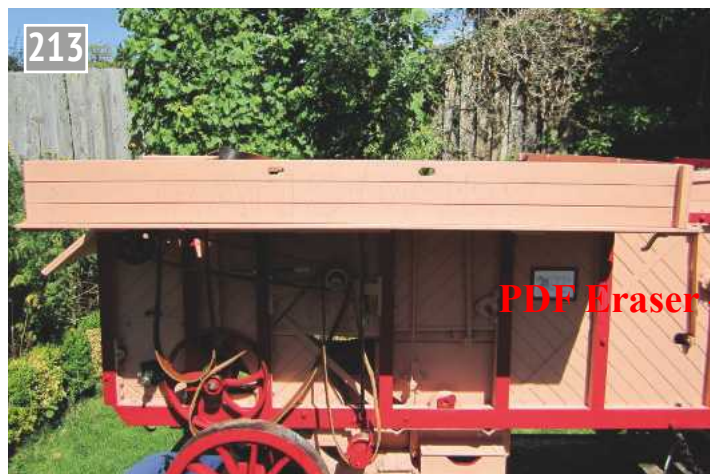
The drum awaiting fitting.



The wind hood under construction.



The 3-D printed stencil.



RANSOMES marked in pencil awaiting sign writing.



I was pleased with the result.

The Beginner's Guide to Non-Destructive Testing

Peter King shares his experiences in crack detection and disaster prevention.



In days of old when Knights were bold ... etc. the method of testing the integrity of a structure was to hit it with a big hammer! This has certain draw-backs and is not very scientific either; for one thing there is a certain degree of imprecision in the 'blow force on aspect'.

Things having moved on and as customers prefer items without great dents in them, a number of different testing methods have been developed to find out how good, bad or indifferent a product is. Metallurgists still use the 'Big 'Ammer' approach to ascertain how brittle a test sample of an alloy actually is, but the weight and degree of its swing is precisely known and all samples are prepared in as near identical a way as possible.

Having got that out of the way, let's get back to testing. First of all, what are you testing for? Well it depends on what you are doing and with what you are doing it. There is also the cost of testing balanced against the likelihood of there being a defect and a further balance of how much time and money is wasted by defects failing, against not testing materials. When preparing to make something you need to know:

1. Are the materials free of cracks and similar defects?
2. Does it matter if there are cracks in this artifact, in the application it will be used for?
3. Are the castings free of voids?
4. If there are going to be voids can they be inveigled into a place where it does not matter?



Kits can be purchased from engineering supplies emporia.

5. Is the sheet material free of laminations?
6. Do laminations matter?
7. Is the material to the correct specification?
8. Several other factors also apply but are not as relevant.

Some of the above factors may be irrelevant to the home workshop, others may be very relevant. In most of these aspects we have to rely on the suppliers to have tested and ensured that the brass/ bronze/ steel etc. meets specifications as to purity, alloy content, hardness, machinability etc. and that the castings are good without hard spots or voids and porosities in embarrassing places. All this leads to a component manufactured to meet its specification for a particular job and having a reasonable working life. Such testing as is required will be vastly different between a home workshop and that in a factory.

The next aspect is when preparing to repair something, you need to know:

1. Which components are cracked from service loadings and to what extent they are cracked? This leads on to other factors.
2. How long has the device been in service?
3. Is this the expected life of the component?
4. How expensive are spare parts?
5. Are there any spare parts available?
6. If the component material is upgraded will this cause something else more expensive to fail? (This is an important consideration).

The next aspect of testing is getting down to the 'nitty gritty': what methods of non-destructive testing are available and how much they cost. There are several common methods of testing:

1. Ultrasonic.
2. X-Ray.
3. Magnetic.
4. Dye-penetrant in two forms; one is coloured and the other more expensive fluoresces under light from an ultraviolet lamp. The fluorescing type set-up is much more expensive (it usually includes the lamp) but will detect smaller cracks. 'Dye' costs about \$25, 'Fluorescent' about \$450+ for a kit including a lamp and about twice as much as ordinary dye for replacement spray cans. (One NZ Dollar is approximately 55 pence Sterling.)

For the home workshop the last, Dye-penetrant, is the only financially feasible method as the first three require a very substantial outlay of hard earned cash (megabucks) and a fair amount of training (however, with improvements in equipment some of these methods are getting cheaper). The first referred to in the fourth costs little or very little and kits can be purchased from engineering supplies emporia. 'You gets what you pays for' however, and the dye penetrant method will not find deep seated defects that the others will find with ease.

Workshop testing

We will leave the factory situation and now just consider the application of testing in the home workshop; where it is worthwhile and where not or impossible. Let's start with 'making from new' and leave repairs until later. Here's another list:

1. We have to accept that for us there is no financially feasible method of testing any iron castings other than machining until a defect is found. All reputable foundries will replace defective castings.
2. If using second hand bar, shafting, gears or other components then crack testing by a cheap method will save much heartbreak.

- This is probably one of the major applications for the home workshop.
3. When inspecting bar - whether round, hexagon or square, be suspicious of any thin dark lines running parallel to the axis, particularly near the cropped end of a bar. A cheap crack test will show up a 'hot shut' or a 'cold shut' created when the bar was rolled. These usually show up as you machine a bar by the 'shut' opening up, because there is substantial stress 'built in' to the defective bar and it is released by the machining away of what was restraining it. Basically these 'shuts' are caused when a billet is rolled; the outside squeezes forward forming a cup shaped hollow in the end of the billet. If this hollow is not cropped off but the billet is further rolled then the 'cup' is closed down and will form a lamination or something

electron microscope, where they appear as a series of steps with ragged 'risers'. Be very suspicious of any apparent shallow 'blisters' in sheet or plate. This is probably not as much of a problem as it used to be as reasonably cheap alloying can eliminate or reduce the incidence to a negligible level and steel made for boilers or other devices at risk will be of this type of alloy.

Repairs will often involve testing, if only to avoid putting defective components back into whatever you are repairing. Usually the repair is being undertaken because something has worn out and is clattering or has broken. The broken component is easy - replace it! But always consider that when it broke it may have overstressed something else, so carefully examine all parts and then THINK! What you are going to

Repairs will often involve testing, if only
to avoid putting defective components back
into whatever you are repairing.

- similar to a flattened pipe down the middle of the billet.
4. Enclosed laminations are extremely difficult to find as they are, to all intents and purposes, invisible unless you dye test a finish machined component. I have seen a lamination in a steel plate that was over 200mm in diameter. These start out as very small inclusions in a cast billet and the rolling process turns them into an extremely thin pancake of vast size. (One of the reasons for failure of some sea mounted oil drilling rig legs was lamellar tearing, where the thin webs between laminations tore where welds pulled on them and the 'tube' failed.) These laminations can only be seen under a high power or

have to do is to analyse the device and figure what else could have been overstressed. The following are likely areas for damage involving cracks:

1. Splines on shafts.
2. Keyways on shafts.
3. Keyways in pulleys and gears.
4. Any bearing seating in cast housings, particularly near web braces.
5. The tracks of any ball or roller bearings.
6. Along the line of welds.
7. Water cooled cast iron cylinder heads and blocks
8. Around valve ports of internal combustion engines.
9. Around bolt holes of flywheels, differential housings and brake drums.

10. Just about anywhere a reversing or cycling load occurs.
11. Anywhere where there is a sharp change in section without generous radii blending that change.
12. Anywhere where there are machining marks (grooves) around a rotating member - torsion will start incipient cracks from these tiny marks.
13. Along welds in stationary structures subject to vibration - particularly where there is a degree of undercutting along the weld.
14. Along welds where the weld is not completely filling the space allowed and narrow, shallow, 'valleys' are left along the sides.
15. Along welds where the weld itself is too heavy and causes a stress raising change in section.
16. Along any weld that has been made under wet conditions - 'Hydrogen cracking'.
17. Under certain circumstances in the 'heat affected zone' along any arc weld.

Dye-penetration testing

We now come to actually using the method of dye penetration testing (I have never used the ultra-violet type so I will ignore it); applying it is very simple and very effective:

1. Thoroughly clean the whole component; wash it down with kerosene (paraffin) or a proprietary solvent cleaner.
2. Dry it off with rags and then blow dry it with an air blow gun.
3. Lay it on clean rags and then spray it with the solvent de-greaser/ cleaner supplied in the kit.
4. When thoroughly dry, spray all over with the dye penetrant - all over for a small component and on the suspect areas for a large component. This is usually a poisonous orange/red or blue colour.

5. Leave for the time specified in the kit instructions and then wipe down with clean rags.
6. Spray with the 'developer' - this usually dries to a white 'chalky' coating.
7. Leave to stand for the time specified by the kit instructions.
8. Inspect the component for thin coloured lines in the white coating. Sometimes leaving the 'apparently okay' component for a further 24 hours will reveal that it has micro cracks that are only 'surface' but will probably give trouble in the future.
9. Vague coloured areas probably means that you have not cleaned the test piece satisfactorily - on castings this often means it's micro-porous - particularly with cast aluminium.

Keyways and splines commonly have lines in the corners following the cracks, bearing outer and inner tracks for some reason, usually have curving lines likewise following the cracks. Sometimes you will be horrified at the vast pattern of lines that are shown up on bearing outer tracks or on the surface of case hardened and ground pins and you will wonder how it all holds together.

Always test wherever there is a change in cross section in a shaft, as this is where you will find circumferential cracks caused by stress raising machining marks. If you have an old axle half shaft, try the test on the splines; usually the cracks are (as mentioned above) at the bottom corners of the splines. I have, however, seen a shaft with a longitudinal crack from the end of one spline to another spline at the other end - it had wound up like a rubber band! This may have been a 'hot shut' in origin but did not look like it. If you wish, you can hacksaw through the splines and then grind and polish the cut; a test on that end face

will show that the cracks are radial. Gear teeth that have been overstressed will usually have cracks at the base.

The cracks from keyways in gears and pulleys are typically at an angle of 30 - 45 degrees to the vertical face of the keyway from the corners; in shafts the cracks are similar to those in splined shafts. Another place to look for cracks is at the bottom of screw threads; there are some places where this can occur due to poor engineering - viz: a flywheel secured with bolts but without any locating dowels. The flywheel will 'work' the bolts which are already tensile stressed and will initiate cracks - always

components and analyse the results: the more you do the more experience you will build up. The experience will also teach you a lot about good and bad engineering practice and good and bad finishing. Merely polishing shafts and other structures will reduce the incidence of cracks just because you have removed the marks from which they propagate and ensuring a generous radius on a change in section will remove stress raisers. The fundamental factor throughout this exercise is ANALYSE, ANALYSE, ANALYSE - don't just accept something but think out what has happened and why because if you are

2. It was not heat treated like the original.
3. The threads were cut in a lathe NOT ground to a polished finish like the original.
4. The bottom of the threads was therefore not smooth and polished like the original and normal torsion in use started a lot of fatigue fractures from the marks, one of which proceeded to failure.
5. The changes in cross section were not nicely radiused and were left in a 'rough machined' finish and started further fatigue fractures.

The dye test carried out to see if the crack in the replacement unit was an isolated event raised eyebrows when the number of cracks was revealed. The cracks were everywhere and a chastened owner placed an order for a heap of genuine replacement parts. A classic lesson in not knowing what you are doing.

Another example of wrong material where crack testing was irrelevant: a small factory made components from mild steel, which were subsequently 'hot dip' galvanized. The steel supplier ran low on mild steel stock of that size and replaced it with medium carbon steel (well, it was better quality, wasn't it?) but did not tell the client. When the components were returned from the galvanizers, they were tipped out of the boxes on the back of a truck onto the concrete floor. This is where the 'Oh Dear' factor comes in; there was a terrible noise as the components shattered. It so happened that the 'hot dip' temperature raised the steel to exactly the right temperature to be hardened, if - as is usual with galvanizing - the components are dropped into water to cool off! Glass hard carbon steel shatters quite nicely if dropped about four feet onto concrete!

With that joyful thought. I will leave you to practice NDT.

ME

Always test wherever there is a change in cross section in a shaft, as this is where you will find circumferential cracks caused by stress raising machining marks. I have, however, seen a shaft with a longitudinal crack from the end of one spline to another spline at the other end - it had wound up like a rubber band!

look for signs of 'fretting'. I once made a new bull wheel/pulley carrier with a larger key and modified the mandrel of a lathe, because when the carrier was removed to replace a belt there was a clear indication that the keyway was inadequate and fretting was taking place between the carrier and the mandrel. Always do a 'crack test' on the end of a crankshaft where there is a threaded stub that mounts a pulley or gear, also where there is a taper (often with a 'Woodruff key' slot) for a flywheel. Cracks are likely around the Woodruff key slot and where the section changes from a thread to the taper seating.

Analysis

From the above information you should now be able to test

going to make a replacement, then quite minor modifications may extend its life.

An example of not analysing: a hefty shaft with machined bearing seats with retaining tab lock washers and large lock nuts, pulley seats and similar fastenings, with a substantial flange on the end mounting a crankpin had been in service some 1000 hours. This had been damaged and bent by an accident and was replaced by a new unit machined locally. As a replacement unit would take six months to deliver (?), the new unit only lasted about 20 hours and damaged several other components when it failed - why? Because:

1. It was of a different specification of steel from the original but not wildly different.



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Bolton Corporation No. 46

Ashley Best's illustrated description of an award winning, scratch built model in 1:16 scale.



When Number 46 was withdrawn for scrapping in 1937, it was just another typical British four wheel, double deck balcony tram. There was nothing to indicate that it was, in fact, a significant tramcar. This article explains the significance and describes the making of the model (photo 1 and fig 1).

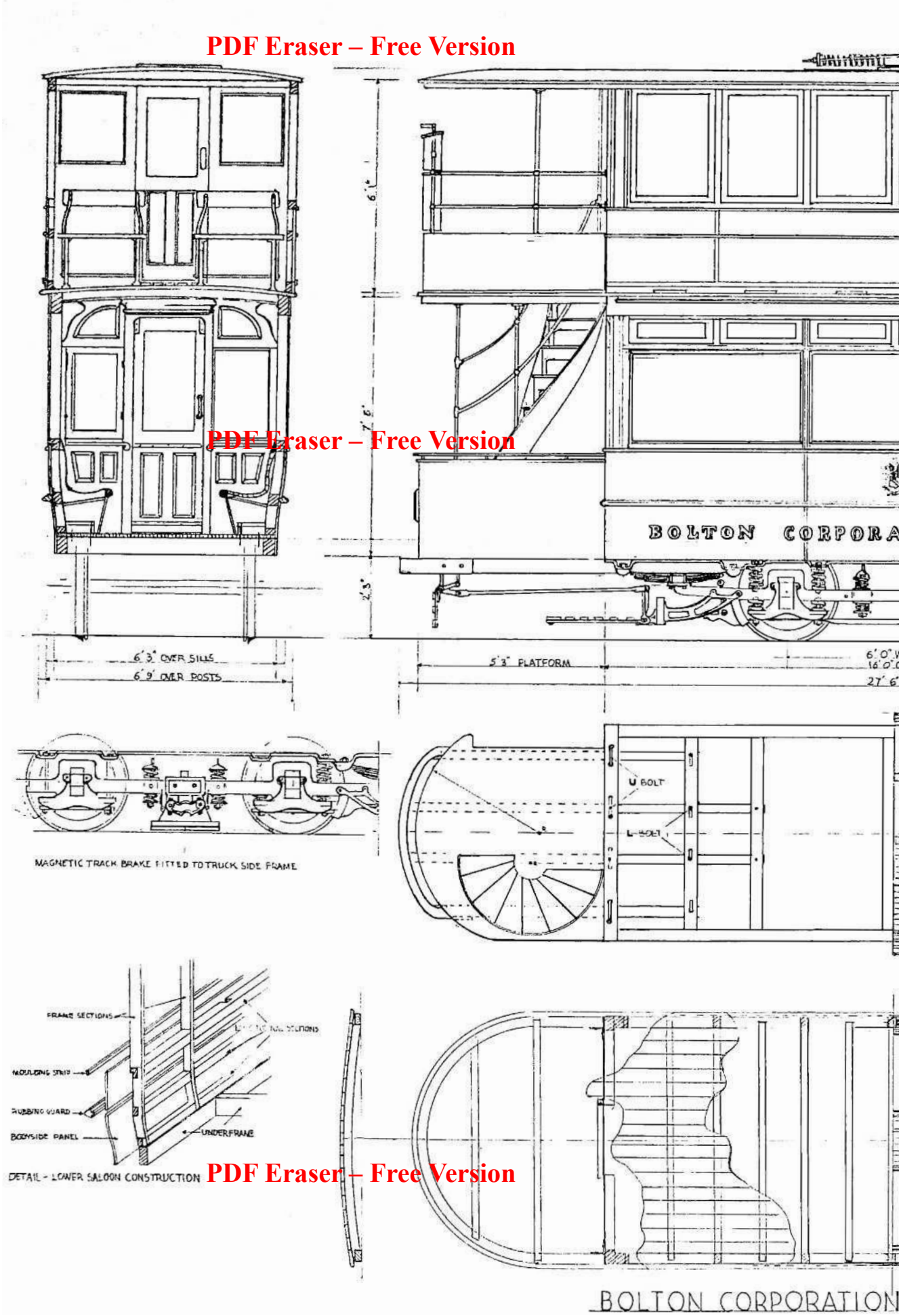
Bolton's tramways were opened to electric traction early in the tramcar era. The first electric cars ran in December 1899 and

the system expanded rapidly thereafter. It was always an individual system which, whilst remaining basically traditional had a number of features that separated it from the adjoining South Lancashire operators. In 1897, the corporation took over and ran the previously leased, extensive, horse tramways in the borough. A depot and power stations were built and electric traction commenced at the very end of 1899 on new routes that were laid specially for the electric cars. Horse trams ran for the last time on January 1st 1900 and electric tramcars then appeared throughout the system.

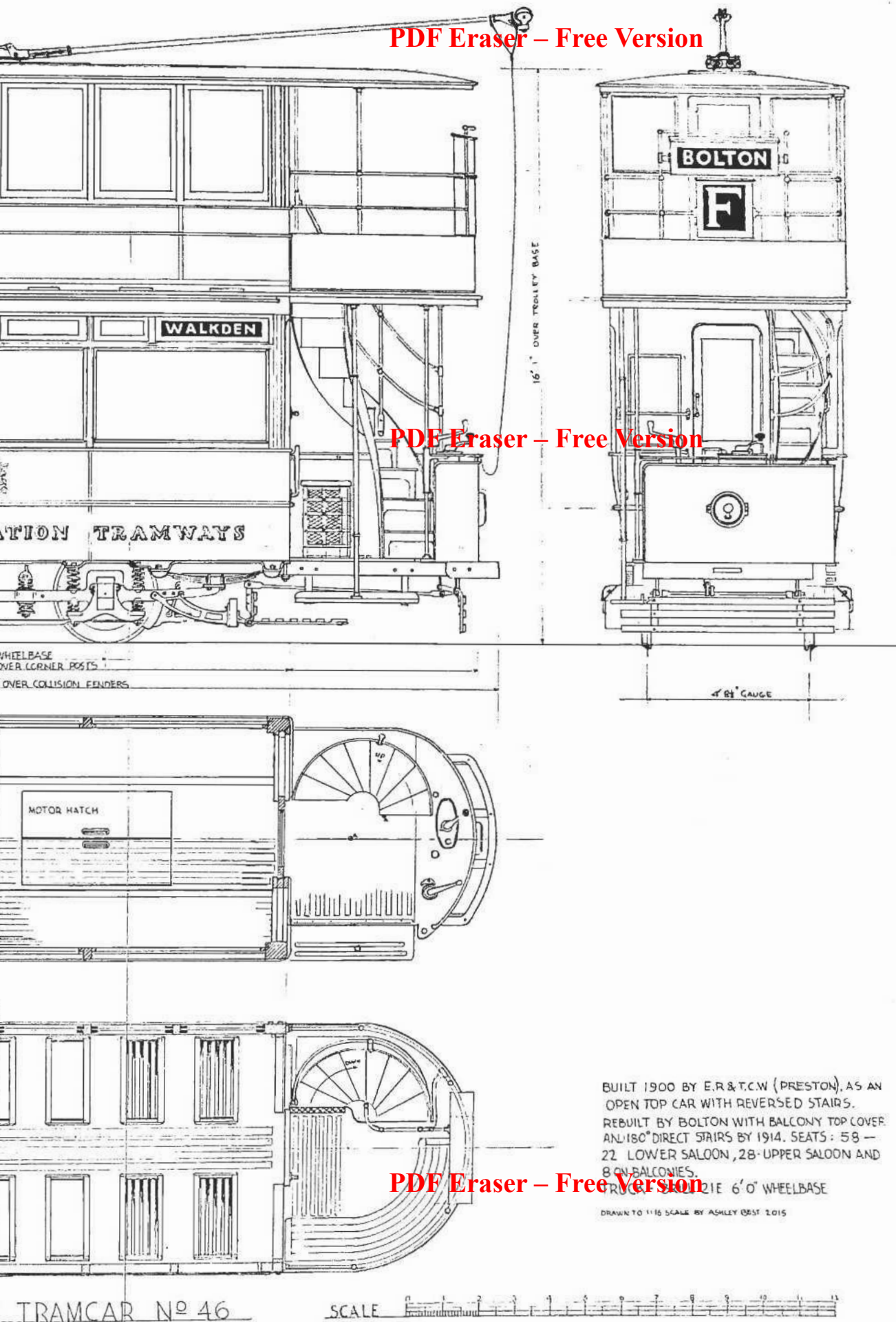
These were early days for the electric tramways and Bolton's haste to get their tramways into operation led to serious difficulties. The engineers had assumed that the previously laid horse tramway tracks in the town centre could simply be used by the new electric cars, which were much heavier vehicles. This proved to be a disaster and there many derailments. At first, the tramcars themselves were suspected of being faulty. These were supplied by the Electric Railway and Tramway Carriage Works of Preston along with its associated manufacturing company, Dick,

Fig 1

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Kerr and Co. (these companies were later to be amalgamated and in time became the English Electric Co. Ltd.). The tramcars were entirely blameless and Dick, Kerr Co. reported that the trouble was caused by attempting to run electric cars on horse tram tracks. Bolton's experiences were a lesson to others!

The tramcars

The rush to electrify tramways, not just in Bolton, placed huge demands upon manufacturers at a time when designs were still developing. Bolton started with an order for 70 four wheel open top trams from the Electric Railway and Tramway Carriage Works, Preston (ERTCW). The initial car design was rapidly abandoned in favour of what became established as the 'Preston' style standard tram, which became the accepted car, not just in Bolton but all over Britain. This standard tramcar had a three window, 16 foot saloon, a short canopy body and was mounted on a four wheel truck (photo 2). Similar cars were the mainstay of most early British tramways with only the larger systems, which included Bolton, also making use of large bogie cars. Some tramways operated throughout their existences with 'Preston' style four wheel trams.

An innovation and developments

It soon became apparent that an open top car on a short wheelbase, four wheel truck had its limitations and principal among these was the open top deck which obviously was unsuited to the British climate. It is here that what made the No. 46 special can be revealed. The Bolton tramways manager, Mr. Arthur Day took No. 46 in 1903 and fitted his own design of a top covered saloon and, by a narrow margin, this was the first such application in Britain to a four wheel tram and set the standard throughout the country (photo 3). This first design provided a huge improvement for the travelling public, but was only a first step. The new top deck had a short central covered saloon with long open balconies at the ends.

The short centre was almost certainly a result of caution because of the perceived danger of high winds overturning the tram, the short centre being considered to offer less wind resistance. The design was a success and Bolton then had further cars delivered to very similar designs. A feature of the initial experiment was the upper saloon windows which were of the drop-down opening type



Front end of the model.

without the small ventilator half-light above. Some of the cars delivered at first to the basic design were, in fact, fitted with half-lights (photo 4). Bolton standardised on the

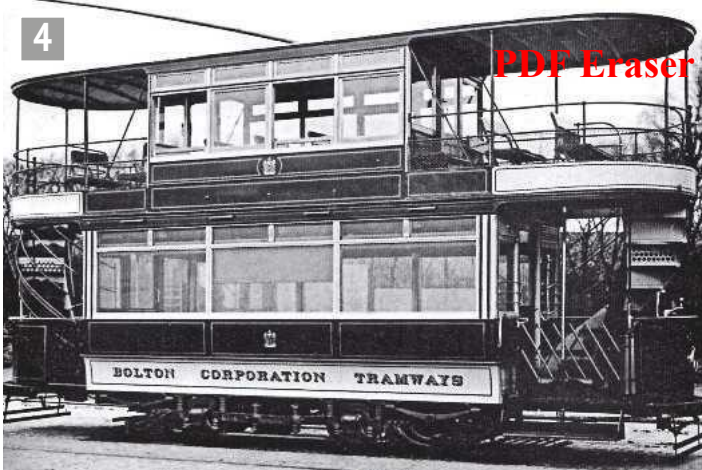
full drop-down windows for all its cars except those acquired second-hand or built new as double deck bogie cars. All the open top cars were eventually modified to have upper saloons with drop-down



First design – open top car.



First top cover.



Preston-built variant.

windows. These were fitted in Bolton's own workshops, some with bought-in saloons to Bolton's design which gave the fleet a distinctive, standardised appearance.

All this is running ahead a little because this article is concerned principally with No. 46.

No. 46 – evolution

Bolton's tramways had an extensive and fully equipped workshop and although clearly capable of doing so, did not build its own tramcars. Most cars were built by the United Electric Car Co. (English Electric) with a few by Brush. The top deck covered saloon, built in the workshops, was found to be so successful that it rapidly became standard but quite soon the fears of wind resistance were overcome and the short saloon was extended to the more familiar, full length 16 foot saloon to match the length of the lower saloon. Open balconies and open driving platforms remained. This development produced the aforementioned British standard balcony four wheel tram. Developments had not finished and other changes occurred, so the fleet gradually became modernised by small alterations. The original balcony modifications incorporated reversed stairs. These required passengers to climb from the platform in a clockwise direction (photo 5). Such stairs caused a serious restriction to a driver's vision to the rear of the car

and so were mostly replaced by direct 180 degree stairs, where passengers climbed anti-clockwise to the top deck (photo 6).

The original Brill 21E trucks had their narrow wing axle boxes (photo 7) replaced by the wide wing variety (photo 8). Track brakes were fitted, either mechanical or electrical - or combined (photo 9). Some cars acquired longer wheelbase trucks. Finally, after 1927 when Bolton purchased its last new trams as totally enclosed bogie cars, many of the rest of the bogie cars in the fleet were fitted with fully enclosed top decks and some of the four wheel cars also received this feature (photo 10).

Apart from the 1927 bogie cars, all Bolton trams kept open drivers' platforms as it was considered too expensive to fit full screens that would have required much



Reversed stairs.



180 degree direct stairs.



Narrow wing axle box.



Wide wing axle box.



Track brake.

modification to the platform equipment. Not all the four wheel cars were given the full modifications and one car,

No. 45, survived throughout the Second World War with old-fashioned reversed stairs (photo 11).

●To be continued.



Final top deck development.



No. 45 kept its reverse stairs.

Champion 20VS Mill from Chester Machine Tools

John Smith compares the requirements of the model engineer with the offerings of this milling machine.



In this article, the author proposes some mandatory and desirable requirements for a vertical mill for the model engineer. He then assesses the Champion 20VS mill against these evaluation criteria, showing how to measure the accuracy of the basic geometry of any vertical milling machine. The objective: to help you choose a mill that will enable you to do good work. Finally, he puts the mill to work to assess its flexibility, usability and performance.

Introduction

Vertical milling machines come in a range of sizes from the Proxxon MF70, on which you could mill the horns of an O-gauge locomotive, to machines costing hundreds of thousands of pounds on which you could machine the horns of the *Flying Scotsman*.

If you were a well-heeled Formula 1 team in the market for a toolroom-quality turret mill (on which, incidentally, you could undertake all the milling operations for a 10¼ inch gauge locomotive), a Bridgeport Series 1 with hand-scraped, chrome-plated ways, ball screws, a three-axis DRO, one-shot lubrication and power traverse would be a wonderful machine to own but it would cost about £22,000. Even industrial users have to be satisfied with knee mills made in Taiwan or China and perhaps 'finished' in the US or the UK and costing around £12,000. CNC machining centres cost a whole lot more.

Let's get real. We are hobbyists making model stationary engines or locomotives of 3½ or 5 inch gauge. Most of us don't have the 8 x 6 x 7 foot space needed to accommodate a Bridgeport and we don't have the budget for it either, so we are grateful to companies like Chester, Warco and Axminster for supplying vertical mills which meet our needs and budgets.

I was delighted to receive an invitation to review the Champion 20VS from Chester which, at £1185.19 (including VAT) for the mill with drip tray and stand, is a truly affordable machine for the model engineer. In my research, I discovered that Chester also supplies a range of large machine tools to industrial

users in the UK and abroad, so they clearly know a bit about workshop machinery.

Review criteria

Whatever the size of vertical mill you are considering buying, there are some requirements which, I suggest, are **mandatory** if you are going to be able to produce good work. Most important first, these are:

1. The basic geometry of the mill must be of acceptable accuracy. Specifically:

a) The spindle should be acceptably close to being perpendicular to the table of the machine. This is not an issue on a Bridgeport which provides the means to adjust the verticality of the head in both left and right and fore and aft planes. But it is an issue on small machines which either provide no adjustment of the head or adjustment in one plane only. If the spindle is not perpendicular to the table:

- i. End mills will cut deeper on one edge, which means that you will have to make multiple passes over a workpiece to achieve a truly flat surface,
- ii. When using the side of an end mill, the milled surface will not be at right angles to the clamping face of the workpiece,
- iii. Fly-cutting will not produce a flat surface.
- iv. Drilled holes will not be vertical.

v. When you are jig-boring holes and moving the head up to cater for larger and larger drills, the drill will be increasingly off from being co-axial with the hole. The hole will draw the drill in but the bending moment in the drill will force it to cut the hole deeper on one side than the other, so the hole will wander.



What is 'acceptable accuracy' I hear you cry? Well my Myford VM-B is 3.1 minutes of arc away from vertical measured left to right and 1.9 minutes of arc from vertical front to back. This doesn't sound too bad, but the error is sufficient to force me to think about how best to machine each workpiece to minimise the impact of the error. I obtain a more accurate vertical edge when milling with the side of an end mill along the X-axis than I do when milling along the Y-axis. Translating 3.1 minutes of arc into a slope, it equates to about 0.001 inch per inch. I would not want to use a machine much less accurate than this so this is the figure I will use as a benchmark.

b) The X-axis and the Y-axis should be acceptably close to being at right angles, otherwise you will not be able to mill the ends of a workpiece square to its length or use the mill as a jig-boring machine to mark out a set of holes on a plate (such as a bunker rear). Once again, I will use 0.001 inch per inch as an acceptable error.

c) The vertical (Z-axis) slideways should be acceptably close to being vertical to the table, otherwise you won't be able to bore a hole which is vertical to the clamping face of the workpiece. Once again, I will use 0.001 inch per inch as an acceptable error.

d) The ground vertical faces of the table (front and back) must be parallel to the X-axis slideways. The reason for this is that vices, angle plates and workpieces are usually positioned on the table by reference to these ground edges. I think an error of 0.0002 inch/inch is acceptable. If I owned a machine with an error larger than this, I would ask a local precision engineering firm to grind the front of the table.

e) The top surface of the table must be parallel to both X-axis and Y-axis slideways, otherwise the milled top surface of a workpiece will not be parallel to the clamping surface. Errors of 0.0002 inch/inch are acceptable.

2. The mill should be sturdy enough to undertake milling tasks appropriate to its size. The rigidity of the vertical column is of prime importance here. The column acts as a cantilevered beam which has to resist the bending moment imposed by the tool in use. As you will remember if you studied the bending of beams, beam deflection is inversely proportional to the second moment of area of the beam. If you double the size of a beam, therefore, keeping the same cross-sectional shape, you get 16 times less deflection.

3. The speed range must allow both high-speed drilling/spotting of small holes and low speed work such as boring, fly-cutting, counter-sinking and counter-boring. A slowest speed of 60 rpm or less is ideal. It's not just a question of speed; the torque available at the slowest speed must be sufficient to overcome the resistive moment imposed by the tool which (for a fly-cutter) can be substantial.

4. Clamps should be provided to clamp the head, the quill and the table (both X and Y axes). This provides additional rigidity when milling.

5. The dials on the X-axis and Y-axis handwheels must be capable of being set in any position. This is important when using a centre-finder to position a workpiece relative to the spindle for jig-boring work.

6. There must be a quill stop for reasons which I will explain later.

7. The quality of manufacture must be acceptable. Finest quality, such as parts bolted together being precisely located with dowels, is an unrealistic expectation for a budget-price machine. But badly tapped threads, poor quality fasteners and excessive slop in leadscrew nuts are not acceptable. And remember - a ground surface does not automatically imply high accuracy!

Then, of course, there are also desirable requirements, such as:

1. The maximum headroom should permit a chunky workpiece to be milled.
2. The minimum headroom should ideally allow a workpiece clamped to the table itself to be milled without the need for parallels or a box angle plate.
3. The table should be large enough to accommodate a good quality machine vice. I find the modular CNC type, as manufactured by Gerardi and ROHM, easiest to use. These are made of alloy steel, are hardened, are accurately ground all over (unlike some budget vices, unfortunately) and are easy to set up on any milling table. Whilst offering precisely-ground vice jaw height when the jaws are fully tightened, loosening the spring-loaded jaws also provides a downward force on workpieces from both jaws, if this is what you want.

They are not cheap, but you will never regret your investment.

Approach to the review

I'll start by reviewing the mill against the mandatory and desirable requirements. I will describe in detail how to measure the accuracy of the geometry of any mill. Then I will assess the ruggedness and usability of the Champion 20VS by making some brackets. What I will *not* be doing is making replacement parts for the mill; that is a job for Chester and the original equipment manufacturer. My philosophy has always been that I would rather buy than make tools. That way I can spend more time making models.

The Champion 20VS Mill

This is a keenly-priced mill, designed for the hobbyist (**photo 1**). It is suitable for bench mounting (if you have a really solid bench) but a stand and drip tray are also available. The specification is as follows (**table 1**, taken from the Chester web-site).

● To be continued.

Table 1

Max. Drilling Capacity	20mm
Max. End Milling Capacity	20mm
Max. Face Milling Capacity	63mm
Table Size	700 x 180mm
T-slot Size	12mm
Cross Travel	175mm
Longitudinal Travel	490mm
Vertical Travel	290mm
Max. Distance Spindle to Table	360mm
Taper of Spindle Bore	MT2
Spindle Stroke	52mm
Number of Speeds	Variable
Range of Spindle Speeds	50~2200 rpm
Headstock Tilt Left & Right	±90°
Motor	1HP
Dimensions (W x D x H)	960 x 570 x 970mm(max)
960 x 570 x 780mm(min)	
Max Spindle to Table	390mm
Throat	165mm
Net Weight	113kgs

FEATURES:

- variable spindle speed
- dovetail column
- digital quill depth readout
- column guideway covers
- tilting head
- large table size

STANDARD ACCESSORIES:

- drill chuck
- drill chuck arbor
- chuck guard
- drawbar
- manual and parts list

Valve Gear Link Hangers

John A. Stewart describes a simple CNC operation step-by-step.



I required three little links, called valve gear hangers, for the engine unit of my Kozo Hiraoka-designed 3½ inch gauge Shay locomotive. These are little links that go between the valve gear lifting arms and the actual valve gear expansion link on Stephenson's valve gear. Many references call these 'lifting links', but in the Kozo Shay plans they are referred to as 'link hangers'.

They are, at first glance, quite simple. A link with two reamed 2mm holes, 21mm between centres. The difficulty comes in because they are not only barbell shaped but the metal between bosses is also thinned on all sides, thus requiring machining on all surfaces.

Photograph 1 shows a completed hanger. What follows in this article is a description of how I arrived at producing a set of identical hangers for this locomotive.

For this job, I decided to mill the links out of a piece of BMS bar, that was slightly thicker than the finished links.

For those not familiar with the expressions peculiar to CNC, I should clarify some terms used here; 'profiling' is equivalent to milling/filing/sawing to a scribed line where only accuracy to the line matters. 'Pocketing' consists



A link complete; a small file removed sharp burrs on the edges.

of creating a depression in the material, where all sides (whether straight or curved) and the depth matter; an example might be the valve ports on a slide-valve steam cylinder.

My process consisted of three distinct groups of steps:

The first group:-

Step 1: draw in 2D CAD, three layers consisting of a) the two points for drilling, b) the link outline for profiling and, lastly, c) a dog-bone shaped line for pocketing the bit between the bosses.

Step 2: create in the CAM software, three individual programs, one for drilling, one for profiling and one for

making the pocket. I have a manual tool changer (that's me) so I choose to run three distinct programs and change the tool before each program is loaded.

Step 3: run the drilling program. Note that I did not drill completely through the material into the underlying table, but did drill through into a bit of sacrificial scrap aluminium that was between table and BMS bar.

Step 4: run the profiling program, then run the pocketing program. For setting the Z axis zero, I used a bit of thin paper so that the tool was not quite (but, very close to) touching the surface of the material.

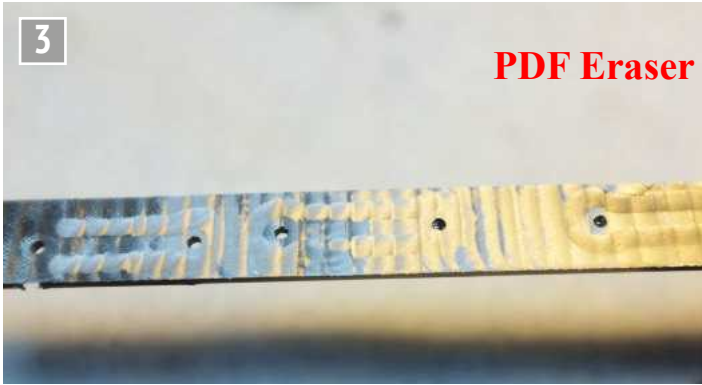
Step 5: unclamp the material and move it along a bit, and run through the machining steps again until you have enough links cut to this stage.

If you refer to **photo 2**, you can see the results of this step; the link is outlined, the material between the bosses is lowered and the drilling is completed. You can also see the bit of sacrificial scrap aluminium underneath the BMS.

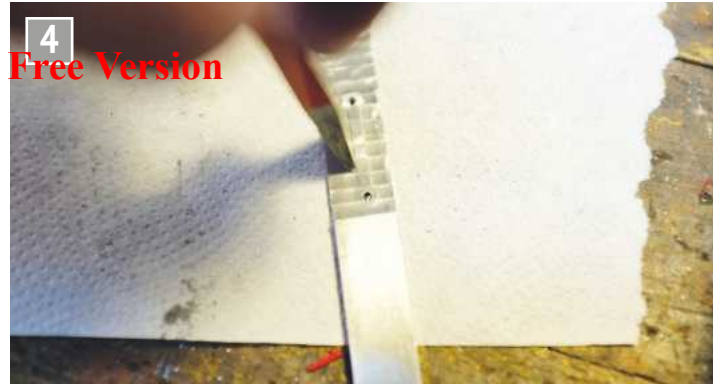
Now the fun part! This is the second group of operations:



One link drilled, cut and pocketed.



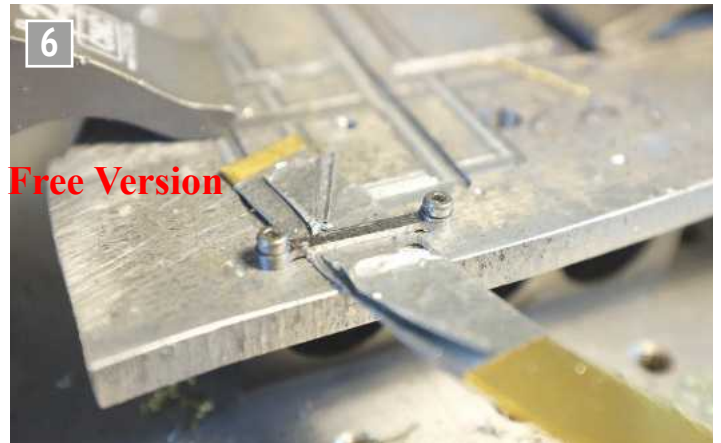
Back of the material thinned to the outline of the link - material was supported to ensure that the link was not pressed downwards by end mill cutting forces.



A cold chisel and scriber were used to remove the thin material between the link and the stock.



Links requiring filing and pocketing of the back of the link.



Back of the link reduced in thickness by running a pocketing operation.

Mill the back of the BMS bar down to the thickness of the links, ensuring that all of the underside is supported. If you have measured and set the depth of cut correctly, you should end up with a sliver of metal holding the links in place; this sliver of metal will hopefully be the thickness of the paper you used to set the tool height for the profiling operation. As you can see in **photo 3**, then, the hanger

outlines will be visible from the back. I took a cold chisel and a scriber and, by hand, punched through this thin sliver of metal (**photo 4**). In **photo 5** you can see the links as they came out, ready for the last group of operations.

Finally, in my bit of scrap aluminium, I drilled (by CNC) and tapped (by hand) two holes for 2mm cap screws 21mm apart. Each link was put in place, finished side

down, with a bit of a spacer underneath to support where the pocketing was previously cut. I used a bit of brass and kitchen foil to achieve the correct thickness. The pocketing program was again run, resulting in the back of the link reduced to the correct thickness as shown in **photo 6**. A little bit of fettling, and the three links were finished.

Astute readers will note that on the pocketing operation,

I did not adhere to my description of 'pocketing' that is found at the beginning of this article. For these links, only the radius at the bosses and the depth of cut were important. The remainder of the sides of the pocket were cut in thin air but the CAM Pocketing tool was used nonetheless.

ME

No.254

IN THIS ISSUE THERE'S MORE TO HELP YOU GET THE MOST OUT OF YOUR HOBBY... **ON SALE NOW!**

MODEL ENGINEERS' **WORKSHOP**

- › Myford Bed Regrind – Laurie Leonard reports on what's involved
- › Get every joint right with the help of David Banham's guide to Silver Soldering
- › Ben Tubbing looks at what Spark Erosion has to offer the hobby engineer



George Punter makes the engine for his 1913 agricultural tractor.



Saunderson & Mills Tractor Engine

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PART 12

Continued from p.597
M.E. 4558, 14 April 2017

In *Model Engineer*, issue 4511 (26 June 2015) I began my description of the building of the chassis of this unusual tractor. Now I shall describe the engine. The engine is the heart of this tractor and is the most complicated part to design and make. This article and the accompanying drawings describe how I did it.

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Inlet manifold fitted prior to painting.

Manifold

The auxiliary air valve seats onto a bronze fabricated housing and is controlled by a light spring. To quote the manual, 'the mixture can be diluted by means of an adjustable pure air valve to the most economical point'.

Included this time are all the drawings relating to the manifold (photos 50 and 51).

Ignition

By now the tractor was taking shape and looking quite interesting. The driver's end

of the engine is the busy end and has the controls and electrical parts for the ignition system (photo 52). The controls have small, cork faced cone clutches built into them as this enables them to be moved independently or together. The larger handle is connected to the advance and retard on the distributor and magneto while the smaller handle is connected to the governor via a spring and then on to the butterfly throttle valve. The vertical shaft that is driven from a 1:1 bevel gear in the crankcase also drives a step up bevel gear to the magneto. This means that the magneto revolves at engine speed. Small castings were made for the magneto, the stand and the gear case. These were machined up and fitted in place (photo 53). It did take some time to line all the parts up (photo 54).

The magneto (see *M.E.* issue 4544, 30 September 2016) is a dummy and actually houses the trigger system for the transistorised ignition system. A horizontal shaft is carried in two small ball races and on the end of the shaft is the slotted 'interrupter'. As the unit has



Manifold after painting.



The finished engine; driver's controls.



Under construction; showing the machined castings in place.



A closer view of the distributor.

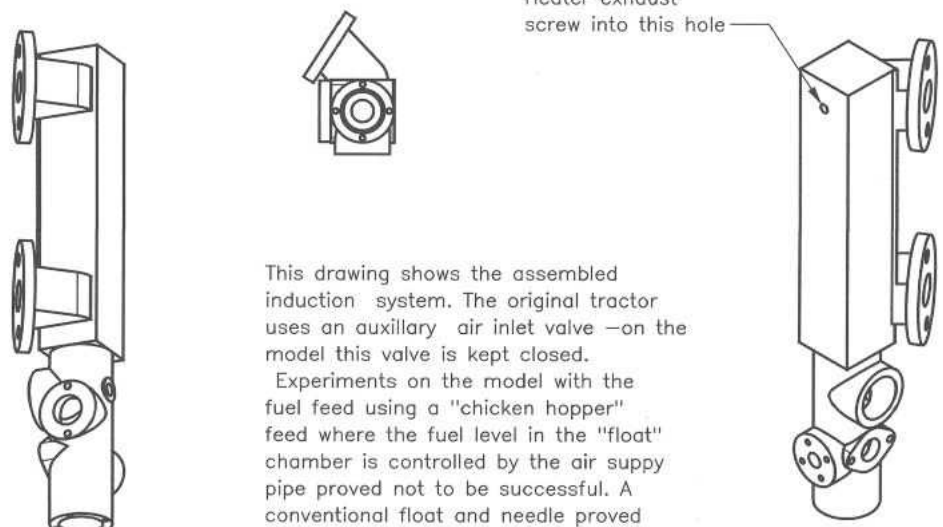
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to cater for the advance and retard the outer end brass unit that houses the small magnet is made so that it can revolve in the magneto housing. The Hall effect transistor housing is made from an insulated material and fits into the brass unit. The machine in the Geraldine museum had the magneto removed so I modelled mine on the type seen on old engines of that time. On the top of the vertical shaft sits the distributor and this is made from an insulated plastic material, as is the rotor.

The wooden box at the front of the tractor houses the transistorised ignition board, a small coil and the battery and switch. This system was made up by a friend, Jeff Jorgensen and tested on a four stroke model aircraft engine before being used on the tractor.

●To be continued.

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This drawing shows the assembled induction system. The original tractor uses an auxiliary air inlet valve —on the model this valve is kept closed.

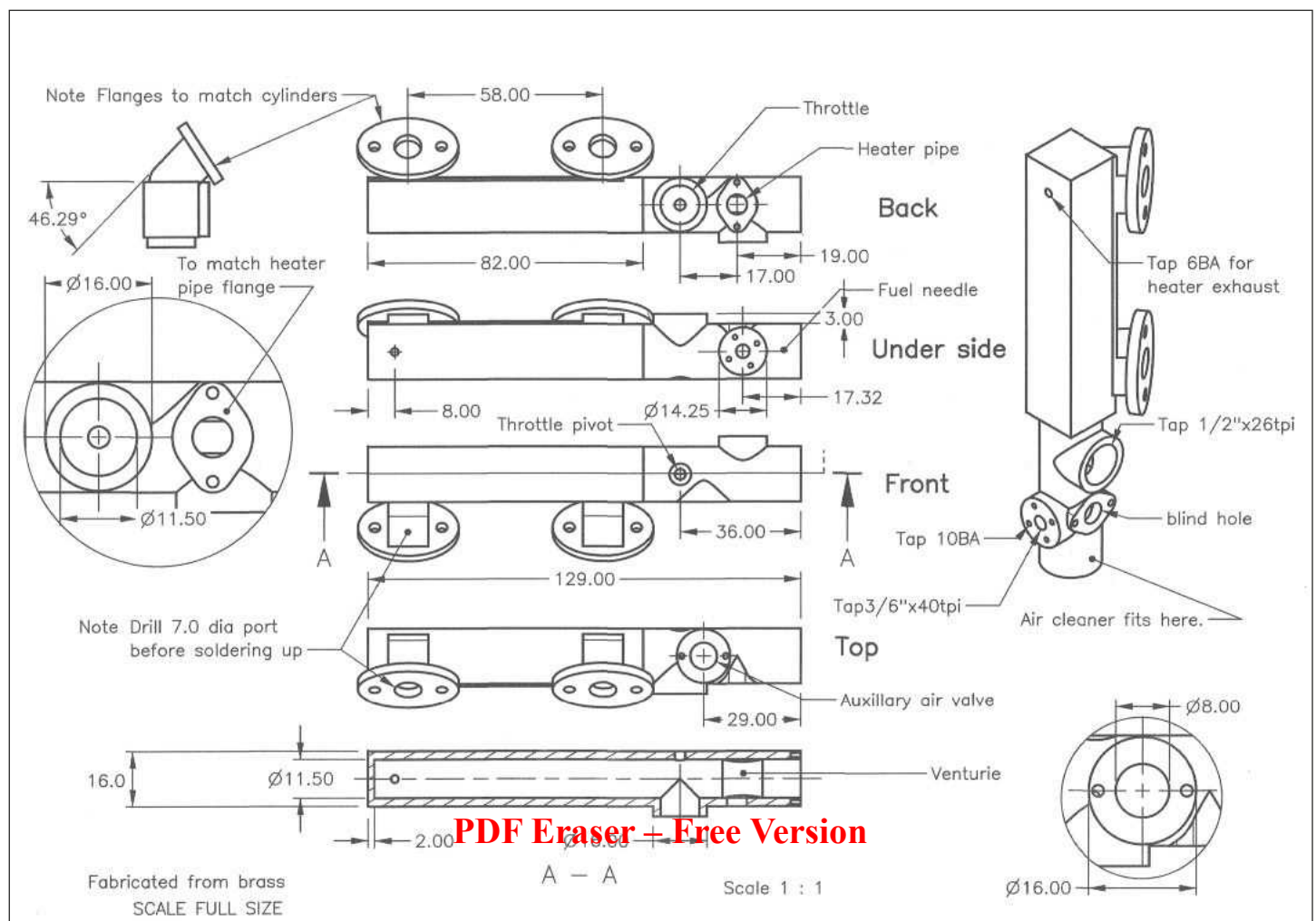
Experiments on the model with the fuel feed using a "chicken hopper" feed where the fuel level in the "float" chamber is controlled by the air supply pipe proved not to be successful. A conventional float and needle proved more successful.

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G.Punter A4

INLET MANIFOLD G.A.

Drg.No.16A



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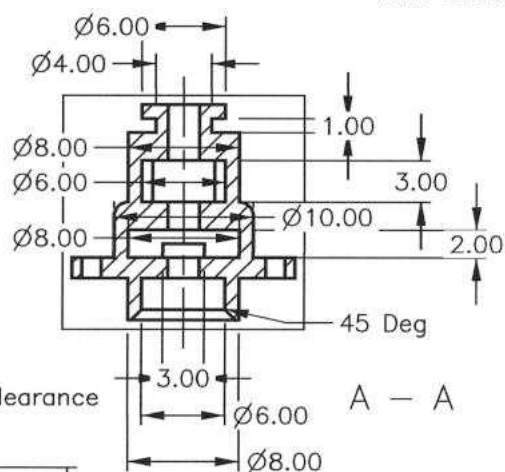
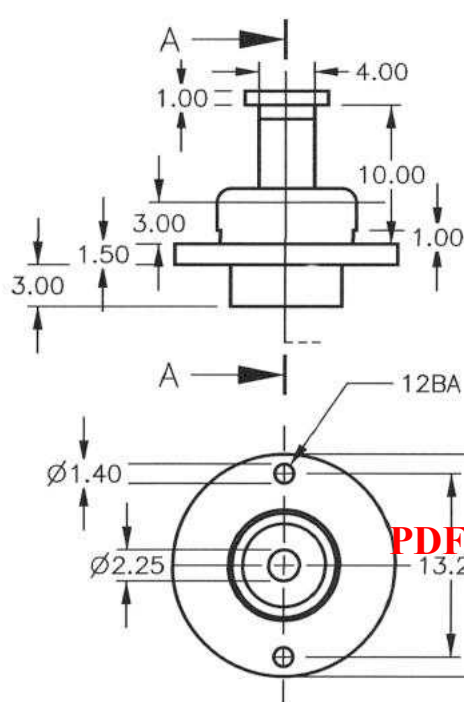
G.Punter A3

INLET MANIFOLD.

Drg.No.16B

Material – Brass fabrication

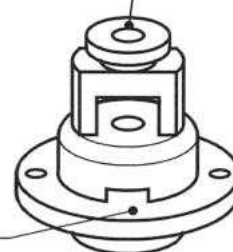
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Valve seats on here



Light valve spring and retaining nut on valve stem.



Air inlet

Bolts to the top of the inlet manifold.

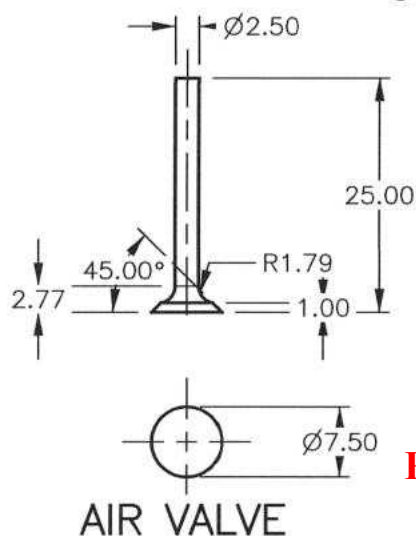
G.Punter

AUX. AIR INLET VALVE.

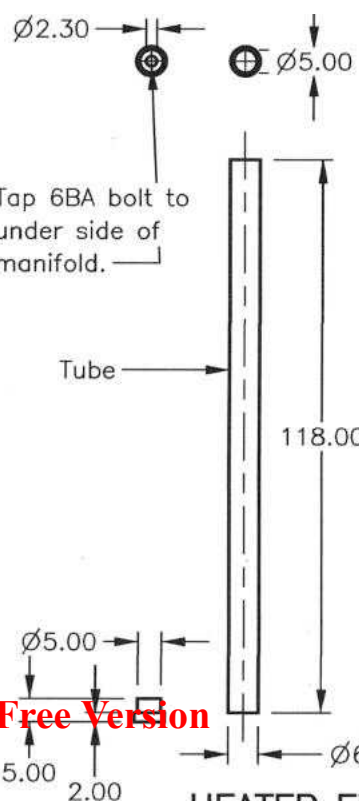
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Thread end 4.0 mm with 2.5 x .45 for retaining nut, washer and light spring.

Material – steel



AIR VALVE



HEATER EXHAUST

Silver solder together

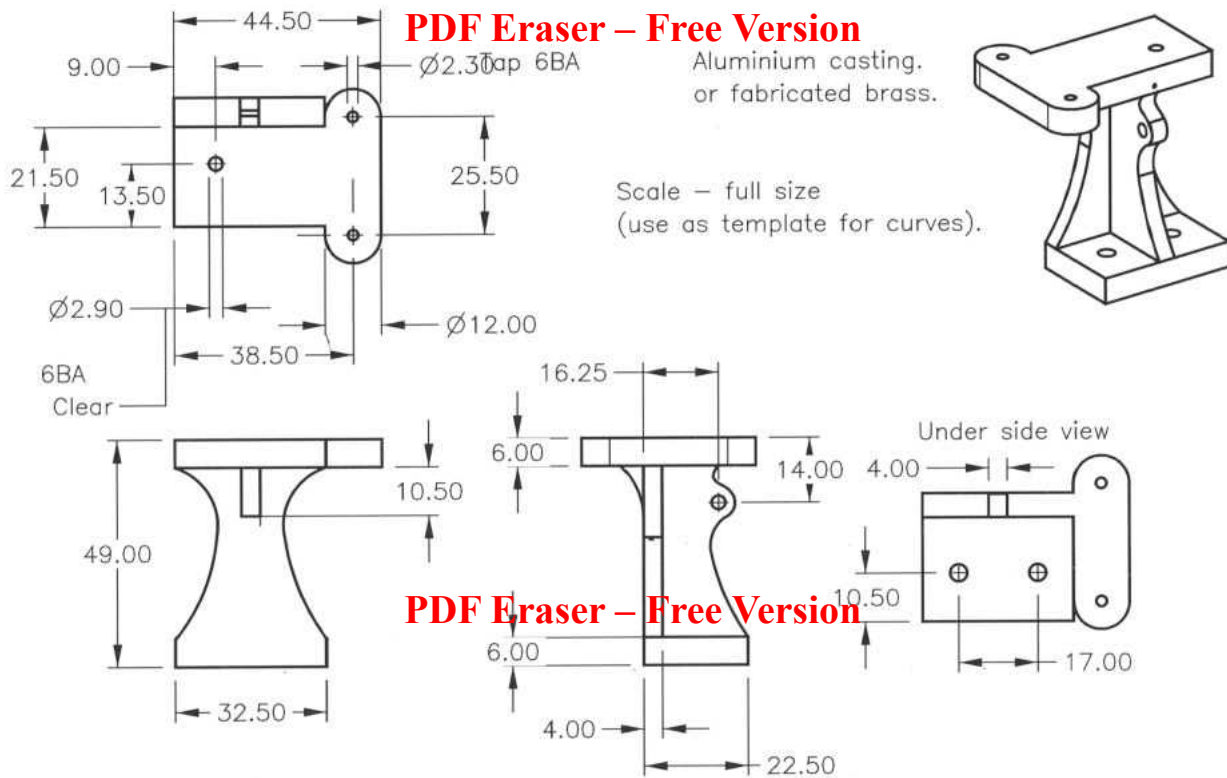


Material Brass

G.Punter A4

INLET MANIFOLD PARTS

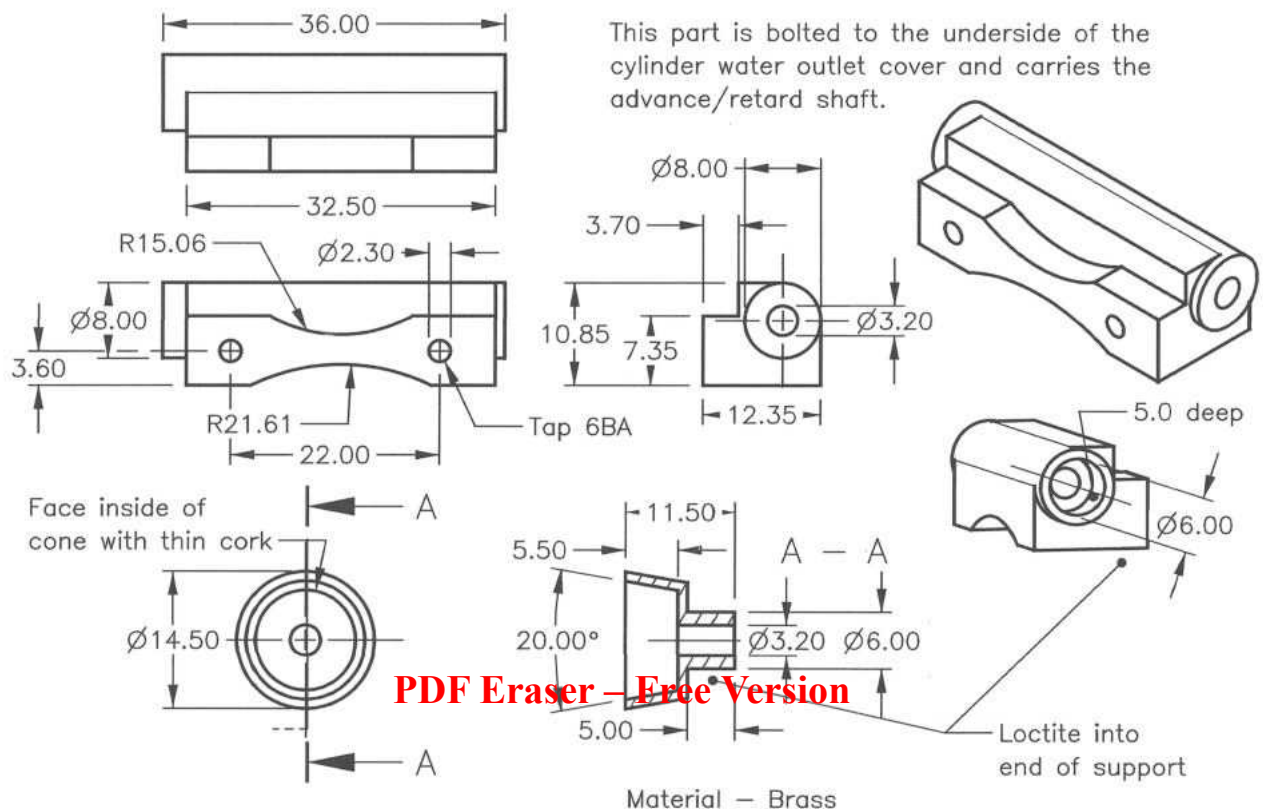
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G.Punter A4

MAGNETO STAND

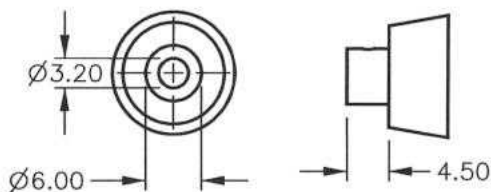
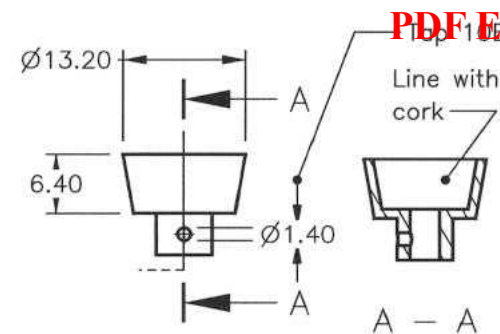
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G.Punter A4

ADVANCE SHAFT SUPPORT

Drg.No.18B

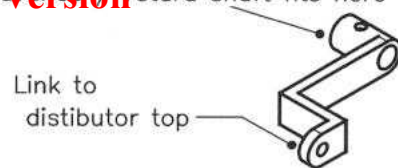


SMALL CONE
Brass

This small cone is attached to the end of the advance / retard shaft.

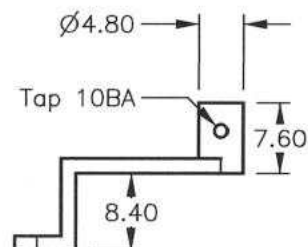
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Adv/Retard shaft fits here

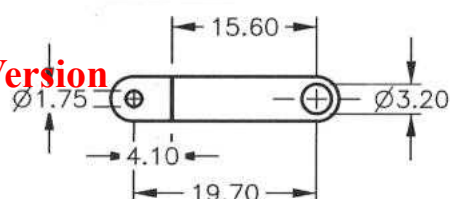


Link to distributor top

Material – steel



Tap 10BA



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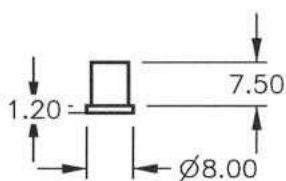
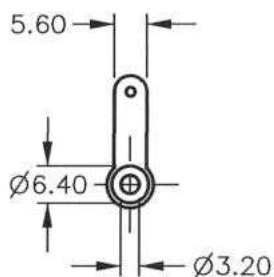
G.Punter A4

CONTROL LINKAGES & PARTS

Drg.No.18C



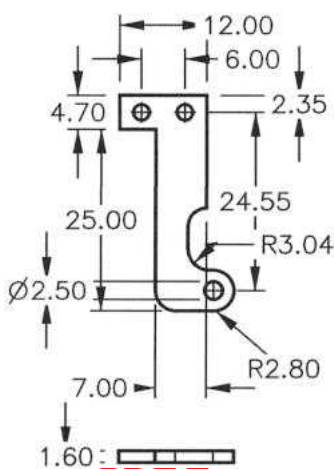
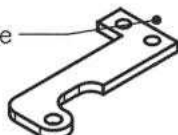
Material – steel



Adv/Ret LEVER

8BA

clearance

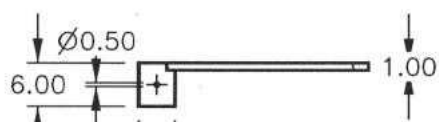
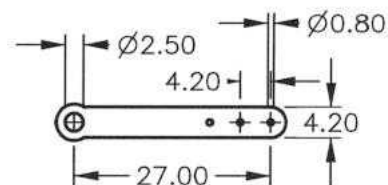


GOVERNOR SHAFT SUPPORT ARM

GOVERNOR SHAFT LEVER

Pin/ Loctite to shaft

Governor shaft is 2.5 dia 92.0 mm long



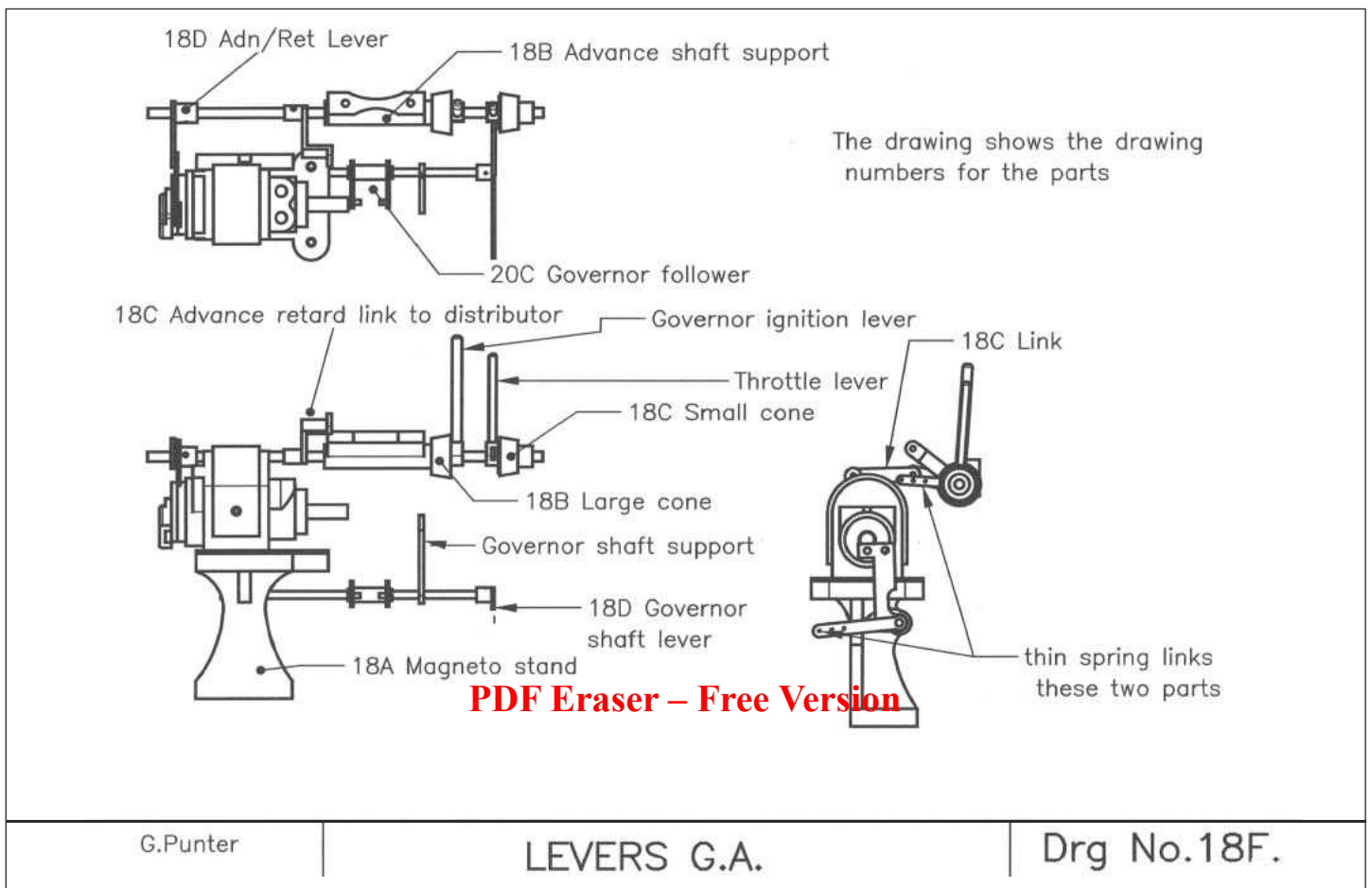
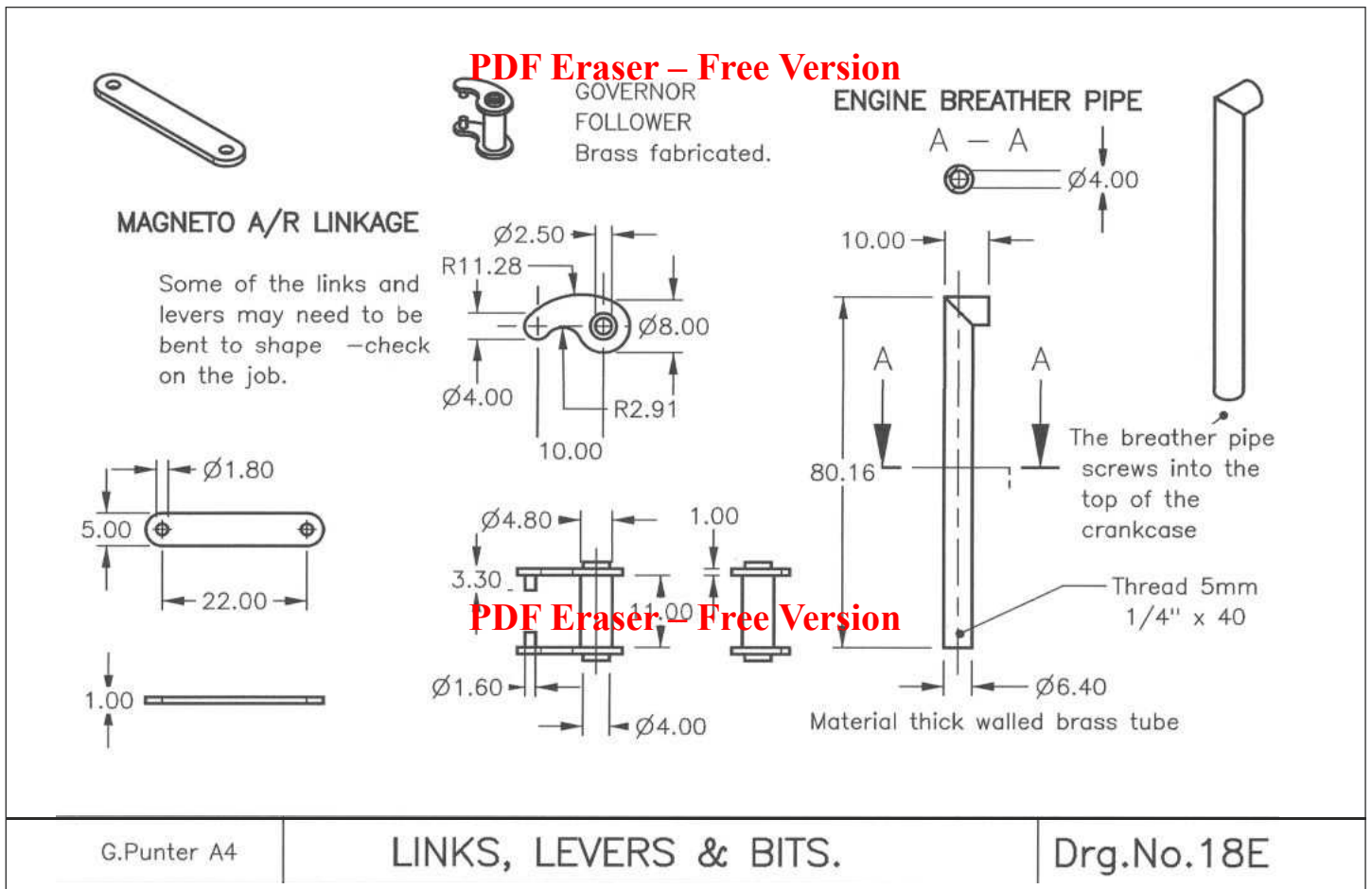
All levers made from brass or steel

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G.Punter A4

LEVERS & SUPPORT ARM

Drg.No.18D



Garrett 4CD Tractor

in 6 inch scale

PART 33

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Chris Gunn
starts
construction
of the belly
tank.



Continued from p.446
M.E. 4556, 17 March 2017

This article has been written to guide the builder through the construction of the 6 inch scale Garrett 4CD tractor designed by Chris d'Alquen. The writer has previously built a 4 inch scale Garrett and a 6 inch scale Foden wagon so has the benefit of considerable experience in larger scale modelling. Most machining can be done in the average home workshop but the supplier from whom the castings and drawings are currently available is able to provide a machining service for the largest items if required.

In the previous episode I described the final assembly of the tender and the next item was to be more sheet metal work; the belly tank. I am not a big fan of sheet metal work, I much prefer machine

work, but the methodology I use gets me there, with the equipment I have, but it's not perhaps in the easiest way. In my working career I worked for two companies that did a lot of sheet metal work but I

never did a hands on stint on the shop floor so my practical sheet metal working knowledge is a bit skimpy. The belly tank assembly is shown in Drawing No. 9 of the set available from A. N. Engineering.

The belly tank ends are available as a pair of pressings with radiused edges so naturally I decided to use these as the starting point. These were supplied in much the same state as the tender sides so the first job was to trim all the flash off leaving the tank ends with an even flange all the way round. So far so good but the real issue was how to hold the tank ends in the right position while the belly tank wrapper was fitted. I tried a couple of set ups, involving many G-clamps (one can never have enough) but none would allow me to manipulate the wrapper and get in at the holes. In the end I rang Bob Whitehead for some advice, as at the time he was still selling the castings as well as building an example of the 4CD.

The method he used was to make six tubular stays that could be welded at the six corners of the belly tank ends; the six stays included two for the corners at the cut-out that fits around the boiler. Once the stays were all welded in position, this would form a rigid structure around which the wrapper could be fitted. The wrapper would be fitted with temporary bolts and once it was fitted all round, it



Turning the belly tank stays.



The sides are supplied as pressings.



The set-up to get the belly tanks ready for welding.



Corners welded.

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could be removed, the stays cut out and the whole thing reassembled again.

The next decision to be made was the wrapper arrangement. The steering shaft brackets are fitted to the bottom of the tank and require reinforcing plates to be fitted on the inside. The steering shaft passes through the tank and this needs a suitable tunnel, which also requires some reinforcing around the cut-outs in the tank. There are several other items that need to be fitted around the tank: some oilers for the steering gear, the water strainer and the water lifter, plus the two manholes in the sides. In view of all these additions and the belly tank support, with yet more reinforcing plates, I decide to make the wrapper in four sections.

The first would cover the majority of the bottom, the second would cover the curved section that sat under the boiler and I would fit one plate either end to wrap around the ends. The joints would be reinforced with joining strips and they would be positioned so they could not be seen when the belly tank was installed. This way I could have access to all sides as assembly progressed and, when I was happy, I would rivet the bottom and sides but fit the curved top with button head screws so access would still be possible through the big hole in the top, should it be necessary. I am a great believer in keeping one's access options open, having worked on machinery where the frame or cladding was

welded in position and this prevented access to some item that needed fixing.

The next step was to obtain some tube for the stays; I checked the radius of the corners and also measured the width of the wrapper and the length of the pieces I would need and then set off. At my local structural steel stockist's I found some tube exactly right for the corners of the tank. It was 48mm outside diameter and seemed to be a standard size as there were off-cuts aplenty! I bought a couple of these and then went to one of our local sheet metal workers who was happy to cut up some of their 1.5mm thick off-cuts the right width and lengths for my needs in exchange for a contribution to their biscuit fund. I've said this before but I find it helps to take a picture of what you are making to show them and, usually, folk are interested as building a half size traction engine is a bit out of the ordinary. I also find approaching smaller companies is best as one can usually talk to someone directly connected to the shop floor, whereas larger companies tend to have a hard-hearted receptionist who will stop you seeing someone more sympathetic.

I headed home with my materials and set to work. The first job was to cut the stay tubes slightly over length. Then I put the fixed steady on the Bantam, faced off the tubes all to the same length and put a small chamfer on for the weld bead (**photo 293**).

Once all six were done, the next step was to hold them in

position and weld them. This was easier said than done and it turned out to be one of those jobs when an extra pair of hands would have been useful. I tried at first to hold the eight items together with a pair of sash clamps and after about 30 minutes without any success - at which point I would have been happy with four pieces held in position - I gave it up as a bad job. When I had calmed down and thought about it, I found a couple of wide pallet boards and some odd bits of studding and finished up with the set-up shown in **photo 294**.

Photograph 295 shows the set-up from the front of the tank.

It was hard to get all six tubes held in position all at once, due to minor variations in the lip of the tank ends, but this did allow me to tack weld a couple in place and then add additional stays once those were secure. Eventually all six were tacked in position and I removed the assembly from the clamp to check for square and to check the width was the same over the outside of the ends. When I was happy with that, I clamped it all up again to stop it moving when welding and put a decent weld around each corner (**photos 296 and 297**).

Once the welding was completed, the welds were ground back flush with the lip around the tank ends and I was now able to start adding the sections of the wrapper. I decided to start with the curved section that forms the top of the tank under the boiler. I reasoned that this

might be easier to do with the tank the right way up and firmly down on its base. You may wonder where the bench space big enough to accommodate this work has come from; it is in fact a temporary worktop which I can bring into use for jobs like this. I built my benches to fit the workshop on a frame made from 50 x 50mm box section, with some horizontal beams running from the wall to the front of the bench top. At some point I rescued some solid square bars about 1.5 inch square, about a yard long, from our scrap heap and drilled them with a series of holes. I slid these into the bench top tubing and I can pull them out to make a couple of rails on which I can place a piece of 20mm ply to act as a temporary bench top. The bench top is flat and can be stowed away and the square rails can be slid away when not required. I have a few coach bolts, which locate the top to the rails to stop the whole thing moving about.

Back to the belly tank. I selected the piece of plate designated for the curved section, marked a centreline and drilled a pair of $\frac{3}{16}$ inch holes at the correct width for the two rows of rivets that would be fitted on each side of the tank. I marked out the lines where the rivets would go along the edges of the plate as well. I then marked out the centre of the belly tank inside the curve and carefully marked out a pair of holes at the right centres to match those in the plate and drilled them $\frac{3}{16}$ inch. I pulled the plate partly down into the curve with a ratchet strap and then inserted a couple of long bolts and tightened these until the centre pulled down into position. Once the centre was down, the plate was checked to be square and the edges parallel with the ends, I moved the ratchet strap and pulled it down a bit more until I could add the second temporary bolt (**photo 298**).



Another view of the part fabrication.



The curved section marked out and temporarily fixed.

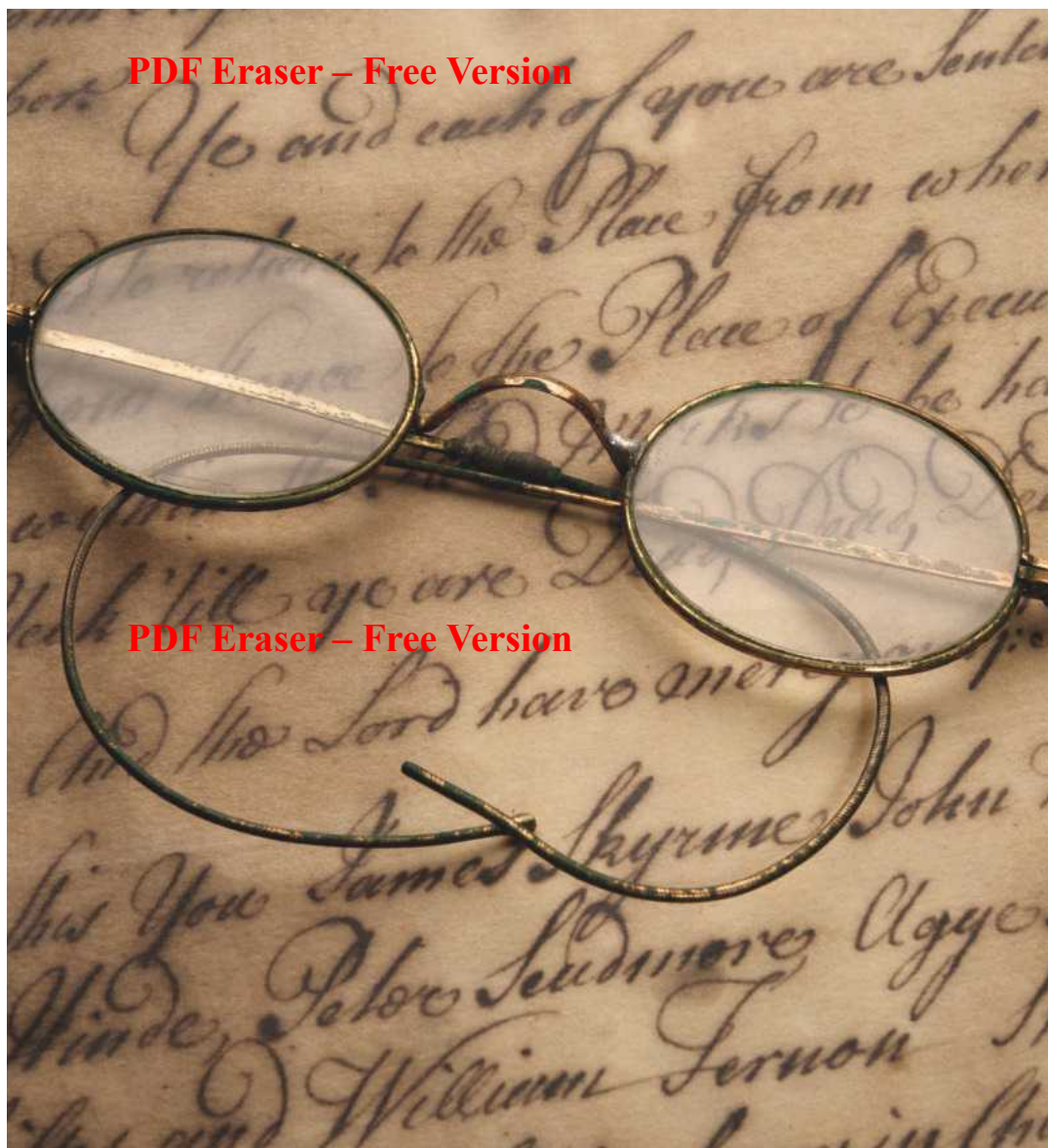
●To be continued.

Don Allen
takes a
closer look!



PDF Eraser – Free Version

PDF Eraser – Free Version



Focus on Bifocal Spectacles and Other Workshop Matters



The new height of the new 'surface plate'.



The plate is actually a thick piece of float glass.

PDF Eraser – Free Version

For the benefit of those who enjoy 20/20 vision, bifocal spectacles have two lenses; the main ones are for distance and the lower sections are for reading. Consequently, when reading, you naturally look downwards at an angle. This is all well and good when reading a book or a drawing, however considerable difficulties arise when using a surface plate or carrying out bench work.

Large surface plates in general are quite heavy so nearly all are mounted on a substantial bench, therefore when trying to set a scribing block to a rule or a height gauge whilst looking through the lower portion of your spectacles, you have to take up a semi-kneeling position - or wish you had a double jointed neck from birth.

My answer to this problem gives a choice of two options: option 1 was to construct a concrete pit with steps leading down from the workshop floor; option 2 was lift the surface plate up to a comfortable level, i.e. a few inches below the bottom of the reading segment of the spectacles - 4 foot 10 inches is okay for me (**photo 1**). Fortuitously common sense prevailed and I chose option 2 (**photo 2**).

Lifting a very heavy cast iron plate to the requisite level is not without its problems, mainly caused by the weight; also constructing a strong enough shelf would require some extremely stout brackets with very strong fixings or some powerful sky hooks.

You will see from the picture, my 'plate' is, in fact, a sheet of thick float glass 3 feet 4 inches x 2 feet 3 inches. This plate has served me very well for more years than plenty. It's main benefits are threefold: i) it is only a fraction of the weight of a comparable sized cast iron plate; ii) because of the weight difference a much larger plate can be accommodated than the cast one, allowing, in some cases, the whole model to be positioned on the plate. This is very handy for transferring a datum from the front to the back of the model or, for instance, the quartering of wheel sets; and iii) it's very cheap to replace.

May I suggest you try this higher altitude of working on any convenient shelf to explore the idea? A great place to carry out this experiment is the upper kitchen cupboards as the shelves have various height differences. (I advise a degree of caution to avoid large volumes of flack; the

phrase, 'what the eye doesn't see ...' springs to mind.) Once a suitable height has been established I feel sure some workshop changes could well be forthcoming.

For a supplier of thick float glass, look for a glass merchant who specialises in glass worktops for kitchens and bathrooms; you may be surprised just how cheap an off-cut can be. It would appear that pieces any smaller than a bread board, or 'clangers', are tossed in the skip. (My dad always told me it was far better to be born lucky than rich; this might have been because he had no money.) My particular piece was a Rep's sample with all the plus ground and bevelled but if you are not so lucky, it is not beyond the wit of man to stone off the edges and corners or fit a timber bead around the sides, so why not try your luck?

A raised bench

When I was constructing my 7¼ inch gauge Union Pacific Centennial Locomotive the two bogies ('trucks' to use the American vernacular) weighed 247 lbs each, therefore they had to stay on the bench. However, as the trucks at this time were finished and painted, some form of protection was required so a lightweight cover that could easily be lifted off without damaging the paintwork was made. The top of the cover finished at 8½ inches above the bench height.

As if by natural instinct or, indeed laziness (I prefer to think the former) I found



A raised section of bench space. 8½ inches is right for me

myself using this higher level for small work - assembling, marking out and most close-up work. I found it to be far more comfortable to work at the higher level than at the lower bench; it was also much less strain on the back.

When the Centennial was completed the cover was no longer required, however, I had become so used to working at the higher level I decided to make a more substantial raised section on the bench (**photo 3**). Not only did this give me my happy fiddling height but it provided extra storage space underneath.

The raised section is 8½ inches above the bench. Understandably this dimension may not suit all so I am afraid, for you, it's back to the test bed in the kitchen. With the aid of various tins etc., and the bread board, a comfortable working height

can quickly be determined. (Please don't forget the flack precautions.)

Convention states that the recommended height for the top of a vice is approximately your elbow height but maybe the choice is personal. When I am working on small parts in a vice set at such a level, however, I come back to the bifocal and back issues. To resolve this problem a 3 inch vice was mounted on a removable swivelling plate (**photo 4**) which was positioned on the top of the raised bench level. I have to say how much better it is, when using a file on small parts, when you can see what you are doing (**photo 5**).

Raised table height

Still on the subject of bifocal viewing - when I purchased a small Proxxon drilling machine complete with a compound table and a rotary table (**photo**



A vice on a removable swivelling plate...



... is mounted higher than conventionally.

6), I thought this too should also be mounted at an easy working height. Accordingly I made a small chest of three drawers and mounted the drill on the top. The drawers hold all the bits and bobs associated with the drill. The carcass raised the drill to a convenient and comfortable working height.

As an add-on, one of those little work lights was fitted: as I said previously, it really does improve the quality of your work when you can actually see what you are doing (photo 7).

Eagle eyes may be wondering about the purpose of the attached digital calliper in photo 7. Well, this is fitted onto the compound slide and fixed with a simple removable clamp. When clamped, the calliper and the slide are both as one (photo 8) yet still allowing the depth gauge finger to move freely into contact with the lower casting (photo 9). A small stub was turned to be a good fit in the centre hole of the rotary table



A small drill with the table at comfortable eye level.



Good task lighting also helps enormously.

(photo 10): the smaller end to be secured in the chuck of the drill. The rotary table at this time was loose on the compound slide. Once the rotary table was positioned directly under the drill chuck using the X-Y screws, the rotary table chuck is then tightened and the rotary table clamp bolts are tightened onto the slide. The stub is then

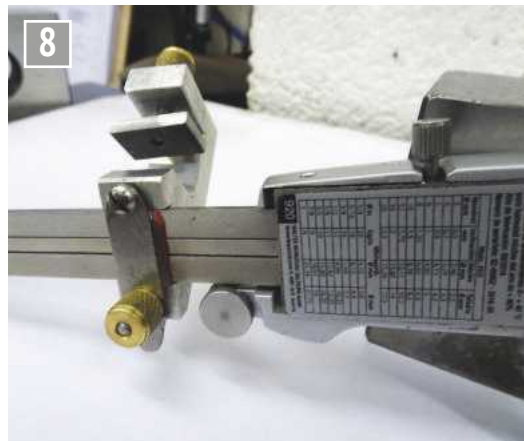
removed and the chuck is now set absolutely on the centre of the rotary table.

So shall we put the contraption to work? If we consider the holes in a cylinder cover, for instance, the method adopted is as follows: zero the calliper with the finger in contact with the lower casting (photo 9). Calculate the distance from the centre

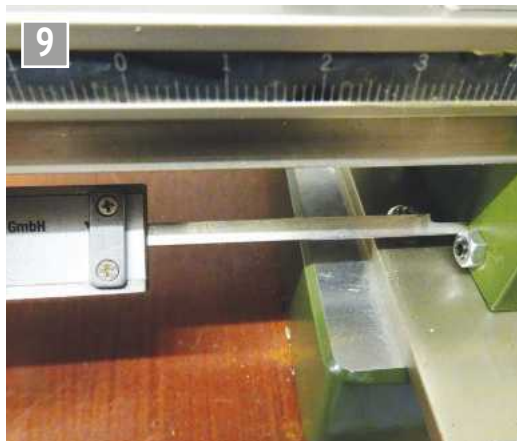
of the cover to the centre of the stud holes and set the calliper to that value (photo 11); move the table to the left using the X screw and read off the dimension on the calliper until the calliper returns to zero. Next, zero the rotary table degrees dial (photo 12) and read off the number of degrees (photo 13) to give the desired number of holes in the cylinder cover.

It's now time to drill the holes. Start with a small centre drill and change for the stud clearance drill for each hole and drill though; continue with the next hole (photo 14). Simple ... but it works.

Before closing, can I briefly go back to the subject of the vice? On both my vices the gripper serrations have been ground off the jaws on a surface grinder (photo 15). I find holding small parts in removable soft jaws can be a pain in the proverbial ... and



Calliper and clamp work together.



The depth gauge finger still works as normal.



A stub for the alignment of the chuck/ rotary table.



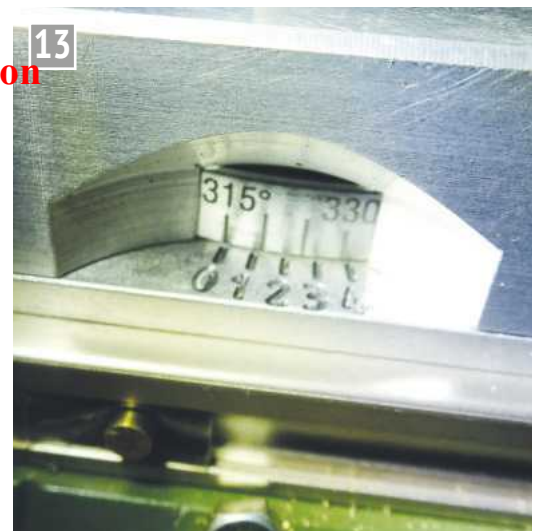
The distance from the centre of the cover to the centre of the stud holes.

I find holding small parts in removable soft jaws can be a pain in the proverbial... and having used the vices in this condition for more than 30 years without causing damage to the smallest piece of work, I regard the small price (if you have to pay, that is) for the surface grinding, a very cheap investment when compared to the benefit of easier working.

having used the vices in this condition for more than 30 years without causing damage to the smallest piece of work, I regard the small price (if you have to pay, that is) for the surface grinding, a very cheap investment when compared to the benefit of easier working. You can trust me when I say a 'cheap investment' because it can be just another way of saying a pint or two at the backdoor (or a tin of biscuits through the front door) of a local machine shop.



The rotary table degrees dial.



Number of degrees relates to number of holes.



Simple but effective.



Permanently smooth vice jaws.

Not many things in life are chipped in stone but the one exception - something that cannot be denied - is the fact that we are all getting older and, hopefully, long may it continue. Consequently, some of the above ideas may suit non-bifocal workers also.

Thank you for taking the time to read my ramblings. I hope someone may benefit from same.

Workshop pictures, **photos 16 and 17** may be of general interest.

Anyway, as the great man said, 'Nuff said!'.

Incidentally, I have no connections with Proxxon, however I will say the drill (given its present set-up) has turned out to be a great and simple piece of kit for me.

ME



Workshop view - raised bench on the left.



Another view of the workshop.

Geoff Theasby reports on the latest news from the Clubs.



Odd how the mind works at times. I attended a local scientific meeting recently and was convinced

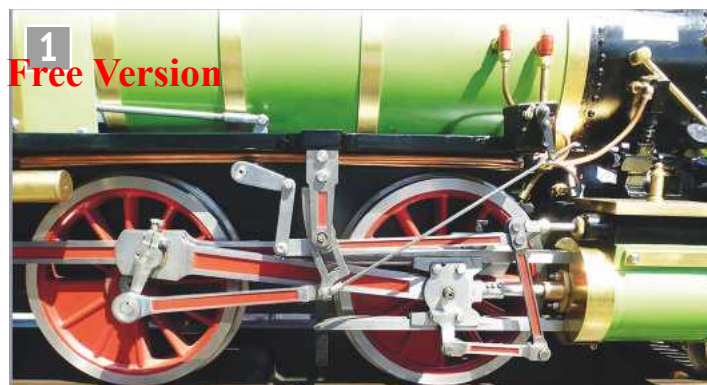
I spotted a friend of mine, one Roger, after we were all seated. When the meeting concluded, I made my way over, tapped his shoulder, held out my hand and said, 'Jonathan!'

In this issue: Punctuality, plastic gears, a slide rest, dripping, unbending, a Centenary, tectonics, a spray booth and a long lens.

The News Sheet, March, from **North London Society of Model Engineers**, begins with Ian Johnston perusing old copies and noting that the publication had shrunk from A4 to A5 and contributors then were many and varied. Nowadays it is easy to compose and dispatch an article on a variety of electronic equipment with much less effort and inconvenience than before but fewer offers, so how about it? (I reckon that goes for all the other clubs out there – Geoff.) Most of the rest of the newsletter was taken up by details of a general discussion meeting, including a suggestion that a moratorium be declared on new projects, allowing members to have fun and just get on with running the railway. It was generally agreed that the evening had been very useful and should be repeated.

W. www.nlsme.co.uk

The Whistle, March, from **British Columbia Society of Model Engineers** has a beautiful picture of a Walschaerts valve gear on



Valve gear on a NZ Phantom at BCSME. (Photo courtesy of Paul Ohannesian.)

Editor, Paul Ohannesian's 'Phantom' locomotive, *Phoenix*. Pin-sharp, it would be ideal for enlarging and using as a visual aid in explaining how the valve gear works (photo 1). More next time! Lindsay McDonnell writes a full article on the Society's Hudson; its history, how it was made, how it works and what it can do. Doug Bach then explains the setting of locomotive valve gear and ways of doing it. Chuck Laws found a little video on how to remove rusted nuts from any machinery. The URL is very long but all it shows is, warm up the nut with a cigarette lighter and drip candle wax onto the nut and its thread. Only a few seconds is required and the nut unscrews immediately. No gas torch or torque wrench, not even a little propane burner. Magic!

W. www.bcsme.org

Worthing & District Society of Model Engineers' Newsletter is always interesting and humorous (not that the others aren't, of course. In fact, - I'll shut up now and stop digging – Geoff). The

Charity Day raised £1700 for Kamelia Kids and 300 bags of donated sweets were given out. An interesting factoid reveals that the profit on a new car ranges from £2000 for Nissan, to £117 for Opel. Well, we now know Opel's fate, sold to the French PSA group! Complaints about Southern railways are not new; Mike dug up some details from an 1889 book, *Express Trains* by a Prof. Foxwell, in which punctuality, or the gross lack of it, is clearly not a new phenomenon. Mike Wheelwright explores the cost of railway engines over the years, finding that a Black 5 70 years ago cost £½ M in today's money, whilst in 1880, £5,000 was average for a locomotive or, about what you would now pay for a 5 inch gauge Jubilee kit, in contemporary money. Peter Guy begins a series on the history and models of the Stuart Turner company. David Baldwin discovered the *Velorail Suisse Normande Val de Maizet* ('rail bike' to you, sir!), a four wheeled velocipede, rather like the Social Cycles found in South Coast resorts years ago but used on otherwise abandoned railway tracks. (Search for 'velorail de france'). The Spring issue reports the death of Dr. John Sayer, whose family donated the contents of his workshop to the Society, from the sale of which a 5 inch gauge Class 73 Electro-diesel Pullman kit was bought. It will be named *Dr. John*.

W. www.worthingmodelengineers.co.uk

Blast Pipe, March, from **Hutt Valley & Maidstone Model Engineering Societies** opens with Murray McKenzie's newly



'Danger, men at work' From Blast Pipe. (Photo courtesy of Peter Anderson.)

made Dulcimer. That's rather different! The risky business of feeding the train crews on the Waitangi Weekend, including an evening meal for eight on the Sunday evening was carried out by Claude Poulsen and David Grant-Taylor (**photo 2**).

W. www.hvmes.com

The Link, March, from **Model Engineers' Society (NI)** reveals John Matthews' new project, an LNER D14 Super Claud 4-4-0. The rolling chassis stage is imminent. Three good railway jokes and another cartoon, this time illustrating holding up the traffic - not by a caravan, but an ancient (Foden?) steam lorry...

W. www.mesni.co.uk

Another *The Link*, March, from **Ottawa Valley Live Steamers and Model Engineers**, had from Johns, Stewart & Bryant at the Show & Tell evening, a 3-D printed plastic gear produced for a lathe to screw cut an 8BA thread for an antique steam engine. Guy Cadrin is refurbishing a South Bend lathe for another member and making a good job of it too. Following this, Editor, Graham Copley describes the Roberts lathe in the UK Science museum. Richard Roberts worked at first for Henry Maudslay and this lathe is an early example of the slide-rest tool holder with which we are all now familiar. Lacking business sense, Roberts died in poverty. Graham then

introduces the Ottawa LRT which begins service in 2018. W. www.trainweb.org/ovlsm

Northern Districts Model Engineering Society (Perth) sent *Steam Lines*, March/April, in which we learn that the January school holiday runs were very successful, more than expected and on the third such, the queues did not diminish until 2pm. Running on Tuesdays at these times also proves useful but balancing the aims of a club track with running a public miniature railway is sometimes fraught. Phill Gibbons has built an 0-6-0 O&K 7¼ inch gauge locomotive in a year but without any plans! It is scaled up from a 5 inch gauge Polly, with details from an O&K spare parts catalogue (**photo 3**). Phill made his injectors, not as LBSC did, but using taper reamers ground from old taps. He tells us how it is done. Editor, Jim Clark builds a spray booth, cutting down on fumes and overspray. About a 1m cube should deal with most items. (I recall seeing at Keighley Bus Museum such a booth capable of containing a full-size double decker - Geoff.) Various simple accessories on which to hang or stand small parts, including a simple turntable, may be contrived. The plate and trivet from a defunct microwave oven might find a new life here. Les Harris has finished his 2-8-0, consolidating (!)

his recent efforts, with a little assistance and unhelpful witty banter, to get it in steam. On the February club run his wide smile said he had succeeded!

W. www.ndmes.net

A collection of *Ellies*, at **Sydney LSLS** is shown in **photo 4**. Veritable Superpower! W. www.sls.asn.au

Model & Experimental Engineers' Auckland sent their February Newsletter in which two neat twin cylinder vertical engines were presented, one a Stuart 10. Dave Hamp had a problem with an oriental dividing head in which the index pin did not fit the plate correctly, leading to a misshapen tooth on a clock wheel. Graham Quayle's bent boiler is now okay and work continues, leaks fixed. It is for a Fowler compound Showmans' engine. More 'unbending' by Michael Cryns restored a clock lantern pinion, damaged when the spring broke, sending an uncontrolled power surge through the gear train. Murray Lane converted a small crane arm, intended for a 'ute' (a pickup truck in the UK) into an engine lifting device for his garage, replacing a chain hoist that suffered from inadequate headroom. A small crane on a pickup sounds useful, especially if you get a puncture. You could use the crane to hold up that corner as you change the wheel, or while you get to the tyre depot. *Couldn't you?*

Er... Guys...? Auckland SME's oldest member, Jim Greasley is 100. Well done Sir! Jim built many good models including a scratch built BSA motor cycle and a Shand Mason horse drawn fire engine with two hand carved wooden horses, when he was 93. He was honoured with Life Membership in 1984.

PEEMS Newsletter, February, from **Pickering Experimental Engineers & Model Society**, has new Editor, Neville Foster, pondering the continuation of the humour practiced by his predecessor. He has decided that discretion is the better part of valour, at least until he gets his feet under the table. (If I may be so bold; be your own person, Neville, develop your own style and see what happens - Geoff.) A recent talk by Roger Taylor on modern fuel injection systems is written up, with Roger's assistance.

One club member is in hospital and a visiting fellow member took along a hot air engine to demonstrate one day, which intrigued the other patients and staff alike. Good idea! An extract from *M.E.* of 1945 describes a child of nine building a steam engine in the 1880s, from a cocoa tin boiler, jam pot lid wheels and scrap lead and which worked, despite capsising on the doormat, spraying burning meths over the floor. From that moment, 'Curly' Lawrence - LBSC - never built an engine that didn't work.



Phill's O&K at NDMES. (Photo courtesy of John Shugg.)



Supercalafrajalisticexpo Ellie docious, Sydney LSLS. (Photo courtesy of David Judex.) ➤

Bradford Model Engineering Society Open Day is on June 17th, with Diesel Day a month later, both on the Saturday. A recent talk on silver soldering, by Cup Alloys was very well received, with several intelligent questions asked. In contrast, they said, some talks are received in complete silence. Graham Astbury wrote up the talk for the March *Monthly Bulletin*. Road Vehicle News covers motor cycles. Several members have vintage machines, even arriving at club events on them. Models, projects and weirdo bikes are discussed, one of which last was a WWII half-track m/c, Sdkfz2, over 8,000 of which were built. Editor, Frederick Bilney has resigned his post and Graham Astbury assumes the penthouse corner office.

W. www.bradfordmes.co.uk

Ryedale Society of Model Engineers' Monthly Newsheet, February, reports that a height difference has developed near Erimus Yard, suggesting that the Gilling Tectonic Plates have shifted in three directions and may need jacking up. (Maybe being nearby Ampleforth is responsible, over-zealous campanology perhaps? - Geoff.) An encounter in traffic between Eoin, receiving a lift home, and his Mum was interesting as the enthusiastic gesturing was

misinterpreted and led to some confusion.

W. www.rsme.org.uk

Lachlan Clark, from **Otago MES** is having a quiet run on **Hutt Valley & Maidstone's** jigger in photo 5.

Fareham & District Society of Model Engineers, Modelling Ways, March opens by discussing Charles Babbage and his Difference Engine. Having begun work, he then conceived a better design, the Analytical Engine, which made it obsolete. This did not please the government, which Babbage was asking to pay for it. An interesting 52 inch model pond yacht, Moonbeam, from 1913, has been produced as a kit. Sir Dugald Clerk was a Scot who was the first to analyse the I/C engine scientifically and was admired by the great Sir Harry Ricardo. Unfortunately, Sir Dugald declared in 1896 that electric ignition was a non-starter (my pun – Geoff). Linda Gearing repeats details of the Third IMLEC in 1971, held at Southampton SME. The Birmingham party numbered 180 and they chartered a train!

Gauge 1 Model Railway Association, Yorkshire Group's March Newsletter mentioned the AGM at Chesterfield MES, 1 April, on their newly refurbished track - an event I considered attending. Watch this space!



1917 Standard Sentinel waggon at Elsecar Sentinel Spectacular.



Lachlan Clark, Editor of the Otago MES Conrod having a bit of exercise on the jigger in Hutt Valley & Maidstone's Blast Pipe. (Photo courtesy of Peter Anderson.)

A good programme of events runs to September, when Gauge 1 North occurs at Bakewell on the 2nd. of the month.

W. www.g1mra.com

Reading Society of Model Engineers' The Prospectus, March has John Chapman fitting a three-phase motor to his Holbrook lathe, driven by an electronic inverter. Of course, the new motor was different; even removing the old one was frustrating as it had to be dismantled. Then a spacer was machined and also a spline adaptor. Dave Scott and the Young Engineers had a day with several, nay, many locomotives to try. His cordless drill-driven version ran well, except that the batteries lasted longer than his finger muscles. (See M.E. 4558). Peter Farley's new diesel-outline locomotive is not yet painted, being a gleaming white (so that he can keep it in the kitchen, without alarming the many Meme's? - Geoff.)

W. www.prospectparkrailway.co.uk

Port Bay Express, March/April, from **Portarlinton Bayside Miniature Railway**, now in full colour, says that passenger numbers are

down severely for February. A five year strategic working plan has been agreed for the railway and thanks are offered to Tourism Geelong for assistance. Tail Disc, closing the newsletter, shows a train in a sylvan setting. The use of a long lens on the camera does not do justice to the state of the track!

In March there was a Sentinel celebration at the **Elsecar Heritage Railway**, near Barnsley. They have several products from this company, both steam and diesel. Also present was this highly polished and glittery 1917 Standard Sentinel. More next time (photo 6).

W. www.elsecarrailway.co.uk

Guildford Model Engineering Society' GMES News, Winter, says they have named their track the Stoke Park Railway, using a familiar design of poster.

And finally, from SMEE: 'Looking for a boyfriend in engineering? The odds are good but the goods are odd!

Contact:
geofftheasby@gmail.com

- MAY**
- 8 Peterborough SME.**
Bits & Pieces.
Contact Terry Midgley:
01733 348385.
- 8 Sutton MEC.**
Afternoon running from
noon. Contact Jo Milan:
01737 352686.
- 10 Leeds SMEE.**
Roger Blackburn:
Further Experiences
on the East Coast
Main Line. Contact
Geoff Shackleton:
01977 798138.
- 10 St. Albans DMES.**
Michael Bailey: The
Archaeology of Early
Steam Locomotives.
Contact Roy Verden:
01923 220590.
- 12-14 National Model
Engineering and
Modelling Exhibition,
Doncaster Racecourse.**
[www.thedoncaster
show.com](http://www.thedoncaster
show.com)
- 11 Worthing & District
SME.** Meeting -
Bits & pieces.
Contact Ian Aitken:
07500 611166.
- 14 Grimsby &
Cleethorpes MES.**
Public running, noon -
4pm. Waltham Windmill
site. Contact Dave
Smith: 01507 605901.
- 14 Sutton MEC.**
82nd Annual
Exhibition, 13.30.
Contact Jo Milan:
01737 352686.
- 14 Wolverhampton DMES.**
Public running at
Baggeridge Min.
Rly. 1 - 5pm.
Contact Ian Priest:
01384 287571.
- 14 Worthing & District
SME.** Public
running, 2 - 5pm.
Contact Ian Aitken:
07500 611166.
- 15 Lancaster &
Morecambe MES.**
Geoff Holme:
Major Hext's railway
at Coniston.
Contact Mike Glegg:
01995 606767.
- 15 Peterborough SME.**
Bernard O'Connor:
Churchill School of
Saboteurs. Contact
Terry Midgley:
01733 348385.
- 16 Chesterfield & District
MES.** Public running
Building with Laser
Cutting. Contact
Ian Blackburn: 01909
562458.
- 16 Grimsby & Cleethorpes
MES.** General monthly
meeting, 7.30pm.
Contact Dave Smith:
01507 605901.
- 16 Model Steam Road
Vehicle Soc.** Club
meeting. Paul Burnett:
Wrecks to Relics.
Village Hall, Longford,
Gloucester. Contact
Richard England:
01452617057.
www.msrvs.co.uk
- 16 Nottingham SMEE.**
Nigel Smith & Co.:
Ffestiniog Railway;
History and Present.
Contact Pete Towle:
0115 987 9865.
- 17 Bristol SMEE.** Peter
Norbury: A Life in Air
Accident Investigation.
Contact Dave Gray:
01275 857746.
- 17 Salisbury DMES.** Colin
Jones: Engineering
Fasteners. Contact
Jonathan Maxwell:
01722 330488.
- 19 Rochdale SMEE.**
General Meeting
Castleton Community
Centre, Rochdale. 7pm.
Contact Len Uff:
0161 928 5012.
- 19 Stockport DSME.**
Tony Holdsworth:
Wolsley Aero Engines.
Contact Dave Waggett:
0161 430 8963.
- 21 Chichester DSME.**
'Steam on Sunday' at
the Blackberry Lane
track. 2pm - 5pm.
Contact Ben Ernschaw-
Mansell: 01243 773451.
- 21 Grimsby & Cleethorpes
MES.** Public running,
noon - 4pm. Waltham
Windmill site.
Contact Dave Smith:
01507 605901.
- 21 NW Leicestershire SME.**
Public running
12 noon to 4pm.
Contact Den Swain:
01530 412048.
- 21 Plymouth MSLS.**
Public running at
Goodwin Park.
Contact Malcolm Preen:
01752 778083.
- 21 Rugby MES.** Public
running at Rainsbrook
Valley Rly., 2pm - 5pm.
Contact Ken Eyre:
01788 842709.
- 21 Welling DMES.**
Public Running 2 - 5pm.
(Behind Falconwood
Elec Sub stn.) Contact
Martin Thompson:
01689 851413.
- 24 Leeds SMEE.**
Members' Hints
& Tips. Contact
Geoff Shackleton:
01977 798138.
- 25 Worthing & District
SME.** Club meeting.
Topic t.b.c.
Contact Ian Aitken:
07500 611166.
- 28-29 Bolton Steam Museum.**
Engines in Steam 10am
- 4pm. Contact John
Phillip: 01257 265003.
- 28-30 Cardiff MES.** Public
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- 28/29 Grimsby & Cleethorpes
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- 28 Leeds SMEE.**
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the track. Contact
Geoff Shackleton:
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- 28/29 Nottingham SMEE.**
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Contact Pete Towle:
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- 28/29 Wolverhampton DMES.**
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5pm. Contact Ian Priest:
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- 28 Worthing & District
SME.** Public
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Contact Ian Aitken:
07500 611166.
- 29 Lancaster &
Morecambe MES.**
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Contact Mike Glegg:
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- 29-31 Vale of Rheidol Railway.**
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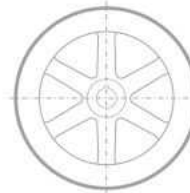


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Available again, in this book Peter Manning provides detail dimensioned CAD drawings plus 3D ones, of the second Garratt locomotive built - the 'D' class for the Darjeeling Himalayan Railway, plus drawings for the 'B' class 0-4-0 tanks it was intended to replace. Whilst a significant development in the evolution of Garratts, the 'D' class locomotive wasn't repeated, and the 0-4-0 tanks continue to the present. With a model of the Garratt available for 16mm narrow gauge, and drawings and castings available for the 'B' class in larger gauges, this is a most useful book for modellers. 72 landscape format ringbound pages.



Model Power-Boats: Steam, Petrol, Electric.

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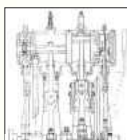
What attracted us to reprint this book was the sheer spread of its coverage - amongst the 15 chapters are 'Types of Models', 'Theoretical Consideration', 'Resistance and Propulsion', 'How to Design a Model Boat', 'Construction of Hulls', 'Steam Machinery explained', plus 4 chapters on methods of propulsion, including flash steam, 'Deck Fittings' etc., etc., all from a time when you built very largely from scratch. The book's attractions for model boat builders are obvious, and for model engineers the methods of propulsion, notably flash-steam, are of considerable interest. There really is a huge amount of information in this book's 338 pages. Around 380 illustrations, both B&W photos and line drawings. Paperback.



Arthur Leak's 3" & 5" x 3" Marine Compound Engine

Full set of eight drawings • £12.00

These downloadable drawings (only available via our website) are the full set for this engine, reduced in size for printing on A3 size paper. 'Hard' sets of drawings for this engine are also available full size in A0, and reduced to A3 size.



Building a Marine Compound Engine • Leak • £ 6.00

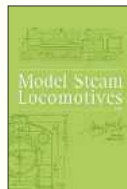
Only available via our website, this is the 'Words and Music' for the drawings above and is based on the original articles which appeared in *Model Engineer* in 1982 & 1983. Full drawings, as above, and castings are also available.



Model Steam Locomotives

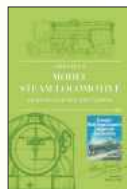
Greenly rev. Steel • £ 20.60

A reprint of the eighth (1954) edition of this wonderful book, revised and updated by his daughter and son-in-law, but still very much Henry Greenly's work. Greenly's experience of designing and building model locomotives covered all gauges from Gauge 1 to 15" gauge; all are covered here, but the mid-range gauges are stressed. The first four chapters cover choice of scale and gauge, locomotive types, principles of model locomotive and boiler design. Another twelve chapters cover specific parts of the locomotive. All are very fully illustrated with drawings, tables and photographs. Any book which has effectively remained in print for over sixty years has to be top quality, and this is one of the very best books written on building model and miniature steam locomotives, and an invaluable reference for model locomotive builders in the 21st century. 322 pages and paperback.



Greenly's Model Steam Locomotive Designs and Specifications • Greenly rev. Steel • £ 8.90

The companion handbook to *Model Steam Locomotives* (above). In the first half you will find sections covering Fundamentals of Design, Dimensioned Designs for Cylinders and Valve Gears, Design of Boilers, and Handling Model Locomotives - anything from 0 Gauge up to 15-inch gauge. The other half of this book is used to describe twenty locomotive designs, from a simple 0 gauge 0-4-4 tank locomotive to seven Gauge 1 locomotives, three 2½-inch gauge, two 3½-inch gauge, three 5-inch gauge and two 7¼-inch gauge locomotives, and two 15-inch gauge designs. Not only does this book contain a wealth of useful design information, it reveals just how good and versatile a designer Greenly was. 60 page softcover, profusely illustrated with drawings.



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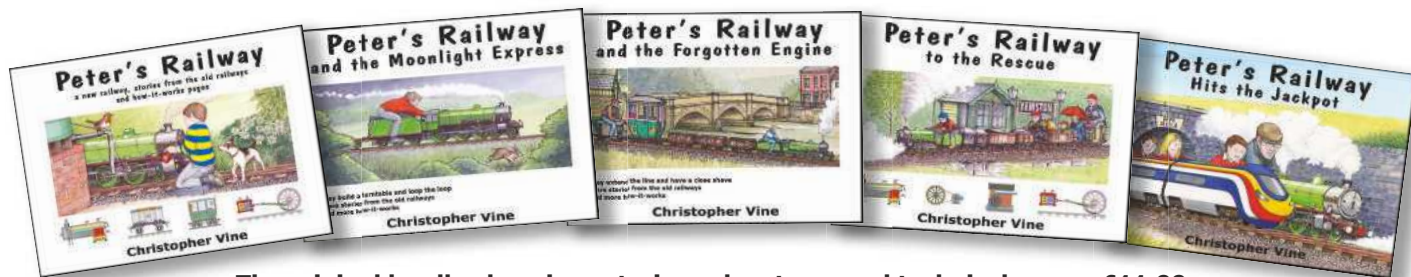
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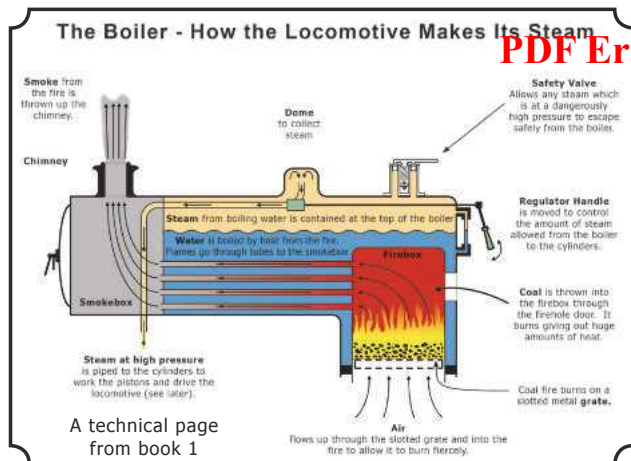
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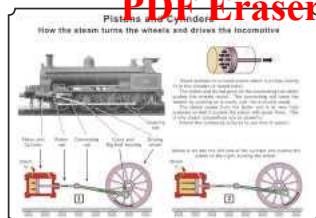
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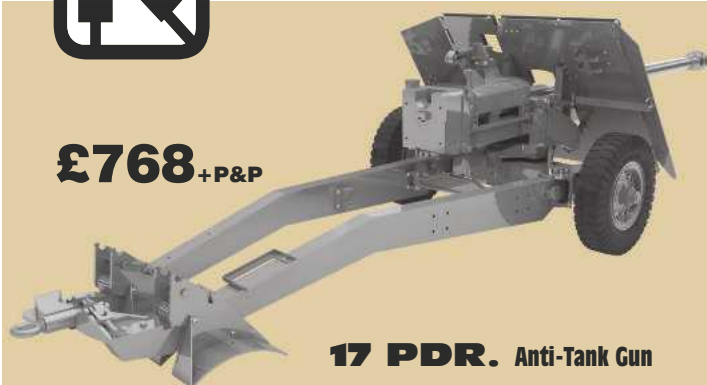
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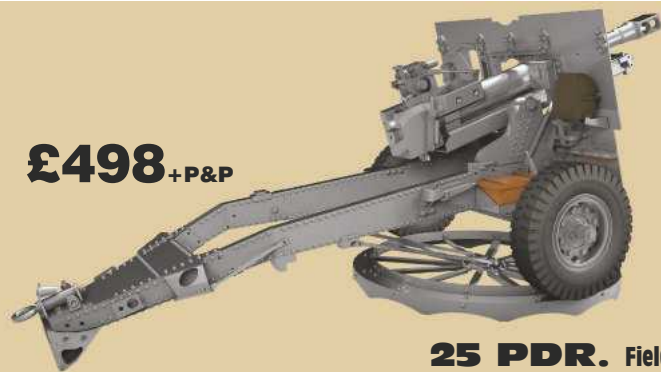
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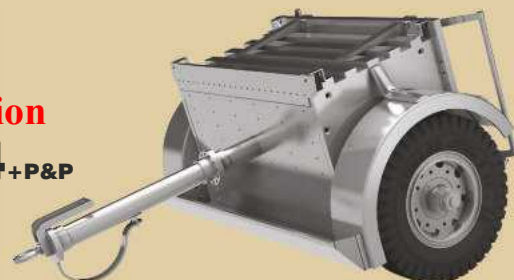
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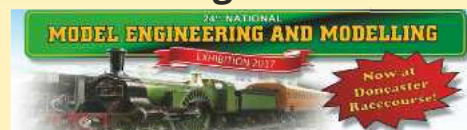
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