

THE ORIGINAL MAGAZINE FOR MODEL ENGINEERS

Vol. 224 No. 4636 • 10 - 23 April 2020

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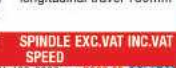


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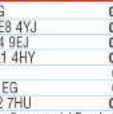
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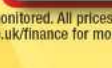
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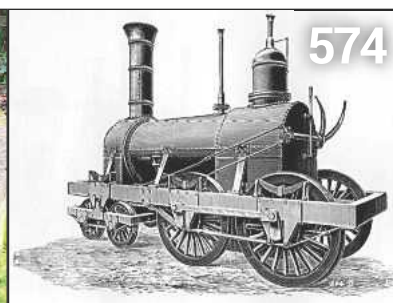
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A printed edition of this book is also available • £14.45 inc. UK P&P



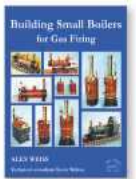
Lathe and Planer Tools • {1908} • £ 3.90

Originally Published by The Industrial Press in 1908, then reprinted by Lindsay Publications in 1986, but out of print for many years, we have brought this back as a Digital Edition because it is just very good. Written many years before diamond tipped tools were introduced, in fact at a time when most machine shops would have forged their own tool steel, this concentrates largely on the correct shape of the tools for various turning or planing operations and how to achieve them. Like most American books of this period, it is clear, concise and to the point; discard the out-of-date information and there is still much here of value. 40 pages. 59 illustrations and engravings.



Building Small Boilers for Gas Firing • £10.00

Here Alex Weiss covers the materials, tools and techniques needed to build smaller copper tubed, gas fired, boilers that can be soldered in a single session. With a capacity of under three bar/litres, boilers of this size require less-extensive independent testing for public operation. Full description of how to build three vertical and three locomotive boilers, complete with drawings and copious constructional photographs. Aimed at the beginner who wants to build gas-fired boilers to run his smaller Stuart type stationary models from, or to fit to their 16mm NG or Gauge 1 locomotives, there is a lot here that will be of general use to builders of larger copper boilers. 120 pages with drawings and all colour photographs.



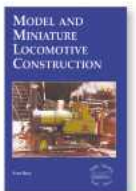
'LBSC' His Life and Locomotives • £12.00

Brian Hollingsworth's biography of the most famous of all model locomotive designers. There can be few model engineers who have not come across 'LBSC's' designs or writings: 112 designs published over 44 years, over 3000 articles published in *Model Engineer* and other magazines, the last only a month before his death aged 84. And he built 55 small steam locomotives himself. But what made him famous was his style of writing - informative, opinionated and down to earth, they gave the ordinary man the confidence to realise that he could build models if he wanted to, and then told him how to do this. Fascinating and highly readable! 112 pages. Over 220 B & W photos and drawings.



Model and Miniature Locomotive Construction • £12.00

Well known author on model engineering matters Stan Bray covers the construction of model and miniature locomotives from Gauge 1 to 7¼" gauge, with the accent on the passenger hauling gauges. The bulk of the book is Stan passing on hints, tips, ideas and practices he has picked up over fifty years as a model engineer, and he covers the subject with chapters on each major part, such as frames, axleboxes, valve gear, cylinders, boiler, platemwork etc. He also covers electric and I.C. powered locomotives, a subject not covered before in a book like this. 208 pages. 158 drawings. 300 B & W, and 32 colour photographs. 12 charts.



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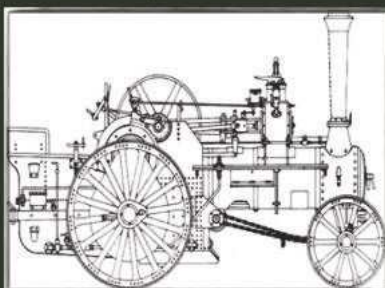
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Coronavirus

Well – we are living in interesting times, aren't we?

I doubt that many of us can recall times that quite match these. Most of us are living in self-imposed isolation and have been thrown very much onto our own resources.

This is of course one way in which we model engineers have an advantage over most other people. With our gardens and our workshops we have plenty to do to keep ourselves occupied! My workshop is now tidier than it has been for years and I am hoping that I may make some good progress over the next few weeks. I hope that you will too and that there will be lots of new articles written over the summer describing what you have been up to!

You may be wondering what will happen to our magazine. The short answer is 'nothing'. We intend to keep printing the magazine. If you have a subscription in the UK, everything will carry on as normal but I'm afraid overseas subscriptions will be suspended for the duration. This is because of difficulties with customs etc. It may be difficult for those of you who normally buy their copies over the counter at W H Smith. Instead you will be able to buy single copies from mags-uk (www.mags-uk.com) who will

be supplying the current issue as well as back numbers.

As some of our advertising, not surprisingly, has dried up we have dropped 8 pages from the magazine (mostly advertising). This includes the diary page. With the current restrictions on movement it would be irresponsible of me to encourage readers to trek across country to other clubs' events! In any case, most clubs' events have now been cancelled for the duration.

Southern Federation

The recent Southern Federation AGM included a workshop to garner comment and opinion from affiliated member clubs. Topics under discussion included strengths and weaknesses of the current services offered by the Federation, opportunities for enhanced services for the future, and the appetite among volunteers for support and expansion. There was lively debate in a full venue and all the views expressed were recorded by the participants for analysis by Federation committee members. The spirit was open and much was learned by those attending, not least those representing the Federation!

Owing to the difficulties of travelling and current health issues, it was noted that some were unable to attend despite

their wish to do so. There is therefore an opportunity for affiliated clubs and their members to add comments to those collected under the topics mentioned above. Any wishing to express their views are invited to send comments by e-mail to Paul Naylor (paul.naylor@sfmes.co.uk) or Ivan Hurst (ivan.hurst@sfmes.co.uk) **before 30 April 2020**.

Since we want to make sure we address all aspects of model engineering, we would also be very pleased to hear from other clubs or their members not affiliated to the Southern Federation of Model Engineering Societies.

After all the data have been assembled and analysed, the Federation looks forward to holding key discussions regarding its future direction. This will be the subject of articles and other communication when the time is right.

Common Misperceptions

In the last issue's Postbag page, Duncan Webster stands accused of a 'common misperception'. This refers back to Postbag and Smoke Rings of issue 4622 (27th September, 2019). I believe that the common misperception referred to was in fact mine, where I talk in Smoke Rings about boiler efficiency. Duncan's letter was mostly about condensation. I was wondering speculatively about to what extent boiler efficiency affects the overall efficiency of a miniature steam engine. I can't claim any great expertise in boilers so it's quite possible that I was mistaken to think there might be a link!

Cock-up Corner

In the contents page of the last issue, I carelessly attributed the workshop tip about Boring Eccentrics to Brian Baker rather than to Ray Griffin. My apologies are due to one or possibly both gentlemen for this mix-up!

Chester Machine Tools

Chester Machine Tools would just like to let you all know that we are still open, despite covid-19, and taking internet, email and telephone orders. We have limited staff in the office and warehouse at the moment so please bear with us at this time.

Our showroom is currently closed to the public due to the safety of both our customers and staff. This means it won't be possible to view our products in person for the time being.

You can still contact us by all the conventional methods, live chat on our website, shop.chestermachinetools.com, email sales@chestermachinetools.com or call us on 01244 531631. If you want something to look through we can send you a catalogue - just email us your name and address to sales@chestermachinetools.com and we will send one out to you.

Martin Evans can be contacted on the mobile number or email below and would be delighted to receive your contributions, in the form of items of correspondence, comment or articles.
07710-192953
mrevans@cantab.net

Ipswich Celebrates its 75th

Martin Evans went along to join in the festivities on the 7th March.



The Ipswich Model Engineering Society must be one of the oldest clubs in the country. It can probably also claim to possess one of the longest continuously occupied club premises. There are plans though to build a new clubhouse – when funds permit.

I arrived in good time for the 10am start – I only live an hour away – and was made welcome by the club chairman, Mark and secretary, Terry. The welcome included a cup of coffee and some very excellent sausage rolls (**photo 1**), just the job after a long drive down the A14!

The main business of the day was the dedication of the commemorative tree to celebrate the occasion, followed by the running of trains on the 45mm



A sausage roll was very welcome after a long drive down the A14.

railway and the steaming up of locomotives. This was interrupted only by a fish and chips lunch. A wary eye was occasionally turned skywards, wondering if the weather would hold, which, I am glad to say, it did.

I have included pictures of only a small selection of the

models on show. For more, please go to the club's website (www.imes.co.uk), where you can find a photo gallery of the event, and also a gallery for the 50th anniversary.

My thanks to the Ipswich club for inviting me along and for providing a short history of the club.

ME



Chairman Mark Dearman officiates at the dedication of the new tree.



The commemorative plaque for the tree.



John Bloom's 3½ inch gauge LBSC 'Mabel' Caractacus, an LNWR 'Jumbo' locomotive. This model took 5 years to make and the tender is John's own design, taken from the original at Shildon.



A display of stationary engines, seen in the clubhouse. Of particular interest was the 5 cylinder radial aero engine (top right).



The very extensive 45mm railway – rather longer than the raised track – was very busy all day. This is a major interest in the club.



A 3 inch Ruston Proctor engine, being constructed by Alan Burrows. This is a model of Alan's grandfather's engine, still on display at Thursford, and is a replica of the original. Alan made the patterns for the castings himself. This is an ongoing project, having been started in the mid 1990s.



Terry Woodward's 5 inch gauge J15 locomotive, built mainly from photographs, with a chassis based on the Metro tank. This locomotive took 5 years to build.



A 5 inch gauge Dean Goods by Dudley Deas. This model was finished 6 months ago, having taken just 2½ years to build, but has not yet been steamed.



Tom Rose's 5 inch gauge 'Maid of Kent' locomotive. This took 23 years to build, with a lot of redesign along the way. It self-identifies as a Midland compound.

HISTORY OF THE CLUB

Just after the Second World War, in 1945, a group of like-minded individuals formed a club to cater for those interested in model engineering. They used to meet in the town centre, with early exhibitions being held in the Corn Exchange. The group was called 'The Ipswich Society of Model and Experimental Engineers'.

In around 1947 the present site was purchased and a redundant ex-US Army Air Force building was acquired - the current Clubhouse. Town maps from the late 1940's show a circular miniature railway track on the site, although this has been rebuilt over the years.

Membership of the Society ebbed and flowed, but in the mid 1970's there came a situation where the Club almost closed down. A small group of members including Edgar Wright and Graham Austin decided to re-launch the Club under the name 'Ipswich Model Engineering Society' with Edgar acting as secretary.

The 45mm railway is a relatively recent addition to the club's facilities. From small beginnings, it has grown into a magnificent layout with a double track main line, and loops and sidings totalling over 1,100 foot in all.

The railway has become very popular with members and visitors alike. In 2015 the society decided to acquire Limited Company status, and this was achieved on the 1st October 2016. The club recognises its long history, for instance the library is dedicated to long standing member, the late Ivan Jarman.

IMES currently has around 65 members, and some of those members are practising modern skills such as laser cutting and 3D printing, so the 'Experimental Engineering' tag from our early days is still pertinent today.

Magdalen Road Revisited

Jeremy Buck invites us back for a further tour of the Magdalen Road garden railway.



Continued from p. 521
M.E. 4635, 27 March 2020

J69: No. 87

Just as the A4 was approaching completion, I took the opportunity to acquire from Station Road Steam a well made ex GER 0-6-0 'Buckjumper' tank locomotive, classified J69 by the LNER. Built in 1986, this had fallen on rather hard times but required little work – a new smokebox door, freeing of the seized screw down regulator, replacement of some boiler fittings and alterations to injector and feed pump pipework to suit my preferences - to get it running. Although, if anything, it is less powerful than the Y4, it certainly looks more at home hauling our coaches (photo 109). It does exhibit one significant drawback, especially for a ground level line; accessibility of the motion for lubrication is seriously impeded by the side tanks and more trust than I would prefer has to be placed on the lubrication pipework delivering oil from the oil boxes behind the smokebox to the big ends and eccentrics.

Claud: No. 1870

Although bogie coaches make a perfectly suitable load for the J69 and, indeed, the tender engines it occurred to me that they make a totally inappropriate train for the Y4.



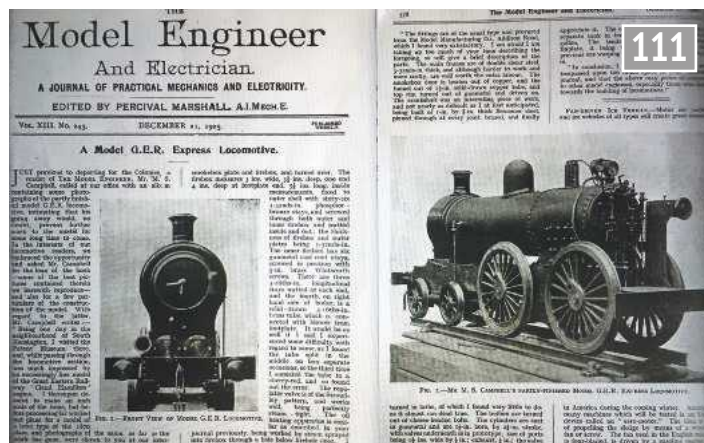
No. 87. Not quite a recreation of the 'Jazz' out of Liverpool Street, but it makes a good combination with the Aristocrat coaches.

I had never been particularly interested in goods wagons but, with the commissioning of the J69 which would be equally at home hauling goods and passenger stock, it seemed the right time to acquire some goods vehicles for the railway. Not having any inclination to make them myself, I looked around and found a selection of second hand wagons for sale by the Miniature Railway Supply Company. On a visit to that company's premises to collect two of the five wagons (photo 110) that I purchased, the owner, Jeff Price, casually asked if I was interested in vintage locomotives. I am not particularly so inclined, but was curious nevertheless, so Mr. Price showed me an engine that had been hidden

from sight under some dust sheets. What was revealed was a genuinely vintage engine but what proved to be of great interest to me was not so much its age, but what it was. It was a GER Claud Hamilton 4-4-0, classified D14 by the LNER, and as evidenced by a delightful account – I especially liked 'Just previous to departing for the colonies a reader of MODEL ENGINEER, Mr. M. S. Campbell called at our office' - in the December 1905 issue of *Model Engineer* (photo 111), its construction was well advanced at that time. That would have been almost contemporaneous with construction of the prototype. Closer examination revealed that, under an accumulation of dirt and rust,



No. 226: Goods train.



No. 1870: Write up in a December 1905 issue of *Model Engineer*.

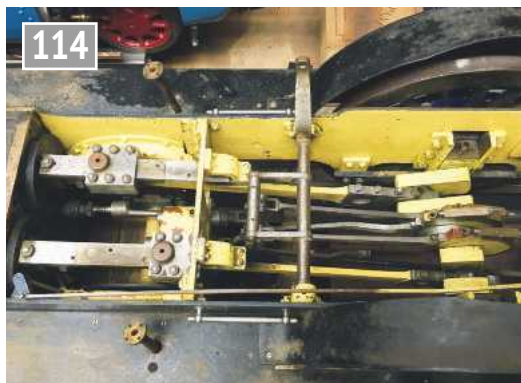
the chassis and platework had been constructed to a good standard and that a comprehensive but incomplete refurbishment, including the provision of a replacement boiler, had reached an advanced stage. A purchase price was agreed and yet another 'project' entered my workshop (**photo 112**).

Restoration of this locomotive raised interesting questions around how far one should go in seeking to conserve rather than rebuild an old model. It is beyond doubt that parts of the engine and tender are over one hundred years old, but I know nothing about its subsequent history. It may be that it was originally built for 4¾ inch gauge. As part of the deal, I acquired the original rivetted and soft soldered boiler which is without doubt that which is described and illustrated in the contemporary edition of *M.E.*; and as further evidenced by the builder's plate which indicates that it was built in 1903 (**photo 113**). However, I suspect that the silver soldered boiler which it now carries dates from around 1970. The valve gear now fitted probably dates from the same period as the replacement boiler. Similarly, much of the tender – the tank certainly – is not that which is illustrated in the December 1905 *M.E.* The paintwork was certainly not original so there was no question of retaining and, where necessary, matching that.

What was not in doubt was the underlying quality and, in returning the locomotive to working order, I determined that where appropriate I would retain all parts whether of 1903/5 vintage or much later, but not shy away from making changes and improvements were I deemed them to be desirable. Whether or not to dispose of the original boiler remains an unresolved problem. I did remove the builder's plate (some may regard that as sacrilege) and it is now affixed to the near side main frame of the locomotive.



No. 1870: As received.



Motion layout.



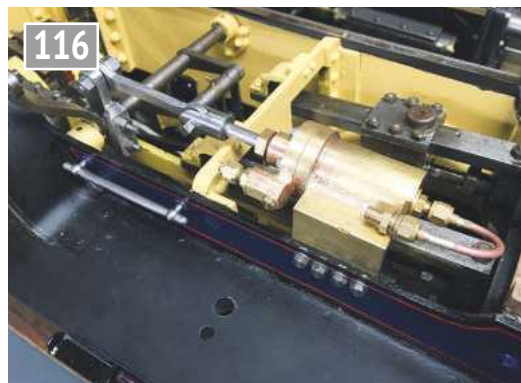
Reverser mounted on cab platework.

Unlike No. 8783 (see part 3), the valves of which, non prototypically, are above the cylinders driven by the Stephenson's link gear via rockers, the slide valves of No. 1870 are correctly situated below the cylinders and directly driven (**photo 114**). However, as received, the motion was seized solid and it took copious amounts of oil in the cylinders and all oiling points in the rods and links before the driving wheels were persuaded to turn. Even then, raising and lowering the expansion links, particularly from the full gear positions,

required considerable force at the reach rod; mainly, I think, due to their angularity. It was obvious that the close to scale proportioned screw reverser supported off the cab side sheet (**photo 115**) would be too flimsy to be effective. Initially I thought that I would have to make and fit a more robust reverser supported off the main frame (as illustrated in the 1905 *M.E.* article) but this would have been very obtrusive within the cab. The prototype provided the solution – a power, or at least power assisted, reverser. At first I was thinking in terms



Original 1903 boiler backhead with maker's plate.



New air cylinder for power assisted reverser. It makes lubrication of the motion a little more difficult but access from the other side is reasonably good.

of using steam to provide the power but I knew only too well that condensation and consequent loss of pressure would adversely impact on performance. Again the prototype provided the solution – air pressure. The Westinghouse pump (another project for my son, Jonathan) could not be expected to create the compressed air but why not install within the driving truck an air reservoir of ample capacity which could be periodically charged using the workshop compressor which is conveniently located next to the turntable? In the

prototype the power cylinder is situated between the driving axle and weigh shaft, and below the latter. This would be impossible to access in the model so I located the model cylinder in front of and above the weigh shaft and this gives a good balance between unobtrusiveness and accessibility (**photo 116**). The control valve is mounted on the spectacle plate outside the cab (again for reasons of accessibility) and operated by a lever on the side of the screw reverser (**photo 117**). Pipework is 3/32 inch OD to minimise wastage of air (**photo 118**). To move the die blocks from mid gear to full forward, the lever is pushed forward, thereby admitting air to the rear of the air cylinder. The handwheel of the screw reverser can then be used to lower the expansion links, the pressure on the piston in the air cylinder actually doing the work. When the required setting is reached, the lever is returned to its neutral position which exhausts the air cylinder on both sides of the piston. To notch up the valve gear, the lever is pulled back, thereby admitting air to the front of the air cylinder which then provides the power to enable the screw reverser to raise the links. When the desired cut off is reached, the lever is again returned to its neutral position. Operation of the system does not replicate prototype behaviour in that the screw reverse cannot be disengaged from the power cylinder, but it is simple and it works. Of course, the screw reverser will still be subject to racking forces due to die slip when the locomotive is in motion; time will tell if these prove too much for the 10BA fasteners between splasher (on which the reverser is mounted) and cab side sheet.

The brake cylinder under the cab floor is also operated by air pressure, the application/release valve being situated next to the reverser. The brake is of the simple type, i.e. a return spring which holds the blocks off the wheel treads

except when air pressure acts on the piston in the brake cylinder. An air pressure gauge is provided (**photo 119**).

The air reservoir in the driving truck (**photo 120**) incorporates a pressure gauge and shut off valve (**photo 121**) and air is piped via flexible connectors through the tender to the control valve on the engine.

The total reverser and brake system is shown diagrammatically in **fig 4**.

Reaction at the wheel tread to a brake application is instantaneous. The adhesive weight on the coupled wheels is about 50 lbf so to deliver

100% braking force via the 1:2 ratio of the lever between the compensated pull rods and the power cylinder requires a force of about 30 lbf (including that required to stretch the return spring) on the piston in the 1 inch diameter cylinder. 80 psi in the air reservoir proves to be ample for multiple brake applications with the shut off/reducing valve set to give not more than 40psi at the gauge on the backhead; this pressure also being quite sufficient to provide the powered assistance to the screw reverser via the ½ inch diameter power cylinder. Of course the locomotive brakes

are no substitute for robust and effective brakes on the driving truck, the controls of which are evident in photo 121. Incidentally, I use Halfords car brake pads, suitably cut to size and shape, for the brake blocks on both of my driving trucks.

The boiler is of silver soldered construction with threaded stays nutted and caulked with soft solder on the inside of the firebox. There is no superheater. I had taken a calculated risk in that there was no paperwork to accompany it, but as I intended to operate the locomotive only on my own railway that was a matter for me only. I set the



Control valve for power assisted reverser. The valve is operated by the lever on the side of the screw reverser. Both the reverser and lever inside the cab are close to scale but the control valve outside most definitely is not. I anticipate that it will be less obvious when the Westinghouse pump is fitted; although there is provision for a steam supply via the union connection in front of the handrail the pump will be a dummy.



View showing the pipework under the cab floor with the compressed air manifold and brake valve prominent. Below the footplate the offside pressure connection is for the tender hand pump, the nearside pressure connection is for air with injector feed pipes either side. The oil reservoir for the hydrostatic lubricator is below the drag box on the near side. The spring loaded push rod on the offside operates the drop grate.



Brake valve component parts with mounting for air pressure gauge, also shown.



Driving truck with seat removed to show the air reservoir and connection for charging from the workshop compressor. The reservoir is formed from a suitably modified MIG welding CO2 bottle.

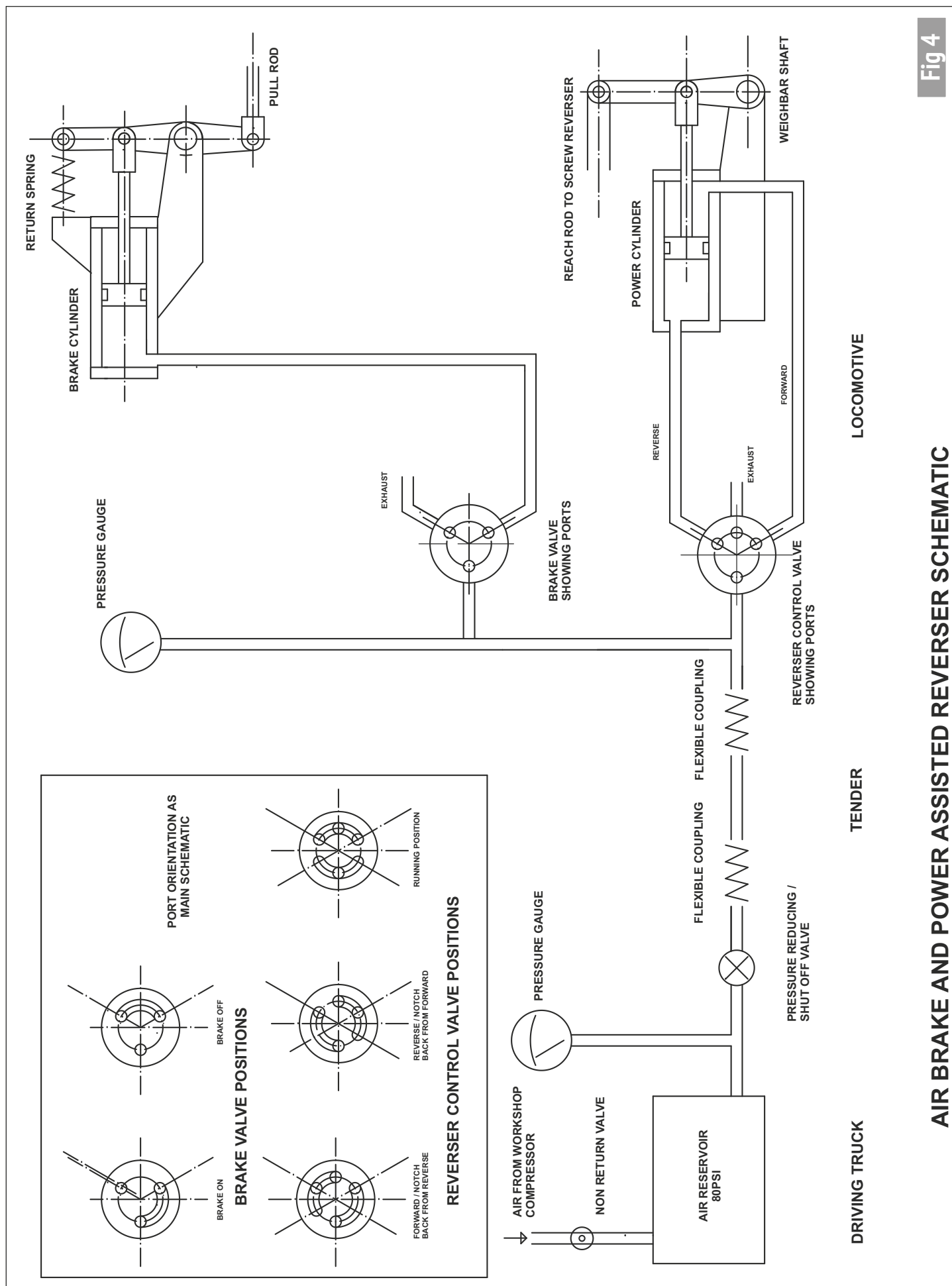


Fig 4

AIR BRAKE AND POWER ASSISTED REVERSER SCHEMATIC

boiler up for a hydraulic test and to my initial dismay the screwed longitudinal stays at the smokebox tubeplate leaked copiously at about 30psi. However, the stay nuts were easily removed and reinstalled after application of 'Permatex' thread sealant. Retesting went much better and 150psi was achieved with no apparent distortion, but tiny beads of water at a significant number of stays within the firebox were visual evidence of why the pressure gradually fell away. I have no doubt that the boiler is structurally sound but clearly the stay nuts need to be recaulked before it can be put into service. This is a job that requires facilities that I do not have at the time of writing and which I decided to defer pending completion of other projects – in particular the final locomotive that will be briefly described next.

No. 1870 is a fairly simple engine to assemble and dismantle so, after painting (for which I reverted to brush applied enamel) and lining in the magnificent blue and red GER livery, and re-assembly, it is presently presented for static display only (photos 122 and 123).

Garratt finale

I mentioned earlier my enthusiasm for the EAR 55 Class and my unfulfilled aspiration to build a Beyer Garratt locomotive. That will not now happen, but I do have a Garratt. It is a 5" gauge model of the first standard, indeed any, gauge Garratt built for use in Britain (photo 124). Four locomotives of this type were built by Beyer Peacock between 1927 and 1937. The most well known is the last one, preserved at Bressingham Steam Museum where it has been since withdrawal in 1968 from service at Baddesley Colliery in Warwickshire. The wheel arrangement is 0-4-0+0-4-0 which is a far cry from the 4-8-2+2-8-4 that I envisaged forty years ago. Despite the apparent complexity, all the moving parts are readily accessible for inspection and



Driving truck showing air reservoir pressure gauge and shut off valve.



Cab view of No. 1870. Both pressure gauges are faulty and temporary, awaiting replacement.



I think the Claud comes close to matching the elegance of the Stirling single – compare with photo 14 in Part 2.



Garratt awaiting attention.

lubrication, which I consider to be ideal for operation on our railway. Yet another purchase from Station Road Steam, there is not too much to do to complete the locomotive and, with more leisure time in retirement, I hope that it will not be too long before it is added to the operational fleet.

Concluding remarks

I think the railway demonstrates that it is not necessary to model narrow gauge prototypes for operation on a 5 inch gauge railway laid out in a modestly sized garden (in this case 150 feet by 50 feet). Of course,

one cannot expect standard gauge Pacifics to negotiate 20 feet radius curves, but two, four and small six coupled locomotives are perfectly practicable.

Although there is always something requiring attention on at least one of them, it can reasonably be argued that four, potentially six, operational locomotives on a small railway is an indulgence. I suppose the railway approximates to the main line – but without the sidings – of what I would have liked my Hornby Dublo 00 gauge model railway to have been sixty years ago had I had a baseboard twenty feet by

six feet and a lot more pocket money than my parents were prepared to grant. And what model railway does not have more and larger locomotives than it needs for the traffic on offer?

Acknowledgements

Photographs 30, 31 and 91 are reproduced with the kind permission of Mike Palmer of Station Road Steam.

Thanks to my wife, Nancy, for her forbearance and to my son, Jonathan, for his valued assistance and encouragement.

Mastering Non-Ferrous Metal Casting

PART 1

Gerald Martyn sets up a home foundry.



BOOKS LIST

Foundry Work for the Amateur, by B. Terry Aspin. Pub. Special Interest Books.

How to Cast Small Metal and Rubber Parts, by William A. Cannon. Pub. Tab Books.

The Complete Handbook of Sand Casting, by C. W. Ammen. Pub. Tab Books.

SUPPLIERS LIST

I have no link with any of these suppliers except as a satisfied customer:

John Winter

All the essentials such as sand, flux, core binder, bricks, safety kit, metal etc. Occasional advertiser in *Model Engineer*.

www.johnwinter.co.uk/foundry/model-engineering

Artisan Foundry

On-line shop for the essentials, and particularly Superwool, furnace building and metal casting courses.

www.artisanfoundry.co.uk/product_info.php?cPath=28&products_id=81

Vaughans (Hope Works)

Foundry and blacksmith tools and equipment

www.anvils.co.uk



Completed 5 inch gauge LSWR 'Metropolitan' tank locomotive.

Over the past 50 or so years I've progressed from building a Rob Roy, through more complex designs, to own design and build. So many models of prototype locomotives are available as drawings, kits, or ready-to-run that I now try to find something a bit different. LSWR Locomotives Volume 1, by Don Bradley, covering the early years before the arrival of William Adams, has provided my inspiration in recent years. There are new challenges in each design and whilst I've used and adapted commercially available castings where suitable the cylinder set for my most recent project could not be matched to any available from our usual traders and something new was required.

My project was a 5 inch gauge LSWR 'Metropolitan' tank locomotive. These were built under the orders of William George Beattie (the

less than competent son of Joseph Beattie of 'Well Tanks' fame) by Beyer Peacock in 1875. After a faltering start, they were subsequently modified in 1877 and later fitted with Adams stovepipe chimneys and gave over 30 years of good service. This latter is the state I have modelled (photo 1)

There are a number of unusual features in this design. The cylinders are steeply inclined and the attachment flanges are fore and aft rather than above and below. In fact, there is no frame to attach to at all above the cylinders. The connecting rods are mounted inboard of the coupling rods, a good design feature which reduces crankpin bending, so the cylinder centreline is rather close to the frame. Without matching these features in the model, it would surely not look right. It was clear from fairly early on that no existing

design had cylinders remotely suitable and that a completely new cylinder casting set would be required.

I have a liking for gunmetal cylinders, having built all my previous locomotives using nothing else. It is easy to machine, more malleable than cast iron, corrosion resistant and wears well. The only negative, so far as I can see, is the likely cost. To mitigate this, I decided to try casting at home. In spite of the various books on the subject I've found that there's still plenty of the black art involved. This article is based around my experiences with fairly basic non-ferrous casting into traditional sand moulds. No fancy oil-based sands, no quality methods like investment casting, just the age-old method. My aim is to describe the process and discuss some of the things I have learned, some of the things that went wrong, and

some issues well-hidden or not in the books. Also, perhaps, writing about my experiences will encourage a few others to 'have a go'. After all, people have been melting and pouring bronzes for about 5000 years so how hard can it be?

Pushing the cylinders supply problem aside for a while I proceeded with my drawings on CAD. For me this has become just as much fun as making the parts. Where, in the past, I would have sketched out minor parts on an envelope I now enjoy creating the proper drawings. This forces careful thought and allows mating parts to be overlaid onto the General Arrangement as they are designed to ensure they fit. I've found that parts so designed do tend to be 'right first time' more often than previously, provided they are made accurately to the drawing.

The other essential new casting needed, and earlier in the build, was for the bogie wheels but, obviously, in cast iron. I took my drawing for this casting to 'The Great Dorset' and had a chat with the man at the Bridport Foundry tent. He said they could do it and that the pattern should be made from wood (not MDF); use as much filler as you like and sand it as smooth as possible. A great advantage of CAD is that you can print any number of copies up to the size limits of your printer for peanuts money.

For the wheel pattern I turned up a ring and a hub from a sandwich of some thin pine I had handy, and carved spokes from stripwood. I then glued the whole lot together onto a printed wheel plan to get the correct locations (a bit like we used to pin balsa aeroplane bits to the plans for assembly). After rubbing down and filling with a two-part wood filler a few times I had a nice smooth pattern (**photo 2**). The plan was destroyed in the process, but another can be printed should I ever need it.

After a few weeks wait I went to collect my new castings from Bridport (at the time I lived not too far away).

This was my first success in this, for me, new field. More patterns were to come and each with its oddities (at this early learning stage each one is a new experience) but with careful woodworking and plenty of filler no insurmountable problems have been encountered.

This first pattern was perhaps the hardest as it was to be seen and used by a commercial supplier and so subject to expert scrutiny. I felt it had to be right. On leaving the foundry, and for information to help my planning, I asked how much more it would have cost in gunmetal. Ouch! The seeds were sown, raked-in and watered.

While continuing the drawings I started to gather more information on home casting. There is a book available in 'our' Workshop Practice series. It has lots of useful information but lacks in some respects. Others are available and my main list of books is below. If our regular suppliers don't have them or your local bookshop can't get them then they are available from the usual internet shops. Putting them all together gave a much better picture of what to do, and provided a better reference set for when things went wrong.

The common features in these books are the archaic and substantial furnace designs, generally suitable for much hotter melting than I needed, and using weird and wonderful heating methods such as coke with air blowers. These days there are readily available propane sets capable of providing plenty of heat. A quick check showed mine easily able to melt brass and gunmetal. Actually, I already knew this from a couple of previous soldering operations that got a bit carried away. I thought perhaps I could contain the heat within a simple drystone firebrick enclosure (the furnace).

To get any further I needed a crucible to hold the metal, and something to lift it and tilt it, and some safety gear like a

face mask, gloves and overalls, and some metal (plenty in the scrap box), a moulding box (cope and drag, or flask), sand, and several other things. There are suppliers for these things out there and those I have used have been excellent. They are listed below. There are also second-hand dealers and autojumbles, and the home-made options. I made a list and added up costs. Then I looked through catalogues for similar sized finished castings, and made a list of estimated costs for mine. I had enough scrap to make a start, but would need to buy some metal eventually.

Then a funny thing happened – as word got out about my plan people started to give me lumps of scrap metal; enough to make a good start though I still planned to use known quality purchased metal for the principal parts and any boiler fittings. I compared costs and found a rough balance. The cost of the equipment would be of a similar order to the likely cost of the castings if made commercially. Supposing I could actually produce something then it amounted to budget price parts forever once the initial outlay had been covered by the first set. It was time to start spending.

Model engineering costs money and tools and machines are needed to do almost anything at all. Without a lathe not much can be achieved but most of what is machined on it is made from purchased raw material and the finished part is not realistically available to buy; it can only be made at home. With castings the parts made may well be available commercially but they can also

be made at home and, if from free metal, then very cheaply. Even with purchased raw material the cost saving is very significant. This is provided an up-front investment in equipment is made without knowing if the work can be done successfully. In effect, with casting there can be an expectation of some measure of return on the investment (provided, as this is a hobby, no cost is put on your own time).

Even better, if things go wrong or if an error is made in the machining then it can simply be cut it up and put back in the crucible (with a bit of new metal for losses) and re-cast. Yes! I've done it several times of course. When a mistake is made turning that piece of bar in the lathe then it goes in the bin, lost forever (well not quite, now mine sometimes goes in the scrap-for-melting box). Of course, this is all part of a hobby so should be enjoyable. It may also be seen as a bit of a challenge, and pouring red hot metal is also rather exciting and can lead to a bit of an adrenaline high.

Breaking open the mould to find a perfectly formed piece of metal is immensely satisfying. So, home casting can be done for its own sake, for excitement, as a challenge, to save money, or whatever. I've found this a genuinely rewarding and interesting branch of model engineering and am now generally looking for new bits to cast. I've also discovered why foundry workers are reputed to drink a lot (it's very hot work).

●To be continued.



Bogie wheel and pattern.

The Middleton Double Sided Beam Engine PART 5

Rodney Oldfield constructs another of Bob Middleton's stationary engines.



Continued from p. 442
M.E. 4634, 13 March 2020



Almost complete slide valve.



Valve rod gland nut.

Slide valve

The slide valve is shown as part of fig 8, which appeared in part 3 (M.E. 4632, 14th February).

Machine two square pieces of brass in a four jaw chuck - or a milling machine - to $2\frac{1}{32}$

x $\frac{3}{16}$ x $\frac{1}{2}$ inch. Mill out the $\frac{1}{16}$ inch deep dish $\frac{3}{8}$ inch square (I used a $\frac{1}{8}$ inch ball ended cutter - do not worry about the round corners). Use whatever means you have. Next place the steam chest onto a flat plate with the slide valve in

the correct way round for the direction of movement in the steam chest. Place some packing either side and a distance piece on top to clamp the whole thing together.

It is important that the valve is on the face of the flat cylinder with the gasket thickness under the steam chest only.

Spot through the $\frac{1}{8}$ inch hole in the steam chest onto the valve, drill through the valve, then mill an $\frac{1}{8}$ inch slot, $\frac{3}{8}$ inch deep at 90 degrees to the hole in the middle. Next, with a small piece of $\frac{1}{8}$ inch thick piece of brass clamped into the slot spot through then drill and tap 5BA with a bolt screwed through. File it all square and polish. Take the bolt out and make sure that the nut slides easily in the slot (**photo 25**). Then finish off according to the drawing by milling the $\frac{1}{8}$ inch cross slot into the hole. If you think this is the long way round, do your own thing.

Valve rod gland

The valve rod gland is shown as part of fig 10, which appeared in part 4 (M.E. 4634, 13th March).

Using a $\frac{1}{2}$ inch diameter stainless steel bar, or whatever bar you have, turn down to $\frac{1}{8}$ inch BSP size, 0.380 inch

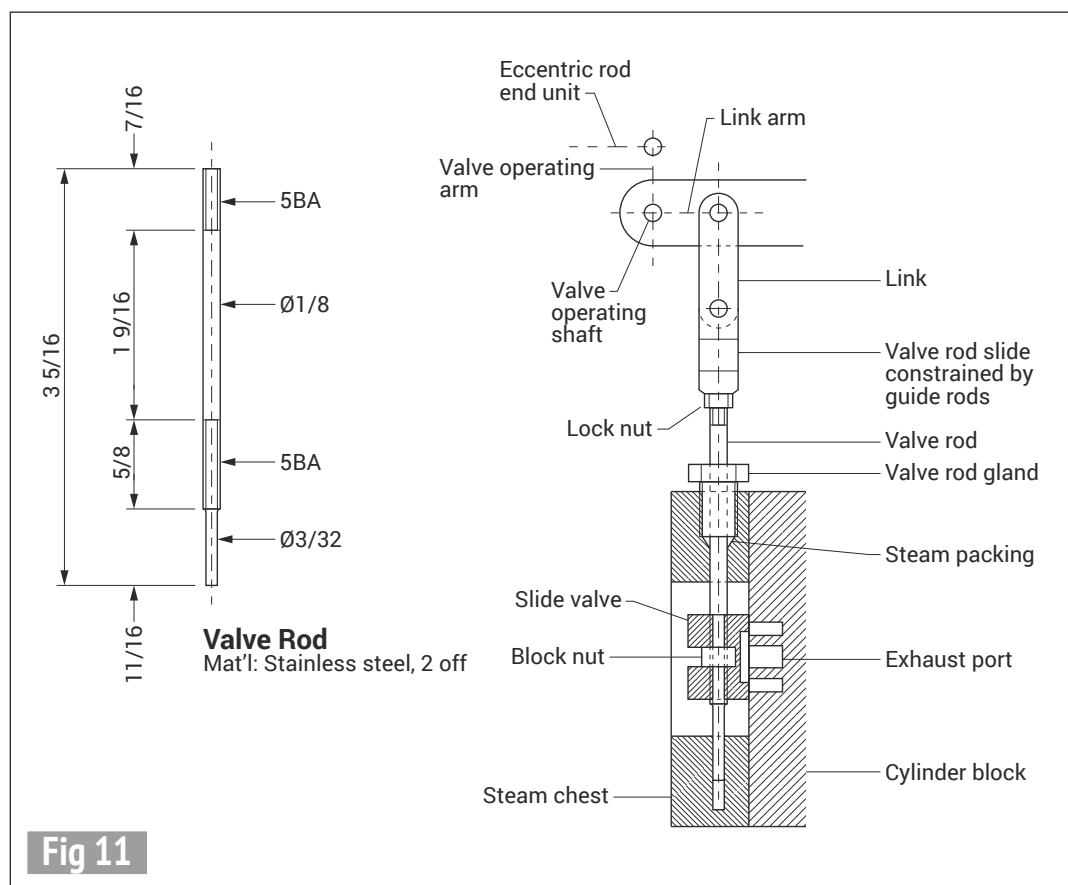
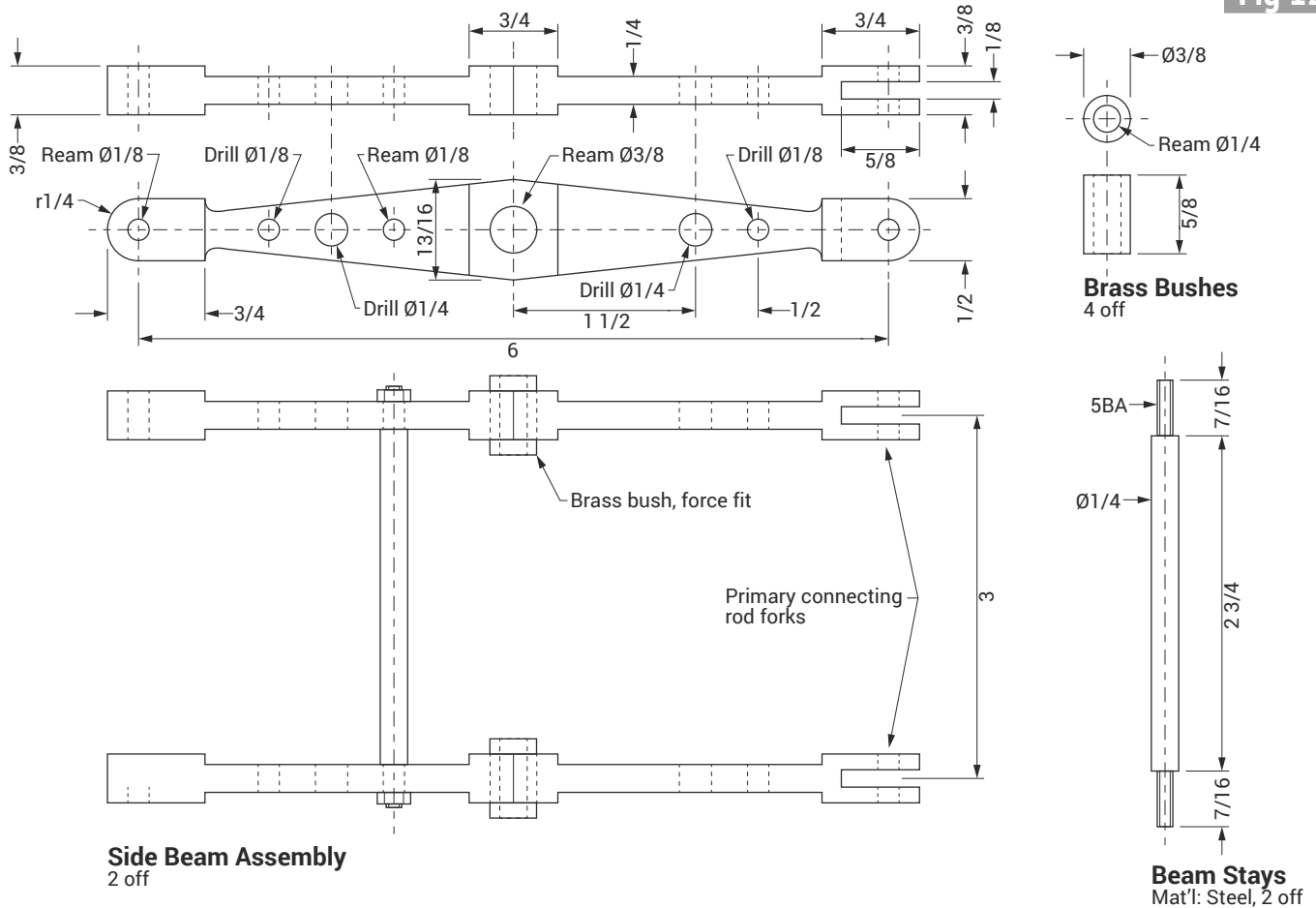


Fig 11

Fig 12



diameter x $\frac{3}{8}$ inch long; leave a strong $\frac{1}{8}$ inch collar and part down to half way (**photo 26**). Place No.1 jaw on top and file a flat on top of the collar. Turn the jaw to the bottom and file another flat on before cutting the gland from the bar. Using a scrap bit of $\frac{5}{8}$ inch bar centre, drill and tap $\frac{1}{8}$ inch BSP, screw in the gland and slightly dome and polish the face. *Keep the tapped bar for later use.*

Valve rod

Figure 11 shows the valve rod.

I felt the best way to make this was to place a piece of $\frac{3}{16}$ inch diameter bar $\frac{3}{4}$ inch long in the chuck, centre and ream $\frac{1}{8}$ inch. Next, push the $\frac{1}{8}$ inch diameter stainless steel into this sleeve, leaving approximately $\frac{1}{4}$ inch protruding, and tighten the chuck. Taking light cuts turn down to $\frac{3}{32}$ inch, slacken the

chuck making sure the sleeve does not move and pull the valve rod out another $\frac{1}{4}$ inch. Repeat this process until you achieve the correct length of $1\frac{1}{16}$ inch. I usually work on the top side and with a smooth file. File it down and polish to correct size.

Next, pull it out to $1\frac{1}{2}$ inches and thread down 5BA x $\frac{5}{8}$ inch long (**photo 27**). File over the top of the threads

until they are just below $\frac{1}{8}$ inch diameter because the threading will have lifted the diameter slightly and it will rip your packing O-rings when you try to force it through. Now turn around and thread the other end 5BA. **If you have a very good three jaw chuck or collets, use them!**

Next fasten the steam chest onto the cylinder and build up making sure that everything slides easily - I used at least two O-rings. If it is a bit tight ease a bit off the bottom of the slide valve with a smooth file. Do not move on until you are happy and everything moves easily (**photo 28**).

The beam

Figure 12 shows the beam. You will need four of these.

Having a piece of aluminium 12mm thick x 4 x 21 inches long I proceeded to saw a $6\frac{1}{2}$ inch piece off one end (**photo 29**) and then in the miller I sawed four bits off using a



Tapping the valve rod.



The steam chest and slide valve components.

slitting saw. (After all my careful measuring and double checking I managed to end up with four pieces 0.100 inch down on the $\frac{13}{16}$ inch size – what a plonker, but I decided to live with it.)

Next mill them all down to $\frac{3}{8}$ inch thick, find the centre of one and centre pop it. From this centre mark all the holes off and drill the appropriate reamer size. Using this as a jig spot through the holes, drill and ream all four beams (**photo 30**).

Place the beam in the milling machine and slot drill a $\frac{1}{8}$ inch slot out, **making sure you have the right end (photo 31)**. Nip it on the $\frac{3}{8}$ inch thick sides and use the $\frac{1}{4}$ inch hole as a stop (**photo 32**) for milling away the sides. This is because once you have your lengths on the Y axis you can zero off on your milling machine for all the rest. I made mine $\frac{7}{8}$ inch from the end and stopped $\frac{5}{8}$ inch short of the centre (but do your own thing). Doing it this way you get rounded shoulders which I think look better. Touch the side and move over $\frac{1}{16}$ inch on the X axis, **not all in one go**. You will find it better if you do not climb mill - if your cutter is going clock-wise, always go from left to right (**photo 33**).

Turn over onto the broad side using the $\frac{1}{4}$ inch diameter hole as a stop, mill out the ends down to $\frac{1}{2}$ inch thick, taking your measurements from the edge of the hole $\frac{3}{16}$ inch either side (**photo 34**).

On the beam scribe a straight line from where it is $\frac{1}{4}$ inch on the drawing to where you want it to come out on top of the beam. Using some scrap aluminium with one straight edge place the beam onto it, mark out a $\frac{1}{4}$ inch diameter hole, drill and ream, then place a $\frac{1}{4}$ inch stud in it. Put the beam back on and swing it so that the scribe line is lined up to the square edge of the jig. Drill and ream the $\frac{1}{8}$ inch diameter hole. Place a $\frac{1}{8}$ inch stud in it. Clamp the jig down square onto the milling table and place the beam onto the studs. Clamp the beam onto the jig (**photo 35**).

Now you can mill the angle on and once you have done



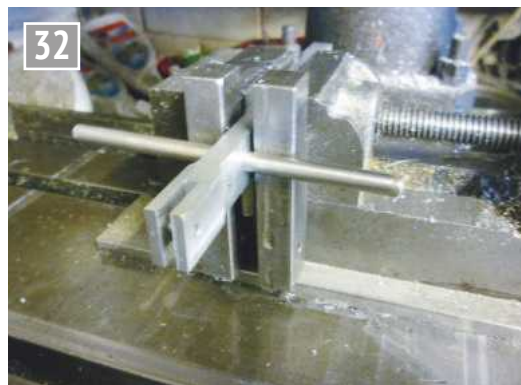
Precise hacksawing of the blanks for the beams.



Spotting through the holes in the beams.



Sawing out a slot in the beam.



Locating the beam for thinning down.



Thinning the beam down.



Making a start on the beam profile.

this go to the opposite end of the beam and repeat. When you have completed this – turn the beam over and do it again.

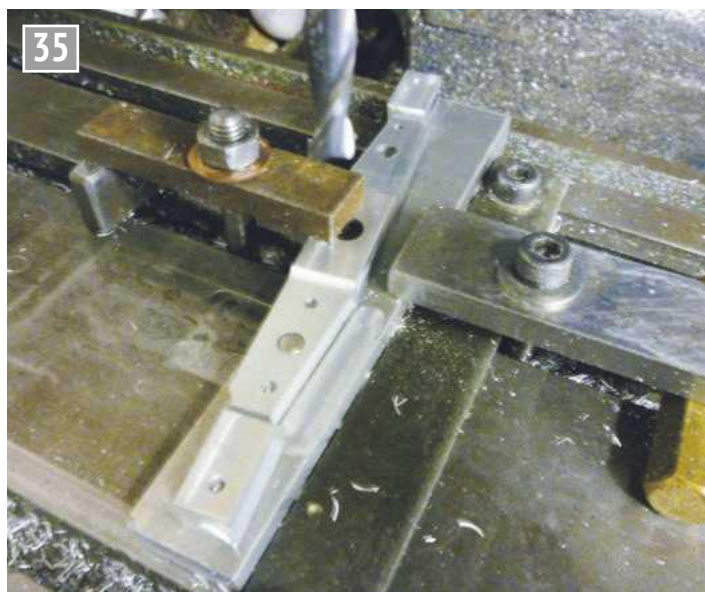
Take the beam off the jig, round off the ends, file off all sharp edges and polish.

(I am sorry if this seems long winded, but it was the only way I could think of machining it. If you come up with a better way, DO YOUR OWN THING!)

●To be continued.

NEXT TIME

We make the main column and the engine platform.



Completing the beam profile.

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Garrett 4CD Tractor

in 6 inch scale

PART 68

Chris Gunn
makes the
chimney.



Continued from p.439
M.E. 4634, 13 March 2020

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.



Once the belly tank and tender are completed a few more details remain to be dealt with before and during the re-assembly of the engine.

Chimney

I described earlier on how I machined the chimney base and the bottom ring for the

chimney, but at that stage I did not machine the hole for the exhaust pipe and the steam blower as I needed the block in its final position to establish the correct place for the holes. The chimney base was clamped onto an angle plate on the Bridgeport, and the hole for the blower was drilled first. I planned to use a commercial

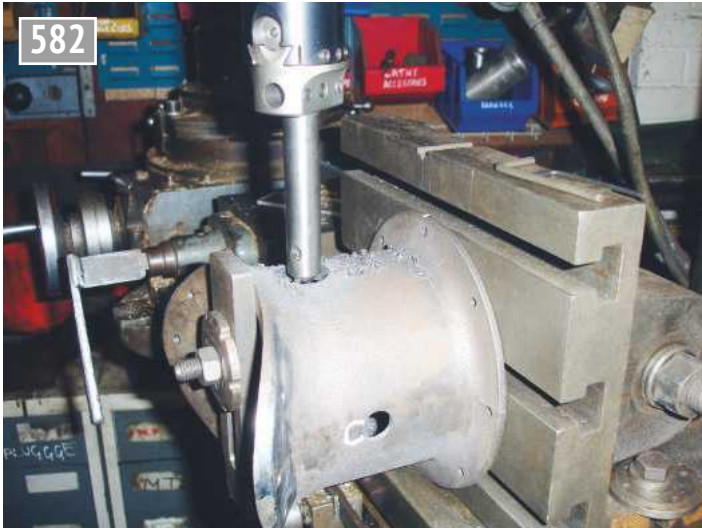
bulkhead connector to connect the blower pipe on the outside to the jet on the inside. The hole was drilled with the appropriate drill, as shown in **photo 581**.

The casting was turned through 90 degrees and the hole for the exhaust pipe was marked out and drilled and then opened up with a boring head for a sleeve that would allow the exhaust pipe to pass through it and the chimney at a slight angle. **Photograph 582** shows this under way.

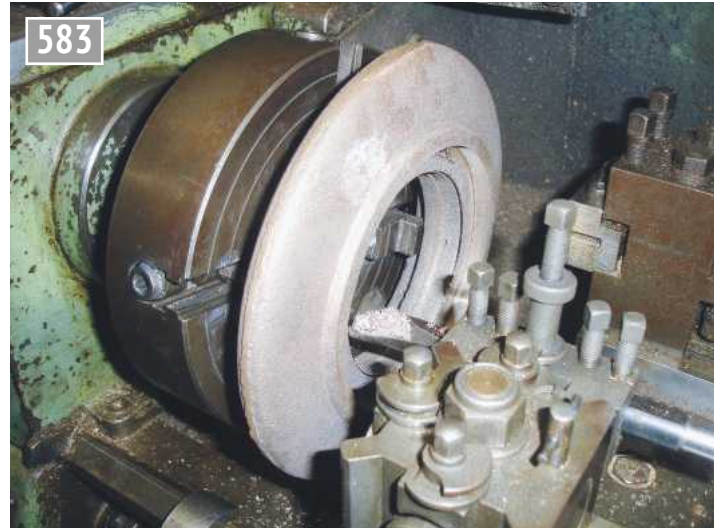
The chimney base castings were now complete apart from the holes that would secure the chimney to the base ring. The next step was to turn the chimney top. This was supplied as a hefty solid casting rather than a spinning. The first job was to clean down the lathe and remove all steel swarf and position my bronze swarf catching trays ready for action. I used my independent four jaw chuck to hold the casting off the cast bore, and



Drilling chimney for blower.



Boring chimney for exhaust.



Boring chimney top.



Machining chimney profile.



Machining chimney profile.



Drilling chimney.

trued up the casting so the outside was running as true as I could get it and then cleaned up the bore, making sure I set my carriage stop so the boring bar did not hit the chuck jaws.

Photograph 583 shows this under way.

Once the bore was done, I set the top slide over to match the angle on the casting and then carefully cleaned up

the casting with my button-nosed tool. I used a form tool I had used for another job to put the radius on the largest diameter. The casting had enough material to allow me to turn a short parallel section to simulate the end of the spinning, so that was cleaned up too. **Photograph 584** shows this under way.

Once the casting was cleaned up I was able to give it a good polish and then I switched to my four jaw scroll chuck, and reversed the casting, and held it on the parallel section in order to finish the second half of the casting. Once the outer face was all finished, I bored the chimney to its final size, stopping the boring bar a few thou short of the end. The flash left behind would be removed afterwards by just

reversing the casting again, and nipping the flash out with a chamfering tool. **Photograph 585** shows the final boring operation.

I had purchased a rolled chimney, which was not joined as supplied, so the next step was to make the joint. The chimney as supplied was bigger along its length than both ends, so I was able to squeeze the chimney down with worm drive hose clips until I could slip the cap and lower ring on their respective ends. The worm drive clips were removed so the ends were held by the spring in the chimney. The joint was painted with marking blue and the rivet positions marked out and lightly centre dotted.

I think I have mentioned before that I built my benches with 50mm square RHS,



Chimney drilled.



Marking out chimney base.



Drilling chimney base ring.



Rivet head held.

with the bench top supports running from the wall to the front of the bench. I have some square steel bars which were recycled from the scrap heap which slide inside the bench supports. I pull these out when I need them, and they are handy to support an auxiliary bench or to support long sections of anything. One of these bars came in handy as an anvil to support the chimney while I drilled the holes for $\frac{3}{16}$ inch rivets freehand with a pistol drill as shown in **photo 586**.

As the holes were drilled I fitted some $\frac{3}{16}$ inch bolts to hold everything together. Once the holes were all drilled, I took the ends off and removed the bolts, and then I was able to spring the joint and clean off the burrs that were thrown up between the joint which would

prevent the joint closing fully. Then the process was reversed and **photo 587** shows the chimney almost ready to rivet.

Before I started riveting, I had to mark out the bottom ring for the rivets around the base. I held the ring in my spin indexer chuck, which was mounted on my rotary table. I held a scriber with a right-angle end in the Bridgeport drill chuck, and marked a line right around, and then indexed the ring and scribed the line by moving the quill up and down at each position as shown in **photo 588**.

The ring was then drilled on the Bridgeport as shown in **photo 589**.

The chimney parts were then reassembled, and 'riveting' started. This was easy riveting. I placed rivets in the holes that did not have a bolt in them,

holding the rivet in place with a worm drive clip as shown in **photo 590**.

Next, I inserted a slightly bent welding rod up the chimney and dabbed it on to the end of the rivet until the rivet was reduced to a blob of weld. I proceeded in this way

working from both ends until all the bolts were replaced by rivets. **Photograph 591** shows the finished riveting.

Then I placed the chimney on a steel plate and set the bottom ring up so the riveted seam was at the back in line with the centre mark on the bottom ring,



Riveted chimney.



Setting up chimney.

and spotted through the holes in the ring adding more bolts to hold everything together while all the holes were drilled. This time I did rivet these in the traditional manner by peening them over on the inside. The chimney was returned to the steel plate and I used my Vernier height gauge to set

the chimney top level. I held the cap in place with some 'G' clamps. **Photograph 592** shows the chimney being set up.

I had decided to put a few screws into the cap drilled from the inside, and I realised I had enough room to get my right angle air drill inside the chimney end provided I used a



Drilling chimney cap holes.

short drill, so I put the chimney on my 'anvil' and drilled it.

Photograph 593 shows drilling under way.

The holes were tapped through the chimney into the cap, and then the top of the chimney cap was marked, the cap slipped down a bit and the end of the chimney was trued up with an angle grinder as shown in **photo 594**.

Once that was done, the cap was fitted, and that was the chimney complete. One other item I made at this stage was a steel plate to which I would add a couple of holes for the tax disc and the NTET disc holders. This plate was big enough to clip on a brief description of the engine

which I laminate and hold on with stationary grip clips. This will also hold a rally number. I used a piece of 3mm steel plate for the plate and a piece of 50 x 50 angle long enough to span the front two holes of the chimney base ring for the mounting. I marked out a radius to match that of the outside diameter of the bottom chimney ring. I cut the radius and then spotted through the two holes and drilled them. **Photograph 595** shows the completed plate from the rear so the mounting bracket can be seen.

●To be continued.



Cleaning up chimney end.



Number plate.

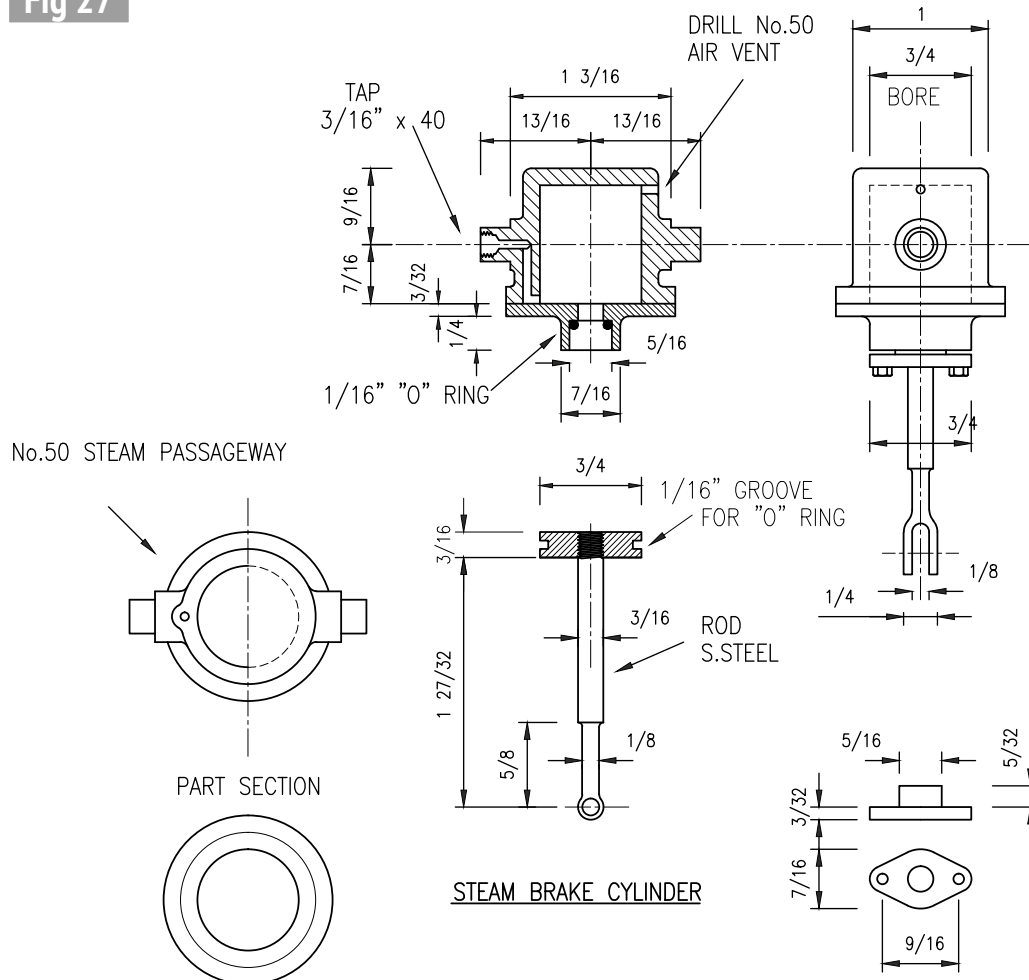
A New GWR Pannier PART 17

Doug Hewson decides that LBSC's well-known GWR pannier tank design needs a make-over.



Continued from p. 426
M.E.4634, 13 March 2020

Fig 27



Hopefully, there will be a new pattern made for the brake cylinder (**fig 27**) which should be available from G & S Supplies and cast in gunmetal. Hopefully it will come with the cap which you

should be able to part off. The cylinder needs boring in the four jaw chuck to $\frac{3}{4}$ inch bore. You need the bore as smooth as possible as you will be fitting an 'O' ring to the piston (they do need a very smooth

bore) and then you will need to drill some passageways into it.

You will then need to turn the two fixing bosses down to size; drill one of them and tap it $\frac{3}{16}$ x 40 so that you can screw a union fitting into it and that will be your steam inlet. The passages can all be No. 50 - you will also need to mill a little passageway across the bottom flange to meet it. You will need to drill a No. 50 hole at the top of the cylinder to act as an air outlet.

The piston can be made from brass as I think the cylinder will be gunmetal. The shaft end can be silver soldered into the end of the stainless piston rod. I think that the bottom of the cap



Steam brake cylinder.



Brake cylinder bracket.

should be self-explanatory but you will need to pop in a fairly light spring so that the piston returns to the bottom.

Photograph 130 shows the brake cylinder of 7754 at the Langollen Railway undergoing overhaul and you can see the steam inlet which has a $\frac{3}{32}$ inch pipe to it. **Photograph 131** shows the bracket which forms half of the support for the cylinder - the other half is supported by the frame plate, of course (**fig 28**). **Photograph 132** shows the end where the steam goes in to operate the brake. There is a pipe here from the steam brake valve which we will come to when I describe the cab fittings.

Photograph 133 shows the hand brake arm and just behind that is the collar which is clamped to the shaft to prevent any lateral movement. At the other side is the steam brake arm seen in **photo 134** and again there is the clamp behind it.

As you will see we now come to making the brake rodding (**fig 29**) which, as I say, should be made in three lengths so that the wheels will flow



Union for the steam brake pipe.



Hand brake arm.



Steam brake arm.



Brake shaft crank.

properly over the rail joints. In **photo 135** you can hopefully just see the very large crank on the end of the brake shaft which pulls the brakes on. I

suggested you mill this out of the solid; I always think that it is as well to get on with it rather than sit and think about it! Actually, the crank is not

right at the very end of the shaft as you can also see on the same photograph the end bearing which bolts on to the back of the cab step.

The brake pull rods are a bit more complicated than you might have been led to believe and as you might expect (from me!) they can all be supplied laser cut, including the thickening pieces for the ends. The brake beams (**fig 30**) are all made from $\frac{1}{4}$ inch round bar with the ends turned down as appropriate to $\frac{3}{16}$ inch and then again to $\frac{1}{8}$ inch with a 5BA thread on the ends. **Photograph 136** shows the end of the front beam on 9681 with the nut and the all important split pin through the end of the rod. Note that these blocks were made by the SVR - The Severn Valley Railway!

Photograph 137 shows one of the intermediate brake beams. **Photograph 138** shows the handbrake on 9681 at the Dean Forest. As you will see it has a chain over the handle to prevent it from turning. I am not sure what LBSC did with this but the drawing shows how it should be. The column itself (**fig 31**) can be made

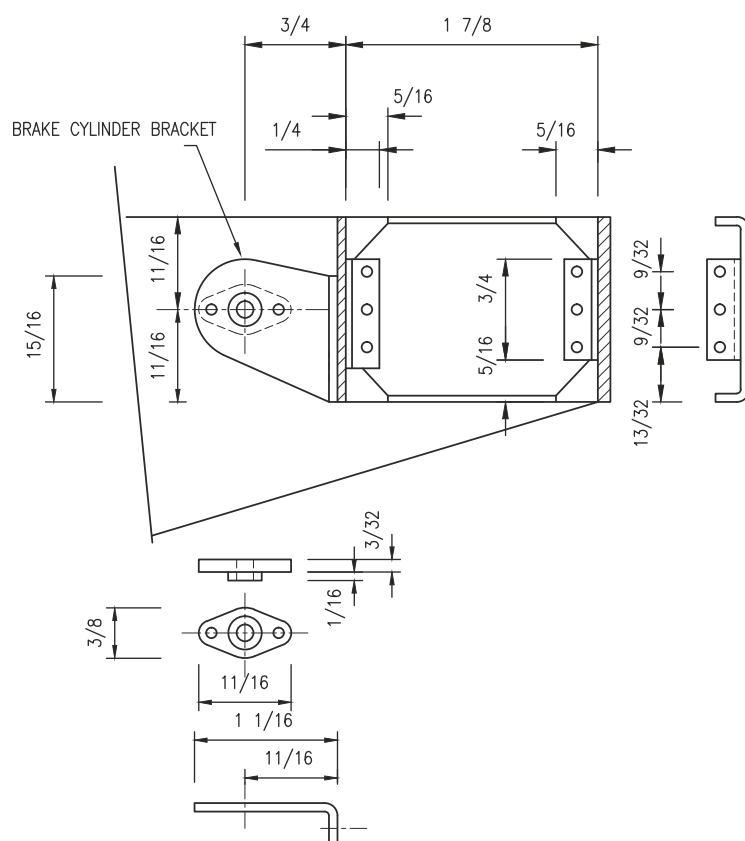


Fig 28

Fig 29

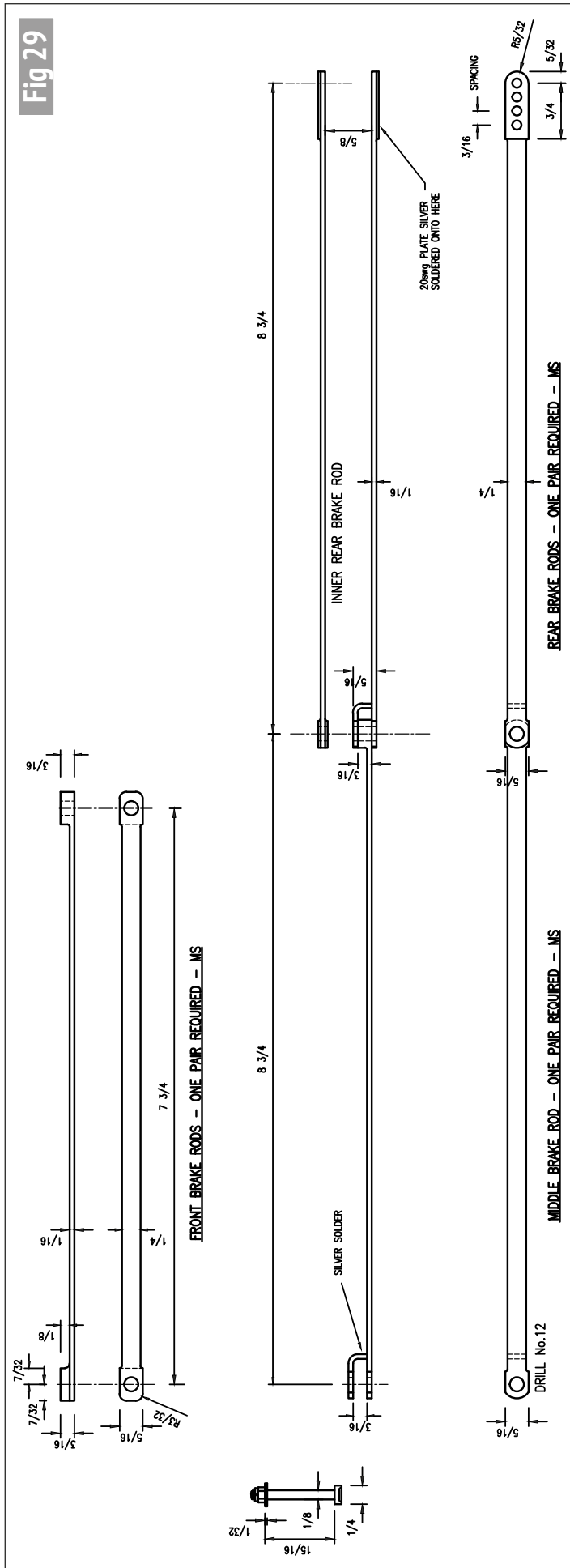
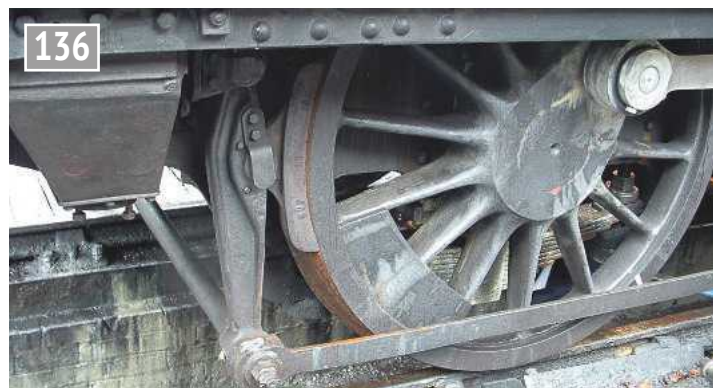
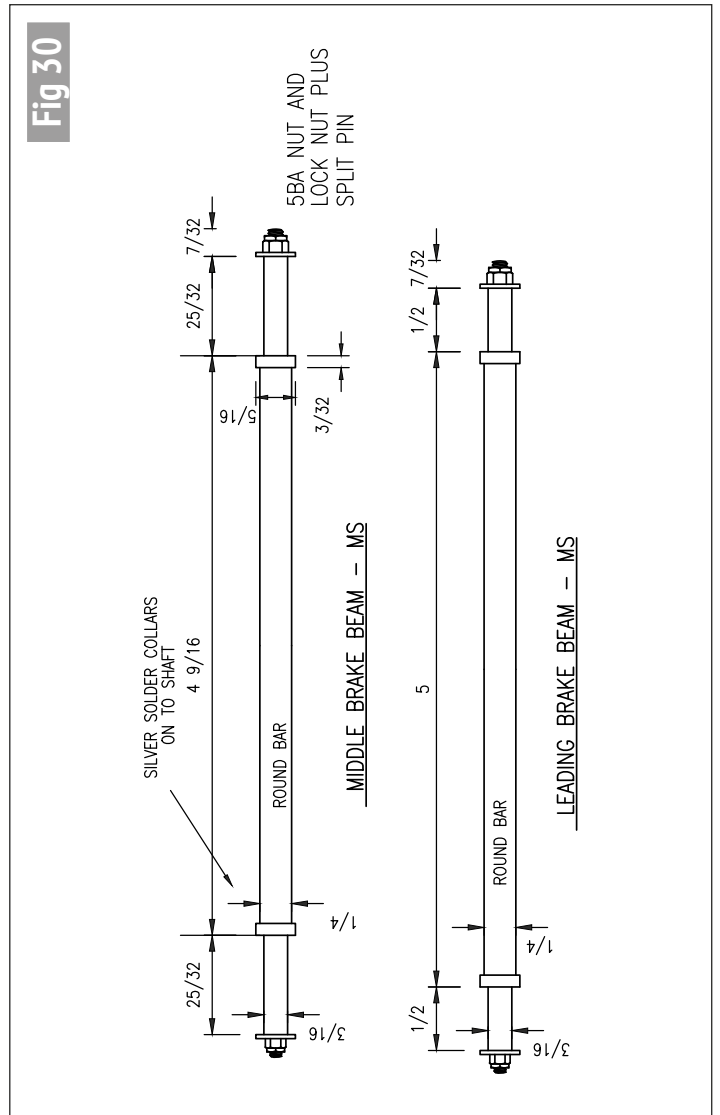


Fig 30

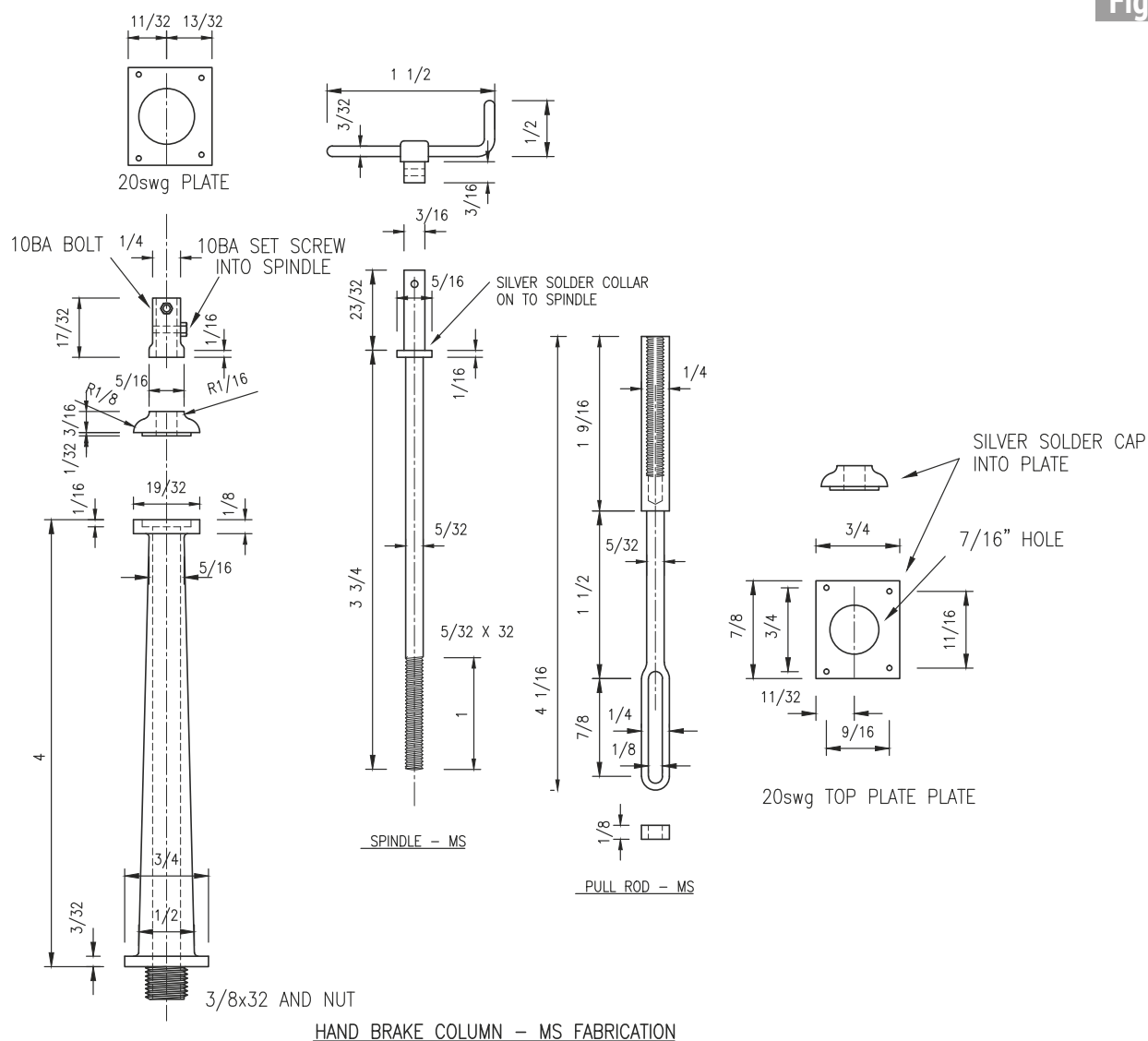


End of the front brake beam.



Intermediate brake beam.

Fig 31



from a piece of $\frac{3}{4}$ inch BMS bar but I would start with a longer piece than you need so that you have something to get hold of.

I think I turned the taper using the top slide set over 1 degree and that just worked out nicely. The top of the column needs a counterbored recess in the top $\frac{1}{8}$ inch deep. The top plate needs the cap silver soldering on and it needs to form a nice running fit in the pocket for the spindle. Note that this top plate is a $\frac{1}{16}$ inch offset. Above this is a sleeve which connects the spindle to the handle. It has a 10BA bolt through to secure it to the handle and a set screw at

right angles to that, to secure it to the spindle. The actual spindle is a plain turning job so no problem there and it needs threading $\frac{5}{32}$ inch x 32 or whatever you have to hand.

The brake pull rod can be made from $\frac{1}{4}$ inch round bar 4 $\frac{1}{16}$ long as the part which is reduced to $\frac{1}{8}$ inch thick will have rounded edges but unless you are entering the locomotive for a Gold Medal I wouldn't worry too much about it as it will still work fine. It will of course need tapping with the same thread as used on the spindle. I hope this is all fairly clear!

●To be continued



Handbrake.

The American Locomotive

PART 1

David Rollinson traces the development of the American railroad locomotive.



The William Crooks (1861) from the New Jersey Locomotive & Machine Co. of Paterson, New Jersey. (Photo, Lake Superior Railroad Museum.)

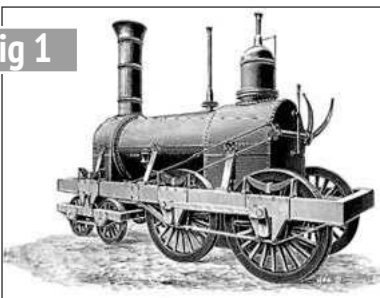
While featured in countless American Western movies, locomotives of the 4-4-0 wheel configuration were not unique to North America. However, for a variety of reasons, they were ideal for use on the burgeoning railway,

or railroad, system of that continent. Originally known as 'eight-wheelers' or 'standard' locomotives, the term 'American' became common after 1872 as the result of an article in the *American Railroad Gazette*. Over 25,000 of these locomotives were reportedly built before the design became redundant in the early 1900s. Why was the American-type 4-4-0 so successful and last so long? To answer that question it is necessary to understand the America of the mid-1800s.

The United States of America is a vast country that stretches west and south from the north east Atlantic

seaboard where the first European settlement began. The Lewis & Clarke Expedition, which reached the Pacific Ocean in 1805, publicised the extent and agricultural potential of the central plains, initiating a slow westward settlement over the following decades. After the passing of the Homestead Acts of 1862, which allowed settlers to claim and cultivate plains land, it was the railroad companies that sold the land to eager buyers, provided the means to ship the grain and livestock produced to eastern markets and ship west the domestic and farm supplies that would

Fig 1



Henry Campbells' 1836 4-4-0 locomotive.

support settlement on the Great Plains. It fell to the iconic American type 4-4-0 to haul the trains that opened up, and then supported, these new farms and communities.

The north eastern seaboard of the United States was well settled by 1861. Large cities such as New York and Philadelphia were bustling commercial and industrial centres. Philadelphia and its population of over half a million people were at the heart of a growing rail network that supported manufacturing and iron working. As one travelled west the population centres became sparser and manufacturing was replaced by agriculture. Beyond Chicago, the settlements and communities became scarcer the further west one traveled. Connecting these isolated communities to larger centres back east entailed the laying of thousands of miles of track, over often indifferent terrain, and the economic viability of these connector lines in the early days of settlement could be fragile.

The speed of expansion of the American rail network, and its extent, was staggering. Using the Federal Government report, *Transportation in the United States*, published in 1890, the growth of railroads in the country and their expansion westward becomes evident. According to the report, in the whole of the country in 1830 there were 40 miles of track, with 30 of these being in New England and 10

in the south. Thirty years later the total had risen to almost 29,000 with 239 in the west, an indication of new settlement. By 1880, the heyday of the American 4-4-0, there was a staggering 87,800 miles of common carrier track, with 15,500 in the western states where agricultural expansion and settlement had taken place. It is these statistics that help explain the mass production of the 4-4-0. The first transcontinental line to join the eastern states with the Pacific opened in 1869. By 1900 it had been joined by four others, each connected to a spider's web of secondary lines that covered nearly every corner of the country.

The first practical steam locomotive to operate in America was the *Stourbridge Lion*, an English-built 0-4-0 supplied by Foster, Rastrick & Co., which first ran in Pennsylvania in 1828. Fitted with the vertical cylinders in common use at the time, the engine was too heavy for the track being used so was not put in to commercial service. However, the appearance of *Lion* spurred local interest in the potential of railways and a version of England's railway mania. Railway promoters and investors began to build commercial lines around the developing urban and industrial centres of Philadelphia and Baltimore, and a local locomotive building industry was born. Locally inspired innovations in design and manufacturing

A 4-4-0 locomotive from The Rogers Locomotive and Machine Works.

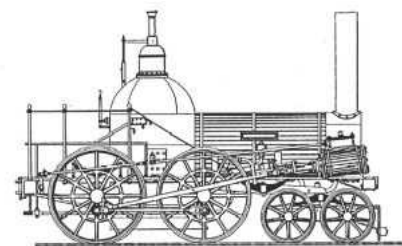


Fig 2

saw rapid changes in engine construction, with these new locomotives reflecting the operating needs and financial capabilities of the railroads.

In 1836 an experienced railway engineer named Henry R. Campbell was issued a US patent for a 4-4-0 locomotive (fig 1). A prototype began trials a year later and proved to be a good hauler, certainly when compared to the 4-2-0's being produced at the time. Unfortunately, Campbell's inside-cylindrical engine turned out to be prone to derailment, probably due to its rigid four wheel leading bogie. Others tried to build 4-4-0s, but again with limited success until an eight-wheeler was built in 1837 that incorporated a more flexible wheel arrangement. By 1840 the eight-wheeler concept incorporating a non-rigid four wheel leading truck had proven itself to be a practical design. The Rogers Locomotive and Machine Works of New Jersey built a 4-4-0 in 1843 (fig 2) that clearly shows its antecedence to later locomotives.

By the early 1850s the eight-wheeler had become a modern locomotive. The round-topped

Bury firebox and hook-motion style valve gear shown on the Rogers design were replaced by a locomotive type boiler and Stephenson's inside link motion. A single pivot four-wheel bogie had replaced Campbell's fixed design, and equaliser beam suspension provided excellent adhesion. By 1855 the eight-wheeler locomotive had become the standard type, in use over most of America's standard gauge lines. Contemporary with the railroad expansion of the mid-1850s a growing economy funded an industrial-scale iron industry able to provide the necessary materials, tools and workforce to build these new locomotives in numbers (fig 3).

In 1861 the New Jersey Locomotive & Machine Co. of Paterson, New Jersey, turned out the *William Crooks* (photo 1) incorporating the features that were to remain the standard for the American 4-4-0 until the early 1900s, when it became an obsolete design. Originally a wood burner, the *Crooks* was fitted with two 12 by 22 inch outside horizontal cylinders with inside Stephenson valve gear. With

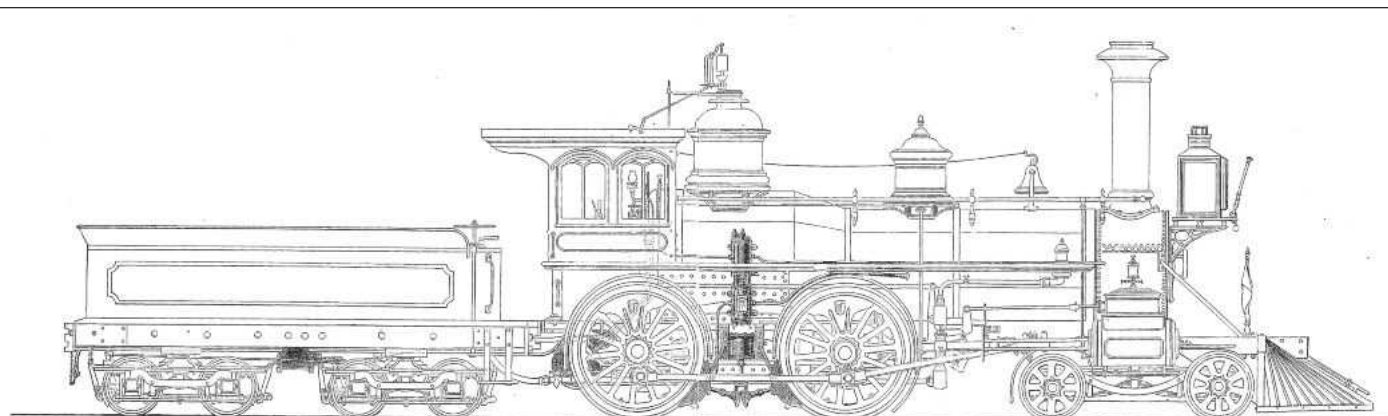
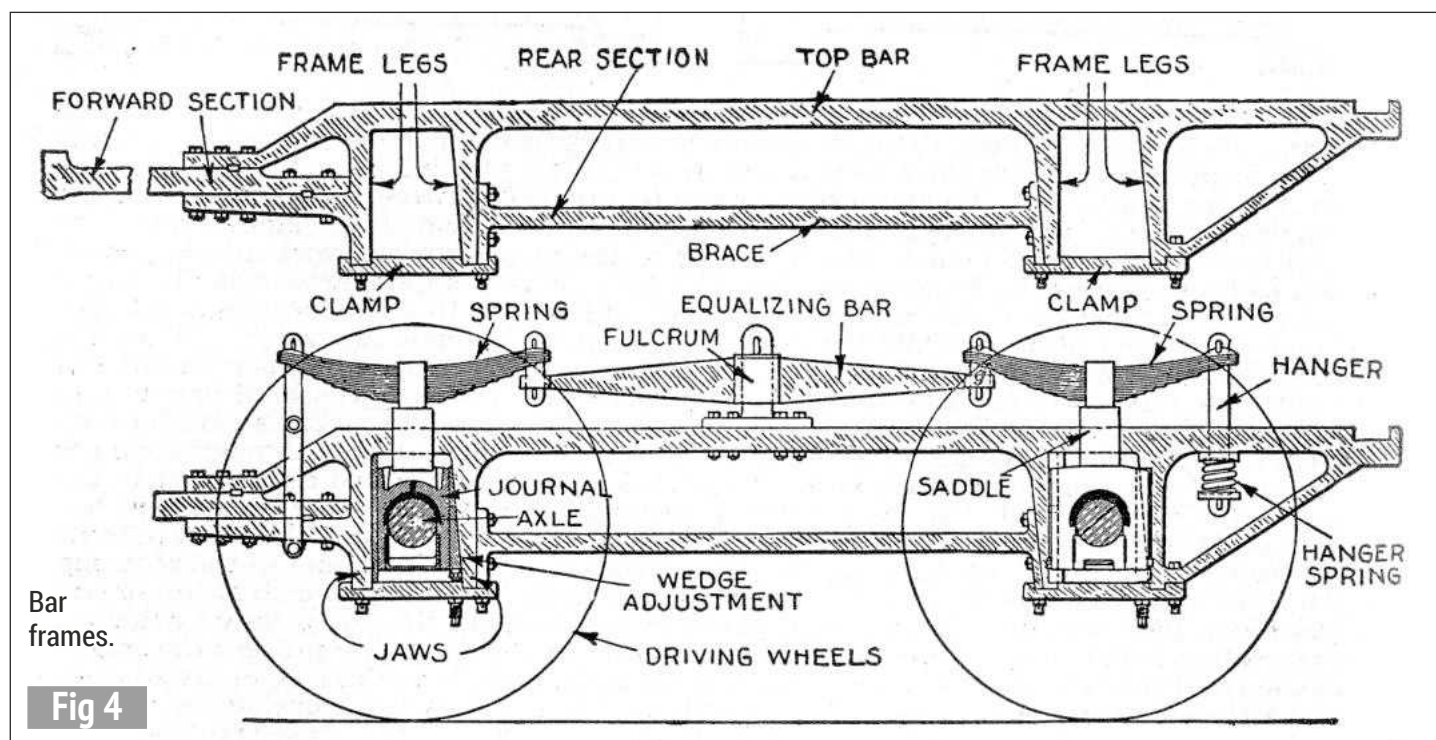


Fig 3

A standard 'eight wheeler' locomotive of 1855.



driving wheels of 5 feet 3 inch diameter and a boiler pressure of 110 lbs per square inch the 50 ton locomotive had a 4,700 lb tractive effort. By the time the *William Crooks* entered service North American locomotives had evolved their own distinctive style.

The rapid expansion of a railroad network over a vast distance required an enormous investment for a still developing county. To help reduce costs, much of the new mileage was laid as single track, using 56 or 66 lb iron flat bottomed rail spiked to wooden sleepers that were laid on a road bed often not much more than a scraped surface. The all-time record for a days single track laying was 10 miles! Any locomotives employed on these lines had to be able to survive operating conditions that at the time would have been considered untenable in England. It is difficult today to imagine the logistics necessary to maintain locomotives over such an enormous geographic range. In his 1937 biography, *Life of an American Workman* Walter P. Chrysler, of car building fame, described his early start in life as a roundhouse mechanic in Kansas. Beginning his apprenticeship

in 1893, in the era when the American locomotive was still common, Chrysler recounts his experiences working to maintain and repair locomotives from small remote shops that were equipped with the minimum of tools and equipment. He also relates how issues related to poor feed-water quality and extremes in operating conditions made the mechanic's job a continual challenge. It was under these circumstances that a simple and ruggedly-built locomotive was essential.

In 1871 Gustavus Weissenborn, an American engineer and technical writer, wrote, "The first and most prominent quality of the American locomotive is its flexibility: in rounding curves, in moving over rough and uneven track, yielding in all directions, it maintains both its position on the rails and its adhesion to them in a surprising manner". Speed was not a requirement on the railroads of the West, but staying on the rails, hauling capacity, ease of maintenance and repair were.

In 1878 Robert H. Thurston, a well regarded and experienced professor of mechanical engineering in America wrote his *A*

History of the Growth of The Steam Engine. The cross section of a contemporary Baldwin American locomotive is included in the book, accompanied by his comments on the type: "The standard passenger-engine on the Pennsylvania Railroad has four driving-wheels, 5½ feet diameter; steam cylinders, 17 inches diameter and 2 feet stroke; grate-surface 15½ square feet and heating surface 1,058 square feet. It weighs 63,100 pounds, of which 39,000 pounds are on the drivers and 24,100 on the truck. The (locomotive) takes a train of five cars up an average grade of 90 feet to the mile.

The American locomotive-engine has a maximum life which may be stated at about 30 years. The annual cost of repairs is from 10 to 15 per cent of its first cost (which was about \$12,000).... And a ton of coal to each 40 or 50 miles run."

The 'cars' in question, if they were regular passenger-type, would be about 46 feet long and 10 feet wide and high. The body would be of heavy wooden construction, supported on an iron frame and riding on two four-wheeled passenger car trucks. Providing seating for 54

passengers, the car weighed in at 39,000 pounds.

Close study of the design and construction of the American-type 4-4-0, a wheel arrangement which was also used in Great Britain and Europe, not only reveals the similarities between the two but also the areas of divergence. At the heart of any locomotive is their frames, with bar frames being used exclusively in the American-type locomotive. Wrought iron bar frames were used by Edward Bury for his 1830 locomotive *Liverpool*, replacing the plate iron and wood combination common at the time. First used in America in the early 1840s, bar frames proved to be ideal for the large locomotives allowed by the more generous North American loading gauge.

Bar frames offered American locomotive builders several advantages. Most importantly, iron plate was in short supply due to a lack of plate rolling mills, but bar stock was available in quantity. Bar frames are not only strong but also easy to produce with limited machinery, an important advantage as, even as late as the 1870s, the Altoona shops of the Pennsylvania Railroad were

relying on considerable hand work for locomotive building. Bar stock frames could be drilled and bolted together with the almost complete absence of rivets. Short lengths of stock could be used, allowing for easy replacement if needed, and few cross stays were required to reinforce the frames. Bar frames made the mounting of cylinders, suspension and brake gear simple, and axle boxes easy to install and maintain. However, there are some disadvantages related to the use of bar frames. When compared to plate frames they are heavy, lack vertical rigidity but are excessively rigid laterally, not good traits when running on poorly-laid track. They could also result in some structural weakness at the front end related to the use of leading bogies, a situation only

resolved with the adoption of cast smokebox saddles.

The layout of a set of bar frames (**fig 4**) shows the arrangement of the major components for an American-type 4-4-0 locomotive. The illustration shows clearly how the frame consists of two separate horizontal sections bolted together using short vertical bars. The forward section consists of a single bar and it is to this that the cylinders and cross stay for the front truck is bolted. The simplicity of the layout is evident, as is the ease of access to all the moving parts. As machine tools became available the frames were machined using large planers, reducing the amount of hand labour required and increasing the accuracy of the assembly.

To ensure maximum adhesion by the locomotive,

its weight must be distributed to all of the driving wheels. In 1838 Joseph Harrison received a patent for his equalising lever, which allowed the weight of the locomotive to be evenly distributed to the driving wheels. This compensating mechanism gave the evolving 4-4-0 the adhesion it needed to become a practical workhorse. Further development of the equalising lever principle evolved into the design shown in the frame illustration. This system of springing must have been effective, as it was fitted to the New York Central's Number 999, a 4-4-0 locomotive known as the 'Queen of Speed', reported to run at over 80mph in 1893 between New York and Buffalo.

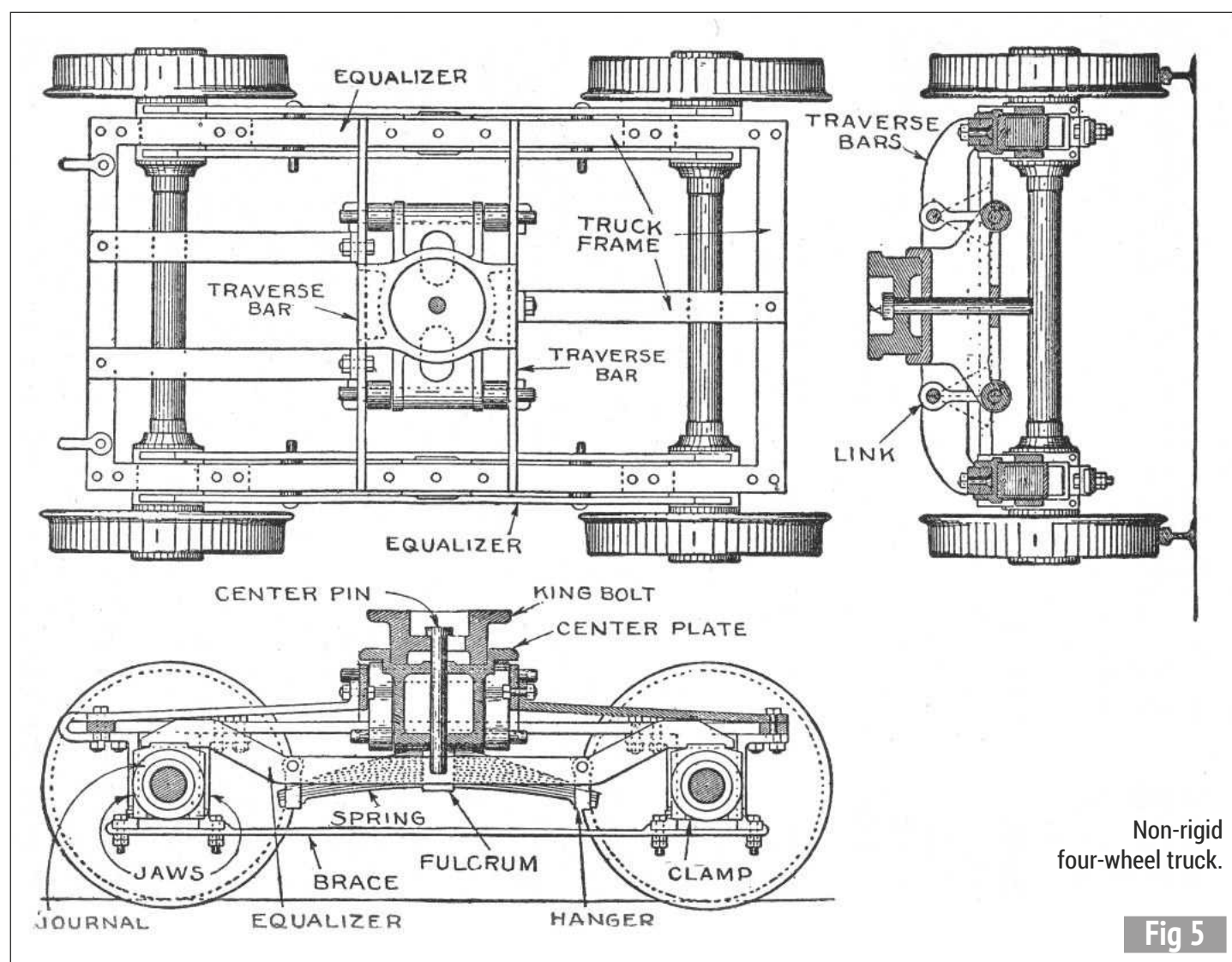
The addition of a leading, non rigid, four wheel truck (**fig 5**) materially improves the steadiness of a locomotive on

rough track and helps guide it through curves, both valuable assets for locomotives operating in the American west. Initially, the truck wheels were placed close together, but as the 4-4-0 evolved the truck frame became longer and the wheels further apart. In addition to improving the trucks control it enabled the horizontal cylinders to be lowered. Brakes were not usually fitted to leading trucks, but NYC Number 999 had a set, probably in deference to her reputation.

●To be continued.

REFERENCE

Audels Engineers and Mechanics Guide No. 3, 1823. *The Evolution of the American Locomotive*. Herbert Walker, 1897.



Non-rigid
four-wheel truck.

Fig 5

We Visit The Wirral Model Engineering Society

John Arrowsmith pays a visit to inspect the results of a major track rebuild.



This was my first visit to the Wirral Society in Royden Park and I was impressed with the attractive parkland location which provides an excellent base for the Society railway (**photo 1**). My visit coincided with their normal working day and members were busy carrying out maintenance work on both the ground level and the raised tracks. There has been a track in Royden Park since about 1966 with continuous operation which has seen three sets of rail renewal. About four years ago, however, it was decided to carry out a major rebuild on the raised track as the sleepers had served their time and some of the rail crests had seen much better days. Some innovative thinking went into this project so that the existing concrete support beams could be used again. Side boards were fixed to the beams and a new concrete skim was poured on the top surface between the boards to provide a new flat surface for the rails (**photo 2**). At the same time an element of super elevation was incorporated into the concrete on the curved



Passenger entrance from the park.

sections which has made a tremendous difference to the running qualities of the track (**photo 3**).

The other major new feature was to add a 7¼ inch gauge rail to the system to provide a safer and more stable passenger experience. Heavier gauge steel section was used as well, so that the new track is a very robust installation. The track is all welded with the tipping rail fixed directly to the track instead of the base (**photo 4**). Again this has proved to be a very good idea and when the track expands due to a temperature rise, the tipping rail moves with it, so

that in two years of continuous operation there has not been one derailment of any kind and the ride quality had improved noticeably. With a track length of 1220 feet, the material statistics were something to seriously consider. The result was 6200 feet of steel section for the rails, 1000 feet of steel for the sleepers and 1000 feet of plastic sleeper material. Lots of jigs and fixtures were used in the construction and it was found that welding the rail section to the sleepers on the underside prevented distortion to the running side (**photo 5**). It took the welder, Barry Birch, about 14 minutes



This shows the new surface skim to the old beams and one of the signalling light reflectors.



The super elevation built into the track base.



An end view of the new track showing the material section and anti-tipping rail position.



The method of fixing rails to sleepers and sleepers to track base.



The lift table ready to receive a locomotive.



The substantial raised track traverser.



A low level carriage store as higher buildings are not allowed in the park.



One of the well maintained club locomotives.

for each 10 foot section. By my calculation that would seem to be well over 100 hours of work just welding. No mean task. A useful rolling machine ensured all the curved sections were rolled to a consistent radius to provide the same level of construction as the straight sections.

An automatic signalling system using a simple light breaking operation enables three trains to be run with a safe distance between them. Drivers are given a good test of their ability as a 1 in 60 gradient on an uphill section sorts out their driving skills. The steaming bays are fully

equipped with water, air and electricity and an hydraulic lift for unloading (**photo 6**). A substantial traverser enables all tracks to be accessed without difficulty (**photo 7**).

Being located in a popular park area of the Wirral, the club have established a good working relationship with both

the local authority and the resident park rangers and, to the club's surprise and delight, they were nominated by the local Mayor to receive the Queens Award for Voluntary Service (**photo 10**). The Society was duly presented with their award by the Lord Lieutenant of Cheshire at a



The Queens Award for Voluntary Service board on show in the workshop.



A well built high powered generator for welding at any location.



Members hard at work on the track crossing.

ceremony which was attended by Frank Stephens and Ian Jameson and the badge is now proudly mounted in their club room and on their outside information board. Apparently this award is equivalent to an MBE for a personal award, so it is quite an honour for the club. I did not realise that model engineering clubs qualified for this sort of award but perhaps other societies like this have

also been rewarded for their community work; let us know if you have - it would be good to promote this achievement.

Having had a good look and discussion about their raised track I then went on a tour of the ground level installation where a very useful welding generator wagon (**photo 11**) was being put to good use adding some additional safety plates to a foot crossing on



The comprehensive yet well planned control cabinet on the ground level track.



Another useful road/rail generator set.



A four road low level station approach track work.

the track (photo 12). A smaller, less powerful generator set was also in use at the same location (photo 13). This equipment is an essential part of their maintenance kit as it allows work anywhere on site without the need for long leads or electrical access points around the site.

The ground level track has a good signalling system controlled from a large control cabinet at the station approach (photo 14). The four track station (photo 15) employs pneumatic/ electrical points which are set at about 20 psi, so if a train should start and run through a point set against it, the point will move without derailing the train. The track is fitted with 'flip flops' for track circuitry (photo 16), activated by passing wheel flanges, which all connect back to the control cabinet. As a train approaches the station a large LED display (photo 17) shows the driver which platform he is designated to. The large turntable at the other end of the station (photo 18) enables locomotives to be turned and run past their train before coupling onto the front again. I was told the system works very well and provides a good reliable service on the club's operating days. The Christmas service is a



One of the track circuit 'flip flop' switches.



The platform indicator LED for drivers approaching the station.

particularly busy time when all the advertised trains are fully booked weeks in advance. There is no charge for rides but generous donations provide sufficient income to maintain all the facilities at the club.

In all, the members here have built a quality installation that is much appreciated by their visitors and supporters. I certainly felt this was a well run society; the members really enjoy their club and they made me feel most welcome. For that I thank everyone I met, particularly Barry Birch, Frank Stephen, Ian Jameson and President, Alan Pennell, for their patience, help and, once again, great humour. Gentlemen, it was a pleasure to meet you all.

ME



The station turntable enables engines to be returned to the front of the train for the next journey.

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● Shunting Puzzle

Mark Rudall finds himself with time on his hands and discovers a way of occupying it, thanks to *Model Engineer*!

● Prince of Wales

The team from the A1 Steam Locomotive Trust introduces their new build locomotive project to its much bigger brother, *HMS Prince of Wales*.

● Weir Pumps

Ian Couchman explains the workings of the Weir pump.

● Polly's 20th

Polly Model Engineering celebrates 20 years in business.

Content may be subject to change.

ON SALE 24 APRIL 2020



Write to us

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Responses to published letters are forwarded as appropriate.

Steam Turbines

Dear Martin,
I've been enjoying Mike Tilby's fascinating steam turbine series and have a couple of comments about Part 22 in issue 4630 (17th January).

The first is a typo. British Thomas Houston should, or course, be British Thomson Houston which was originally a subsidiary of the US General Electric Company of Schenectady, New York, USA, but later became part of AEI.

The second is steam turbines on ships. Whilst warships might be interested in the efficiency over a wide speed range, it is less true on merchant ships. Many years ago I was an engineer officer in the Merchant Navy. I only sailed on one steam turbine vessel, the *Nordic Commander*, a large tanker. We sailed from Rotterdam to Capetown at a constant speed, picked up mail and stores, then steamed from there to the Arabian Gulf.

In about five weeks of constant steaming we ran at a range of speeds for maybe a couple of hours. If the mail and stores were being brought out by helicopter at Capetown we wouldn't even slow down there. The efficiency of the main engine at other than full speed is a very minor part of the cost of running a ship. As an example, if we run a ship at 50% power then the speed will be about 80% of

full speed. That means it will take about 25% longer to reach the destination, that means 25% more debt service on the building loan, 25% more crew wages and supplies, 25% more electrical energy used etc. A few percent change in the thermodynamic efficiency of the main engine is well down that list.

In his book *Prototype Locomotives*, Robert Tufnell states that Stanier visited Sweden at the invitation of Dr. Guy of Metropolitan-Vickers to study the workings of the Ljungstrom locomotive on the Grangesberg to Oxelosung line. This is confirmed in a couple of other books.

I would look forward to reading Mike Tilby's article on LMS 6202 Turbomotive.
Victor J. Croasdale (Spring Valley, Illinois)

Dear Martin,
The Mike Tilby article suggesting a combination of electronics and mechanical engineering has jogged a past memory.

Many years ago there was an article published about an electronic indicator for monitoring the level in a boiler, replacing the usual glass tube boiler water level gauge. There were three simple copper rods screwed into the boiler front, each connected to an LED mounted on a simple panel. A red LED would indicate either a high or low boiler water level

and the centrally mounted green LED would indicate the correct level. Building such a panel I found it worked well although I retained a blow/run down valve.

Regrettably I cannot now recall what I did with the system or the technical details but perhaps one of our more electronically experienced readers could consider resurrecting the project if there is sufficient interest.

Best regards, James Wells

Dear Martin,
In the issue number 4630 (17th January) in his enthralling series on Steam Turbines Large and Small Mike Tilby suggests that he might be prepared to write an article on Sir William Stanier's LMS 6202. I would love to read an article on this locomotive, of which I know very little. Therefore, would you gently twist his writing arm to do so.

When reading the magazine, I usually leave what I think is the most interesting article to read last - just like a dessert after a meal - and Mike's article is that dessert. As I've mentioned previously Mike has brought back memories of fluid mechanics studied decades ago (last century) at college.

I for one find this type of article fascinating - Ron Fitzgerald is not far behind with his informative articles. I think we have an interesting mix in the magazine. I read the magazine from cover to cover and have done so for nearly 50 years. By the way, isn't time we had another engine construction series from Anthony Mount.

**Regards, Tony Reeve
(Tasmania)**

Dear Martin,
What a pleasure Mike Tilby's article on turbines has been. Really sorry it has finished. And how many hours research must have gone into the whole subject! Well done, Sir - FIRST CLASS! Who could follow that?

Regards, Roger Clay

Gas Tanks

Dear Martin,
Much as I am enjoying reading Martin Ranson's articles, I am concerned about his statement in his second article (M.E. 4631, 31st January) where he says he builds his own gas tanks and says 'I always test the gas tanks to 200 psi. I believe the current figure is 377 psi, but it does seem to vary depending on who I ask'.

The requirements in the UK are clear. The UK Boiler Test Code 2018 Volume 3, readily downloadable from the internet, states that gas tanks must be hydraulically tested to 400 psi and pass a safeguard test by a qualified inspector, who will issue an appropriate certificate.

Even small quantities of compressed liquid petroleum gas contain a lot of energy and it is essential that they are safely contained.

Best wishes, Alex Weiss (Chalfont St. Giles)



PART 5

Building Dancer

Finishing Off

Dancer on the Mahurangi River.

John Olsen constructs a 1:1 scale steam launch.



Continued from p. 531
M.E.4635 27 March 2020

In the first article in this series I mentioned that my supposed three stages had really turned into four. Plumbing up and getting everything working turned out to take longer than I had anticipated and indeed this work is still ongoing. *Dancer* has more plumbing than most amateur steam launches will require, since she is set up for overnight

cruising. Since this will not apply to most small steam launches, I won't go into too much detail on the 'house' side of things, although naturally there is some interaction between the accommodation requirements and the needs of the steam plant.

Although I have not dared to keep detailed records of the costs involved, those considering a project of this nature should bear in mind that the actual cost of the hull and plant is dwarfed by some of the other expenditures that have been incurred along the way. One of the major items was the purchase of a trailer to suit. The total weight of the boat and trailer is, by design, just under 3500kg. This means that it can be towed on the road with a reasonably obtained vehicle and without a heavy traffic license. The trailer has to have electric brakes and has a tandem axle. The cost of this trailer was NZ\$ 12,000, roughly equivalent to

£6000. **Photograph 40** shows *Dancer* being winched onto the trailer at our former residence. A vehicle rated to tow this weight was also needed and I was somewhat fortunate to find a second-hand 4.2 litre Nissan Patrol four wheel drive with only 126,000 km on the clock, which was also NZ\$ 12,000. These two purchases exceed what I spent building the hull and plant! Another large expense was building a suitable shed to accommodate the boat and my workshop at our new property. This 84 square meter shed cost NZ\$ 41,000. Together with an existing smaller shed, the total workshop space I have available is about equal to the area of the house.

First problem with plant of this size is actually getting it into and, on occasion, out of the hull. My new shed has a Unistrut rail mounted below the ridge line. This was previously installed in the basement of the Auckland

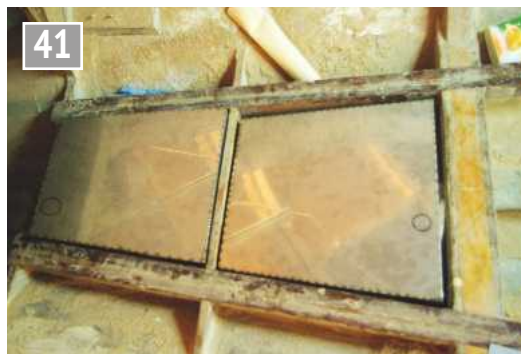


40
The trailer was a major purchase. Here *Dancer* is winched onto the trailer for the first time.

house. This is adequate for lifting the engine in and out and this has occurred several times during construction. It is not really strong enough to lift the boiler, something like 400 kg - although I have not actually weighed it. So to get the boiler in *Dancer* on her trailer and the boiler on another had to be taken to a friend's workplace some twenty miles away where they had a 3 tonne hoist.

Steam boats require tanks for water and in *Dancer's* case, also for liquid fuel. It seemed reasonable to use some of the otherwise wasted space in the Vee bottom to store fuel and water. So some time back I had some tanks made by the brother of a club member. He had access to TIG equipment and was experienced in stainless steel welding. He made three tanks. Two fit into the space between the engine and the stern gland/thrust bearing and have a tunnel through them for the shaft to pass through. These are intended for fuel although they have not been used for it yet (**photo 41**). The other tank is wider and flatter and fits under the boiler and is shown in **photo 42**. It is used for make-up water and also provides a barrier against heat from the boiler reaching the hull.

Later on I required more tanks; a hot well and a header tank for the oil burner. By this time I had seen another friend TIG weld the stainless tube for my chimney and decided that rather than paying someone to weld the new tanks, I would purchase a TIG welder for not too much more and have a go myself. Perhaps a brief introduction to TIG welding would be helpful here. TIG stands for Tungsten Inert Gas and is also sometimes known as GTAW - Gas Tungsten Arc Welding. The significant thing is that the gas must be inert (contrary to an April fools post on the Model Engineer Forum!). The usual choice is Argon, although the process was originally developed using Helium, which is still sometimes used for special



Stainless steel fuel tanks under the floor.



The inboard condenser.

applications. The Argon used for TIG is pure; unlike MIG welding where often some carbon dioxide is included. The inert gas shields the pool of molten metal from the oxygen in the air, so that the composition of the alloy does not change. There are still changes due to the heating effects, but because TIG welding usually proceeds quite quickly, the heat affected zone is quite minimal. TIG welding can be used on a wider range of materials than most other types of welding. It is probably the highest quality and most versatile type of welding that is available to the amateur.

TIG welding turns out to be quite a fun thing to do. One thing I did learn is that you don't actually want to flange the joints. I had folded up the shell, the ends and some baffles for the hot well and found that it is not at all easy to weld the edge of the shell to a flanged end. The solution turned out to be to turn the flanged end around and simply weld the two edges together. This goes beautifully; the bead runs along at quite a remarkable speed and makes a strong joint. So when it came to making the header tank for

the oil burner, I made the ends up without any flanging and simply butt welded the joints together. The longitudinal joint along the approximately rectangular shell is also done in that way, as had been the original professionally welded tanks. For the long joint on the shell, I was able to back the joint with a piece of angle iron clamped into place. This helps keep the two edges together and also serves to help exclude air from the back of the joint, reducing oxidation and what is called 'sugaring' on the back of the joint. Sugaring is where air has got in and changed the composition of the alloy. It is a serious problem on highly stressed structural welds such as high pressure pipelines and so often, for high class work, arrangements are made to flood the back of the work with argon. This was not necessary for my tanks, since they are not pressurised.

With the welds butted together as described, the TIG welding requires very little filler, almost none, making what is called an autogenous weld. The weld progresses quite fast and leaves a very clean bead. Based on some advice in



A tank for water under the boiler.

Frank Rieg's excellent book (ref 10) I had spent a bit extra and bought a machine capable of both AC and DC welding. The most basic TIG welders are DC only and the tungsten electrode is normally negative. The advantage of the AC capability is that it enables the welding of aluminium. On the machine I purchased, another advantage was that it has an HF start capability. This means that instead of scratching the tungsten electrode on the job to start, you just have to press the button to start the gas flow and get the electrode close enough and the arc will start. The HF start facility also works when using the machine as a stick welder. Most TIG welders do also have a stick welding capability, which makes them very versatile and my stick welding with the new machine is much better than I was able to manage with my old AC only machine.

Anyway, getting back to the aluminium, I was able to use this capability to make up some support poles for *Dancer's* canopy. TIG welding with aluminium uses an AC wave form, usually square and

with the ratio of positive to negative adjustable. When the electrode is positive a cleaning action occurs which breaks up the oxide layer on the aluminium, which is necessary. However this also heats up the tungsten electrode more than the negative polarity. By adjusting the ratio of positive to negative, sufficient cleaning action can be obtained while not overheating the tungsten electrode too much. Aluminium is more challenging to TIG weld than either stainless or mild steel. The higher conductivity means that the metal can melt more than intended, especially as you approach the end of a weld. It is very satisfying when you get the knack of it and start to produce welds that look something like the really expert ones that you can find on the Internet. If you are learning to weld, there is a lot of useful advice and demonstrations available on YouTube.

Talk of TIG welding is likely to raise the question of how suitable it would be for a typical copper model locomotive boiler. I have not done a great deal of copper welding, just enough to prove to myself that I can do it. It does produce a good weld. It is easier in one way than aluminium, since it does not need the AC capability, but the high conductivity means that the metal will easily start to melt more than you want. I think that a great deal of skill would be needed to produce a reliable copper boiler using TIG welding. I think also the ideal design would be a little different, probably not needing flanges for instance. So I think for most of us TIG welding of copper boilers is probably best left to professionals who are doing it all the time. I would myself be quite happy to TIG weld a copper tank, if I needed one, but not a pressure vessel. As things are, stainless is cheaper than copper for the tanks that I do need.

So, back to *Dancer*. Having arranged all the necessary tanks, which also included some plywood fibreglass lined

tanks towards the bow for black water and drinking water, the rest of the plumbing had to be sorted out. There are two feed pumps on the engine. These can draw water from the hot well or from the make-up tank. They each feed separate clack valves on the boiler. A hand pump is also provided and this shares a clack valve with one of the engine pumps. I also have a homemade injector, yet to be tested, which will be plumbed in later. Water supply is not actually quite so critical on an oil fired boiler, since if all else fails and the water has disappeared from the glass, the burner can be turned off instantly. Since that would mean that propulsion would also cease quite soon, it is still very important to have at least two independent means of feeding the boiler. It is just not quite as urgent as the case where you have a bed of white hot coals under the crown sheet.

The Leak engine design incorporates an Edwards air pump, a type which is very reliable since it has no foot valve. The foot valve is the part of a pump that is most likely to give trouble and since it is naturally under the pump, it is also very hard to get at to fix. The compromise with the Edwards pump is that because of the way it works, the condensate must be able to flow downhill from the condenser to the pump. This generally means using an inboard condenser, which also means using a circulating pump. This adds complication and requires more power to drive. Actually, since the hull is quite a deep Vee, I could have got away with a keel condenser, not actually close to the keel but further up the Vee about half way to the water line. I decided that an external condenser was a bit of a risk on a boat that will be on and off a trailer often, so went for the inboard condenser. My first attempt at building one was ... shall we say ... not a great success. Then another club member showed me a commercial unit

that he had obtained. These are apparently popular with the members of the Steam Boat Association in the UK. They are a unit fabricated from multiple layers of stainless steel brazed together (**photo 43**). Exhaust is coming in at the top left and a vacuum breaker valve can be seen at top right. This is used to allow free exhaust when warming up. Initially I had some trouble obtaining a vacuum, due to leaks at the exhaust flange. Finding leaks in a vacuum system can be hard and the best approach I have found so far is to fill the whole exhaust system up with water under pressure from the garden hose.

The need for power to drive the circulating pump was mentioned above. One of our club members was very skeptical about my use of an inboard condenser, largely on these grounds. As a result, instead of using a rubber vane type of pump that had been left in the basement of our Auckland house by the previous owner, I purchased a second-hand gear pump. These do not have as much friction as the vane type. Although I have not yet attained quite as much vacuum as I would like - the best so far being 14 inches - the pump is certainly circulating enough water, since the condensate comes out cold and it appears to be using a minimal amount of power from the engine.

It was mentioned earlier that an electric compressor is used to run the burner while raising steam. This is larger than the usual type that you might keep in the boot of a car. It is the sort favoured by four wheel drive owners, who apparently reduce the pressure in the tyres sometimes when going off road. When they come back to the road, they need to restore the pressure on all four tyres to something safer for road use, so a good 'grunty' compressor is needed. This one has to supply a fair volume of air, at around 40 psi for about ten minutes, to get the burner going. In the early

stages, when it was taking more like forty minutes to get the boiler up to 50 psi, the over temperature trip would sometimes operate on the compressor, but now that more heat is being obtained from the burner, the pressure comes up more quickly.

The battery that operates the compressor naturally needs charging. Currently this is done by 300 nominal Watts of solar cells, mounted on the cabin roof. Since these are mounted flat rather than being angled to the sun, they will not generate the nominal power. The solar cells can be seen on the cabin roof in **photo 44**. There is also a generator, driven by belt from the final drive shaft adjacent to the thrust bearing, but this is not yet connected. The battery is a pair of 65 AH absorbent glass mat units and is also used for lighting at night, for the water pump for the house plumbing, for the refrigerator and for an auxiliary electric trolling motor. The latter is intended for maneuvering when the main plant is not in steam. It is rated at 500 Watts and will drive the boat, but may need to be replaced with something a bit more powerful.

Steering is provided for by a wheel in the front of the cabin. So far we have usually operated *Dancer* with a two person crew, with my wife steering and me tending



Flexible solar cells mounted flush on the cabin roof.



The steering wheel and kevlar tiller ropes.



Some tricky routing is needed to get the tiller ropes to the quadrant.



The quadrant and tiller, looking up from underneath.



A marine toilet is shoehorned into the bows.

the steam plant including reversing and throttle. Reversing is by means of a reversing lever rather than a screw reverser, since small boats often require to be reversed at short notice. The steering is connected to the tiller quadrant by Kevlar ropes. These provide a flexible and tidy arrangement, much nicer than arrangements I have seen on some other steam launches (photos 45, 46 and 47).

Dancer is fitted out with a small head with a hand basin and handheld shower head (photo 48). Aft of the head compartment is provision for two people to sleep, with the black water tank under the decking. The black water tank stores waste from the head, the shower and the galley sink. There is provision to empty it into the sewage system at home. Next aft is a small galley and the removable cabin begins here so there is standing headroom. The galley has an electric refrigerator, a gas cooker, a small sink and a limited amount of cupboard space. Lighting will be fitted some time, but so far a portable LED trouble light serves the purpose. The two burner cook top and the sink both slide out for use so that there is more room when they are stowed. The gas bottle is kept in a separate

vented compartment in the forepeak when not in use, e.g. when the main boiler is being fired. The wheel is also in this galley. Under the galley floor is the house battery and a tank for drinking water. There is a hot water cylinder, which is to be heated by water circulated through a jacket on the exhaust pipe. It also has a mains electric heater, but there is no plan to use that at present. Next aft is the boiler, with its water tank underneath. The engine is aft of the boiler, with the hot well to starboard against the side and the oil fuel header tank to port.

Under the deck aft of the engine are two fuel tanks. There is to be a comfy seat here with its back against the aft coaming, but so far there is only a piece of plywood to sit on. The aft deck also has provision for two people to sleep under it. The above probably makes things sound quite spacious and roomy, but the area and volume to work with is really quite limited and everything has pretty much had to be made to fit the space. Still, we have camped out in her overnight enough, both on land and at anchor, to know that it all works. Cruising for maybe up to a week or so without using shore facilities should be possible, although only in sheltered waters of course. *Dancer* is not designed for open waters. She does have a folding tender which can be stored under the after deck, shown being tested in our swimming pool in photo 49.

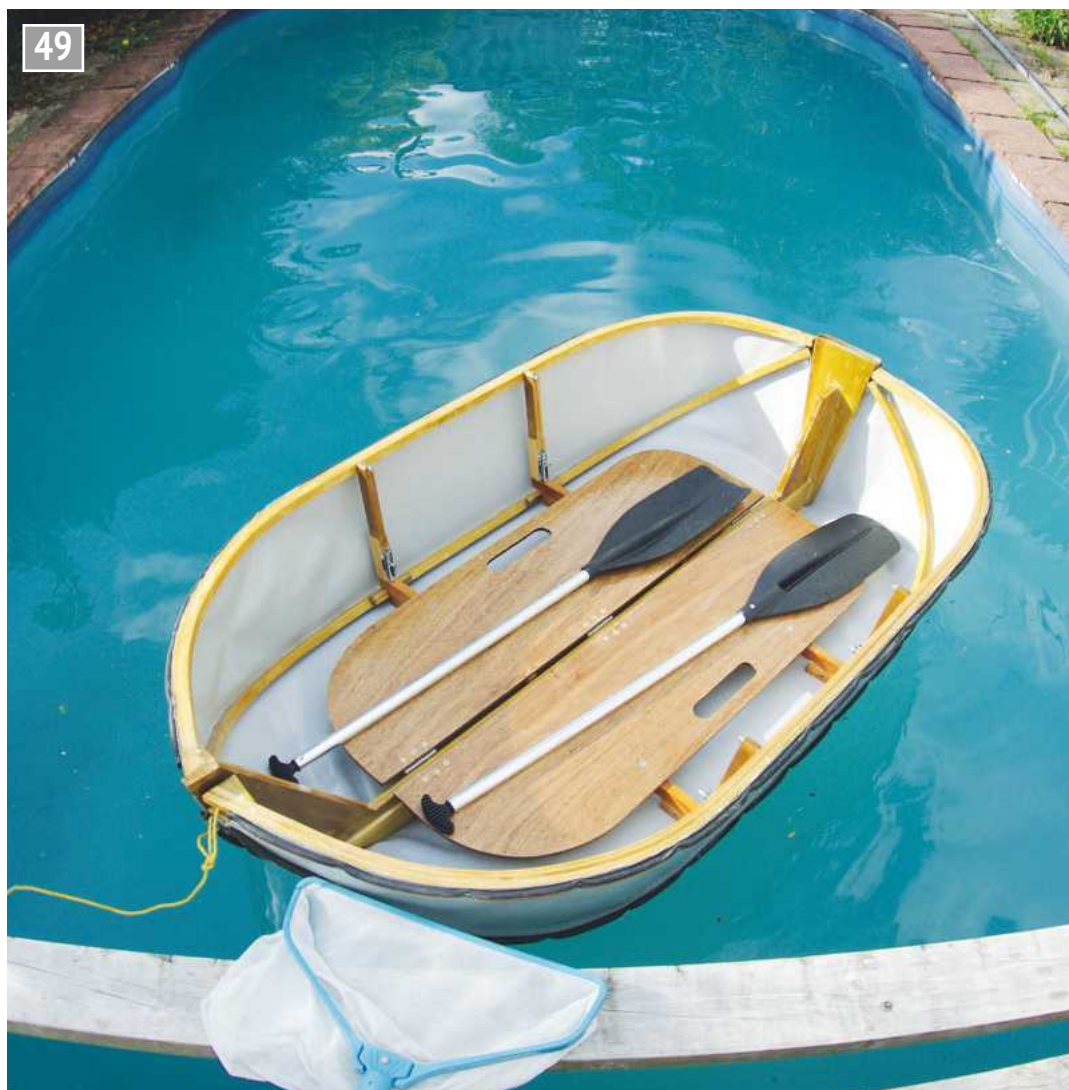
Readers may be wondering what sort of cruising we have in mind for *Dancer*. Well, initially we live very close to a chain of hydroelectric lakes on the Waikato River and these provide us with an excellent choice of day or overnight outings. Last summer we took *Dancer* about four or five hours by road north to a steam launch gathering on the Mahurangi River, where an extensive river estuary provides excellent sheltered cruising for small boats. Once a few more systems are fully debugged, perhaps next Southern

hemisphere summer, we hope to take her on the ferry across Cook Strait and cruise on some of the South Island Lakes, where there is some truly magnificent scenery. Longer term we have some more ambitious ideas, one possibility being to take both *Dancer* on her trailer and the tow vehicle, across the Tasman Sea to Australia, where there are some interesting possibilities on the Murray River and also a uniquely Australian collection of larger paddle steamers at places like Echuca, Swan Hill, Renmark and so on. Getting even more ambitious, we could consider putting *Dancer* into a container and shipping her to Great Britain for a summer season. Cruising the canals in her would be a lot of fun, but there are sure to be some legal and financial hurdles to be overcome before that could happen.

ME

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10. *Schweissen für Hobbyschlosser und Oldtimerfans*. Author, Frank Reig. Publisher, Shaker Verlag Aachen 2015; ISBN 978-3-8440-3542-1.



Naturally a tender is needed. This folding dinghy was built from plans sold on the Internet.

No.293

MODEL ENGINEERS' WORKSHOP

Look out for the May issue, number 293:



We pay a visit to **Patrick Cubbon's** workshop.



Make **Peter Shaw's** Mandrel Indexer.



Bob Edney shares his experience of starting 3D Printing.

On Sale 17th April 2020

The Barclay Well Tanks of the Great War PART 60

Terence Holland describes and constructs two appealing, century old locomotives.



Continued from p.459
M.E. 4634, 13 March 2020

This constructional series addresses Andrew Barclay 0-4-0 and 0-6-0 narrow gauge locomotives supplied for use in the First World War. Built without the use of castings, the 0-4-0 design is described as two versions; as-built for the British Admiralty in 1918 and as rebuilt and currently running on the Talyllyn Railway as their locomotive No.6, *Douglas*. The 0-6-0 engines described were built in 1917 and operated on 60 centimetre gauge track at the Western Front in France. These were small, spartan machines of which only 25 were supplied and none have survived into preservation.

The driving tender

A tender is a useful, but not essential, accessory for all three locomotives and I will deal with construction now, before moving on to describe building the 0-6-0 locomotive. After all, the driver has to sit somewhere!

There's nothing new, of course, about adding a tender to a narrow gauge tank engine – the Ffestiniog do it all the time! Both *Blanche* and *Linda* on the FR, built by Hunslet of Leeds in 1893, came from the 'main line' of Penryn Quarry Railway as big 0-4-0s, sin tenders. Since then they have been extensively modified by the FR, with the addition of not only tenders but also pony trucks and superheating. The first engine of the three to be built, *Charles* of 1882, is, however, in original 0-4-0 condition and can be seen in Penrhyn Castle Railway Museum.

Photograph 286 is a rare view of *Linda*'s tender in the 1970s, as she backs onto the train at Porthmadog station. Who in their right mind takes photographs of locomotive tenders? Apparently I did!

'Er-indoors was not taking things seriously when she read this and was muttering on about a 'tender behind'... But it's not a surprise really, as when I first told her in Dorset that I volunteered as a fireman on a railway in Wales her comment was "that's a long way to go to put out fires"! I know what you're thinking but no – she's a brunette!

Photograph 286 also shows a typical narrow gauge 'centre-buffer-coupler', correctly known as a 'Norwegian chopper coupling'. For constructional details see **ref 58**.

Photograph 287 shows the sorry state of the tender before the recent rebuilding. This resulted in the improved condition shown in **photos 288 and 289**, where the rebuilt tender is shown without the driver's seat pad. **Photograph 290** shows the rear of the

tender complete with seat pad, rear lamp, filler pipe (which doubles up as an indication of the water level) and the new maker's plate. Note also the twin buffers, unusual for a narrow gauge locomotive, but standard fittings for the Talyllyn.

A close up of the new maker's plate is shown in **photo 291**. It was etched recently using hydrochloric/peroxide etchant and is shown on the tender in photo 290. Close inspection shows up a couple of minor flaws, where the resist has started to deteriorate and some damage has occurred to the lettering etc. at the top. This could easily be touched in with acrylic gold paint but it's one of those many jobs for which I need to get 'a round tuit'!

The blank spaces each side of the water tank lend themselves to a logo and in photo 290 one has been applied and the letters CLR can just be seen. CLR stands for Chenil Light Railway – Chenil is the name of the local Andalusian area in which we are located.

The tender GA is shown in **fig 194** (this side elevation drawing was published at the beginning of this series as fig 3) and, as mentioned above, the design is compatible with all three engines. One minor modification has been applied to the original drawing; the main wheel sets have been moved back approximately one inch, so that they sit more directly under the driver.

In fig 194, AMW & B stands for Air Ministry Works and Buildings. This insignia was painted on the two Barclay 0-4-0 well tanks when they operated for the newly-



Linda's tender on the Ffestiniog Railway.



Tender before rebuilding.



Side view of driving tender.

formed RAF at Calshot on Southampton Water, after the First World War. Later the letters AMWD were carried when the title of the department was changed to Air Ministry Works Directorate. Contrary to popular belief the engines were painted green, not blue, and did not carry RAF roundels!

Note that the footwell in fig 194 is intended for size 10 'plates' – if you have smaller feet this may be made shorter for closer access to the cab or vice versa. The bottom of the footwell is left open, although a removable or hinged cover plate could be fitted for the sake of tidiness. The open structure,



Front of driving tender.



Close up of maker's plate.

however, gives easy access to the pony truck, which, in common with all pony trucks, does occasionally derail.

● To be continued.

REFERENCE

58. Terence Holland, *Fairlie Complex: A Beginner's Paradox, Part 5 – Chopper Couplings and Safety Chains*, Model Engineer 4415 – October 2011.

NEXT TIME

We start actually cutting metal for the tender.



Rear view of driving tender.

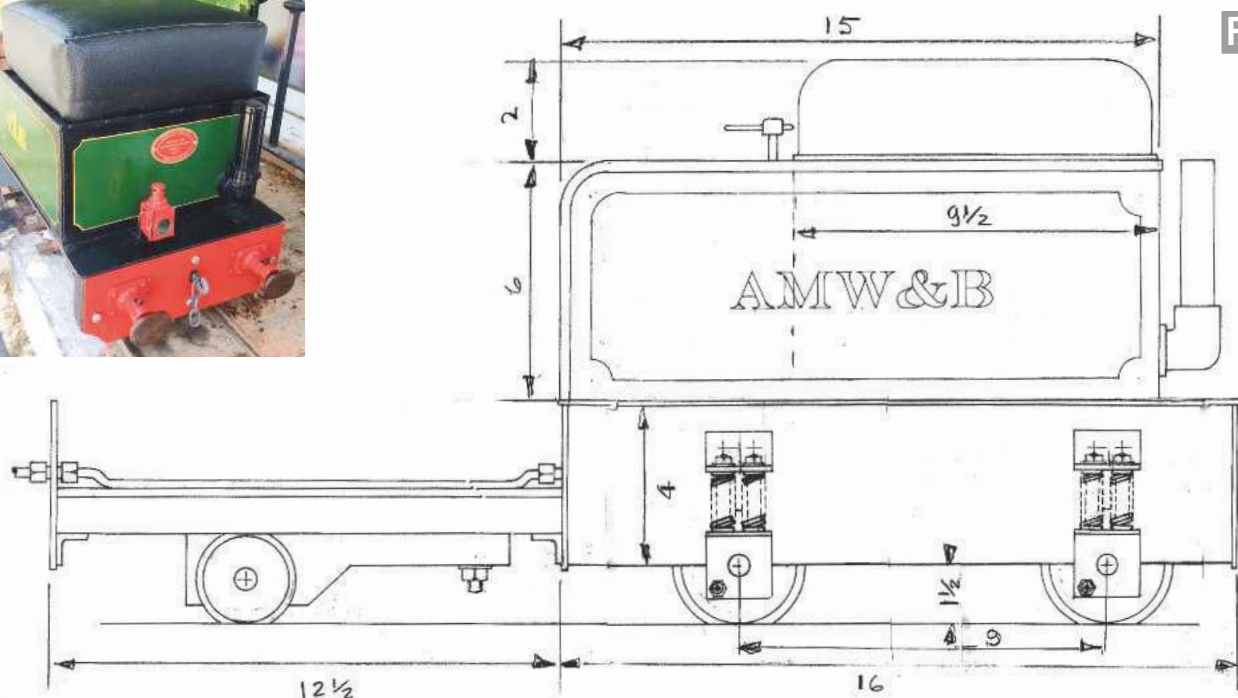
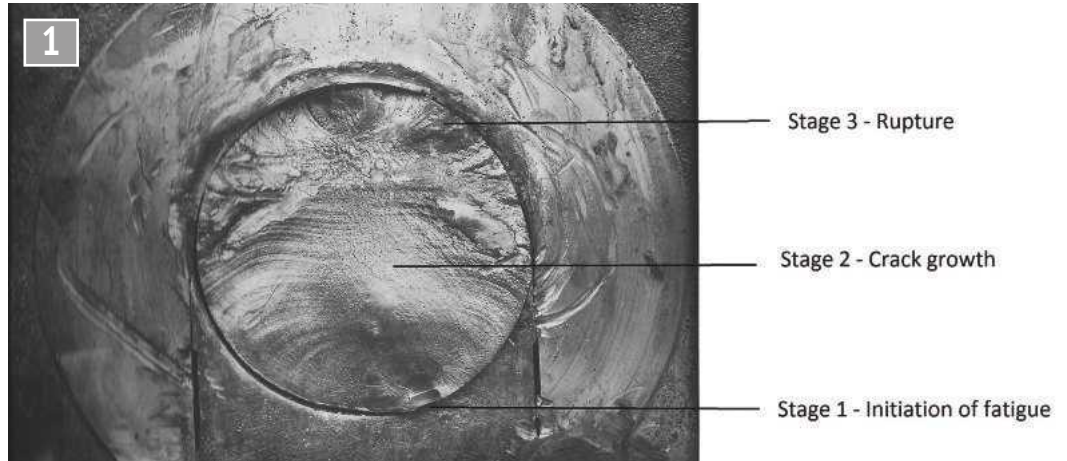


Fig 194

Metal Fatigue

Robert Walker explains what happens to a metal which is stressed repeatedly.



Fatigue failure of the LNER P2 locomotive 2005 crank axle (ref 1).

Metal fatigue is the failure of a metal that has been loaded in tension and unloaded repeatedly. Critically, the tensile load has not distorted the part. It is widely considered one of the most common reasons for structural failure of products.

The main characteristic of a fatigue failure is the almost smooth surface covering most of the fracture surface (see **photo 1**). A fatigue failure starts at a point with a small crack or defect. The crack then slowly propagates through most of the section and then, when there is too little material

to carry the load, fracture occurs suddenly and often catastrophically.

When an engineering part is designed, it must not have its shape changed by the loads expected in service – in most cases. To ensure a part is not overloaded the designer must know what loads are expected in service and hence the stress in the part. Stress is calculated by dividing the load by the area carrying that load. For example if a steel bar is 10mm square and bears a tensile load of 20,000 N the stress is $20,000 / (10 \times 10) = 200 \text{ Nmm}^{-2}$ (200 Newtons per square mm - MPa is the correct ISO measure of stress but is numerically the same as Nmm^{-2}).

The designer must therefore know how the customer will use the product. This is the designers' perennial problem - how will the customer actually use the product? Standard tests can be carried out, for example finding the stress in a car suspension arm by driving a prototype on a section of cobbled road. Once the stress is calculated a material must be specified - for example the yield point for low alloy steel is 450 Nmm^{-2} . This steel will break with a stress of 600 Nmm^{-2} (**ref 2**) - this is known as

the ultimate tensile strength or UTS for short. **Figure 1** shows the stress/strain curve for mild steel.

It would seem that the above example could be safely made of low alloy steel as the maximum stress is less than the yield stress for that material. If the load is not constant and varies between a compressive load of 200,000 N and a tensile load of 200,000 N though then metal fatigue must be considered as a possible failure mode.

If fatigue is to be considered, then the stress expected must be compared with the chart in **fig 2**. To use this chart the stress of 200MPa is projected across until the line is reached and then projected down to the axis. The expected number of cycles to failure can then be found.

Following the above method, the expected fatigue life is between 100,000 and 1,000,000 stress cycles. The horizontal axis is a log scale and difficult to interpret. In my judgement the fatigue life is approximately 300,000 cycles. It must be remembered that the curves are an average of many tests so the part may last longer expected or fail prematurely. If the stress can be decreased to

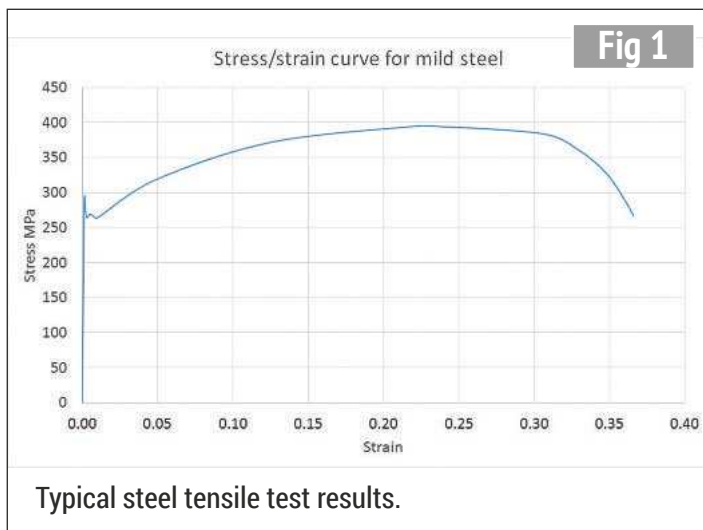
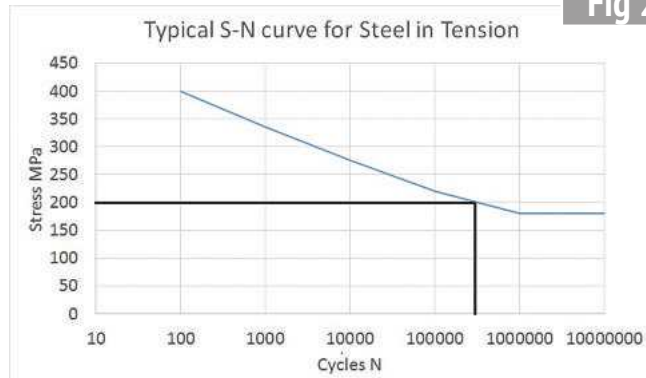


Fig 2



S-N curve for low alloy steel in tension – stress cycling symmetrically about zero stress

below 180 MPa then the part should not be susceptible to fatigue failure.

Miner's cumulative damage rule

In practice the stress on a part or product is seldom if ever constant, so a way of finding the fatigue life is required. A common way is Miner's cumulative damage rule where the fatigue life of every damage causing stress is evaluated and fatigue life found for that stress. The number of stress cycles at that stress are then determined and all the data for that part are substituted into the following formula. If the answer is less than one, fatigue failure is not expected. If the answer is one or more then a fatigue failure is expected very soon if it has not already occurred.

Miner's cumulative damage rule is defined as follows:

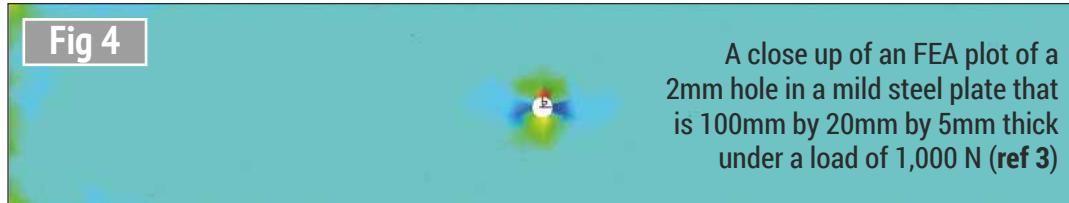
$$\frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} + \dots = C$$
 where n = the number of cycles of a particular type actually done,

N = the number of cycles of the same type to break it,

C = fraction of life consumed
 Note: if $C < 1$ the part in question still has some useful life.

Consider the following example:
 Based on the S-N curve in figure 2 if there are 100,000 cycles at 200 MPa and 1,000 at

Fig 4



A close up of an FEA plot of a 2mm hole in a mild steel plate that is 100mm by 20mm by 5mm thick under a load of 1,000 N (ref 3)

275 MPa is failure expected? The fatigue life at 275 MPa is 10,000 cycles based on fig 2. Miner's rule is therefore:

$$100,000/300,000 + 1,000 / 10,000 = 0.43$$

A fatigue failure is not expected as the result of the Miner's rule calculation is less than 1.

If the stress is not symmetrical about zero then a Goodman diagram is a common method to convert the data to be used in conjunction with a normal S-N curve. A Goodman's diagram determines what is known as the mean stress equivalent and this stress is used in exactly the same way as the stress in fig 2. (Construction of a Goodman diagram is beyond the scope of this article.) However, I do have an Excel spreadsheet that calculates the mean stress equivalent and this can be obtained from me via the *Model Engineer* website. My ID is 'Robert Walker 6'.

Common causes of premature fatigue failure

The above calculation appears simple so what is the problem? Almost too many to list but the most likely cause of premature

failure is a 'stress raiser'. Almost any change in shape from a straight bar with a good finish can cause a stress raiser which in a small area can increase the stress around that imperfection. For example, a small hole on a large plate can increase the stress by a factor of 3. **Figure 3** shows a stress plot carried out with a computer program widely used in industry call Finite Element Analysis or FEA. (A detailed discussion of FEA would need to be another article.) This is the type of software that the P2 project is using to prevent a crank axle failure on the new P2 locomotive *Prince of Wales*. For the purposes of this article, red areas are high stress progressing through to blue like a rainbow. The plate shown in **fig 4** is fixed to an

immovable feature and pulled to the left by a force of 1000 N.

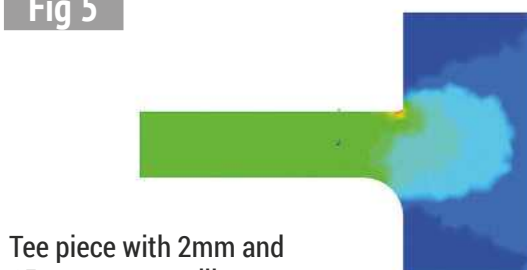
The pale green shows the nominal stress of 10 Nmm^{-2} as calculated using the above method.

$$\text{Stress} = 1,000 / (20 \times 5) = 10 \text{ Nmm}^{-2}$$

In the plot shown the stress around the hole is about 15 Nmm^{-2} (15 MPa). If this stress raiser is not taken into account, then metal fatigue is very likely. Other common causes of stress raisers are manufacturing faults e.g. defects in welds, or overloads from misuse.

A sharp corner will have a similar stress raiser. **Figure 5** shows a tee shaped part with a 2 mm corner radius on one corner and the opposite corner

Fig 5



Tee piece with 2mm and 15mm corner radii

a 15 mm radius. This clearly shows that the small radius has much greater stress than the 15 mm radius and why a well-designed part has nice following curves. Again, the right hand side of the tee piece is fixed and the small end of the tee pulled to the left.

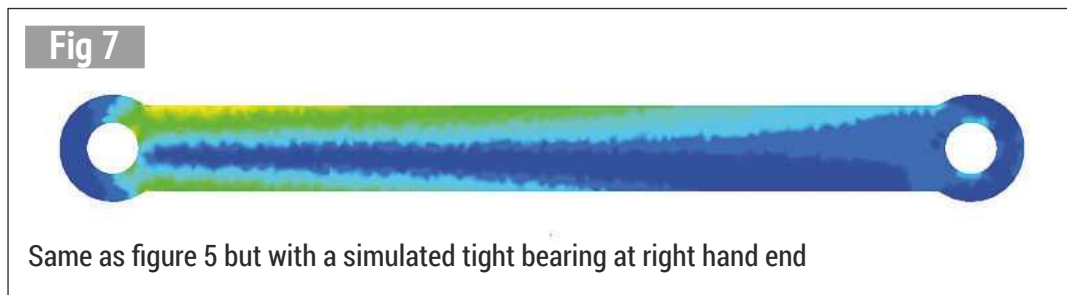
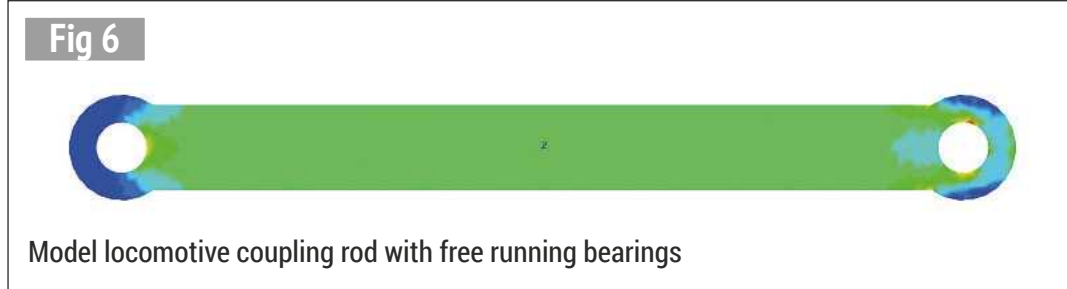
Another insidious problem that can lead to metal fatigue is bearing failure, where the increased friction results in a bending stress (or moment as it is known on a part like a coupling rod). **Figure 6** shows a typical model locomotive connecting rod with a free running bearing and **fig 7** shows the same rod with a significant increase in friction. This increase in friction, increasing the stress in a brake rod, was the cause of the Markham Colliery disaster in 1973, which killed 18 miners.

As can be seen there is an increased stress in the coupling rod shown in fig 7 when compared with fig 6 (inaccurate quartering will have a similar increase stress). This unexpected stress increase can often result in a crack at a high stress point. Once a crack has formed it acts as a stress raiser and the crack grows slowly through the metal often but not always leaving ripples in the surface, as can be seen in photo 1. The crack advances a small amount as every time a tensile stress is applied that is above the critical value.

It must be remembered that the crack is very sharp and the



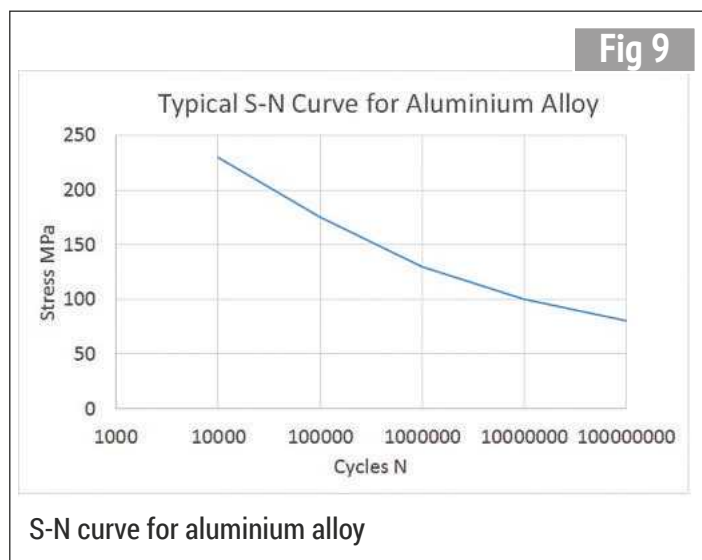
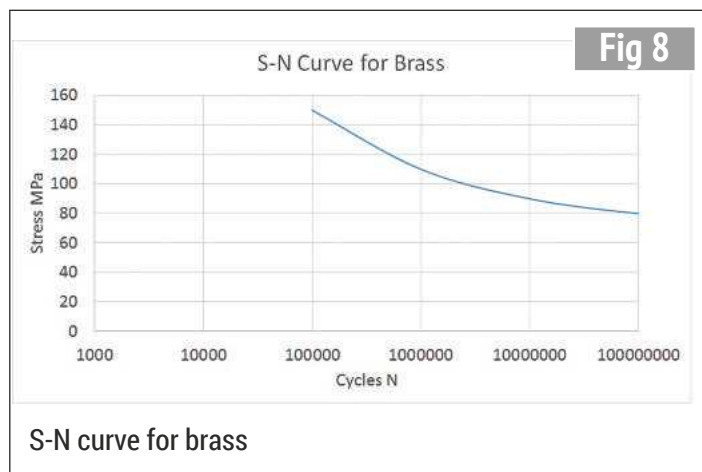
SEM photo of a fatigue fracture surface - the dimension is across two striations. Magnification 6450 times. (Photo taken at Anglia Ruskin University when I worked there.)



stress raiser is very large. How large depends on the material - a ductile material tends to blunt the crack whereas a brittle material tends not to significantly blunt the crack tip. The amount a crack grows depends not only on the metal but also on the stress. The crack will grow by a large amount each high stress cycle and a smaller amount for lower stresses. The crack growth is measured in microns and each time it grows it leaves a small ripple known as a striation. These striations are so small they can only be seen under a scanning electron microscope - an optical microscope does not have the magnification and depth of field to resolve such detail. **Photograph 2** shows the fatigue fracture surface on an aluminium specimen, fatigued to failure on a test machine. The dimension on the photograph shows the size of a pair of striations. Other striations can be clearly seen.

Larger ripples on the fracture surface known as beach marks can often be seen with the naked eye and are caused by variations in the load cycle that occur in normal service. If beach marks are present it is a clear sign of metal fatigue but they are not always present if the loads are consistent as on a test machine.

When the crack has penetrated to a point where the remaining metal cannot



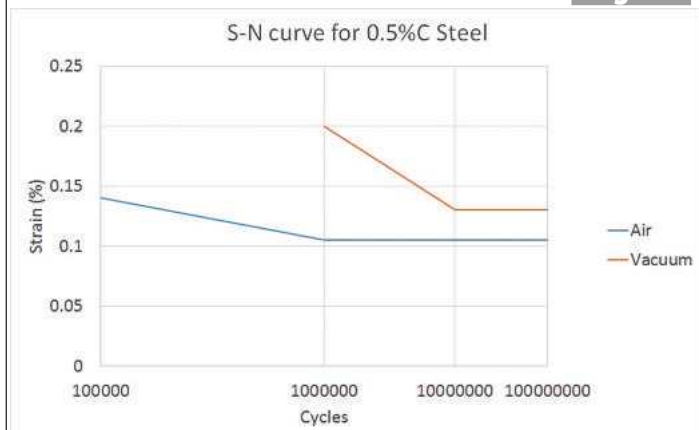
carry the load applied then the part breaks, rapidly.

Nonferrous metals and stainless steels do not have a fatigue limit like mild steel and low alloy steel, and they always eventually fail by metal

fatigue even if it takes many millions of cycles. See **fig 8** for the S-N curve for brass and **fig 9** for aluminium.

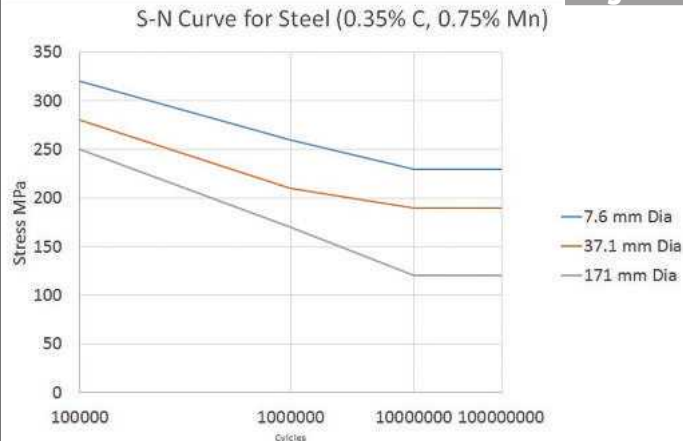
The environment in which the part operates has a significant effect on fatigue life

Fig 10



S-N curve for steel in air and a vacuum (ref 4)

Fig 11



S-N curve for steel for various diameters (ref 4)

(fig 10). Oxygen and moisture in the atmosphere reduce fatigue life for all metals and alloys by between 5 and 15%. Other factors that affect fatigue life of a part include seawater (even just nearby will reduce fatigue life) and poor surface finish, as there tends to be many sharp surface defects that can become crack initiation sites. Cut threads also reduce fatigue life, although rolled threads do not reduce fatigue life due to improved surface finish and compressive residual stress.

It must be assumed that unless stated otherwise the S-N curves are compiled in lab conditions and unless the expected operating environment is similar to lab conditions the published S-N curves must be considered an over estimate of fatigue life.

If that is not complex enough then the size of the section carrying the load also has an effect on fatigue life. Small sections have a longer fatigue life than large sections under the same stress - see fig 11. This complexity may be significant for the model engineer when scaling down load bearing parts that are expected to have a long service life.

Except where referenced, the data used to construct the S-N curves are taken from the internet and are for illustrative purposes and should not be used in practical applications.

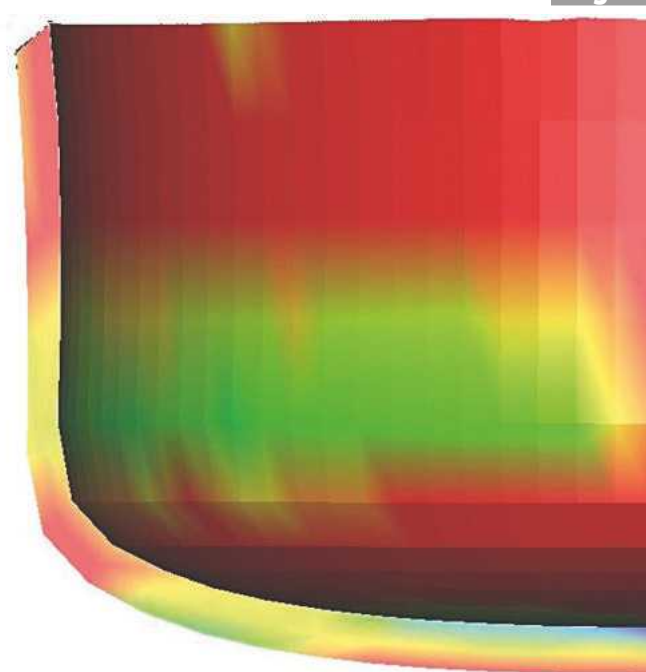
Extending component life

To reduce the likelihood of a fatigue failure, the following design or manufacturing decisions should be made:

- * No sharp corners to reduce stress concentrations.
- * Good surface finish.
- * Anneal cold worked parts to remove residual stresses from cold working.
- * Shot blasting puts the surface into a compressive stress when the part is unloaded, hence raises the allowable stress before fatigue is expected.
- * Case hardened steel parts also have a compressive stress in the surface as hardened steel is bigger than steel in its normalised state.
- * Roll threads.
- * Ensure welds and solder joints are defect free.
- * Inspect parts at regular intervals and replace them when necessary - the intervals may need to be calculated using the above methods.

Figure 12 shows what is known in material science as residual stress but to model engineers is commonly known as work hardening, where the internal stress within the part becomes so great that it cannot be safely be deformed any further. However, in service an additional stress can lead to premature fatigue failure or if the part is brass and

Fig 12



Residual stress in a pressed brass cup prior to annealing (ref 5)

exposed to ammonia stress corrosion cracking may occur.

Perhaps the most important and most difficult is to know

the stress expected in service and to design the parts to carry that stress safely.

ME

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2. Engineers' Data Book, I MechE, Wiley ISBN 978-0-47002-698-4.
3. FEA package Z88 Aurora.
4. Open University Unit T351 9B.
5. FEA package LS-Dyna (carried out when I worked at Anglia Ruskin University).

Geoff Theasby reports on the latest news from the Clubs.



The flooring in my workshop is beginning to sag in places. It was laid by a previous occupant who made sure that every expense was spared, to the extent that the edges of the chipboard sheets are unsupported in places and are now giving way. So, I am covering the floor with quality plywood before I fall or a deep mineshaft is revealed... It also enables me to hide, should I accept this mission, bottles of gin, extraneous cash, rare components or other items.*

Further to comments regarding digital readouts on equipment (M.E. 4626 and 4631) I read an item in the RSGB's magazine *RadCom* (page 46, March) on the subject, initially regarding a personal cross-trainer. It took the form: how accurate is the weighing machine? Is it compared with a standard? When was it last checked? And so on. In engineering similar



Another view of NZ locomotive Prof Fate (photo courtesy of Murray Lane).

provisions apply. That handy 150 mm rule, for instance. It is probably steel, which expands in heat, so what is the ambient and at what temperature was its production machinery calibrated? When was it last checked and against what? If a digital caliper shows 3.51 mm, is the readout true to the measuring jaws, when were they last physically checked for shape, parallelism and flatness,

is the battery in good health?

I built a rolling road for my 5 inch gauge battery locomotive. I also designed and built a control box, as the cheap module I previously used immolated itself, possibly because of a too-small heatsink. Anyway, a rolling road couldn't be simpler. Two lengths of aluminium angle, for which I bought one meter (a yard of Al...) eight M6 screws and nuts, eight bearings (I used 6 x 13 x 5 flanged but they really need to be bigger. 6 x 19 x 6 appears to be the biggest easily available for a 6 mm bore). Hold the angles together with a couple of lengths of M6 studding, with nuts inside and out, and Hey Presto! A rolling road. Some form of fore-and-aft restraint is necessary, so I used a turnbuckle from a model racing car, from www.zdhobby.com. Not only does one end have a left-hand thread, unlike two track rod ends joined by a threaded rod, but the ball ends are threaded M3 so they are easily fitted and removed. I mounted mine on one of the frames, as on a rail vehicle, there is no asymmetric thrust (unlike the case of an engine failure in an aircraft with wing-mounted engines) so such a restraint could reasonably be at one side and indeed works well.

In this issue: Tamping, a young enthusiast, floods x 2, a mystery machine, soup, a Men's Shed testimonial, and a Swiss Role.

The photos... Firstly, another shot of Greg Burrows'



An SYTM interloper, a 'Green Archer' radar.

competition entry at the Hamilton, NZ, convention. (photo 1). On a recent visit to South Yorkshire Transport Museum, this distinctly un-transport-related item, a 'Green Archer' X-Band mortar locating radar, aroused my interest (photo 2). Well, its mobile... Hiding next to a pile of ammo boxes was this part-built Series 1 Land Rover model (photo 3).

Steam Whistle, January, from **Sheffield & District Society of Model and Experimental Engineers** is unusually printed on glossy paper and looks very well. James Ardin tells of working on the VolkerRail tamper in November, passing the club track which is only across the road from the railway line behind a row of houses, as they tamped Dore triangle. Getting home to Doncaster was a problem, as there was flooding on several routes and the driver had not 'signed off' several of the remainder. A route was eventually found via Hemsworth. In February, he spoke to the club on tampers and their work. Alan Cooper writes on rebuilding *Ella*. Built by editor Mick Savage in 1991, it needed some TLC and, in the process, the driving wheels were pressed off, needing 4.2 tons to separate! They had been fixed with high strength Loctite and Alan made a test piece using type 603 and assembled the bits according to the instructions. It was then tested to failure, which occurred at 3.5 tons with a loud 'Bang'. More tests will follow. **W. www.sheffieldmodelengineers.com**

Raising Steam, January, from the **Steam Apprentices Club** of the National Traction Engine Trust is another massive publication to set readers up for the year ahead. The Club's 40th celebrations went very well, and they visited Aberdeen and Dorset, and points in between. Jim Huntley had a ride on a traction engine at the age of three and was hooked! The family encouraged his interest and books etc. followed. He ran Mamod rallies in the



Miniature battery powered car styled after the Series 1 Land Rover.

garden until a halt was called when visitor numbers reached 100... Patrick Tonks took an apprentice on his Foster, 4nhp, *Olive*, to the Great Dorset Steam Fair in 2019. After a shy start, the lad began to open up. I'll call him Oliver, because that's his name. He quickly showed how much he knew about steam power. Patrick has since learned that Oliver's family have now bought a 4 inch scale traction engine. Several other items written by apprentices also appear.

W. www.ntet.co.uk/sac

The Frimley Flier, February, from **Frimley and Ascot Locomotive Club**, says they have a Fan Club! Every Wednesday, they are visited by two ladies, Eve and Paula, who watch the proceedings from a bench dedicated to the memory of Paula's husband. They recently presented the club with a box of biscuits. Peter Gardner regales us with an item entitled 'A brief history of train detection' or, Plan A to E and back to C. This began with products from Maplin. It worked but electronics guru

Brian Atwell decided to design his own system, which is just as well, since the old Maplin is no more. (It has ceased to be...)

W. www.flmr.org

The Link, February, from **Model Engineers' Society, (NI)** has Brian Patton preparing a chart of screw threads comparing the M.E. threads, US usage, and BA drilling and tapping sizes, and reminds us that ALL threaded holes should be begun with a taper tap and finished with a plug tap. This minimizes breakages.

W. www.mesni.co.uk

Hereford Society of Model Engineers, sends *Whistlestop*, winter, in which the bridge, underwater during the Hallowe'en flooding, is featured, entitled, 'Bridge under the River Wye'. Ho Ho, very good! The water reached a height of six feet and rescue teams began work on the locomotives, rolling stock and furnishings three days later. A flood drainage scheme was agreed with Welsh Water and storm drain pipes donated by Lewis Contractors were delivered in a week. John

Arrowsmith reports on the Midlands Model Exhibition, including the fact that the Society won First Prize in the Club Display competition. For the second time! Two of their Young Engineers won three awards between them, two Seconds and a VHC. One exhibit caused editor Martin Burgess some confusion, as he cannot recall what it was. Well! I can only say that from the photograph it appears to be a steam powered, tandem, double-acting 'Thing o' Purpose'. Martin had more success at the 7¼ inch gauge society AGM at Newport, in which he correctly identified Cuprinol Shed of the Year, suitably assisted by a large plaque thereon. Richard Donovan writes on the unique Newcomen engine at Elsecar, near Barnsley. Matthew (Young Engineer) and (Dad) Peter, write Part Two of 'Building a Riding Truck'. A nice touch on the final page is the oft-unphotographed rear view of a locomotive, namely the departing LNER B12, 8572.

W. www.hsme.co.uk

The Centurion Smokebox, February, from **Centurion Society of Model Engineers**, reports on the continuing clean up after the floods. The AGM is imminent and therefore there is not much room for other items. Michael Heyckelhof has been working on his Simplex. It is quite a large locomotive, measured from side to side - it is three feet long and two feet wide. I don't know if it is a 'namer' but I suggest it should be renamed *Wordsworth*. (Think about it...) Editor Jon Shaw visited NZ and the Museum of Transport and Technology in Auckland. Not too many cars (Hawkes Bay is the museum for them - Geoff) but 'standard' and four foot gauge trams, and three foot six inch gauge railways, including a colourfully lined Avonside locomotive (photo 4).

W. www.centuriontrains.com

The Lobby, winter, is the Journal of **Brighton and Hove Society of Miniature Locomotive Engineers**, which has been in Hove Park since

1951. After the recent AGM they elected the youngest Hon. Sec. in the club's history. Luke Parris is 17. Well done sir! For the last meeting of 2019, the speaker was John Chisholm, whose hobby is collecting postcards. Not the ones familiar to ferroequinologists but those produced for many years by Bamfirths of Holmfirth. Attendance at the Saturday working parties has increased to the point where the soup pan runneth over, so the committee has authorised the purchase of a 'Dreadnought' pan (splendid name – Geoff) and wonder if they need to book a weekly soup tanker to keep it full. (Watch out for Clangers... - Geoff) John Coleman provides several workshop tips which he has found useful. Mike Norfolk built a B1 25 years ago and has been driving it ever since. Now his back is feeling the strain of reaching over the tender to adjust the controls so he is converting it to a 4-6-4 Baltic tank, which should be easier to drive.

W. www.hoveparkrailway.com

I received a letter from a reader, which I was interested

to see was very well and legibly scripted, in contrast to all other correspondence from builders to editors, which are word processed or e-mailed. My handwriting has always been consistently awful, which is why I adopted keyboard input (typewriter, Psion organiser, word processor) as soon as I could. Thank you, sir, I appreciate it.

My second visit to the Sheffield SMEE track 'with my little locomotive in my hand' resulted in forward movement, all the way round the raised track to the point of repair, and back, in reverse, on a wet rail. Go me (photo 5)!

A long term friend in Leeds tells me that he has joined his local Men's Shed. I was pleased at this as he will fit right in, although he has horrified the exacting craftsmen there by excessive reliance on his angle grinder to shape metal objects. "Bodge some sense into it" he says, claiming he can make a component by this means whilst the above gentlemen are still selecting their files. He says they are a great bunch of people and recommends



Walking the dog? (Photo courtesy of Deborah Theasby)



Avonside tank locomotive at MOTAT (photo courtesy of David Shaw).

the Shed movement wholeheartedly.

On Track, February, from **Richmond Hill Live Steamers**, brings several YouTube videos to our attention. Mostly they are steam railway related as is fit and proper in our hobby. A couple though deserve closer attention: www.youtube.com/watch?v=i_MMLLksONG tells the story of a US City almost abandoned by industry and how it turned its fortunes around. Then, www.youtube.com/watch?v=3rZKR6LkoFo is about Berne trams, featuring a city tour behind steam tram No. 12, mixing it with modern trams and other traffic. One shot featured a modern tram in the role of advertising hoarding, decorated in very large letters, *Bauhaus*. I wanted a similar model but 'Debbie' wouldn't buy me one... **

W. www.richmond-hill-live-steamers.tripod.com

As a prelude to next months' report on a visit to the National

Emergency Services Museum in Sheffield, here is Barnsley's first ambulance, of 1885 (photo 6).

Welling & District Model Engineering Society's, *Magazine* February-March, begins a series of items by Bob Underwood on 'Richard Trevithick, the man, the legend, and the myths'. Another series on London's railway manufactories, by editor Tony Riley starts with ten pages on Braithwaite and Ericsson.

W. www.wdmes.co.uk

*And finally, how many corpses does it take to change a lightbulb? Well, not 6, because my cellar is still dark...

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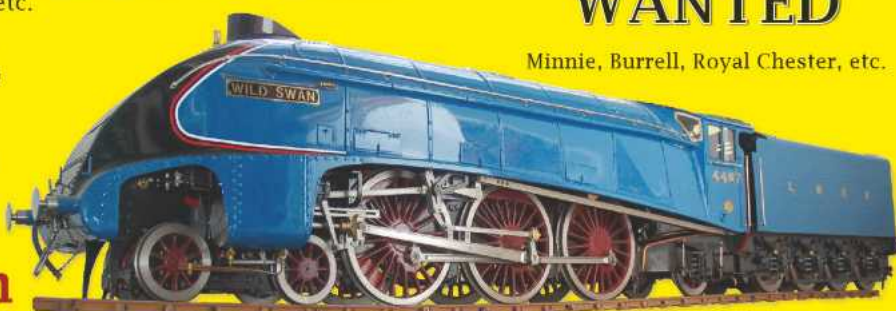
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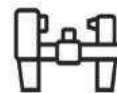
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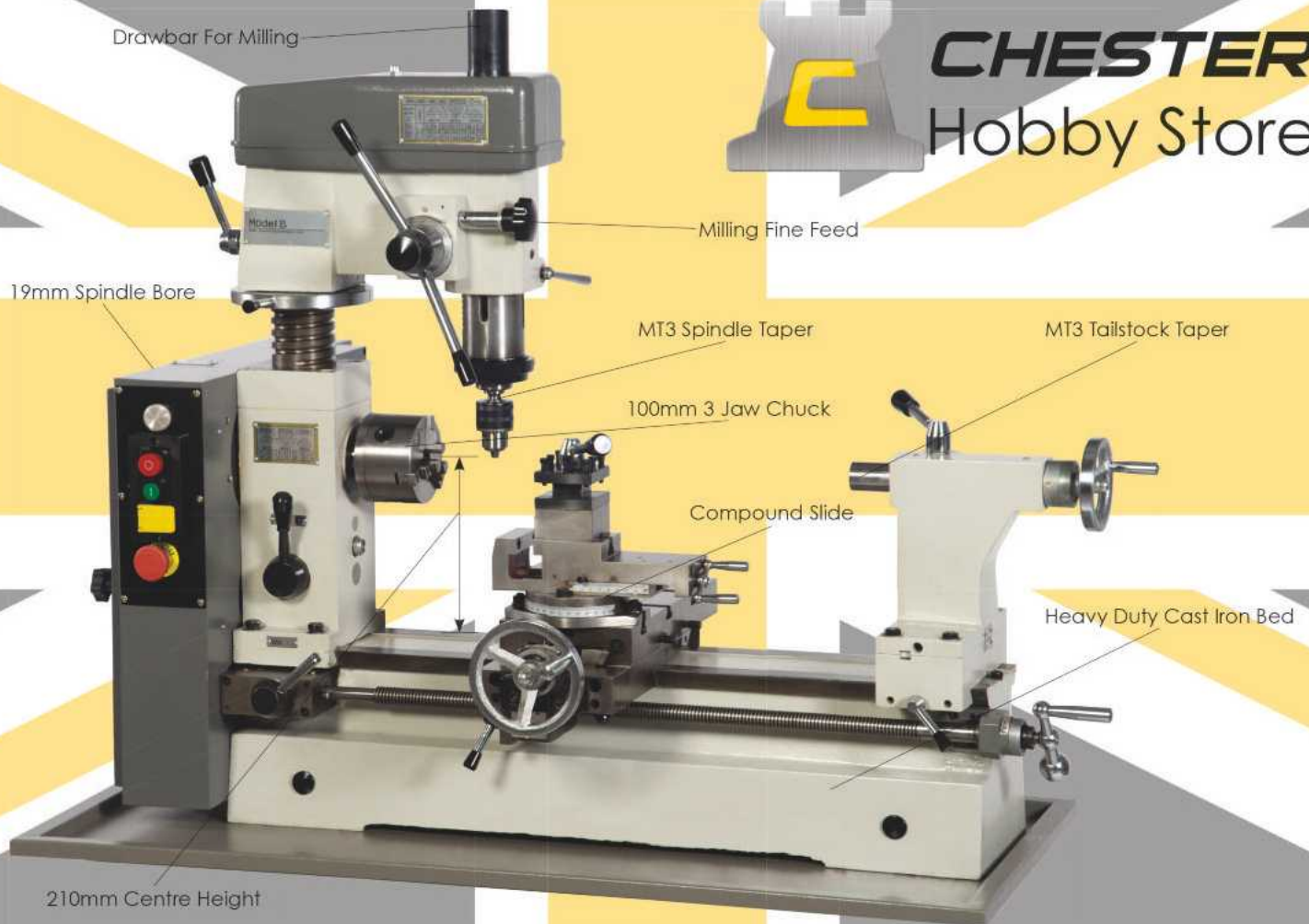
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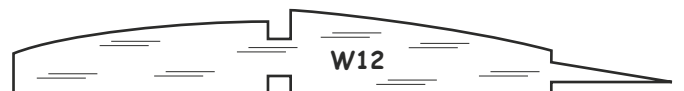
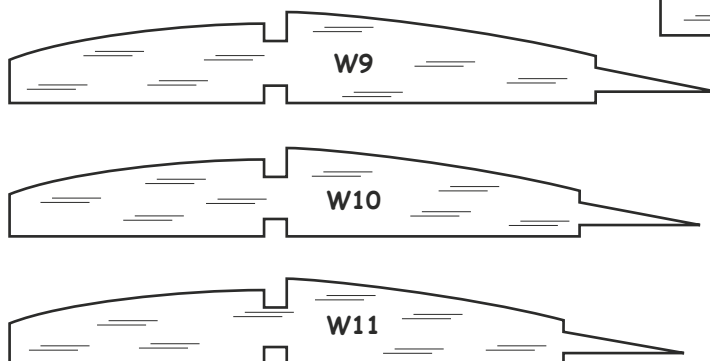
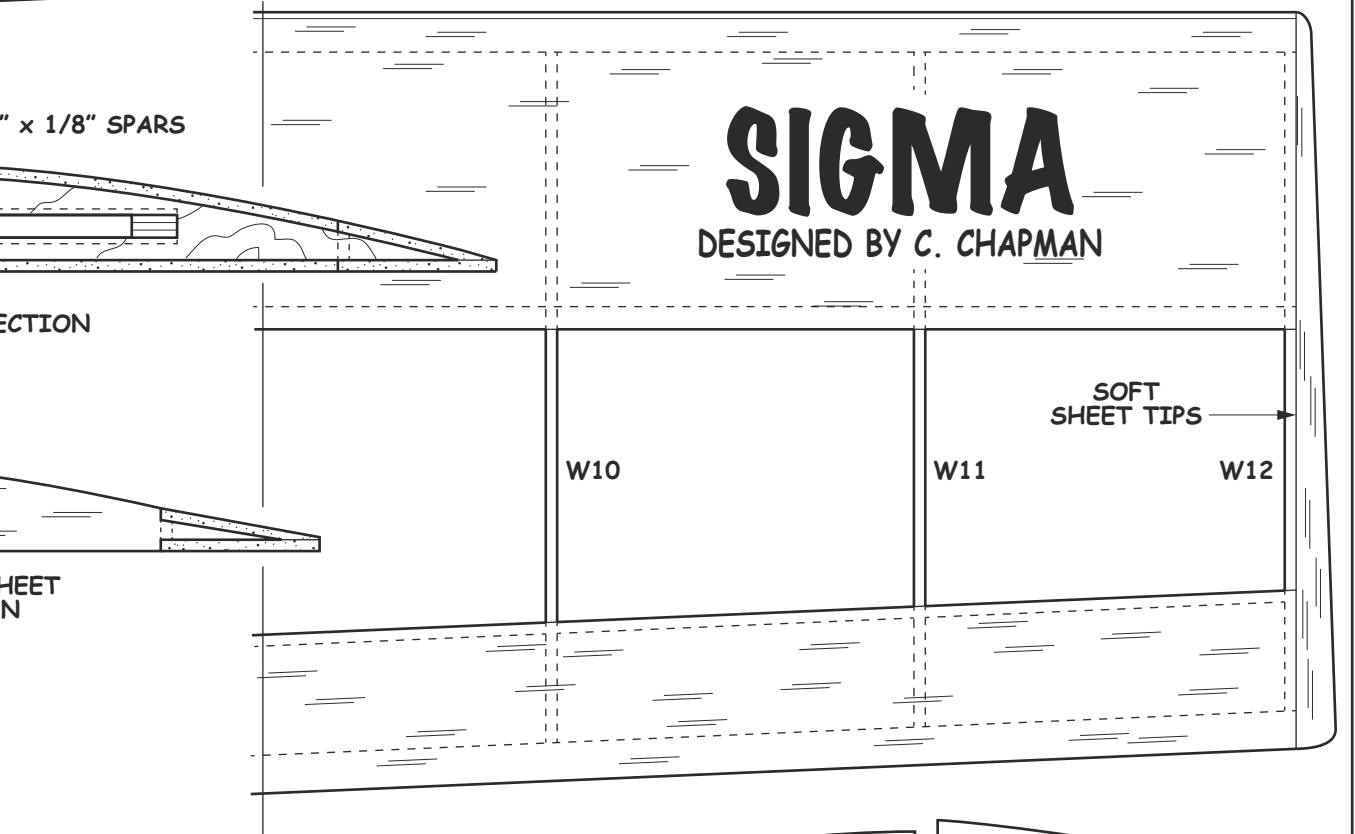
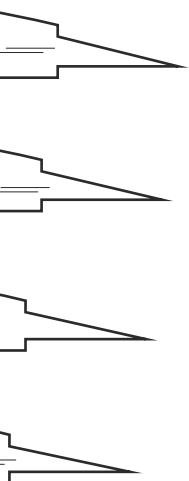
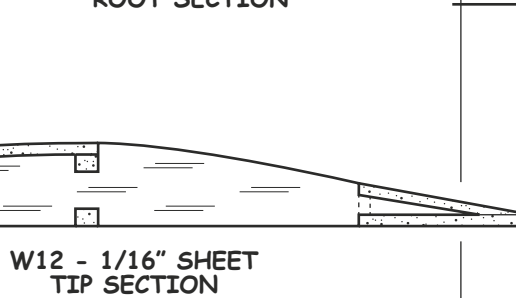
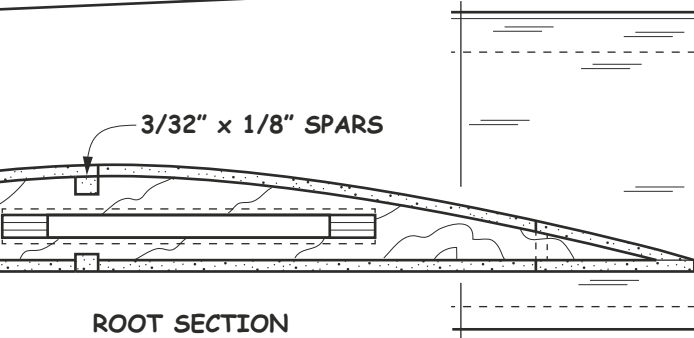
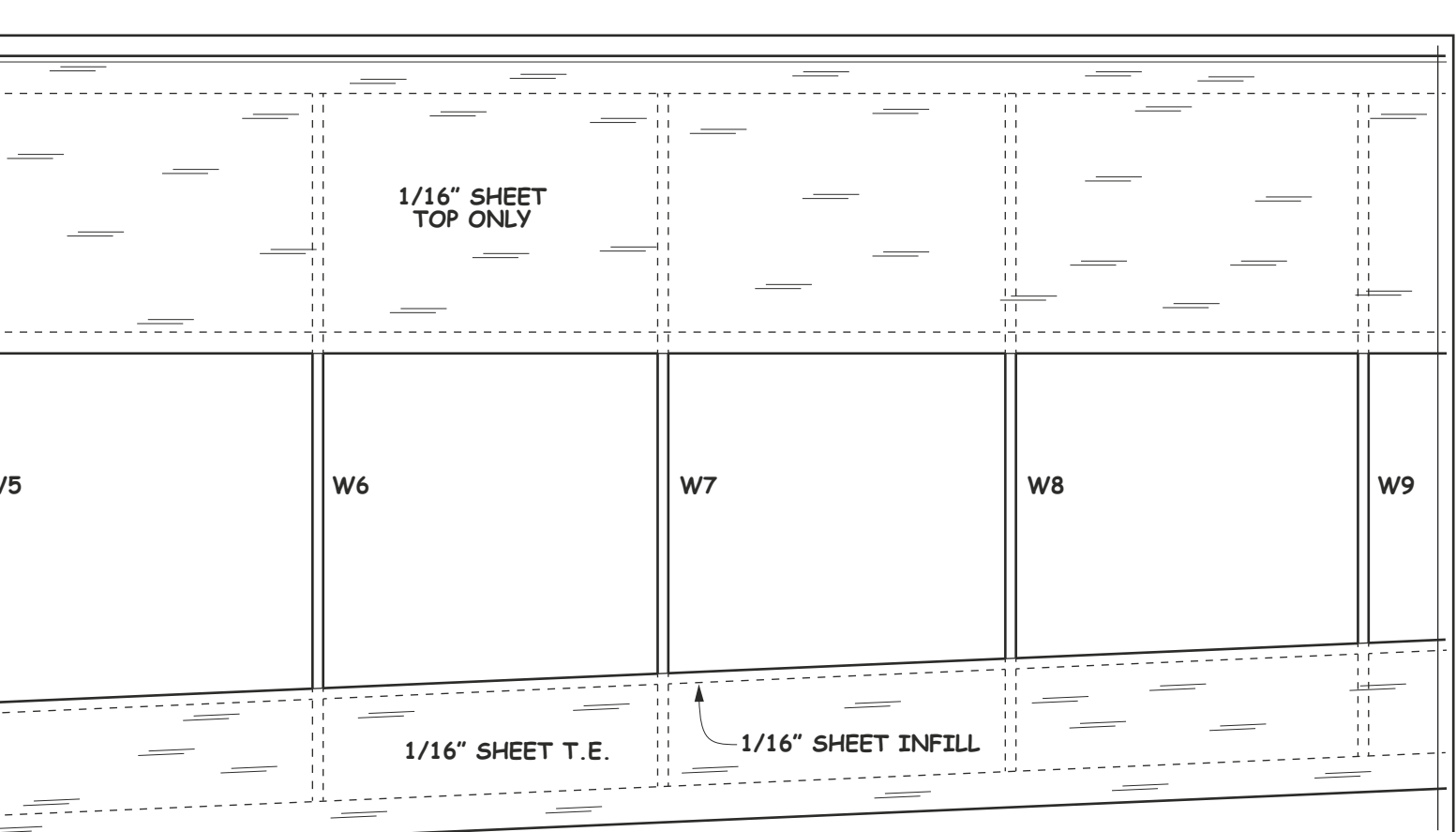
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- MT3 steel centres
- 1-13mm drill chuck and arbor
- Drawbar for milling head
- Dual purpose compound
- Machine vice
- Change gears
- Set of 5 carbide lathe tools
- Allen keys
- Spanners
- NVR switch gear
- 4 position indexing tool post
- Lathe chuck and drill chuck guards
- Manual and parts list

Centre Height	210mm
Swing Over Bed	420mm
Swing Over Cross-slide	130mm
Between Centres	520mm
Width of V Bed	139mm
Tool Size	12mm
Spindle Bore	20mm
Spindle Taper	MT3
Spindle Speeds	Lathe:160-1360rpm Mill:117-1300rpm
Metric Threads	0.2-3mm
Imperial Threads	8-120TPI
Copound Slide Travel	80mm
Cross-slide Travel	185mm
Tailstock Quill Travel	80mm
Tailstock Taper	MT3
Headstock Bearing	Tapered roller
Max. Swivel of Compound Slide	360°
Longitudinal Leadscrew Pitch	4mm
Cross-slide Leadscrew Pitch	3mm
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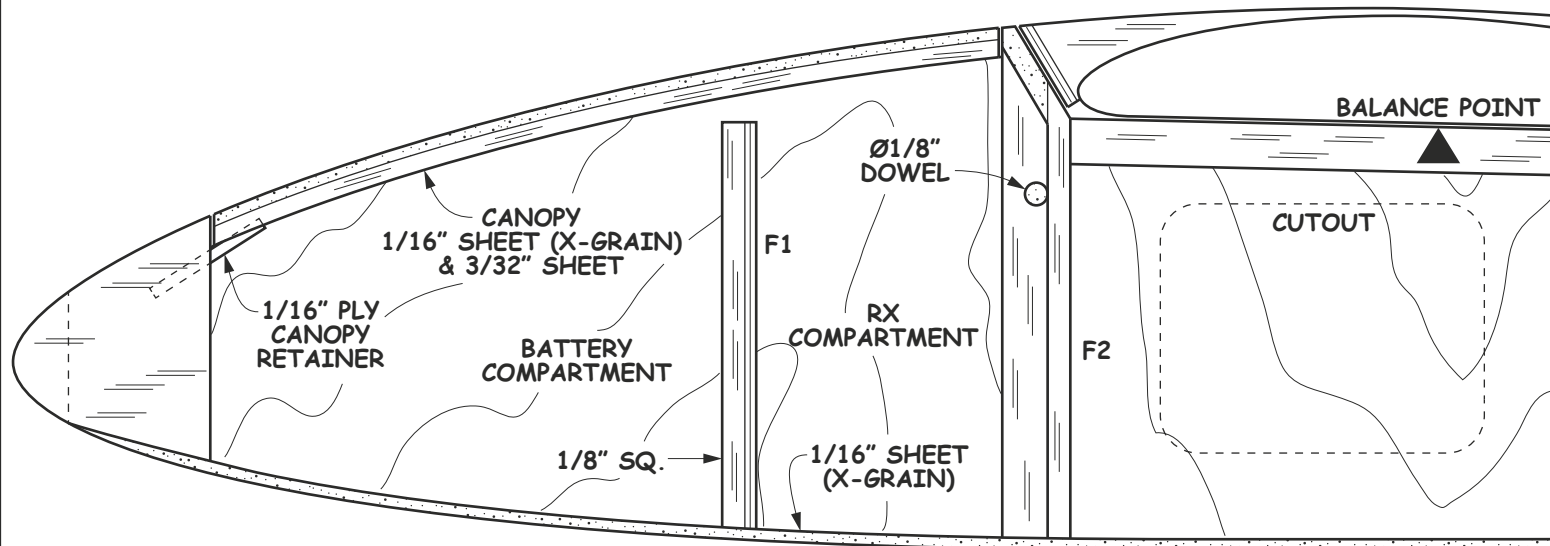
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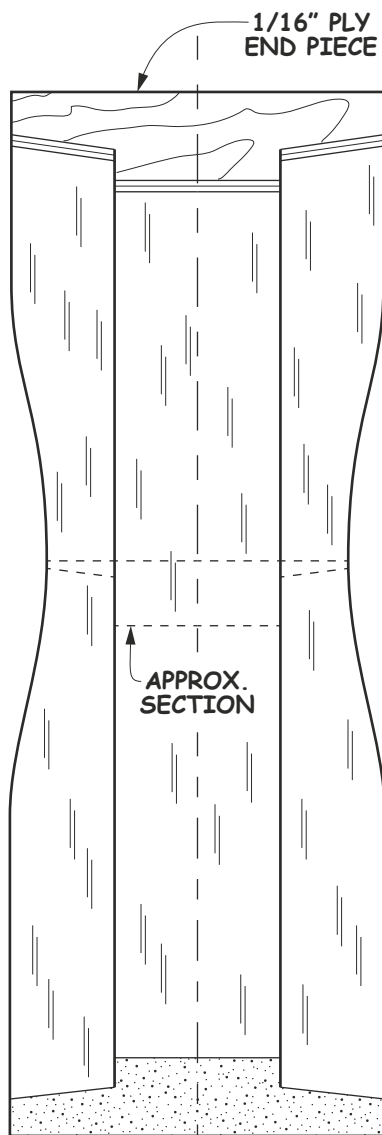
- 3 OFF 1/16" x 3" x 36" MED. SHEET BALSA
- 2 OFF 3/32" x 3" x 36" MED. SHEET BALSA
- 1 OFF 1/8" x 3" x 36" HARD SHEET BALSA
- 2 OFF 1/4" x 1/4" x 36" MED. STRIP BALSA
- 1 OFF 1/8" x 1/8" x 9" SPRUCE
- 4 OFF 3/32" x 1/8" x 36" MED. STRIP BALSA
- 1 OFF 1/8" x 1/8" x 36" MED. STRIP BALSA
- 1 PIECE 1/32" x 12" x 12" PLYWOOD
- 1 PIECE 1/16" x 6" x 6" PLYWOOD
- 1 PIECE Ø1/8" x 9" DOWEL



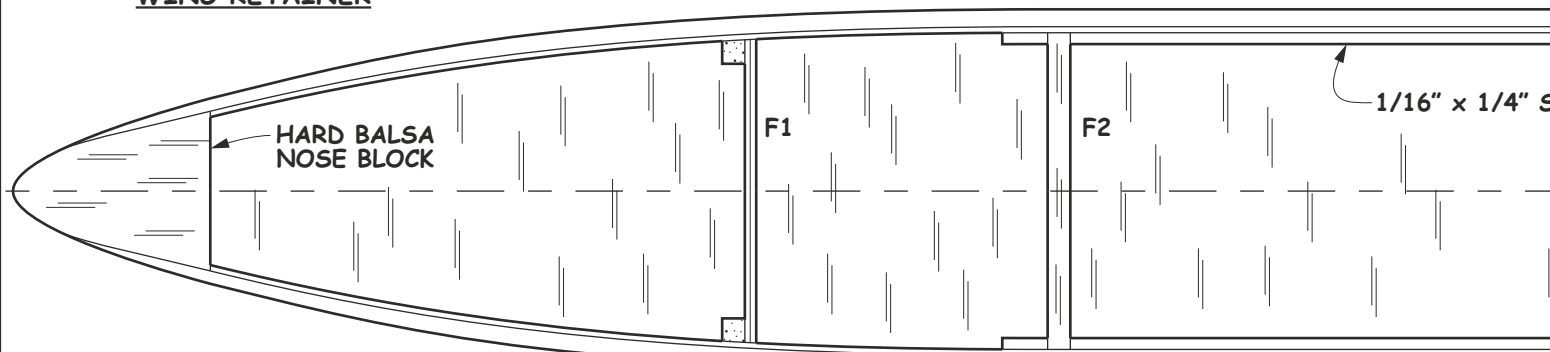
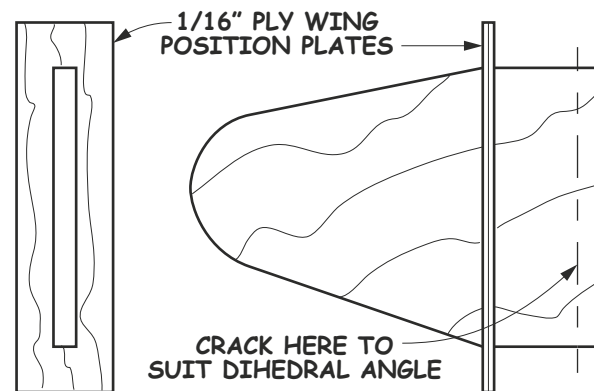
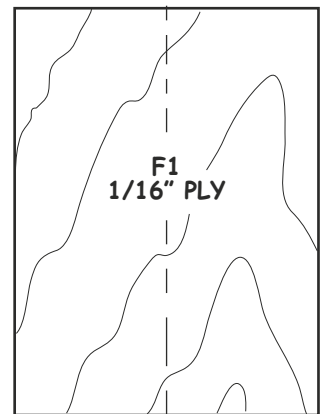
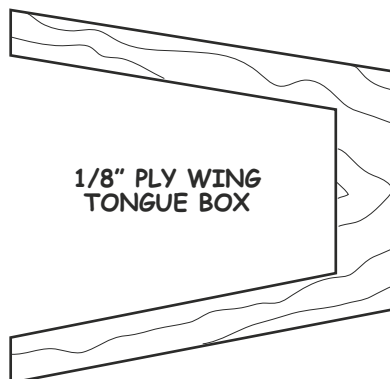
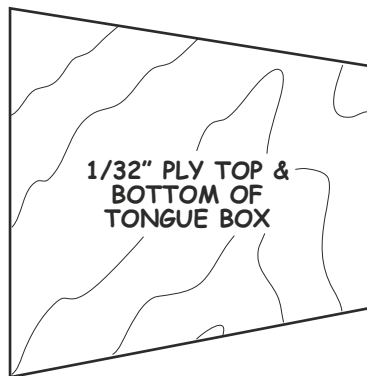
A 45" SPAN R/C GLIDER

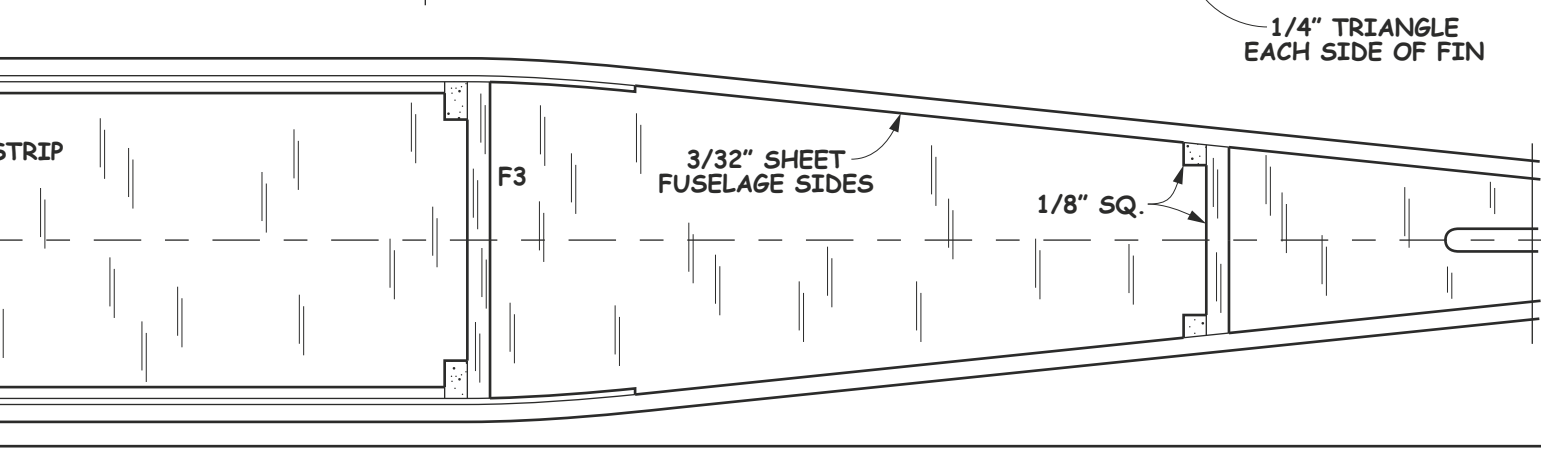
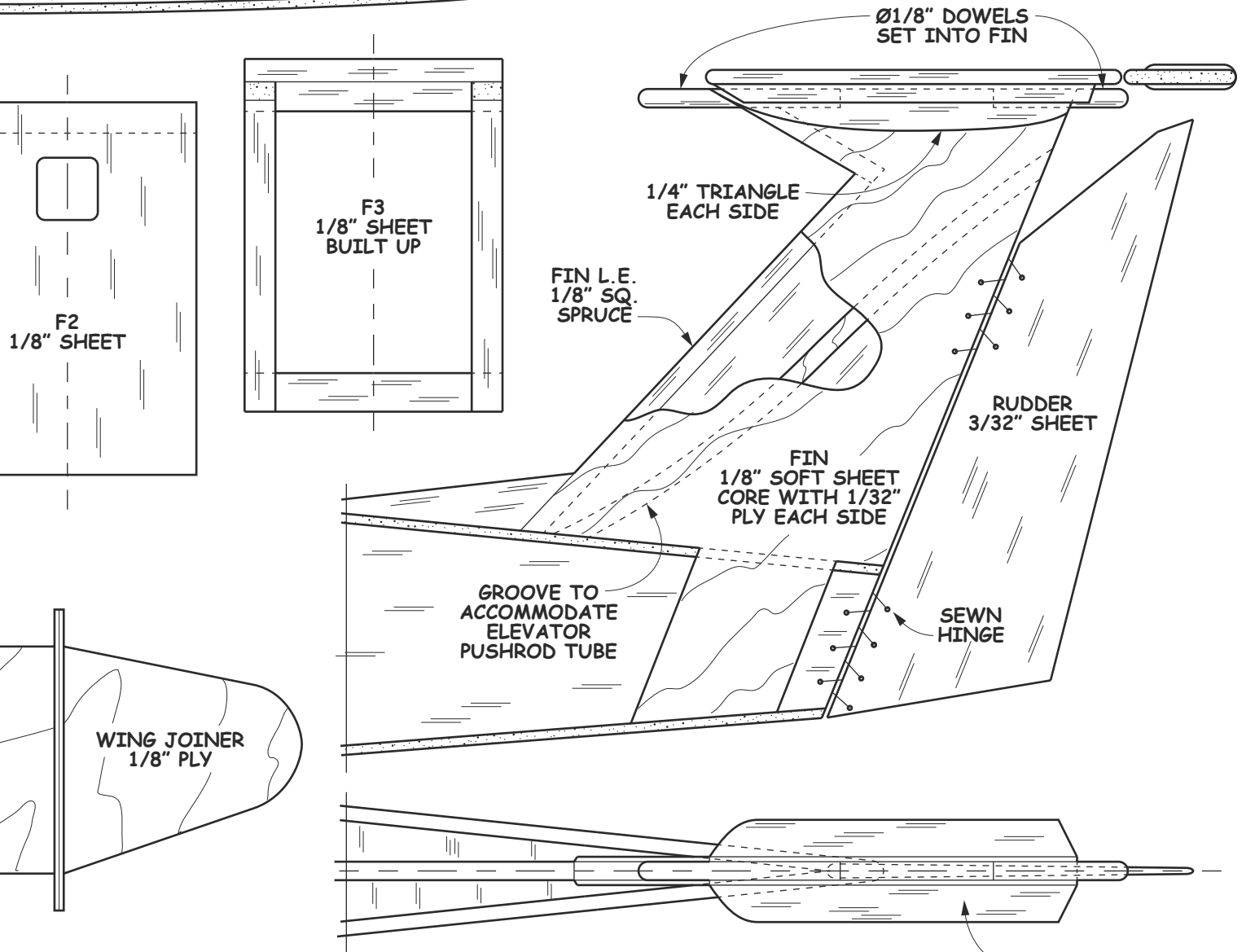
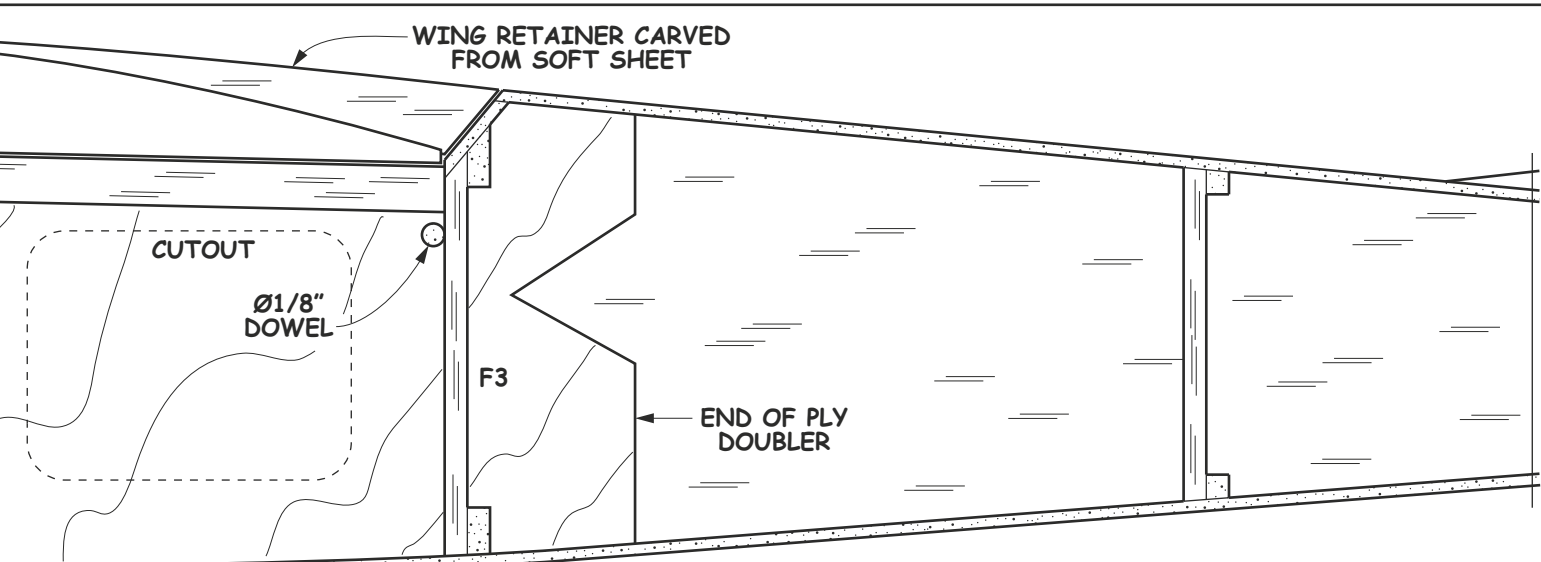
SIGMA

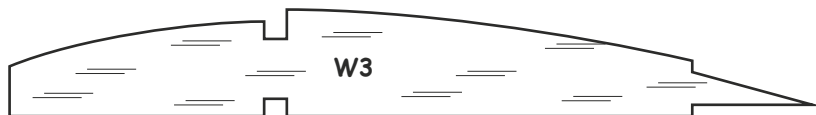
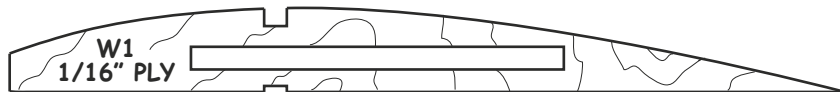
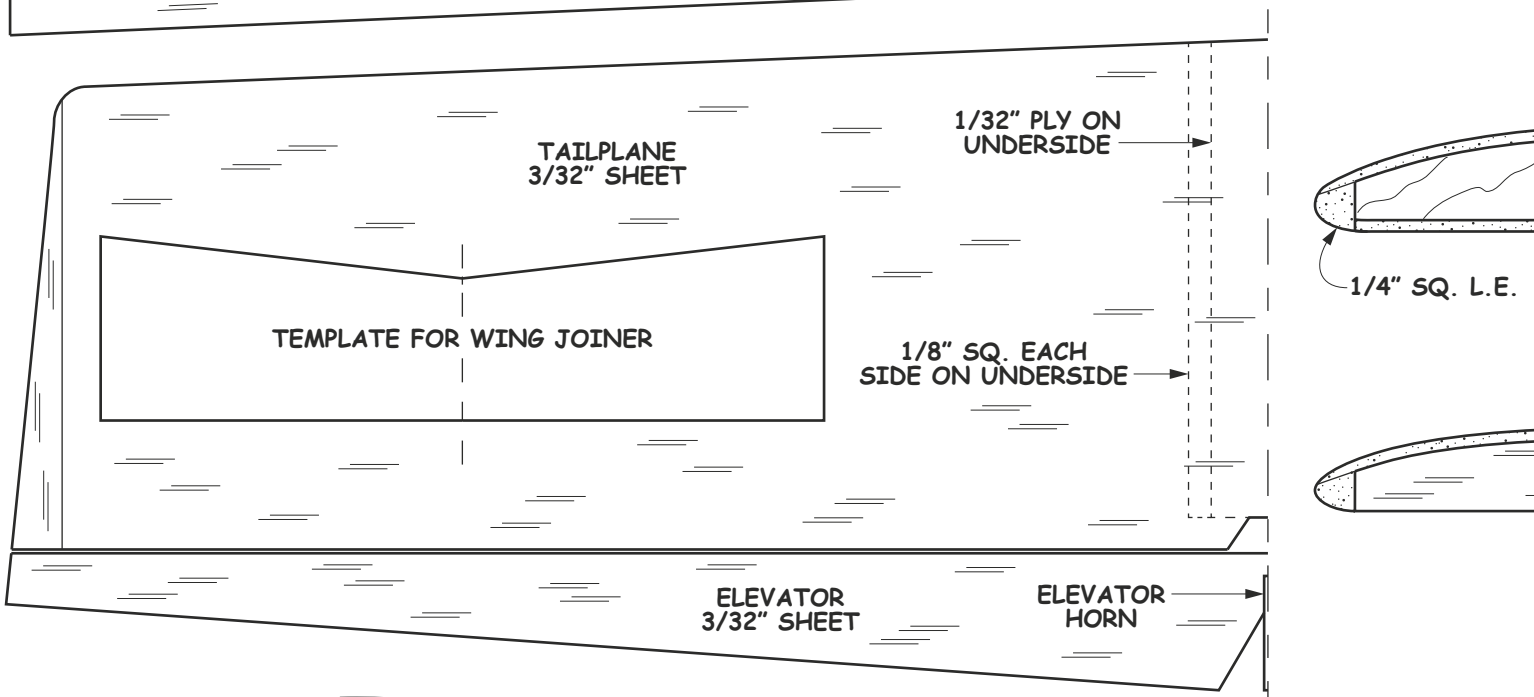
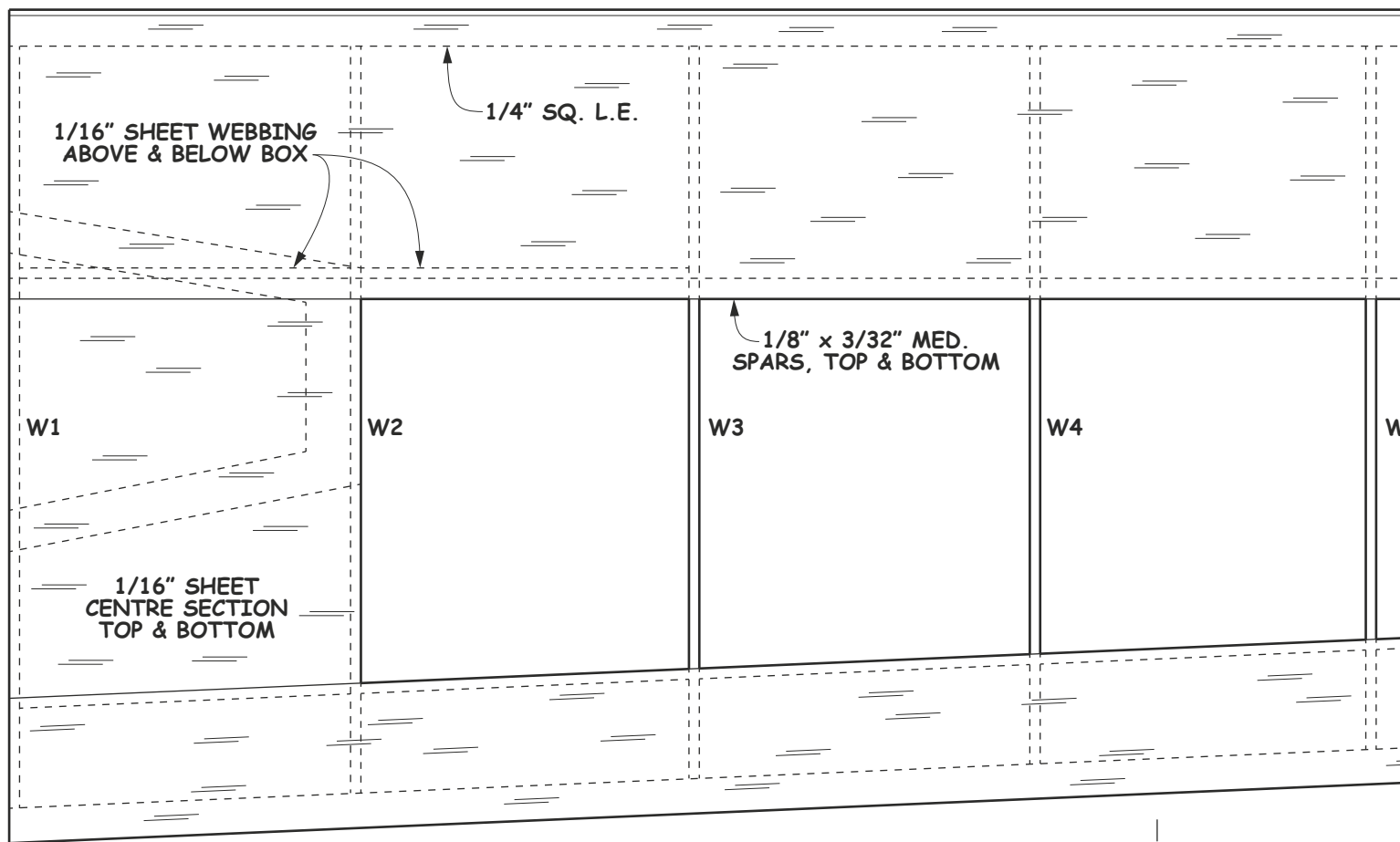
DESIGNED BY C. CHAPMAN



WING RETAINER









A refurb instead of starting from scratch can be a viable option. But if it's a basket case don't bother - it will be quicker to start anew.



Although a simple piece, the wing joiner needs to be strong otherwise your pride and joy will cease to glide and emulate a brick when the wings fold!



You can see the purpose of the 1/16" ply wing position plates here. They keep the wings aligned and make a space for the soft block wing retainer to locate into.

channel slope soaring was fun it made sense to update Sigma by adding an elevator, allowing flying in a greater range of wind conditions.

Modern radio is almost microscopic in comparison to period examples but as the model featured here was recently bought along with some old but very usable 27 MHz Horizon proportional gear, the decision was made to use this to guide Sigma after the refurb. I also saw the potential to possibly add a small pylon mounted brushless motor for flat field use, as I had previously done on my Veron Impala slope soarer.

WINGS AND THINGS

First job is to make up two sets of wing ribs (R3 – R12) using medium 1/16" balsa. You could cut them individually, but the good old sandwich method will be the easiest way. R1 and R2 are shown as 1/16" marine ply but 1/8" lite ply will do as an alternative. There's nothing difficult about building the wings; the box for the ply wing tongue may be new to you but it works well. However, if you're not keen on this method then possibly just use piano wire and brass tubes instead.

Start by placing the lower 1/8" x 3/32" spar over the wing plan. Specified as balsa, I would replace these with spruce as this will add significant strength for nominal weight gain. Position the lower trailing edge and leading edge, then add ribs R1 and R2, assemble the wing tongue box, then the remaining ribs. Glue on the 1/8" x 3/32" top spar and top 1/16" trailing edge and let set. The plan shows shear webbing between R1 to R3 but again for the negligible weight gain I would continue this to R12; don't forget the 1/16" infill pieces on the trailing edge. Once dry, shape the leading edge, add the top 1/16" sheeting and wing tip. A final sanding, then do it all again for the other panel.

You'll now need to make the wing joiner from 1/8" ply, as detailed on the plan; an alternative would be aluminium or Dural. If using ply, then reinforce the dihedral crack line with a piece of bandage and epoxy. The final part of the wing is the soft balsa wing retainer, but this will need constructing after the fuselage is completed because you need to fit the wing to get the perfect shape.

The tailplane is a simple sheet affair and if you look at the relevant photo, you'll see the elevator detail. I would use medium hard 3/32" balsa and don't forget the 1/32" ply shown on the under side.

FUSELAGE

Again, nothing difficult here so start by cutting out the sides from medium 3/32" balsa; you will be able to get both out of one 3" wide sheet. Next cut and glue the 1/32" ply doublers with Aliphatic or PVA as shown, weighing down on a flat surface until dry. Now stick the 1/16" x 1/4" and 1/8" square balsa strips in place. When set glue F2 and F3, ensuring everything is square and true. Next job is to join the fuselage rear, then add F1 (a clamp will keep it in place until set) and ensure it isn't emulating a banana. Leave to dry then fix the nose block on; again a clamp will help things stay in place until firmly set. Sheet the underside of the fuselage with 1/16" med balsa. Depending on how rugged your slope is, it may be worth using 1/16" ply from the nose block back to F2. As mentioned, the ideal way to connect up the elevator is using a thin piano wire push rod in a PTFE or nylon outer tube. Tube in tube will also be fine for the rudder but to make things easier it's better to accommodate these before sheeting the fuselage top rear with 1/16" balsa. The plan also details a weight box; this was useful because it allowed you to securely add up to 6 ozs of lead to increase the wing loading when

flying single channel, as it extended the range of wind speeds you could commit aviation in. With an elevator this is less of an issue and left out on the refurbished model.

Regarding the modified fin (to accommodate an elevator push rod) it's probably simpler to look at the accompanying photo to see how it was constructed rather than describing its assembly. Originally made from 1/8" hard balsa, you can cut the new fin core from 1/8" soft balsa and skin either side with 1/32" ply after cutting a channel out for the push rod outer.

Don't forget the triangular fillets as they form the base for the tailplane. Another modification is to extend the fin post so it protrudes through the fuselage bottom; this raises the rudder from the ground so could potentially help prevent damage. If you look at my model, you'll see I've also extended the rudder to compensate for the section removed to facilitate the elevator push rod. The canopy hatch was originally made by laminating a lengthwise 3/32" balsa piece with 1/16" cross



When adding an elevator, the fin needs modifying to accommodate the pushrod outer. The final position ended up being lower than depicted here.



My elevator pushrod and horn set up. The horn was made from thin glass fibre board but 1/16" ply could also be used. I know it looks a little strange, but it works. Take your time so it is bind free.



Traditional tube in tube set up for the rudder. When modifying for an elevator the rudder area needs increasing as shown due to the section that's removed to accommodate the elevator push rod.

grained balsa, but 1/16" lite ply would make a very suitable alternative. After an overall final sanding you are ready to get covering.

PAINTING AND DECORATING

Slope soarers generally experience more punishment than your average grass strip model, especially the fuselage, so need to be robust. For balsa fuselages, nylon or Solartex type coverings are ideal; glassing is better but like nylon and dope it's definitely a messier option. Although our beloved Solarfilm and Solartex products are no longer manufactured, there's a surprising amount still available if you ask around, because most modellers are hoarders.

There, I've said it! We have a problem, but it's not a bad thing is it? Thousands of metres of film are languishing in workshops and sheds all over the world just waiting to be liberated.

The model featured here (being refurbished) had a nylon and dope finished fuselage, with Solarfilmed wings and tail, as per the 1971 RCM&E article model. The fuselage was in pretty good condition so it was simply wiped down with thinners after giving an overall sanding with 400 grit flour paper, followed by a coat of stabilising primer and the original colour reapplied from a rattle can. The fin, tailplane, elevator and rudder were filmed, with control surfaces hinged using furry Mylar glue-in types. Although the wings were film covered, they were tired and needed redoing. I also wanted to check that the structure was intact, with no broken ribs or detached glue joints etc.

My preference was always to use Solarspan on slope soarers as it was less prone to damage and not significantly heavier than Solarfilm. But the new films now available from China work very well and appear to have excellent puncture resistance in use. Keeping with the original colour scheme I recovered them in yellow, with some custom cut vinyl decals.

RETRO RADIO OR NEW?

As previously noted, along with the Sigma I also bought a retro two channel Horizon 27MHz set with the intention of installing it in the model. Now there's nothing wrong using older gear as long as a few rules are followed.

Obviously, it needs to operate reliably, with full range and any unexpected signal loss, dithering or twitching should give immediate cause for concern. Assuming this base level of functionality is passed then check inside to see if there's any evidence of corrosion to the circuit board, electronics, switches etc. (caused by leaving the batteries inside or storing in a damp shed). If so don't use it as it's an accident waiting to happen, but you will have a unique paper weight.

Receivers of this era usually had the cases fixed together with tape or, in the case of MacGregor, screws. You'll need to have a look in here as well but be careful not to disturb any of the wires and damage the soldered joints. Next, inspect the plugs, leads, battery box, switch and carefully examine servos for erratic movement, poor centering, cracks or damage. Servos on some early radios had four wires, the extra wire being a centre tap on the power supply; modern servos can be used but you need to have some

understanding of electronics. Later sets have three wires, so it's not a problem, except Sanwa used a different ordering on the servo wires and certain examples, such as the Horizon were unique to the brand.

Assuming you're happy at this point replace all the batteries and give the set a soak test, i.e. leave it on (with the aerial extended) for a good few hours and keep wiggling the sticks to check all is in order. Remember at the end of the day it's your responsibility to ensure the gear you use is safe and serviceable - and don't forget the frequency flag.

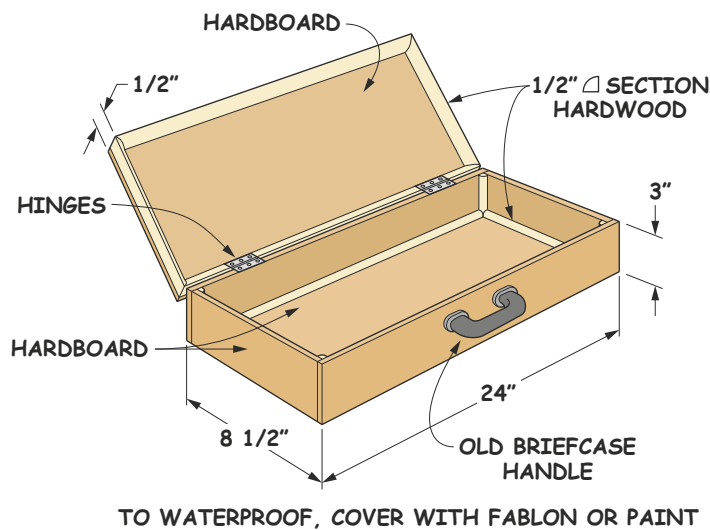
Now you may well be asking why bother, especially as 27MHz is more prone to interference and you have to wield an aerial that's as long as a fishing rod. But why not? It will certainly provoke comments at the slope (not all may be favourable, however!) and remember modellers have made millions of successful flights over the years on 27 and 35MHz frequencies.



Old school servos are huge in comparison to modern types. For current radio gear 9g servos will be fine, but metal geared examples are worth the small additional cost to survive the rough and tumble when landing on a slope.



Like the servos this retro receiver is a big lump and it's only two-channel! It was a squeeze to get it in. Using four AA cells the C of G came out spot on. I didn't use a switch, just plugging the battery into the receiver as required.



Left: A simple carry box was shown on the original plan.
Below: The carry box needs building along with the model.
Novel, quick and easy, it will protect your Sigma.



Just waiting for the delivery of some foam so I can make a custom interior to keep everything in place and damage free in transit.

It really brings home how far we have come - after installing the Horizon gear, the fuselage felt like a brick! I've got so used to the feather weight of modern 2.4G radio and powerful but small servos.

TIME TO FLY

Check the Centre of Gravity is as shown on the plan, the wings are warp free, control surfaces move in the correct direction and don't bind. I would suggest that a 15mph wind straight up the slope would be ideal for the test flights. The speed range of the original was between 8mph to 35mph when ballasted. My Sigma was heavier due to the two-channel retro gear, but it still flew well. Sigma is capable of loops, rolls, rolls off the top and many more, but as the designer, Mr. C. Chapman, noted in his original article, make sure you have a strong wing joiner.

THE BOX

The carry case was what initially appealed to me on reading the article and its construction is very simple but remember don't make it heavy; it's not a piece of furniture. The one featured in the original article used simple hardboard sheets, 1/2" quadrant hardwood strip and was covered in vinyl to waterproof. It can be made larger than shown if you want to include your transmitter, sandwiches, flask and usual field repair kit - a slope session in a box!

My Sigma box has a hardwood top and bottom with 1/4" lite ply for the sides, then painted. You could even use 8-10mm Depron, I guess?

Have fun on the slope and remember, how can your significant other ever complain when you go flying, because the real reason you do it is that you are selflessly exercising and getting fresh air to keep fit for them... Will that work as an excuse?

As always, don't forget to send in your pictures to: thatbloke@garritys.net

DATAFILE

Designer:	C. Chapman
Model type:	Sport Slope Soarer
Wingspan:	45"
Length:	22"
Weight:	17 ozs max



"Sigma is capable of loops, rolls, rolls off the top and many more"

On the slope and ready to get skyward.
This pocket rocket won't disappoint.
Mental note to self - remember to extend the transmitter aerial!

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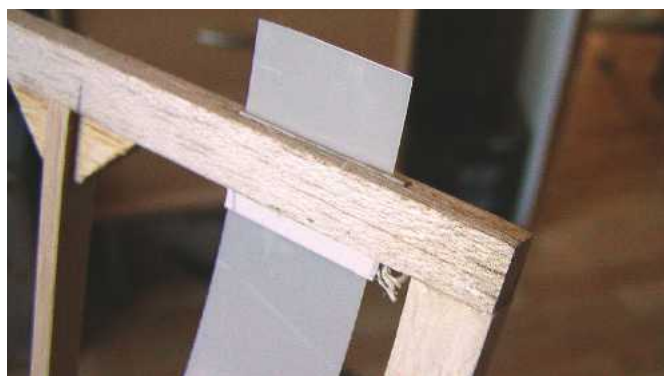


Kevin.Crozier@mytimemedia.com



TOP LETTER

Now this, dear reader, is a handy gift. For his letter this month Andrew McKelvey wins a very popular LiPo and low self-discharge Rx pack combo courtesy of Overlander Batteries - www.overlander.co.uk



REVERSE WOOD BUTCHERY

Flying my Seagull Extra 300S in a stalled condition through a stand of willow trees resulted in clipped wings and a severely damaged tailplane. Repairing the latter meant removing the elevator, the hinges of which were very firmly affixed and needed a lot of digging to get them out. When doing this I made a bit of a mess of the surrounding balsa, to the point that the replacement hinges would be a very sloppy fit. I didn't want to build another tailplane, so what to do?

My initial brainstorming conjured up the idea of using 0.8mm ply to make the proposed repair but this turned out to be too thick, so my

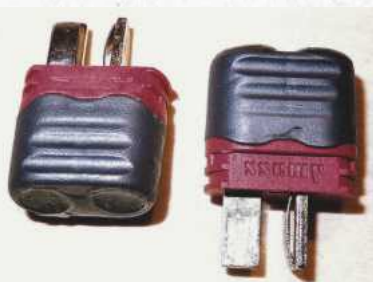


thoughts turned instead to thin cardboard, which looked about the right thickness when folded double.

I cleaned each old, butchered hinge slot with a broken hacksaw blade, cut the cardboard to size, doubled it over and stuck it firmly in the slot with PVA, separating the folded halves with a length of Mylar hinge material to avoid them getting stuck together whilst the glue dried. I then removed the Mylar and fitted a new hinge into the snug slot. Works a treat.

Andrew McKelvey

PERFECT ISOLATION



I enjoyed reading David Ashby's 'Perfect Isolation' article in the March issue and wholeheartedly agree that it's so important to take great care with the throttle stick when handling 'live' electric-powered models. To that end, I use a trick that I picked up from members of the Truro MFC to make the

throttle stick safe. Simply wrap a daisy chain of elastic bands around the Tx handle, run it down the back of the case, around the underside and back up the front under tension, looping around the throttle stick to keep it at its lowest setting. Works a treat.

I'm also a great believer in having an arming plug system to isolate the battery, as discussed in RCM&E some time ago. I use the Deans system as sold by HobbyKing, however the kit doesn't include a



proprietary finished arming plug so I fabricate my own using Deans connectors that have a plastic cap to cover the soldering tabs. I solder a brass finger (cannibalised from another Deans) across the solder tabs of a male Deans connector and then epoxy a covering cap in place. It's a good idea to make plenty of spares because they're easily lost, especially in long grass.

R.G.Willis



HIGH ON HAHNENMOOS

Although no longer an active modeller I still very much enjoy reading RCM&E. Simon Cocker's article in the March issue about Alpine flying reminded me of a tour I was leading in Switzerland back in 2005 where, whilst walking over the Hahnenmoos, we came across an annual event with flyers from all over Europe enjoying perfect weather soaring from the ridge. The German gentleman in the photo attended every year and was kind enough to allow one of my group to hold his model – one of many packed into the adjacent hotel.

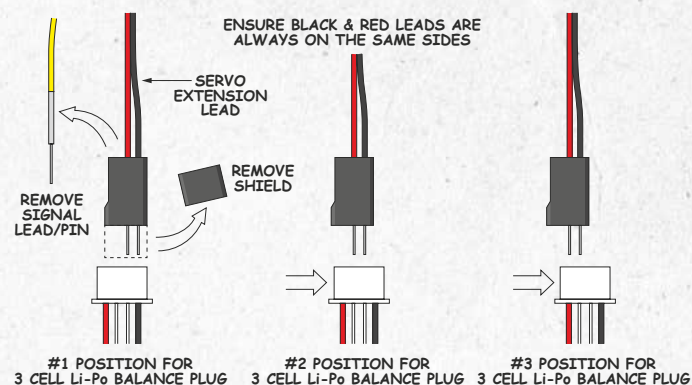
Brian Bloomfield

EASY CHARGE LEAD

Having trouble getting a well-balanced charge on my 3S LiPos, over 300mV low to high, I remembered Dave Burton's article in the November 2018 issue RCM&E regarding charging single cells to rectify balance issues. Reading the article again and duly making up the lead mentioned in the article, I found that by taking a standard (Futaba) type servo extension lead the charge lead could be made as follows:

- Remove the shielding from the male end
 - Remove the signal lead and pin (yellow) from the male end (apply pressure on the pin end whilst pulling the wire and it comes out quite easily)
 - Remove the signal lead from the female end (similar method to above)
- There you have it - a single-cell charge lead without the need to of source a pin header, and no soldering.

A note on safety - double check you've connected the black wire towards the black wire end of your balance plug and red towards the red.



IN A STROP

Alex Whittaker's piece on fuel proofers in the February issue prompted me to relate my experience using Ronseal floor varnish as a fuel proofer on models using fuel containing fully synthetic oil with 5% nitro.

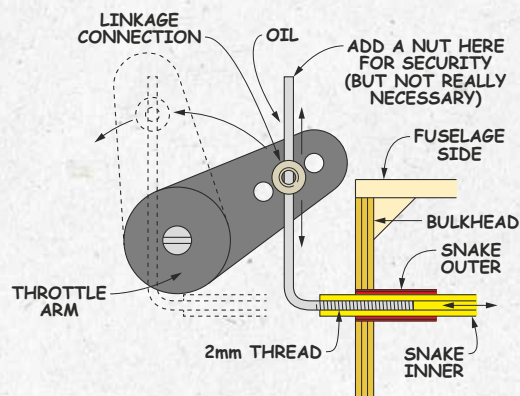
After the first flight of my Ronseal-proofed SE5a, any area that received a coat of engine exhaust turned to a sticky treacle-like surface that proved to be impossible to rectify, even after several years.

More recently, despite all my models now being fully electric, I've once again been affected by old, burnt synthetic fuel. My models are stored hanging from the ceiling of my workshop by strops made from

leatherette (a synthetic upholstery material with a fabric backing), some of which were contaminated with small amounts of burnt fuel from when they were used with IC models. The issue came to light when I used these to hang up my latest creation which, as opposed to the film covering of the rest of my squadron, is finished in Halford's rattle can enamel; where the affected strops touched the suspended fuselage the paint finish is now dull and matted.

Goes to show that burnt exhaust material doesn't lose its potency over time, so beware!

Alan Howland



PLAN VIEW WITH SIDE MOUNTED ENGINE

REAR CARB LINKAGE

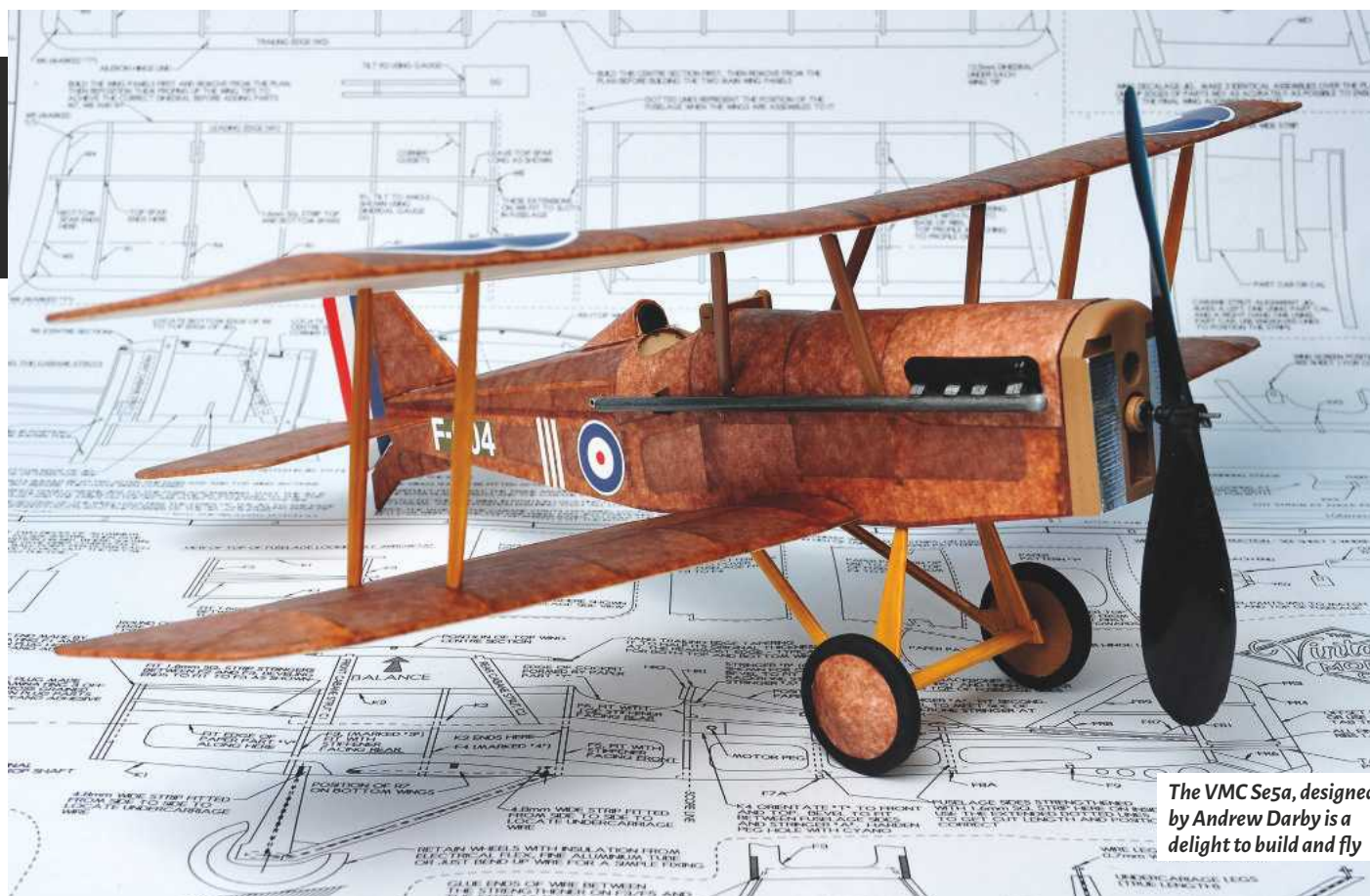
I thought RCM&E readers might be interested in my solution to the problems I experienced when fitting a side-mounted four-stroke engine with a rear carburettor to a narrow fuselage. The issues were two-fold: firstly, the throttle arm was very close to the bulkhead and secondly, it was beyond the outer edge of the fuselage.

Fit a metal linkage connector to the throttle arm, minus its locking screw. Select a length of piano wire (or bicycle spoke) that's the correct diameter to pass through the linkage retainer and into one end cut a 2mm thread, approximately 12mm long. As shown in the diagram, bend the unthreaded part of the wire at 90° to produce an L-shape (dimensioned to suit the installation – mine measured approx. 20mm x 20mm), the threaded end of which is then self-tapped into a fluted-type snake inner. The corresponding snake outer is then fitted, the end of which is lightly belled out and glued almost flush to the bulkhead. It may be necessary to add additional support along the snake's length depending on where the throttle servo is located. The servo end of the snake inner is fitted with a longer length of part-threaded piano wire, cranked to align with the throttle servo arm and secured to it with a second linkage connector.

In operation the linear motion of the snake inner is transmitted to the movement arc of the throttle arm by part of the L-shaped wire sliding in the linkage connector (the small amount of throttle barrel vertical movement is allowed for by the inner snake flexing, helped by the belled outer snake). For added security (although in my experience it's not necessary), fit a nut onto the exposed wire end beyond the throttle arm.

With careful alignment the above produces a neat, low-friction solution.

John Cleverley



INDOOR SCALE

What with all the poor weather lately, and then global health concerns, Danny Fenton has been keeping busy with regular doses of indoor scale modelling

words & photos » Danny Fenton

I have had an eventful time since our last coffee and biccys. I have had to take a step back from the Scale Indoor R/C Nationals as I disagree with the direction it is going, not that I doubt for one minute it will be a wonderful event; I struggle with how free flight modellers can truly understand the need of the R/C community.

As I type the decision has just been made that the Scale Indoor Nationals event is to go ahead. My preparations and those of my friends are forging ahead. Many of which are on models which will only fly for three minutes in a fun pylon race over lunch. The enthusiasm of some of my indoor friends is quite astounding. As such I will be awarding an extra trophy for the modeller that inspires, encourages or just shows the most enthusiasm for the event. I picked up a nice vintage desk clock, based on an aircraft altimeter, but with hindsight, as it's for a speed event, perhaps a clock based on an airspeed indicator would have been more appropriate!

I am really looking forward to flying indoors over 12 badminton courts and under terrific lighting for a change. It should be a great day with great friends.

The dates to remember are April 18/19th at the Wolverhampton Sports Complex (Walsall), The University of Wolverhampton, Magdalene Road, Walsall WS1 3TA.



Transair sell these desk clocks, based on vintage aircraft instruments. This one is a prize for my most inspiring Pylon modeller.

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Scale Indoor Nats - still on as of this time.

FURY UPDATE

The Hawker Fury that I have been trying to finish has had to take a back burner over the last few months as I have been struggling to get a kit scale entry ready for the Indoor Nats. But hopefully I'll come back to it soon.

SE5A CONVERSION

You may recall a few years ago, with just two weeks to go to the Free Flight Nationals, I built a Vintage Model Co. SE5a - my first free flight rubber powered model in nearly five decades! As this year we are introducing a new class at the Scale Indoor R/C Nationals - Kit Class - I thought I would convert that VMC model to R/C. It has been good fun.

I got into trouble on the maiden at Shawbury and the model crashed, wiping out all four wing panels, so I have had to repair it. The method I have used to operate the flying surfaces on the tail (Elevator/Rudder) is quite ingenious, if I do say so myself. I hope it proves reliable as it is a bit sensitive to temperature changes, but the beauty of the tensioned pull system is it adds virtually no weight to the tail end of the model, reducing the need for nose weight.

The VMC SE5a was a delight to build and I would highly recommend one of Andrew Darby's designs as an introduction to the world of indoor free flight modelling. They fly extremely well.

The SE5a lends itself perfectly to an R/C conversion using one of the Spektrum AR6400 Rx bricks. These units are very simple and have two onboard linear servos, and a built-in brushed 2A ESC, though they are a bit expensive at around £40 each. A cheaper route is to pick up a tatty old indoor E-Flite or Parkzone model and harvest the bits. Unfortunately, this has pushed the price of second-hand models up a bit. A lesson in supply and demand!

The tailplane was supported and the elevators separated along a convenient balsa spar; the same for the rudder. For Kit scale you can deviate from the plan only in a few areas. Cutting movable surfaces is obviously one. The modeller must however follow the correct scale outline of the surface, be it an aileron/elevator/rudder/flap etc. So, if the full size has an all moving tailplane the model should also have this style and slitting the tail plane to give separate elevators would be penalised. Other modifications allow access to the radio and battery, as well as the fitment of an electric motor. Additional exits are allowed for pushrods, etc. Otherwise the model must be as per the plan. Covering can be altered from tissue, but you need to



*Left: Elevator and rudder separated from the model. Hinged with diskette internal film.
Below: Motor fitted to nose block and Rx brick ready for fitting.*



*Above: Very popular AR6400 Rx brick positioned on a small shelf. This is a 3-channel unit, with a built-in brushed ESC and two linear servos
Left: Polythene sheet keeps the magnets from sticking together when glued in place*





The completed model ready to try.

Wings re-attached and sporting a rather fine Dave Banks pilot figure.



remember that the judges will need to at least see the outline of the internal balsa structure to ensure it is as per plan.

So, with the rudder and elevators separated the elevator halves were joined with a small section of 0.5mm carbon rod. Carbon rods were also used to create the control horns. The surfaces are hinged using strips cut from the inside of diskette drives.

For free flight the nose block is normally retained simply by tension in the rubber motor, so all I did in this respect was remove the prop and bushing, then hollow out the rear of the block to allow space for the gear box of the brushed motor. Six 1mm neodymium magnets hold the nose block and motor in place. Inside the nose of the fuselage a small shelf is fitted onto which is attached the AR6400 Rx brick and onboard linear servos.

The conventional route here would be to fashion some carbon push rods to operate the control surface to the rear of the fuselage. But you know me well enough by now -

convention is not always my strong point! I used some 1lb fishing line to run a pull line to the horn on the control surface. The other pull line is fed back to the nose, where it is attached to a 25mm length of 0.5mm elastic. This pulls the surface up, the servo pulling the surface down. Similarly, for the rudder.

On the bench it works just fine, however the first trip to the freezing cold RAF Shawbury hangar caused the elasticity to alter and the surfaces could not be trimmed to be level. A tweak at home sorted that out and the next visit saw the surfaces aligned. However, an extremely close near-miss incident during the maiden caused me to panic and I crashed the model, taking the wings off.

Repairs have been carried out and longer horns fitted to the elevator, to reduce sensitivity, so I am hoping to try again at the High Wycombe taster session this weekend - fingers crossed! I won't get any practice before the Nats, but hopefully it will fly predictably. It is an SE5a and they ALWAYS fly well!

ONE CELL WATTMETER

I hope you aren't getting too bored with all this indoor scale. I am a bit obsessed with indoor scale at the moment. With all the rain and wind, and now the potential restriction on group gatherings thanks to the COVID-19 outbreak, indoor scale keeps the enthusiasm going. I hope to be back onto outdoor scale in the next few months, so be patient.

Staying with indoor, it has become apparent that us indoor (low power typically, using a single LiPo cell) modellers could do with some tools suitable for our requirements. With that in mind my modelling chum and ace electronics guru, Chris Bott has been designing gadgets for me. I am constantly in awe of his creations and I know he does get some help from other electronics egg heads on the forum, but Chris is able to work it all out and pull it together. I am indebted to you Chris.

The first gadget is a wattmeter. Now you are going to say, we already have those. Well that's not strictly true. What we have are modified larger scale watt-meters, for measuring hundreds of Watts and up to 100A in some cases. When you try to use these on a 1S system you hit a few issues. First, the 1S cell is often not enough to power



Chris even programmed the Arduino panel to personalise the wattmeter he made for me!



The wattmeter ready for action. It works well. Colour display coming next.

the meter itself. Second, the AR6400 Rx has a max current rating of 2 - 2.5A typically. The modified watt-meters are quite poor at that very low end of the range.

This is where Chris stepped up to the plate. He has designed a self-powered meter (9V battery inside) that will measure up to 5A, roughly a staggering 20W. I have used the unit for several weeks now and it is fabulous for checking power sag with various LiPo cells and for getting an idea of the power output for various models and set ups.

Chris wasn't happy with the monochrome display and has updated the design to include a colour display. I am trying to get Chris to supply a kit of parts and an article for these hallowed pages, so if you are interested email me and we will see if Chris can be persuaded.

IN A BIND

Another area with indoor modelling which can be very frustrating is with regards to the bind and fly models all having different protocols. I built a Spektrum module (well, okay, Chris did!) and that has been great, not missing a beat in three years. However, the holy grail has been to find a way to bind to Hitec/ARES models, of which I have several. These have to be flown currently with the rather budget handset that comes with the models - or the electronics removed and replaced with an AR6400.

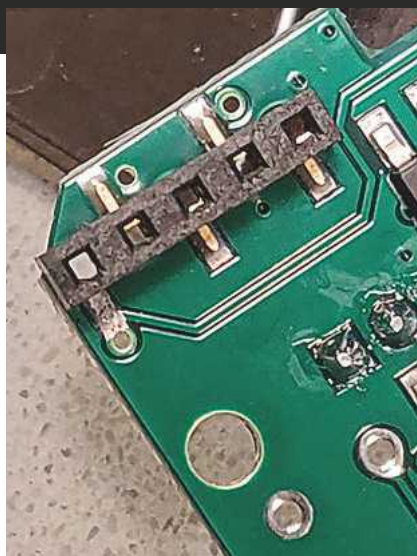
Hitec Red protocol seems to have been a difficult one to accommodate.

This is where we stumbled across a new multi-protocol module made by Jumper. This module does all the usual protocols that we usually see, however the blurb quotes Hitec and Graupner HOTT, which I hadn't seen before.

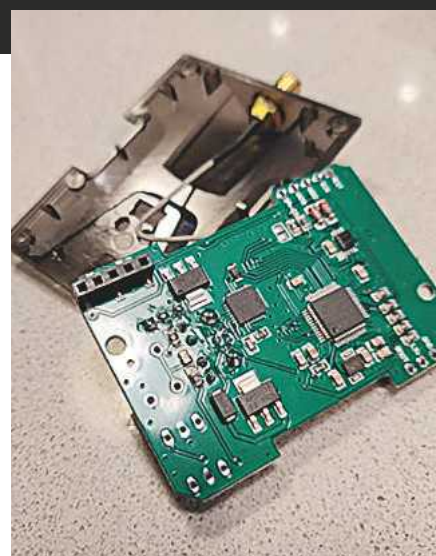
I duly ordered a unit and sent it over to Chris for him to tinker with. Pointless me looking at it - I do the rivets and he does the clever stuff! Anyway, to cut a long story short, we ended up with three modules from Flying Tech Models. Flying Tech specialise in the FPV and drone community and although the module is available cheaper elsewhere, I wanted to go with somebody that could help if things didn't go to plan. And I am glad I followed that route.

The module looks basic and incorporates (in my simplistic understanding) four RF chips. These four chips cover the majority used by all the manufacturers. For example, Hitec and FrSky use the CC2500 RF chip. They then encode it in their unique way.

In the menu of the FrSky Taranis Tx (OpenTX) the various protocols are selectable as an external protocol. The one



Multimodule showing the missing contact on the left pin.



Multimodule board opened up. No doubt we voided the warranty, but it is now fixed.

I was really interested in was Hitec Minima and Spektrum DSM/DSMX/DSM2.

To cut a long story short, the first module had to be flashed to the latest firmware from GITHUB to support Hitec Minima. The Open TX also had to be at the latest version. Once done the module did indeed bind to an ARES Fokker DVII as hoped, and all was rosy. However, a couple of minutes later the module unbound. This required the Tx to be power cycled before it would re-bind. Chris thought the CC2500 chip was overheating as the same was happening when FrSky (which uses the same chip) was selected. But it worked fine with Spektrum.

Will at Flying Tech was very helpful and shipped us another module. In the meantime, another friend who was following our activity offered to send Chris his unit to play with. This unit duly arrived and worked fine with FrSky for a prolonged time. Chris then updated the firmware; this unit then bound and stayed bound to Hitec and FrSky, so was a great result. However, the telemetry wasn't working. Not a big deal for me indoors, but it should work.

Chris poked around inside and spotted that the connector was missing a contact in the end pin. This carries the telemetry information. Chris fashioned a repair to prove his theory and of course that cured the issue (I had no doubt he would be right).

The replacement unit arrived for the overheating module from Will at Flying Tech and that one worked in all respects.

So, the module does seem to do what we want and handle lots of protocols, meaning that I can now fly my ARES foamies using my Taranis X7, as well as my other bind and fly Spektrum based models, as well, of

course, as my FrSky ones.

This does highlight that of the three modules, two had problems. Flying Tech were great in responding to my queries, but it may be something to watch if you buy a module from outside the UK?

SCALE UNCOVERED

This last weekend I was delighted to be invited along to Buckminster in support of Graham Kennedy's first in a series of Scale Uncovered events. Scale Uncovered is a series that Graham is going to run to try and embrace and encourage budding scale flyers into scale competition. Alas the weather didn't play ball and the hoped-for flying session couldn't take place; that has been postponed to a later date.

Watch this space for updates on that event and more Scale Uncovered events over the next year, perhaps exploring areas of detailing, design and building. Plus, of course, your feedback on flying the scale schedule.

The event on Sunday was well supported, especially when you consider the poor weather and that the demographic of scale modellers is at the older end of the spectrum. Some 20 people enjoyed talks by Graham Kennedy and John Carpenter on all aspects of scale competition and what to expect. Manoeuvre selection, documentation etc. were all topics that were explored.

There was plenty of time to discuss techniques etc. as several models had been bought along to encourage discussion. My Chipmunk had me explaining panel lines, rivet application and glue choice, and all manner of subjects. Very enjoyable.





Twenty scale buffs enjoyed the first 'Scale Uncovered' workshop at Buckminster.



Graham Kennedy, who master minded the day, explaining some of the aspects that are key to good documentation.



John Minchell helped co-ordinate proceedings and gave valuable insight as a recent Team Manager.



John Carpenter shone the bright light of scale wisdom in our eyes.

“Gyros don’t make the modeller fly better; they make the model fly better.”

Perhaps some areas were not discussed in fine detail, but the day was more about encouragement and harnessing the enthusiasm. The breakout sessions over the next 12 months will fill those gaps and build on the obvious enthusiasm that was shown by all. An interesting note is that the age of those that attended was younger than the normal scale crowd, which is very encouraging.

One comment that John Carpenter made rang true with me. This was regarding the use of gyros in scale competition: “Gyros don’t make the modeller fly better; they make the model fly better.”

As always if you want to drop me an e-mail, I can be reached at: cammnut@gmail.com ✈



Before everybody arrived, but showing the relaxed nature of the Scale Uncovered Event

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IN SHORT SUPPLY

Despite supply problems from virus hit China in particular, some new tech is making it through.
Lee Schofield takes a look at recent arrivals

words & photos » Lee Schofield

The recent issues around the Covid-19 (Coronavirus) virus have shown how reliant on Chinese manufacturing large parts of the modern hobby are. Every year there is a lull in supply of new technology and products, with the impact being felt towards the last week of January and right through to around the 11th February. The supply issues were compounded this year as many vendors and factories staying closed well into the second half of February as measures were taken to stop further the spread of the virus.

Many products and prototypes that I have been waiting to get my hands on have been impacted by these closures, so some of the products expected have still not made it into my hands. Products affected include new technology for flight controllers, models, FPV and

radio systems, with manufacturers still playing 'catch up' with the pent-up demand.

The issues have been felt all through the hobby as not only the brand-new products have been affected. Stock of existing favourites and essentials were impacted, with the delays in manufacture and shipping causing restocking problems. Many resellers found themselves unable to keep a stock of the basics, with lead times far longer than normal. So, if your local hobby shop hasn't been able to get you something you need it's not their fault.

The result is a slightly shorter round-up this month. The effects are still being felt in terms of supply but here is the best of the new technology that has come across my desk over the last few months.

LI-ION BATTERY PACKS

GET IT FROM: ZOHD stockists

I was made aware of the usefulness of Li-Ion batteries about two years ago. Lithium Polymer (LiPo) batteries are the go-to for electric flying. A lot of the innovation over recent years has been driven by the ever-increasing demands for high currents from multirotor pilots. Many LiPo batteries have huge 'C' ratings (the 'C' rating is how much current the battery can supply safely) and these modern LiPo packs have more material in the internal electrodes and conductors to handle those higher amp draws. That adds a lot of weight. With a fixed wing model, it is far more common to just have one motor and prop, so huge currents are not needed. The Li-Ion pack has the majority of the weight of the battery as the electrolyte rather than the electrodes. This means that it can store far more energy, weight for weight, than a LiPo. The drawback is a lower maximum amp draw but this can be a far better fit for many fixed wing models. For the same weight of battery, a Li-Ion can provide well over twice the flight time when compared to a high C rated LiPo pack. Despite these clear advantages for fixed wing flyers few vendors are producing the packs in volume, so it's great to see a company like ZOHD starting to produce them. Maximum continuous current is just over 10A and the packs can sustain around 15A for a few seconds (handy for take-offs and high throttle climbs). While this will not be enough for a larger fixed wing model, aerobatic or high-performance models, it's perfect for smaller models or those with efficient motor and prop setups. There are a few things to be aware of with Li-Ion packs: the discharged voltage is lower than a LiPo, so you may need to tweak the voltage cut-off on your ESC if you want to use the full capacity of the pack. And the lower current rating needs to be checked so that you have enough power available for take-offs and short full throttle manoeuvres. If you've never investigated using a Li-Ion for your model, then it is worth a look.





FRSKY ROVER3

GET IT FROM: FrSky stockists

It is interesting to see that over the past 4 - 6 months many of the vendors who have enjoyed a lot of growth from the multirotor boom are now looking to new markets as that part of the hobby shrinks. We've already looked at the fun, inexpensive EMAX Interceptor R/C FPV car and the BrainDART from BrainFPV. The FrSky VANTAC Rover 3 is something that a few of you may recognise. Pre-release samples of this product were shipped to a small number of testers in November last year. Resembling something that would look more at home in a science fiction film, this tri-copter has more to it than you'd expect at first glance. It is beginner friendly, with a very stable flight and no need to use a computer to set up anything - just follow the manual, bind and you're set. The front two motors are tilted with servos to allow for pitch and yaw and it comes complete with a decent FPV system. Since the model flies by tilting the rotors rather than the whole chassis the FPV camera is always looking forward and this makes for a very different flying experience. Flight times of around 15 minutes are easy to get and its unusual appearance turns heads – in a good way. Sadly, there isn't a case with it and you'll need a LiPo battery and an FrSky radio to bind to it. If you have been looking for a multirotor but don't want something that's all carbon fibre and exposed wiring, then this may be for you.



MENACERC AEROPOD FPV ANTENNA

GET IT FROM: MenaceRC stockists

Over the past year the interest in flying first person view (FPV) in fixed wing models has increased dramatically. Flying wings are inexpensive and can be built cheaply, while offering a world of new challenges and fun for the fixed wing flyer. Until now if you wanted to add FPV to any model you will have used the 'electric dandelion' or similar design of antenna that has the antenna elements arranged at the end of a length of stiff co-axial cable. I have been pestering MenaceRC for nearly two years (apologies to the team at MenaceRC) to create an FPV antenna designed specifically for fixed wing flyers and they have finally released it. The AeroPOD is a one of their excellent pagoda style antennas, enclosed in an aerodynamic shell that can be mounted on the underside of a wing out of the way of harm and not causing the same drag as a traditional antenna. The AeroPOD is designed to be sunk into the wing of the model so that only the active antenna elements are proud and covered. A short length of RG402 and a longer length of RG178 terminated in a UFL or MMCX miniature coaxial connector allows for the cable to be run easily inside the wing, or a channel, and connected to a traditional FPV video transmitter. The AeroPOD is only 10mm high and 28mm wide and has the same performance as the existing excellent MenaceRC 'Thrasher' antenna. This is a much neater solution for fixed wing FPV, with the antenna pointing down towards the pilot, giving better performance. I'm sure other antenna manufacturers will design something similar if it is a big hit.



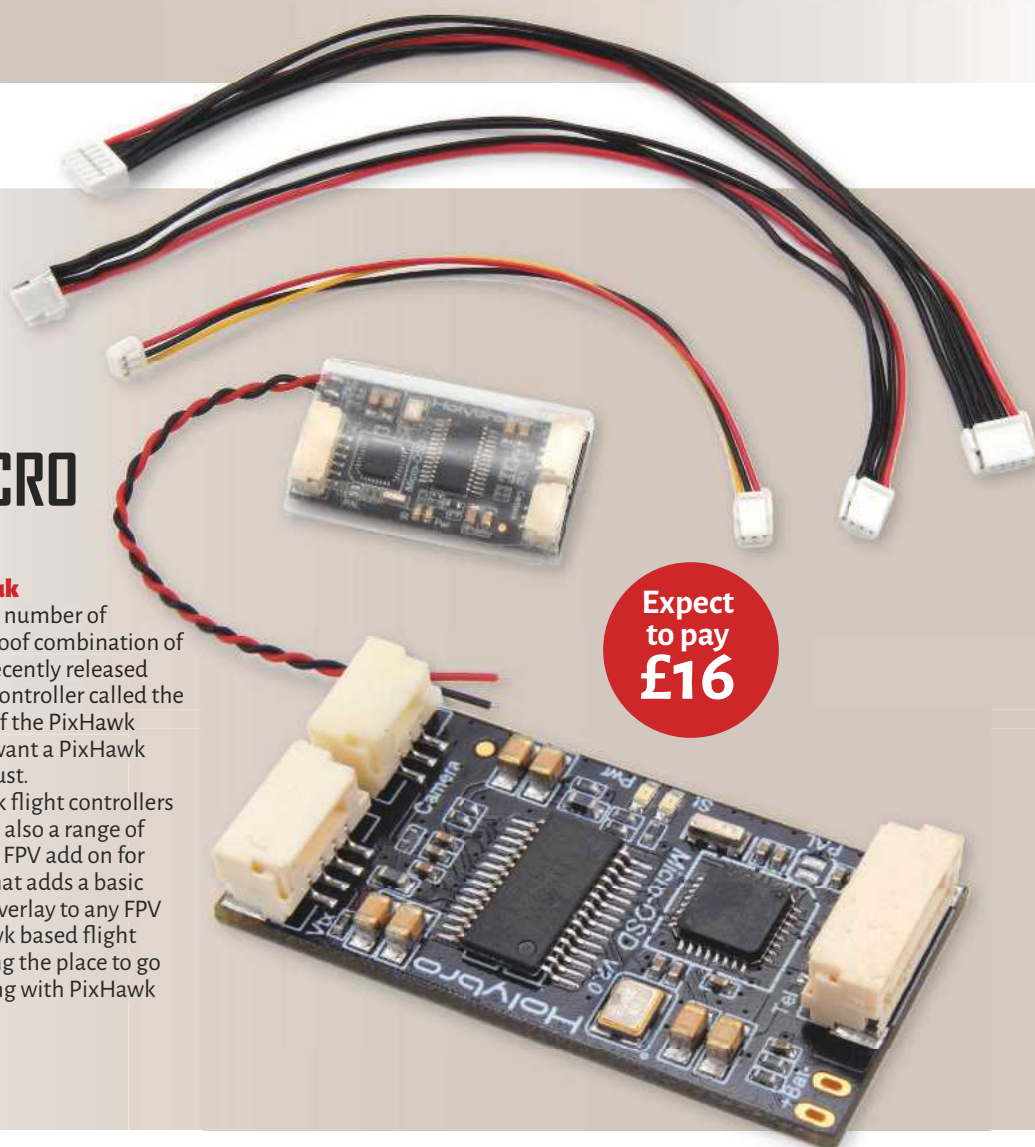
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HOLYBRO MICRO OSD V2

GET IT FROM: www.3dxc.co.uk

Holybro continue to bring out a number of products based on the bullet proof combination of PixHawk and ArduPilot. They recently released another PixHawk based flight controller called the Durandal that is a good choice if the PixHawk Cube is too expensive, but you want a PixHawk system from a brand you can trust.

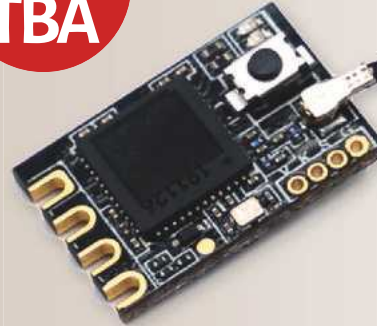
In addition to all of the PixHawk flight controllers they are making now, they have also a range of sensors and add-ons. The latest FPV add on for PixHawk is the Micro OSD V2 that adds a basic ASCII based on screen display overlay to any FPV image you have on your PixHawk based flight controller. HolyBro are becoming the place to go to if you want to build something with PixHawk but don't want a PixHawk Cube.



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FRSKY 'ARCHER' RECEIVERS

GET IT FROM: FrSky stockists

FrSky continue to release new products on a regular basis. The new Archer-M+ receiver is tiny and uses the new ACCESS protocol. ACCESS provides the lower latency and increased performance of their popular XM+ receivers, which are very popular. As with all of the latest receivers from FrSky it has lots of new features and supports OTA (Over-The-Air) firmware upgrades, so there's no need to remove it from the model to update things. This receiver is handy if you want to connect it to a stabiliser or flight controller as it only has support for SBUS and iBus but does support telemetry with around 500m range. The other new receiver is the Archer-GR8 (see what they did there?) This is a larger unit with an inbuilt variometer, which makes it perfect for slope-soaring or gliding. Weighing 9.8g it's still compact enough to squeeze into those places where you can't spare much space or weight. It features ACCESS protocol and receiver redundancy with eight high precision PWM outputs. Sadly, these newer receivers from FrSky are no longer supporting the hugely successful D16 ACCST protocols that most FrSky pilots have been using for years. If you want to use these latest receivers, then you will sadly need to update your radio or get a new one with ACCESS support.

FRSKY RB30 & RB40

GET IT FROM: FrSky stockists

FrSky have had the RB20 predecessor of these latest products out for a while. These newest switchboard modules from FrSky allow you to connect multiple receivers, batteries and manage all of the power systems and redundancy from one place, perfect if you are building a large sailplane or glider. This smart hub connects all of the pieces of the model together and adds a number of very useful features that include overload protection, redundant receiver support, full telemetry feedback, LCD screen (RB-40 only) and non-contact switching. In addition to the hub features, these latest switchboard modules also provide a stabilisation feature using an inbuilt gyroscope and current sensors for a complete view of the model's health and performance while flying. Dimensions are 114.4 x 73.4 x 18.7mm (RB-30) and 163.2 x 100 x 23.5mm (RB-40) and weighing 97g for the smaller RB-30 and 265g for the RB-40. You will need to plan your build to fit one of these inside but if you are running a larger electric model on 11 - 26V and have been looking for a way to reduce the chance of a failure in flight bringing down your pride and joy then these are worth a look.



Expect
to pay
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GOING PLACES

Diary dates for the coming season

APRIL 2020

April 11 Indoor Flying At Sutton St. Helens. Elton Head Rd. WA9 5AU Merseyside. From 1pm - 4pm. £80 for September - April payable in advance or £13 per session on the day. Shockies not allowed, heli's and quadcopters small 1S only. Contact Eric Strefford on 07711 268699 or email ericstrefford@gmail.com

April 14 Waltham Chase Aeromodellers Indoor FPV Meeting in the Meon Room at Wickham Community Centre, Mill Lane, Wickham, Hants, PO17 5AL. From 7pm to 9.30pm. Admission £4 for fliers and £1 for spectators, accompanied children free. Junior fliers charged as adult spectators. Proof of insurance required. Multicopters limited to a maximum weight of 95g in flight trim, including battery (not to exceed 2-cell LiPo) and a motor to motor diameter not exceeding 6" (152mm). Helicopters and fixed-wing models may not be flown. For further details please contact Alan Wallington on 01489 895157.

April 18 Tonbridge Gassers and Rubber Fanciers Indoor Flying at King's Rochester Sports Centre, 601 Maidstone Road, Rochester, Kent, ME1 3QJ. From 6.30pm until 10pm - free flight and lightweight R/C timed flying sessions throughout the evening. Contact Steve on 0208 942 5000 or Eric on 01622 737814.

April 18 Scale Indoor R/C Nationals at Wolverhampton Sports Complex (Walsall), The University of Wolverhampton, Magdalene Road, Walsall WS1 3TA. See the finest indoor R/C scale models in the well lit, spacious Wolverhampton University Sports hall. Three competition classes: Scale, Flying Only and Kit Scale. Lunchtime fun pylon races for scale competitors. From 8.30am - 6pm. For more information email Danny Fenton at cammnut@gmail.com or visit scale.BMFA.org.

April 19 GBR/CAA F3A National League competition. Skelbrooke. All schedules. See gbrcaa.org 'Competition Entry Form' for fees and payment, and 'forum' 'Competition News' for details. Visitors welcome but please contact Contest Director, Bob Rowland, on 07368 521164 for details.

April 19 Frome Model Flying Club Spring Swapmeet at The Conygre Hall, North Road, Timsbury, Bath, BA2 0JQ. From 9am till 12.30. Tea, coffee and bacon rolls available. Entry £1 per person and tables are free. Pre-booking required for tables. Entry from 8.30am for sellers. For more information and to book a table please contact Rob Buckley 07791 278292 or email rob@rwbuckley.co.uk

April 24 We Fly Indoors at the Weatherly Centre, Eagle Farm Road, Biggleswade, Bedfordshire, SG18 8JH. From 6.30pm till 10pm, door open at 6.15pm. Free Flight - Hangar Rat, Gyminnie, Easy Bee or similar. Electric Fixed Wing - Vapor, Lightweight - Slow Fly style. Heli's - MSR style etc. max rotor 410mm, quads max overall 200mm diagonal. Shockies - 500mm max size. All models at organiser's discretion. Flying in approx. 10-15 minute sessions, BMFA insurance to be shown. Admission £5, spectators 50p; includes tea/coffee and biscuits. Good access from north and south on A1, venue is next to Stratton Upper School, good parking. Queries to Andrew on 07974 800463 or email andrewleftwich@virginmedia.com

April 25 UK Classic Aerobatic Association (UKCAA) Fly-in at Loughborough MFC, Northants. This is a Saturday Fly-in with Round 1 contest to Pick5, Pick7 and 1979 rules during the lunch break. Visitors welcome but pre-registration is required at ukcaa.org.uk/events. Contact Martyn Kinder on 079890 25198 or email ukcaa2013@gmail.com

NOTICE:

A number of events have been cancelled as a result of the Coronavirus outbreak and notifications may have missed our print deadline. Please check the events page at model flying.co.uk or contact the organisers direct before travelling

April 25-26 Windermere Model Waterplane Flyers Ullswater Splash-in. Waterside House Campsite, Howtown, Penrith. From 10am to 4pm each day. WMWF members £1 per day. Non-members £3 per day. Proof of BMFA or SAA insurance req'd. Pilots to have min. of a BMFA 'A' cert or SAA Bronze. Car parking to be paid at shop at campsite entrance. Further details on windermere-modelwaterplane-flyers.co.uk, call 07775 506842 or email andrew@windermere-modelwaterplane-flyers.co.uk

April 28 Waltham Chase Aeromodellers Indoor R/C Small Models Meeting. Main Hall at Wickham Community Centre, Mill Lane, Wickham, Hants PO17 5AL. From 7pm to 9.30pm. Models limited to a max weight of 95g for fixed wing aircraft in flight trim, including battery (not to exceed a 2-cell LiPo). Helicopters limited to a rotor diameter of 12" (305mm). Admission £5 for fliers, £1 for spectators and junior fliers, accompanied children free. Flyers will be required to show proof of insurance. For further details please contact Alan Wallington on 01489 895157 or email WCAero@outlook.com

May 2 Fun Flying at Chigwell School Sports Hall, High Road, Chigwell, London, IG7 6QF. For small models, all types, maximum wingspan 20". Flyers £10, spectators £2. For details contact Mike Quille on 0208 500 3549 or email mp.quille@live.co.uk

MAY 2020

May 2 Bickley Model Flying Club Car Boot Swapmeet at the club's flying field: Church Road, Sutton at Hone, Kent, DA4 9EX. From 11am till 3pm. The first of this year's opportunities to move on some of the models, engines and other modelling equipment that you have not used for ages and to pick up a bargain at the same time. Open to all with free entry, but with a £5 charge to sellers who are not BMFC members. Selling only from designated pitches for each vehicle. You will need to supply your own display table. Toilets on site. Free access to food facilities at the gun club down the lane. Details at bickleymfc.org/events or contact John Veasey on 01474 852015.

May 2 Chris Foss Fly-in at St Austell & District Modelling Club, Maggie Pie Dam, St Stephen, Cornwall, PL26 7SB. Join us for a day of anything Foss designed. Sorry, no toilet facilities or glider tug available. Starts at 10am, a relaxed, friendly fly-in and a warm welcome. See staustell-dmc.bmfa.org/ club-flying-diary or call Peter on 01208 879065 or email joandpetersmedley@hotmail.com

May 3 Open Fly-in and 50th Anniversary Celebration at Bickley MFC. At the club's flying field, Church Road, Sutton at Hone, Kent, DA4 9EX. This was historically the event when we had our electric fly-in, but as electric is now mainstream it is now a general fly-in. Open to members and visitors wishing to fly models of all types. Flying will start at 10.30am, so arrive before for the pilot's briefing. No models over 25kg. Camping available at the field by prior arrangement. Food available. Toilets on site. Free access also to food facilities at the gun club down the lane. Details on our website bickleymfc.org/events or contact John Veasey 01474 852015.

May 3 GBRCAA F3A New Pilots Open Day. Leicester. See gbrcaa.org 'forum', 'NOPD' for details. Visitors welcome but please contact Contest Director, Chris Bond on 07811 196418 for details before travelling.

May 3 Wessex Soaring Association Slope Fly-In, first Saturday or Sunday of the month. Various slopes approx. 5 miles east of



For more events go to modelflying.co.uk

Shaftesbury. Non-powered gliders and e-soarers permitted. All welcome but must have BMFA insurance. Contact Pete Carpenter for more details, email pete.carpenter12@gmail.com or call 07919 903742.

May 9-10 PSSA Fly-in at The Blwch, Nant-y-Moel, Bridgend, South Wales. Kindly supported by the SWSA: a470soaring.blogspot.co.uk/. Meet at the 'ice-cream' car park for 10am each day. Proof of BMFA insurance (or equivalent) required. Steve Houghton 07762 256126 or email steve.houghton59@gmail.com

May 10 UK Classic Aerobatic Association (UKCAA) Fly-in at Watford Wayfarers MFC. Fly-in with round 1 contest to Pick5, Pick7 and 1979 rules during the lunch break. Visitors welcome but pre-registration is required at ukcaa.org.uk/events. Contact Martyn Kinder on 079890 25198 or email ukcaa2013@gmail.com

May 10 GBRCAA F3A National League competition at Warboys, Cambridgeshire. All schedules. See gbrcaa.org 'Competition Entry Form' for fees and payment and 'forum' 'Competition News' for details. Visitors welcome but please contact Contest Director, Clive Whitwood on 07941 441090 for details.

May 12 Southend Radio Flying Club Table Top Sale at The Ecko Club, Thornford Gardens, Southend-on-Sea, Essex, SS2 6PU. From 8pm till 10pm. Entry £2, tables £4 including entry. Please book tables in advance with Den on 07745 2219443, or Les on 07729 421939.

May 12 Waltham Chase Aeromodellers Indoor FPV Meeting in the Meon Room at Wickham Community Centre, Mill Lane, Wickham, Hants, PO17 5AL. From 7pm to 9.30pm. Admission £4 for fliers and £1 for spectators, accompanied children free. Junior fliers charged as adult spectators. Flyers will be required to show proof of insurance. Multicopters limited to a maximum weight of 95g in flight trim, including battery (not to exceed 2-cell LiPo) and a motor to motor diameter not exceeding 6" (152mm). Helicopters and fixed-wing models may not be flown. For further details please contact Alan Wallington on 01489 895157.

May 16 Blackpool & Fylde Radio Controlled Model Society Flightfest (sponsored by BMFA NW) at the club field Singleton Road, Weeton, PR4 3NB. From 10am till 5pm. A great opportunity for all those interested in taking up the hobby to chat with club members and have the opportunity to fly using club trainers and BMFA qualified instructors. All ages welcome (Under 16s accompanied by an adult please.) Free car park and refreshments available. Membership concessions for those joining on the day. For further details contact David Kirkbride on 07872 108297 or email david_kirkbride@btinternet.com

May 16 Retro Glider Fly-in on the Leek and Moorland Slopes. For year-2000 designed slope and thermal soarers. Hosted by the Leek and Moorland MGA. Prizes for best retro glider and pilot's retro pilot. A fun event with the possibility of a few fun tasks thrown in for good measure. Exact location is wind dependent so please email or phone the day before for confirmation. Contact Martyn Kinder by email at ukcaa2013@gmail.com or call 07989 025198. Please note that Sunday the 17th May will be a reserve date in case the weather isn't as kind as hoped.

May 16-17 Windermere Model Waterplane Flyers Ullswater Splash-in. Waterside House Campsite, Howtown. Penrith. From 10am to 4pm each day. WMWF members £1 per day. Non-members £3 per day. Proof of BMFA or SAA insurance req'd. Pilots to

have min. of a BMFA 'A' cert or SAA Bronze. Car parking to be paid at shop at campsite entrance. Further details on windermere.modelwaterplane.flyers.co.uk, call 07775 506842 or email andrew@windermere.modelwaterplane.flyers.co.uk

May 16-17 MiniAirshow UK 6 at at Popham Airfield, nr Micheldever, Hampshire, SO21 3BD. After the success of the past couple of years (at the dedicated Popham Drone Zone for unmanned aircraft) Team MiniAirshow are growing the event to use a whole manned runway in 2020! Harking back to the days of Blackbushe, whilst also looking to the future of model flight, Team MiniAirshow are bringing together FPV'ers, large scale models, turbines, heli's, multirotors and more to MA6 at Popham Airfield. More details and tickets available on the website and facebook pages at miniirshow.co.uk. Email contact@miniirshow.co.uk

May 23 Dorset Model Aeroplane Spring Swapmeet at Charlton Marshall Village Hall, Green Close, Charlton Marshall, DT11 9PF. All under cover. Mainly model aeroplanes, but there may be some cars, boats and trains. Main hall at ground floor however there is an available upper level too. Traders from 8.30am at £7 inc. one table and one free entrance. Buyers entry at 9am for £4. Café and free car park plus street parking. Contact John Bainbridge on 01258 458749 or 07864 297226.

May 23-24 Greenacres May Fly-in, Aldridge Airport, off Bosty Lane, Aldridge near Walsall, West Midlands, WS9 0QQ. Campers and caravans can arrive after 1pm on the Friday before. Water, toilets, raffle and catering are all available for a small donation. Visiting pilots fly for £5 per day, but spectators and the public are free! If you have any special requests or requirements, please contact Jim Mchugh at jim.mchugh@greenacresmac.co.uk, see www.greenacresmac.co.uk or www.facebook.com/GreenacresMAC

May 24 GBRCAA F3A National League competition Hurley, Warwickshire. This is designated as a BMFA Team Selection (P21) and BMFA Open Competition. All schedules. See gbrcaa.org 'Competition Entry Form' for fees and payment, and 'forum', 'Competition News' for details. Visitors welcome but please contact Contest Director, Adrian Harrison on 07976 244004 for further details.

May 26 Waltham Chase Aeromodellers Indoor R/C Small Models Meeting, Main Hall at Wickham Community Centre, Mill Lane, Wickham, Hants PO17 5AL. From 7pm to 9.30pm. Models limited to a max weight of 95g for fixed wing aircraft in flight trim, including battery (not to exceed a 2-cell LiPo). Helicopters limited to a rotor diameter of 12" (305mm). Admission £5 for fliers, £1 for spectators and junior fliers, accompanied children free. Flyers will be required to show proof of insurance. For further details please contact Alan Wallington on 01489 895157 or email WCAero@outlook.com

May 29 We Fly Indoors, at the Weatherly Centre, Eagle Farm Road, Biggleswade, Bedfordshire, SG18 8JH. From 6.30pm till 10pm, door open at 6.15pm. Free Flight - Hangar Rat, GYminnie, Easy Bee or similar. Electric Fixed Wing - Vapor, Lightweight - Slow Fly style. Heli's - MSR style etc. max rotor 410mm, quads max overall 200mm diagonal. Shockies - 500mm max size. All models at organiser's discretion. Flying in approx. 10-15 minute sessions, BMFA insurance to be shown. Admission £5, spectators 50p; includes tea/coffee and biscuits. Good access from north and south on A1, venue is next to Stratton Upper School, good parking by venue. Queries to Andrew on 07974 800463 or email andrewleftwich@virginmedia.com

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	4M-094DMGB-014	Digital Metal Geared Ballraced Wing Servo. 8mm Thick - 9.4g	1.4Kg @ 4.8V - 0.12sec/60° 1.9Kg @ 6.0V - 0.10sec/60°	1pcs £10.99ea 5pcs £9.89ea
	4M-090AH-017	Micro - 9g	1.7Kg @ 4.8V - 0.09sec/60° 1.9Kg @ 6.0V - 0.07sec/60°	1pcs £2.69ea 5pcs £2.42ea
	4M-100AMG-022	Micro Metal Geared - 10g	2.2Kg @ 4.8V - 0.12sec/60° 2.5Kg @ 6.0V - 0.10sec/60°	1pcs £4.99ea 5pcs £4.49ea
	4M-100DMG-022	Digital Micro Metal Geared - 10g	2.2Kg @ 4.8V - 0.12sec/60° 2.5Kg @ 6.0V - 0.10sec/60°	1pcs £6.49ea 5pcs £5.84ea
	4M-160AH-027	Mini - 16g	2.7Kg @ 4.8V - 0.13sec/60° 3.0Kg @ 6.0V - 0.11sec/60°	1pcs £5.99ea 5pcs £5.39ea
	4M-175DMG-030	Mini Digital Metal Geared - 17.5g	3.0Kg @ 4.8V - 0.13sec/60° 3.5Kg @ 6.0V - 0.11sec/60°	1pcs £7.49ea 5pcs £6.74ea
	4M-253AB-028	Standard/Mini Size - 25.3g	2.8Kg @ 4.8V - 0.12sec/60° 3.3Kg @ 6.0V - 0.10sec/60°	1pcs £5.99ea 5pcs £5.39ea
	4M-455AH-033	Standard - 45.5g	3.3Kg @ 4.8V - 0.15sec/60° 4.0Kg @ 6.0V - 0.12sec/60°	1pcs £6.12ea 5pcs £5.51ea
	4M-556AMG-087	Standard Metal Geared - 55.6g	8.7Kg @ 4.8V - 0.15sec/60° 9.4Kg @ 6.0V - 0.13sec/60°	1pcs £11.99ea 5pcs £10.79ea
	4M-556AMG-118	Standard Metal Geared - 55.6g	11.8Kg @ 4.8V - 0.20sec/60° 13.2Kg @ 6.0V - 0.18sec/60°	1pcs £13.99ea 5pcs £12.59ea



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83mm	4M-83SPIN-COOL-*	48g	£15.49

These ultra light weight spinners for electric motors are supplied with a specially cut aluminium backplate which pulls cooling air through the nose of the spinner and then forces it out of the back and in to the motor, helping keep the motor cool even on a hot day. Available in 6 sizes and 5 colours.



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SIMPLES MAX

Mike Bell offers up an outdoor version of his Simplex flying wing but with a separate tail that echoes the style of 1970s C/L combat models. words » Mike Bell | photos » Mike Bell and David Ashby

Simplex Max is an evolution of my Simplex indoor flying wing design, published in the April 2018 issue of RCM&E. That design has been tweaked, with the addition of a separate tail and elevator, the intention being to decouple the roll and pitch functions. While the aerodynamic improvement wasn't dramatic the biggest benefit was the appearance, which reminded me of the C/L combat wings that my friends and I had so much fun with back in the 70s. These machines combined rugged simplicity with extreme manoeuvrability and were cheap to make. This look-alike ticks all the same boxes and at one metre span it is compact enough to keep in the car for impromptu flying sessions.

I wanted to keep it small, to suit the popular 3S 2200mAh batteries, but it could also be suitable for a .25 glow motor. Regarding motor choice, I am not a 'leccy' expert, but I had a few spare bits lying around. One was a 4-MAX PO-3547-1190 motor that turned out okay when matched to an 11 x 5.5 APC E propeller and a 60A ESC. At a bit over 400 watts this gives 200W/lb, which is a lot more than it needs but it does make big loops really easy!



Simplex Max evokes memories of control line combat wings.



C/L wing style construction results in an easy to build airframe that's tough too!



Fun to cost ratio of this one is pretty high.

GREAT EXPECTATIONS

So, what can you expect from Simplex Max? You get a simple and cheap to build flying wing with styling that's a bit different from typical foam wing offerings. From a flying point of view, you can expect a smooth flying model capable of all the usual aerobatics that can be done without a rudder. It isn't designed for out and out speed, although it is pretty quick if you need it to be.

The fact that the design looks like a combat wing inspired me to adopt a construction technique that was popular for many of those models. While the plan form of the wing is tapered, the thickness is constant, and the wing section is flat for much of its chord, which makes for easy building with no complicated packing. The leading edge is a composite of balsa strips that makes up a kind of D box and can easily be shaped into a fairly blunt nosed section that is good for benign stall characteristics.

Conventional spars can't be used as they would pass through the fuselage box where the battery (or fuel tank) would sit. I realised that I could get all the strength I needed by embedding spruce 'spars' in the leading and trailing edges. Due to the sweep of the leading and trailing edges these spars have to take on a bend and this further enhances their stiffening effect. Besides, combat wings rarely had conventional spars and they were plenty strong enough under very high G manoeuvres.

If you fancy giving Simplex Max a go you should select balsa that is soft, or on the soft side of medium, for most parts, except the ribs, which will benefit from being medium grade. Heavier grades just add weight with no real benefit.

CONSTRUCTION

Start by making up the leading and trailing edges of the wing. Since the spruce spars have to take a significant bend you will need to pin the parts down very securely to a wooden building board. I used fine nails hammered into a wooden board to resist the spring back while the glue set.

Taking the leading edge first, cut out the upper and lower laminations from 3/8" balsa sheet and cut the angles where they will join



Mike's prototype on a flypast at last year's RCM&E Fly-In at Buckminster.

at the centre line. Pin the lower laminations over the plan and glue the centre join. Next, glue the 1/4" sq. balsa centre lamination over the lowers. I used white glue for all lamination jobs as it gives you plenty of time to position the parts. Don't worry about using fancy scarf joints at the centre join as the spruce spar is going to provide all the reinforcement you need. Talking about the spar, we need to fit that next. I bought my 1/4" x 1/8" spruce in 1m lengths but don't worry if you only have 36" strip. Make sure you place the spar centrally, then just make up the length at the tips with balsa strip; the loads out there are low so this won't weaken the structure significantly. The bend can be induced easily, and the spar can be held to the centre lamination using plastic ratchet clamps. There will be a small gap between the spar and the centre lamination at the centreline, but this is fine. Once this is dry you can glue the upper laminations in place.

Now cut out the LH and RH trailing edge parts, plus the tail, elevator parts and fill in piece, all from 1/4" sheet. Use light wood for these parts and glue together over the plan

but DO NOT cut out the ailerons. Leaving the ailerons uncut will help to maintain the shape of the trailing edge assembly against the spring of the curved spar.

Make sure the assembly is very firmly pinned to the board before gluing the spar, using clamps and pins to keep it in place while the glue sets. Once the trailing edge assembly is fully cured it can be removed from the board, packed up with 3/8" spacers and then re-pinned over the plan.

Cut out the ribs, following the sequence shown on the plan for the trailing edge notch. If you try to cut the notch out after cutting the main rib profile you will break the thin sections of the rib. The rear ribs of the ribs are deliberately not cut to a sharp edge as they will be too weak; you can always sand them down after assembly, but I didn't bother.

With the leading and trailing edge assemblies in place over the plan you can now dry fit all the ribs. Depending on whether there was any spring back in the leading and trailing edge assemblies you may find that some adjustment to the ribs is required. If too tight



Simple firewall mounted motor suits electric or a .25 glow engine.



Open up the wiring access hole to get some cooling air to the LiPo.



Leave the slot open at the back of the fuselage to let the cooling air escape.

sand the T.E. notch a bit deeper (a 1/4" sq. Permagrafit tool is ideal for this) or if it is a bit loose just pack with scrap balsa. Once satisfied glue all the ribs in place. Note that W1 and W2 are shallower to accommodate the centre sheeting and be sure to get both W1s the right width apart as the fuselage sides butt up against them. It is a good idea to add gussets to the rear of the ribs now as this helps avoid breaking the narrow rear rib section whilst handling.

Once dry you can release the wing from the board, trim the L.E. and T.E. to length and glue the tip pieces in place. Use scrap balsa to make L.E. tip fairing pieces; these will help support the covering and give the tip pieces some bracing. Using a razor plane and sanding block shape the L.E. Aim for a smooth, rounded shape with a fairly blunt nose.

BOX FUZ

The fuselage is next but before you cut the sides check one of your batteries over the plan to make sure it will fit for height above the L.E. spar (we will notch into the top L.E. lamination for the battery to fit into). If the fit looks a bit tight add a few mm to the height of the fuselage side above the centre line. Once satisfied the sides are cut out in one piece. While you have the knife in your hand cut the 1/32" ply doublers as well.

Cut the L.E. profile out of each fuselage side then cut each of the sides in half lengthwise along their centrelines. Doing this will allow you to fit the sides over the L.E. and T.E. When you are happy with the fit you can glue the fuselage halves together against W1, which acts as a doubler over the join. Adding ply doublers at the front ties the longitudinal fuselage joint together.

While the fuselage dries cut the firewall from 3/16" marine ply (1/4" ply will be fine too). Mark the position of your motor mount and drill the mounting holes and a central hole for the rear motor shaft, if required. Fit your mount using T nuts, securing the nuts with thin cyano once they have been pulled in by the bolts. When the fuselage is sheeted you won't have access, so they need to be secure. While the mount is in place mark out a slot for the motor wires to pass through the firewall and cut it generously to let a bit of air through to cool the ESC. When happy you can unbolt your motor mount and glue 1/4" square balsa strip to the back of the ply, then glue the

firewall to the inside of the fuselage halves. Make sure the firewall is square; there should be no down thrust, and I haven't felt the need for side thrust either. Use epoxy or PU to secure the firewall.

Cut a slot in the top lamination of the L.E. between the fuselage sides, but DO NOT cut into the spruce spar. This should provide an easy fit for your battery to slide through. Cutting this notch does not weaken the structure to any significant degree, as confirmed by the flight testing, but it does allow the battery to be moved backwards and forwards to achieve the all-important balance. My prototype was built with a much shorter fuselage, but it quickly became clear that to achieve the C of G, I would need to add a drastic amount of nose weight. So out came the saw and a longer nose was grafted on. Such are the tribulations of own design development!

If you intend to fit an IC engine you will probably have to shorten the nose to achieve balance.

Add the 1/4" triangular stock to the fuselage upper and lower edges to provide a seat for the top and bottom sheeting. For the bottom sheet use 1/4" soft balsa; longitudinal grain is fine. Leave the top sheet off for now as you are going to need access for the innards.

Now apply the centre section sheeting using medium 1/16" balsa to avoid damage from clumsy handling. Prior to fitting you might want to feather in the rear ribs of ribs W1 and W2. Apply the sheet cross grain in the normal manner, gluing to the top of W1 and W2 and butting against the L.E. and fuselage sides.

While the above assembly is drying cut out and glue up the fin using light wood as we don't want too much weight at the back. Round the leading edge and top a bit for appearances sake but leave the trailing edge square; it will make the fin more effective.

With the fin built you will need something to stick it to, so cut a 1/4" balsa fill-in piece to extend the T.E. assembly further into the fuselage. This forms a platform to support the front end of the fin and I also used it to attach the elevator servo rails. Mark the centre line on the platform and T.E. to help align the fin. Cut some 3/8" triangular stock and glue it to the platform/T.E. just far enough apart to afford a tight fit of the fin in-between. Do not glue the fin in place yet. Once dry, sand the rear ends of the triangular fillets to fair them in.

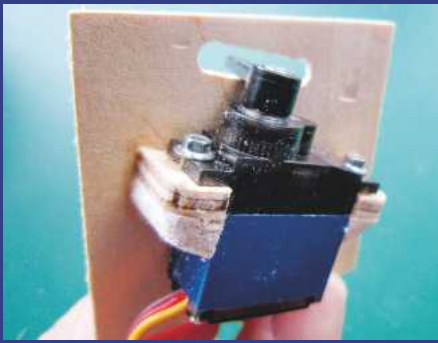


Elevator servo and receiver are located at the back of the R/C bay.

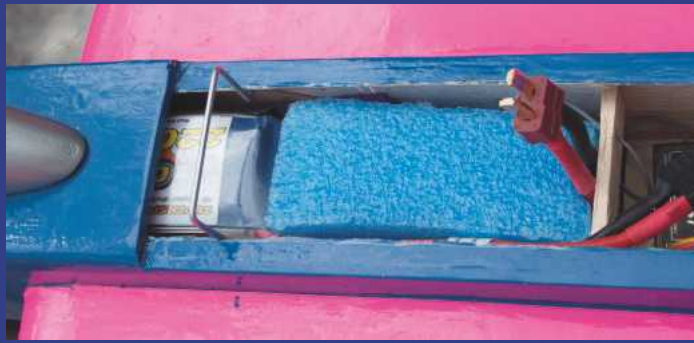
RADIO FIT

You will need three mini-servos, one for each aileron and one for the elevator. I would advise using metal gear jobs, simply because it is possible for the control horns to get snatched by the undergrowth during belly landings, with consequent shock to the servo transmission. I used Tower Pro MG92B units from Webbies Servo Shop. Whatever you use, mount them so that the push rods are kept as short as possible to discourage any control surface flutter at high speed.

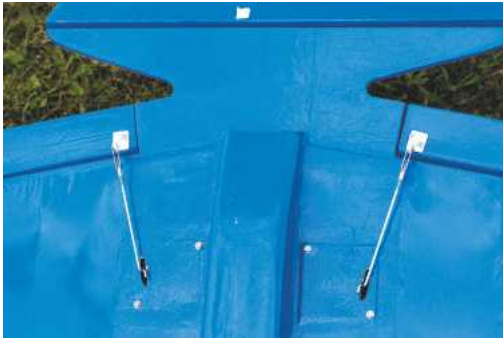
The elevator servo is mounted via the fin platform, as described earlier, whilst the aileron servos are mounted in the wings. The 1/16" ply hatch/servo mount assembly is easy to knock up but remember that the wing depth is pretty shallow so make sure you have enough clearance. You may have to sand back the ends of the servo rails to match the internal profile. The hatch can be tack glued, then held in by the covering material. Or, as I did, provide supports for two short hatch retaining screws to be added after covering and don't bother tack gluing. This allows the servo bay to be opened up in future if required.



Each aileron servo is mounted beneath its hatch.



Battery bay showing the rear foam packing piece and the temporary C of G checking wire hooked under the upper triangular support strips.



Aileron pushrods are short and slop free.



Elevator pushrod has a straight run too.



With the wire hooked in place checking the C of G is a doddle.

“...before you cut the sides check one of your batteries over the plan to make sure it will fit”

My Futaba receiver tucks in at the back behind a battery retaining former, leaving all of the rest of the fuselage for the battery. The ESC sits on the floor under a cross grained 1/8" balsa insert that serves as a support for the foam packing used to keep the battery in place. Place another cross-grained insert in front of the wing to support the foam, which will locate the front end of the battery.

A QUESTION OF BALANCE

Next, have a quick sanity check on the C of G. With the servos, Rx, ESC and fin all in place the motor is temporarily bolted to the front and the battery slipped in. Place a wire rod across the fuselage, under the triangular strip where the balance point should be (70mm from the L.E. at the root). When holding the model up by the wire rod it should hang horizontally. If it doesn't then correct by moving the battery backwards or forwards. In the unlikely event that you can't get the battery far enough forward to achieve balance then you may have to consider moving the motor forwards by use of stand offs.

Top sheeting and a hatch can now be fitted and the whole thing sanded to round the corners. My canopy was made from scrap block balsa sanded to shape, filled and painted. No covering was applied.

The ailerons can now be cut from the T.E. Make sure you mark them L and R, as there is bound to be some small difference, and also make sure that there is a small amount removed from each end to make them bind free when covered. Depending on whether you are going to top or centre hinge, chamfer the aileron L.E. accordingly, but DO NOT round off or taper the T.E.

If you haven't already done so, cut the elevator from the tail and prep its front edge as per the ailerons - again do not round or taper its T.E.

PRETTY IN PINK

Time for a good sanding all over and a decision on covering medium and colour scheme. The obvious choice is film, especially for electric, but whatever you choose keep it light. I went for the scientific 'what do I have in my left-over film box?' approach. The rather

gaudy fluorescent pink Solarfilm I found promised good visibility when matched with a darkish blue for the underside. There was enough of each colour in my box, so the decision was made.

After covering cut a slot in the rear upper fuselage sheet to accept the fin and glue in place. Fit plastic horns of your choice but keep the aileron ones as short as possible to minimise snagging in the grass, cutting off any excess above the clevis. Connect to the servos with 2mm rod. I use a Z bend at the servo and a metal clevis at the horn, but whatever method you use make sure it is slop free. Adjust ailerons and elevator to be at zero degrees at servo neutral. There is no reflex with this aircraft and as for movements use the settings in the Datafile as a starting point, then tweak to your own taste:

Repeat the C of G check, this time in the fully finished condition, and shuffle the battery to achieve the location marked on the plan. Slide some firm foam in front of the battery so that each time you insert a fresh pack you just have to slide it to a stop and the C of G will be the same. Fit a similar packing piece behind the battery.

*Grooving around
- as if on Laystrate!*



*Square fuselage
provides a good
grip for hand
launching.*



BEST BIT

I knew from extensive flying with the indoor version that the C of G should be somewhere near correct. Still, there is always some element of doubt...

The day came and with control checks complete my assistant, Richard got the nod to launch for the maiden flight. Mindful of the excess power available, I was only on half throttle. Even so it climbed alarmingly steeply on release, so the throttle was pulled back a bit while I fumbled for some down trim and soon things were a lot calmer. The elevator was more sensitive than expected and my experience with the indoor Simplex led me to believe the C of G was a bit rearward. It was still easily controllable though, so I flew on and felt reasonably happy with it. A stall check resulted in a nodding steep descent, with no wing drop. Back on the power and a roll to inverted resulted in another desire to climb steeply, which further confirmed my suspicion of a rearward C of G.

Safely down, the battery was moved forward. Re-launching with a fresh battery, the flight characteristics were truly transformed. Pitch was now quite neutral at different throttle



*Simplex Max can be
flown tight and low.*



Be sure to use a contrasting colour for the underside.

“The moral is that it is worth taking some time to fine tune the C of G and control movements.”

settings and inverted flight required just a dab of down, just as it should be. This was much more confidence inspiring, so the flight envelope was explored a bit more deeply.

Rolls are fast, but with 40% expo programmed in you wouldn't call it twitchy. In pitch it is responsive, but I found that during max rate turns the model would nod its head a bit. Funnily enough I remember our C/L combat wings doing the same if the elevator movement was too great, so for future flights the elevator end points were turned down a bit and now this characteristic only recurs if I try to turn too tight at very low airspeed.

The moral of the above story is that it is worth taking some time to fine tune the C of G and control movements. If you have to introduce up elevator trim more than a couple of millimetres from the zero datum, then you probably need to make a C of G adjustment. Do it a little at a time and you will be rewarded with a sweet spot that will make all the difference. If you have any down elevator trim you definitely need to move the balance forward.

After being concerned that the excess power could prove to be a handful, I was happy to find that it is fine so long as you remember that you do have a throttle stick and use it progressively rather than as an on/off switch. As I said at the start, this model was never designed for speed

so while it will go quite fast, it is much better to use the high end of the stick for vertical punch and lower settings for everything else. Your reward will be longer flight times - expect to get seven minutes plus from your 3S 2200mAh packs.

PILOTS NOTES

Pilot skill level - not for beginners, but if you have low wing sports model experience you should be fine.

Take off - can be launched over or underarm, but don't use full throttle unless your set up is of modest power. There is no tendency to torque roll so everything should be smooth and uneventful.

Aeros - just do it! (But remember it doesn't have a rudder.)

Landing - This is no thermal soarer, even though the wing loading is pretty low. You can do a full gliding approach given decent height, but it is much better to have some power available. Once you are over the patch and just a couple of feet up, you can throttle back and let it sink onto the grass. The APC prop has shown itself to be tough enough for these belly landings.

So, if you fancy a compact, easy to build, cheap fun machine, this one might be just the job. ✈️

DATAFILE

Model:	Simples Max
Model type:	Sports aerobatic
Designed by:	Mike Bell
Wingspan:	1m (39in)
Fuselage length: (inc. motor)	64cm (26in)
Wing area:	0.3sq.m. (456sq.in.)
All-up weight:	0.9kg with battery (2lbs)
Wing loading:	3kg/sq.m. (100z/sq.ft.)
Power:	300-400W electric or o. 25 cu. in. IC
Rec'd LiPo:	3S 2200mAh
ESC:	50 - 60A
Servos:	3 mini (metal gear recommended)
Control deflections:	Elevator - 20mm up and down, 40% expo. Ailerons - 20mm up, 15mm down, 40% expo.

Once over the patch and a couple of feet up, throttle back and let it sink onto the grass.



Performance EDF's at Affordable Prices

These EDF units are a new generation of performance EDF units at an affordable price.

The prices include a brushless outrunner specifically designed and developed to work with these units. All of the fans are dynamically balanced at the factory and are therefore vibration free and very efficient. All fans have either 11 or 12 blades which gives them a great "turbine" like sound which adds to the experience of owning a "jet" model.

The 50mm FMS fans are those as used in the Tony Nijhuis "Mini Jet" series, as recently published in the RCM&E.

Diameter	Part Number	Thrust	Price
50mm	FMS 5400kv (3S LiPo - 358W)	620g	£36.99
50mm	PowerFun 4900kv (3S LiPo - 318W)	605g	£28.99
50mm	PowerFun 4430kv (4S LiPo - 458W)	765g	£28.99
50mm	FMS 4500kv (4S LiPo - 486W)	1,086g	£36.99
64mm	PowerFun 3900kv (3S LiPo - 434W)	872g	£32.99
64mm	PowerFun 3500kv (4S LiPo - 541W)	1,072g	£32.99
70mm	FMS 2750kv (4S LiPo - 740W)	1,253g	£64.99
70mm	PowerFun 3400kv (4S LiPo - 776W)	1,435g	£39.99
70mm	PowerFun 2300kv (6S LiPo - 1148W)	1,816g	£39.99
90mm	PowerFun 1450kv (6S LiPo - 1561W)	2,924g	£79.99
90mm	PowerFun 1450kv (8S LiPo - 1528W)	3,360g	£79.99



Complete Electrical Setup For Simplex Max by Mike Bell



Please visit www.4-max.co.uk/customermodels98.htm



Part No.	Description	RRP
PO-3547-1190	35mm Brushless Outrunner Motor	£35.99
4M-ESC60A35	60A Brushless ESC	£44.95
APCE 11x5.5	APC Electric 11" x 5.5" Prop	£4.30
3x 4M-175DMG-030	3x 17.5g Digital Metal Gear Servo 3.0Kg	£22.47
PPL-40C3S-2200	11.1, 40C, 3S, 2200mAh LiPo Battery	£19.99

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A simple tool board like this offers easy access to your most used tools.



It's simply made from scrap wood.



The basic structure can easily be modified to suit your own needs.

TOOL CADDY

In response to our recent request for your workshop pictures (feature coming soon!), Nick Ward also sent in details of this handy tool carry board.
words & photos » Nick Ward

This tool board project is a response to my realisation that despite attempting to confine my model building to the shed and the dog-room, where our springer spaniels sleep, I was steadily creeping back into old habits; the kitchen bench-top is perfectly flat and large, perfect for laying out plans, framing up fuselages/wing panels etc., all much to the annoyance of my beloved wife.

Don't get me wrong, my wife is extremely supportive of my hobby; she has her own creative interests and when we are not gardening together, we often find ourselves sharing the kitchen/living area doing our respective thing.

What annoys her (and frustrates me) is the constant to-ing and fro-ing from the other modelling areas to retrieve tools, followed by the inevitable leaving of most of it out overnight while glue dries and I can't be bothered making the necessary trips to return said tools to their original storage positions!

Most of what I do on the kitchen bench and dining table is related to 'fitting out' radio gear, making up push rods etc. and balsa bashing. Even basic tasks in the building process require a surprising number of different tools and measuring equipment - too much to carry in a couple of handfuls.

This project is not trying to cater for covering and finishing as these operations require 'smelly-stuff', hence they are better left for the shed.

Rather than give a definitive plan to follow, I thought I would give the approximate

dimensions of the bench top tool caddy I came up with. Together with some photographs these should be enough of a guide to get you started if you fancy making one, as I am sure that everyone's requirements in terms of size/shape/tool capacity etc. will be different.

THE BASICS

My caddy was built from some scrap 12mm indoor ply I had left over from another project. The main tool board/carry handle piece measures 16 x 12 inches (x 25.4 to convert to mm).

The base is 13 x 9 ins (allowing for wood thickness) and the front/back walls were 1.5 ins, with the sides triangulated to a height of 3 or 4 inches where they join the tool board for better reinforcement. All pieces were cut out with a jigsaw and the edges cleaned up with 100 grit sandpaper/emery cloth.

I tend to 'over-engineer' my projects; I like to screw them together first, ensuring a satisfactory fit, before taking apart and liberally applying PVA to all the joints before screwing back together and wiping excess glue into the seams with a damp rag.

Sealing with a couple of coats of polyurethane varnish is a good idea to prevent any coffee or tea spills getting into the wood.

The fittings were a combination of cup hooks, plastic U-clamps from garden irrigation and galvanised plumbing brackets of various sizes that I had lying around in my shed. The ledge is there to support pencils and modelling knives etc.

MAKE IT YOUR OWN

There is so much scope to personalise one of these. So for any of you who have not yet delved into the dying art of scratch-building, or if you just fancy building your own version as a project to suit other hobby requirements, this caddy is a great way to store in one place your basic tools in an easily transported, compact package. Mine is in constant use.

*Greta should approve.
Traditional models, engines
and radios are eco-friendly!*



THUNBERG-ING THE FUTURE

According to Whittaker, modern eco-awareness dovetails nicely with traditional modelling techniques. words & photos » Alex Whittaker

The truth is, many modern foam models are very easy to put together. Assembly barely requires the IQ of a fridge magnet. Now there is nowt wrong with that. However, as many modellers are re-discovering, making things yourself can be very rewarding. A few years back I decided to make my own homage to the great David Boddington, and my 'Keil Kraft Years'. In their joint honour, I designed my own Boddo-esque RCM&E Bushwhacker, a traditional 52" span high-winger. It turned out as an easy-build, three-channel, trainer-cum-sports model. I even put G-BODD on the fin and the printed plans. Bushwhacker did well as a free RCM&E plan (MAG1560) and, almost two decades on, it is still available as a Ben Buckle traditional kit.

Now before you ask, no, I have never received any kit, plan or CNC pack royalties! We do this all for the love. At least that's what the Editor tells me...

TRAD BRIT DIY

However, I had an ulterior motive behind the design of Bushwhacker. At the time wooden Clubman ARTFs were at their zenith, and I wanted to re-affirm traditional values. I decided to use the Bushwhacker build process, and its articles and plan, as a thinly disguised 'teach in' for Trad. Brit. constructional techniques. Therefore, Bushwhacker had banded-on wings, hand-made wheels, and a hand-bent piano wire undercart. Furthermore, she had other traditional features like sewn-on hinges for her control surfaces. As we used to do in ye olden days, the new model even had its own (pre-nylon) home-brew bespoke radio clevises.

BACK TO THE FUTURE

The threat to model shops, the reduction in the easy local availability of commercial accessories, plus the rise of the eco frame of mind, now renders those traditional 'DIY' ideas suddenly fashionable again. Mind you, saving

dosh and building everything yourself has never been out of fashion with many careful Trad. Brit. types. As we all know, there are still many unashamed, ruggedly individualistic shed survivalists out there. Those who eschew excessive plastic modernity and prefer traditional hand fabricated solutions.

So, aside from the balsa, everything in Bushwhacker was deliberately chosen so as not to be 'mission critical'. Aye, you could totally ignore modern fripperies like plastic servo mounts, nylon control horns, plastic hinges, plastic tanks and plastic wheels. Now for many 'build it yourself' modellers this minimalistic concept remains a truly liberating thought. You can do it all yourself, lo-tech, and within your shed, and reduce your reliance on petro-chemicals, world transport and toxic plastics. Basic renewable materials in one end of the shed and a fully functional radio model out the other. Yay!



Building your own traditional model is truly satisfying.

ENGINE MOUNTING

Eschewing the plastic, I also dispensed with the use of a commercial nylon engine mount. In fact, I had a bit of innocent fun with my faux-patented 'Pow'R Plate'. This was no more than a slide-in flat plywood engine mount.

It let me test-fly the prototype with four different powerplants: diesel, glow two-stroke, four stroke and a 'leccy motor. Aye, electric recidivism was alive and well then, too. In this way I knew my design was viable with a variety of power plants. My ace clubmate, Neil Shirley even made his Bushwhacker 'Dual Fuel' - both glow and electric. Niftily, my slide in Pow'R Plates had the required IC engine off-set fretted into the plywood, so I could vary the right-thrust for each power of engine. The plate was held between two beech beams on each side and simply secured with some wood screws.

Slacken the screws, slide out the first engine, pop in the second on its own Pow'R Plate and an engine swap took five minutes flat up at the field.

The only issue was that, for lightness, I originally used quite thin plywood for the engine plate. Oddly enough, the two strokes were okay but the less frequent bangs of the .30 four stroke glow option resonated a bit too much! Next time I reckon I would use slightly thicker ply for four strokes to dampen the vibe. Beyond that, it is a system that works well.



Enya SS 15 glow on the Pow'R Plate!



These screws retain the plate in the tight slot, facilitating easy engine swaps.



Ply engine plate slides into a tight slot between beech bearers.





Use good quality colour coded thread from the haberdashers or craft shop.



Mock-up surfaces to develop your sewn hinge skills. Use cyano to seal the knots.

SEWN HINGES

Let's start simply. Most of us these days will use commercial nylon or plastic hinges, or those nifty cyano-in 'paper hinges'. These require adequately thick balsa sheet for the control surfaces because we have to slit the balsa to slide the hinge in and glue it up. Now, when we were nippers making traditional control line kits there were no commercial hinges and we used other means to hinge elevators. Also, in such models the balsa used for elevators and rudders was often too thin to slit. Thus, we used sewn-in hinges.

Therefore, my method with radio models like Bushwhacker is to first build and cover the model. I then take the covered control surface, say the elevator, and mark out where I want the holes for the stitches of the hinge to fall. To mark these out, I use a handy Rollertec drawing aid whose ruler has a neat run of holes at 1/4" centres. (About a tenner second hand on ebay UK). This gives me the pitch of the holes on the elevator. This line of holes runs about 1/4" in from the edge of the projected hinge line. The line of holes on the tailplane are similarly marked out at 1/4" centres. However, these were offset by 1/4". This is to allow the hinge thread to zigzag down the surface as it is sewn.

The photos show you what I mean. I use thick thread from the haberdashery shop, craft shop or sewing machine shop. I was careful to 'code' my thread. In other words, to choose a colour to match my covering, in this case yellow.

Before tackling your model, I advise you to mock-up a short test piece of a dummy tailplane and elevator joint to practise getting your stitches correct. With my method (there are others), I use a thick needle or bodkin to open the sewing holes through the covered surfaces. I then use masking tape to hold the tailplane and elevator together at the correct place relative to each other. Then, beginning at a hole at one end, I take a quick stitch at the end of the elevator, to secure the thread. This first stitch holds the hinge line as I proceed to sew.



I used my trusty Rollertec drawing instrument to mark out the hinge holes.



Up through the elevator, down through the gap, and up through the tailplane.

The sewing method is to come up through the elevator from below, pass the needle down through the gap between the tailplane and elevator, and then loop up to the meet the bottom of the next diagonal hole. The needle then takes the thread up through the next tailplane hole to make the hinge, and repeat. It's like a figure of eight stitch: up through the elevator, down through the hinge gap and then upwards through the next diagonal hole on the tailplane. And sew on!

Note that if you don't go diagonally to the next hole, you will not progress down the elevator! It's much harder to read about than do. Trust me, your test piece experiments will make it all obvious. You only have to draw the thread tight enough to pull the surface against the thread in the gap. When you get to the end, and you are satisfied with that minimal gap, you can make an end stitch, and seal the knot off with bit of cyano. The completed sewn hinge should fall easily under its own weight, without any binding. Such hinges are wonderfully free in action, induce only tiny servo loads, and add negligible weight.



Rudder and fin with staggered holes so the thread will zig-zag down the hinge.

They distribute the load throughout the hinge line too, unlike spot hinges. I have control liners with fifty odd year-old sewn hinges that still work freely and correctly.

DIY CLEVISES

These are easy. With your servo fitted in the fuselage, you make up your 1/4" hard balsa pushrod as normal. You now need piano wire pushrod ends. So, using some piano wire that's thin enough to pass through the hole in your chosen servo output arm, make up, say, a six-inch pushrod end. The last 1/4" of this piano wire is now bent smartly at 90 degrees, to mate with the hole in your servo output arm. Once the wire pushrod end is bound and epoxied to the balsa pushrod the piano wire angle is pushed down from the top, locating into the servo arm. Now this could vibrate out of the servo arm in flight. So, we need to simply solder and bind (with tinned copper wire) a small length of very thin piano wire as a keeper.

The photos show you how. You repeat the process at either end of the pushrod, and Bob's your mother's brother.



Clevis piano wire matches the servo output arm hole. Keeper is thinner wire.



Balsa wheel blanks are scored or cut from sheet with dividers or compasses.



Balsa blanks on a set-screw mandrel are trued up in the drill chuck with a sanding block.



Sanding block set over at an angle to sand a chamfer on the wheel trim blank.

HOMEBREW WHEELS

Although I was a child of The Plastics Age, budget considerations in the 1960s and 1970s meant that those smart but sexy R/C wheels advertised in RCM&E were well beyond my pay grade. I lusted after those German chrome plastic wheels with their stylish whitewall tyres wheels, too. Ineffably cool, but way beyond my student grant. So, many of my early models used home-brew wooden wheels.

On Bushwhacker I revived the old technique: laminated balsa wheels, with brass tube hubs. These latter were cut to length with a tube rolled under a fresh scalpel blade. It works well on brass, ali or copper tube, but nowadays I tend to use a mini tube cutter.

To make the wheels I chose 1/4" balsa sheet. I scribed the diameter of the wheel I wanted on the sheet with compasses or dividers. If you scribe deeply from both sides of the sheet, the wheel blank soon falls out. I tend to use three laminations per wheel. The laminations were glued together with balsa glue, and a nice tight hole drilled to take the brass tube hub.

This hole is also used to mount the wheel blanks on an M2.5 x 60mm set screw. This screw, with the widest washer I had to hand under its head, was passed through the laminations and secured on the other side, with another large washer, topped off with two locknuts. This in effect becomes a mandrel, with its protruding thread used to mount the balsa blanks in the drilling machine chuck. When spun up in the drilling machine, I used my Permagrit sanding block to sand the wheel rims exactly round.

I then used a rat-tail file on the circumference of the wheel to cut a depression in the edge of the rim to take the intended rubber tyre. If you wish, you can use files or mini gouges to cut scale hub lines or profiles into the face of the balsa wheel as it spins.

On Bushwhacker, just for swank, I made slightly coned balsa hubcaps with sanded-in chamfered edges. It is all very quick easy and great fun to do. Once all parts were sanded smooth, I used lots of



Wheel (left) has a seat for the tyre cut with a rat-tail file, with chamfered wheel trim on right.



Inside face of wheel showing brass axle and washer.

ciano glue to harden the deep groove at the rim where the tyre will sit.

Obviously, my original choice of balsa diameter matched my intended tyre. For years, I used Hoover drive belts as tyres. I bought these in bulk in two sizes from market stalls or 'appliance fixer' shops. Rubber drive bands for machine tools and sewing machines provide another happy hunting ground. As for tyres in other sizes, I have found that miscellaneous exhaust and car part rubber rings, seals and doughnuts can produce suitable 'tyres'. Have a good nose around a car accessory shop - you may be surprised at what you might turn up. The brass tube hubs were simply epoxied into the wheels and finished with washers at the hub.

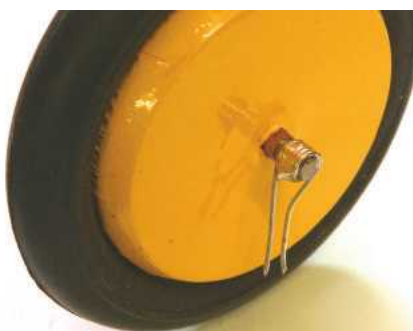
All in all, such wheels are a nice easy project. After literally thousands of landings my home-brew wheels have never given up the ghost. Laminated balsa, stiffened with cyano glue, is much tougher than it looks. Just make sure the



Wheel with tyre fitted and wheel trim ready to be glued on.



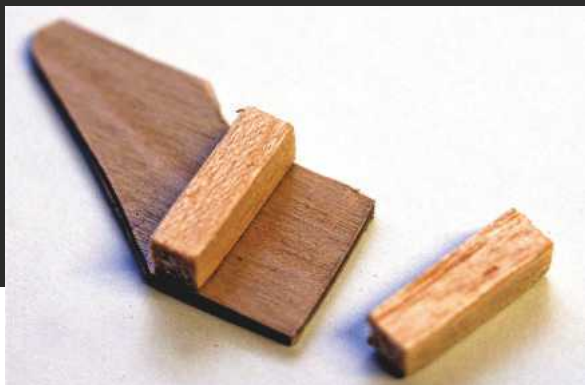
Wheel with tyre fitted and Solarfilm applied.



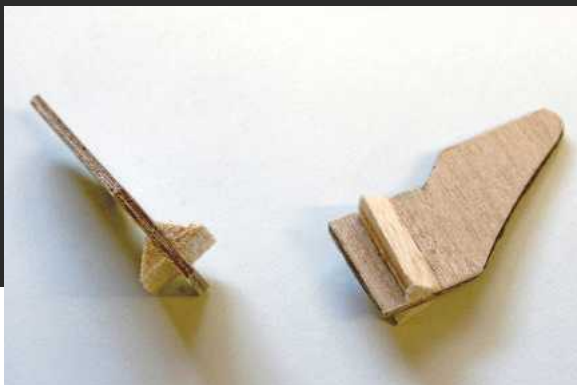
Use a twist of tinned copper wire and some solder to retain wheel. Snip off the excess!

lamination blanks are 'quartered' before you glue them up. In other words, their grains are set at right angles to each other. Finally, for wheel retention onto the piano wire axle, two or three neat turns of tinned copper wire soldered on works well. Be sure to thoroughly clean the jointing areas first with wire wool or emery cloth.

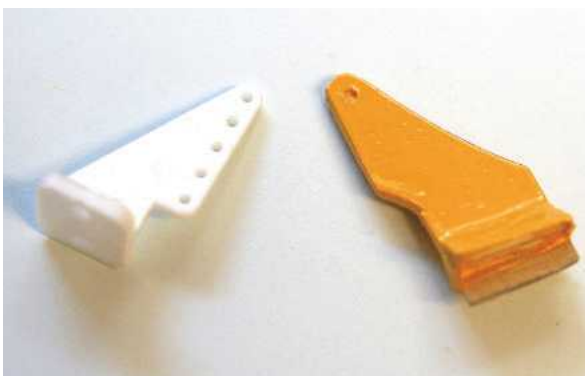




Basic idea of a DIY control horn: a plywood blade with balsa feet.



I found it sleeker to use triangular balsa for the feet.



Once covered in Solarfilm or painted it will look like a commercial item.



Hardest bit is cutting the neat slot for the blade through the control surface!

DIY CONTROL HORNS

These are a doddle to make. In fact, I just copied the normal commercial nylon design in wood. There are a number of ways to make them. Essentially, I make a lite ply blade, to site the clevis holes, and add two quarter inch balsa feet to support this blade.

Naturally, the flat blade blanks have first to be drilled to be a neat fit with your chosen DIY piano wire clevis. Note that the foot of the lite ply blade has to be long enough to go right through the control surface, where it is glued with epoxy. I cut the balsa square strip into triangular sections to 'fair in' the feet of the horns.

The hardest bit of this system is to cut the neat, tight slots through the balsa control surface. Sometimes, I make the lite ply blade long enough to go right through the control surface, with some blade deliberately protruding on the other side. This protrusion takes a keeper made from a short section of cocktail stick, pushed through. The lot is then epoxied up so it cannot pull out!

I confess that with normal commercial nylon horns I do prefer those that bolt through a surface to mate up to fishplates on the other side. Very secure indeed. However, these simple glued-in jobs on the Bushwhacker have lasted almost twenty years with no issues.

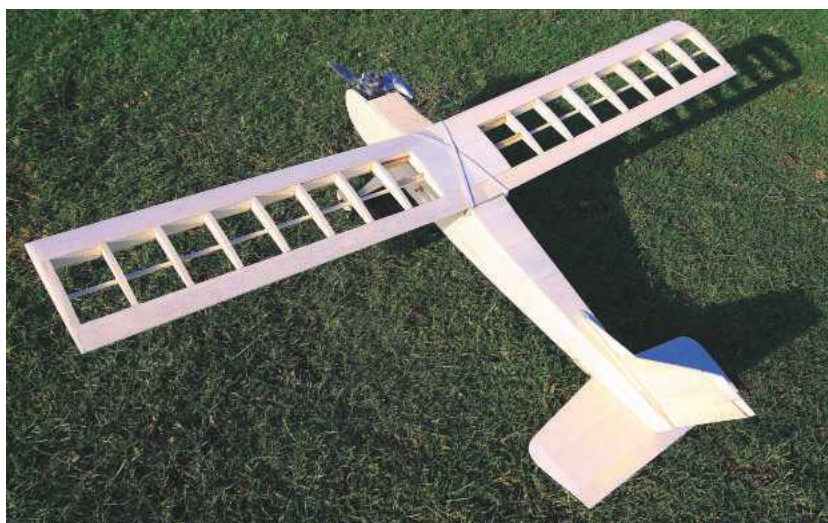
BANDED ON WINGS

Banded on wings are quintessentially traditional, wonderfully crash-proof, and quick and easy to install.

In the days of single channel, where you had no control over throttle or elevator, different engines of different power outputs produced different rates of climb. So, slipping

some balsa packing under either the leading or trailing edge of the banded-on wing could provide some adjustment to the rate of climb. For beginners at the building stage banded-on wings mean that no critically accurate marking out for wing pegs or retaining bolts is required.

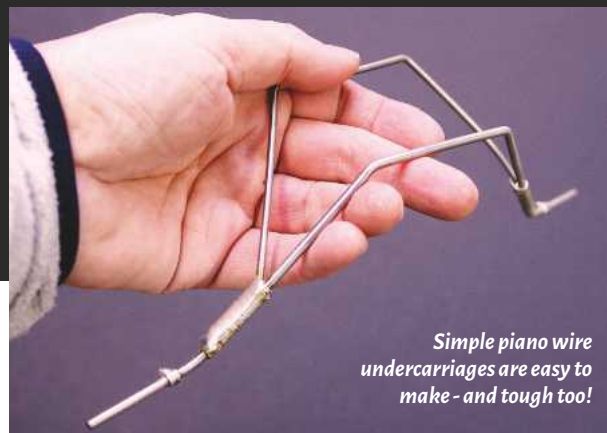
I love banded-on wings, though naturally,



Boddo and KK inspired Bushwhacker, a one-time free plan in RCM&E. Copies can be obtained from Sarik Hobbies.



Left: Banded-on wings and undercarriages aid a trainer's survivability in a crash.



Simple piano wire undercarriages are easy to make - and tough too!

with any traditional design that uses them, you can always choose to retrofit alternative bolt-on methods. Bushwhacker uses simple pine wing band dowels from the DIY store, with the ends lightly chamfered with a pencil sharpener, or the touch of a sanding block as you spin them up in your power drill.

For constructional simplicity Bushwhacker also has a banded-on DIY piano wire undercarriage. Now the Aeromodelling Ancients of Days Past were not stupid people. Banded-on wings and banded-on undercarriage can take a terrific amount of trainer punishment, avoiding all those bitter tears and emotional setbacks whilst you are learning.

Again, you can retro-fit bolt-on systems later if you prefer, which is a nifty compact learning project in its own right. Most of us like tinkering with established designs. Anyhow, both systems require local hardening of the airframe where the wing securing loads are to be transmitted to the fuselage via the dowels. In Bushwhacker I wanted simplicity. So, I went for simple lite ply strengthening discs, with neatly fitting dowel-sized holes in the middle. I simply stamped these flat doughnuts out of lite ply with one of my set of leather punches.

I got these inexpensive Chinese implements from a tool stall at a big summer show. These discs are simply epoxied on to the fuselage sides where the dowels need to be fitted. I also used identical discs to support where the radio aerial came out of the balsa fuselage. I even used one where the receiver switch's piano wire extension exited the fuselage.

Job done.

NEXT TIME

We'll make our own DIY tin fuel tank! ✈️



Above: Doughnuts provide local strength where needed for wings, undercarriage and aials.

Left: Using a leather punch to knock out doughnuts from scraps of lite ply.



You can still get the Bushwhacker traditional kit from Ben Buckle #NoRoyalties!

WOT 40!

40 years on, David Ashby finds designer Chris Foss still cutting WOT4 kits. words & photos » David Ashby





After 40 years, the Wot 4 remains in production.



That the first ARTF version of the WOT4 was so well received was thanks in no small way to Chris Foss' overview of the production process.

Here's a little-known fact of model aviation; I bet you didn't know that the WOT4 name first appeared on an experimental glider, and a V-tail one at that? It was one of Chris Foss' prototypes that didn't progress to a plan or kit, but he liked the name and gave it to the power model he'd been developing since the mid-70s.

The WOT4 first arrived as a foam wing/plan pack in 1979 and was so successful that word soon got around and shops started asking for a kit version. Chris obliged and the first boxes hit the shelves a year or so later. Not that the Foss name was unknown. The Middle Phase slope glider had been selling very well since its launch in 1976, alongside Chris' glider plan range. A versatile multi-purpose power sport model was the next logical development for the business.

DNA

Although the prototype first flew in 1977, the WOT4's DNA can be traced to the fun fly multi-task competitions earlier in the decade. Models were required to compete in a number of disciplines including limbo, touch & goes, climb & spin and pylon racing. With a built-up wing and matched with an O.S. 61 two-stroke, Chris' lightweight, 4.5lb design performed well. Flyers who saw it wanted one and a foam wing/plan pack was the eventual result.

Speaking of engines, Chris thinks that a .70 four-stroke is the IC sweet spot but a good .46 suits the '4 nicely too. The Mk.2 prototype flew with an unusual engine in the form of a Webra four-stroke, and the model still sits in a corner of the factory. Although some have tried a .90 four-stroke, as Chris points out, "Anything larger than the .70 makes the model nose heavy, so the extra power is negated to a certain extent by the increased engine weight and associated tail ballast necessary to achieve the correct C of G."



Launched in 1976, the Middle Phase was the first Foss kit. Like the WOT4, it still looks fresh.



The words 'timeless classic' were never more apt. This is RCM&E's review model from 2006.



Above: The Mk.2 prototype still sits in a corner of the factory. Note the unusual Webra four-stroke.

Left: It's a versatile beat where engines are concerned, although a .46 two-stroke is just fine.

Below left: Would you believe the name first went on a V-tail glider wing?

Below: The Mk.3 was redesigned with a pronounced under-fin to help with knife-edge flying.

EVOLUTION

Recognising the earlier 1977 design, the first kit version was a Mk.2. The Mk.3 followed in 1992 with a slightly tapered wing and restyled fuselage - in particular the under-fin and rudder were more pronounced to help with balance in positive spin and flick manoeuvres - and a variable position bulkhead so larger engines and four-strokes could be fitted with greater ease. Some flyers asked for the Mk.3 fuselage with the Mk.2's thicker, straight wing so in 1996 the Classic version was born. Both the Mk.3 and Classic have remained in continuous production ever since.

Chris admits that very little has changed over the four decades. "In some ways there was little to change, the WOT4 had its own style, and I was always conscious that it would become a different model if too much was altered."

PRODUCTION

So, what made it a best seller? For anyone who's flown one the question seems superfluous, but it was, and remains, the perfect combination of good flying traits, a very forgiving nature and strength that forgave mistakes and shrugged off the rigours imposed by a grass flying field, especially in winter. It could accept a wide range of engines and was easy to repair. Like all classic designs, be they cars or watches, there's something about the WOT4's styling that transcends fashion; it's rugged yet elegant at the same time. It looks 'designed' and modellers soon come to appreciate the thought and care invested when they start to build it.



Mk.3 was released in 1992 with a tapered wing and a restyled fuselage.



Chris' original sketches for a couple of famous designs.



Chris selects the wood for every kit....

...and every foam wing is checked before packing.



Every part of the kitting process moves through Chris' hands, and always has done.



Chris tested the water with the Wot Trainer before committing his special design to an ARTF.

Missing thus far is the word 'quality'. Chris' kits were always lauded for the fact, but the word takes on special significance when he reflects, "I was producing 100 kits a week at its peak, and at least 50 of those were WOT4s".

What's remarkable is that Chris has cut, packed and checked every single kit he's sold over the last 40 years. Not a single pair of foam wings has left the factory without his personal scrutiny. It's not just the 4s but Middle Phases, Phase 6s, Acrowots and so on. For each and every kit he'll have personally selected and graded every single piece of balsa, cut the parts, packed the kit, printed the instructions, stapled the boxes then printed and fixed the outer label. Jane, his wife, was in charge of assembling all the accessory packs - the nuts, bolts, control fittings and associated hardware. With that all done, and especially in the early days, he'd often fill his car and delivered boxes to the local model shops.



The ARTF versions have built-up wings.



This, the light and agile ARTF Pro version, is your scribe's personal favourite.

Consider that some 20,000 WOT4's alone have been sold over the period (you can assume a similar number for Middle Phases and Acrowots etc.) then, as Chris says with typical understatement... *"that's a lot of cutting."* More to the point, through blood, sweat and tears, no one can deny that he's earned and deserves every plaudit.

ARTF

Needless to say, volumes aren't what they were in the 80s and 90s. But the quality mantra, combined with a lean 'n' mean approach, gave the business a good foundation from which to weather the 'Almost Ready To Fly' tidal wave that arrived in the early noughties.

An ARTF version might seem inevitable with hindsight, accepting that a built-up wing would replace the kit's foam core version, but when Chris was approached by Ripmax with a view to producing an ARTF WOT4, he decided to initially test the water with the Wot Trainer (itself a scaled-up Uno Wot trainer) before committing his special design to the process. That the ARTF version subsequently sold in large numbers may come as no surprise, but that's also a reflection of Chris' involvement with the design and testing process. Several prototypes were rejected until he was happy with the model's strength and overall quality. People may complain about the resilience of their ready-made models, but almost never when the subject turns to the ARTF Wots.

ONWARDS

Plenty of Wot aficionados claim there's no substitute for the real thing though, so Chris is still at it, making kits, albeit at a slower pace than the heady days when he'd fill his van with 100 boxes for the Sandown Park Show and return home empty.

He still flies, mainly e-soarers, although his favourite grab 'n' go machines over the last few years have been a WOT4 Foam-e and the electric version of the WOT4 Mk.3. What else?

WOT4 TIMELINE

- 1977 - Mk.1 prototype flies
- 1979 - Mk.2 plan pack launched
- 1980 - Mk.2 kit commenced production
- 1994 - Mk.3 version released
- 1996 - Classic version on sale
- 2009 - WOT4 ARTF (produced by Ripmax)

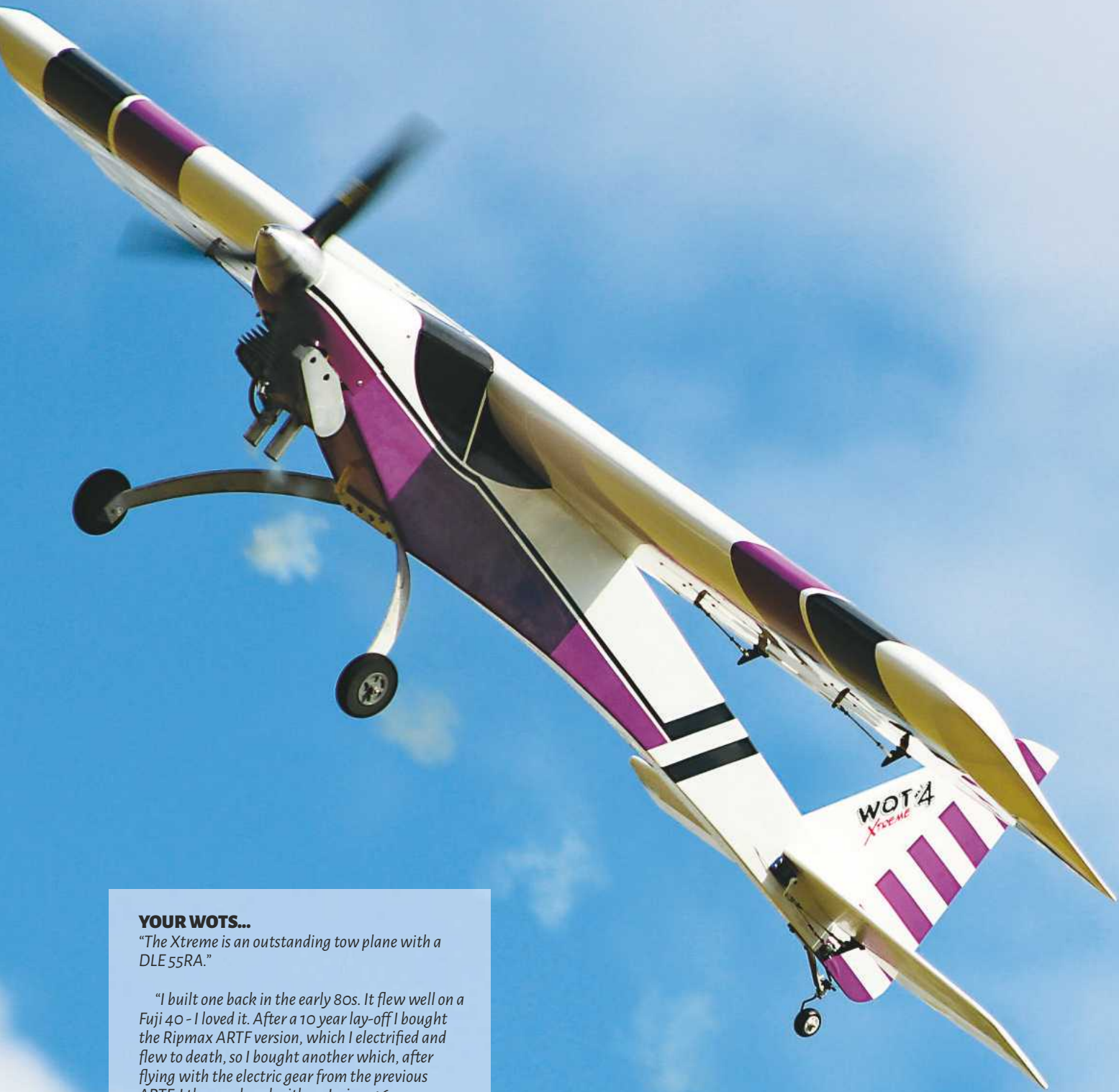
WOT variants have been plentiful. This is the balsa electric version.



WOT4's come in all sizes!



It's good to know that the kits will be in production for some time to come.



YOUR WOTS...

"The Xtreme is an outstanding tow plane with a DLE 55RA."

"I built one back in the early 80s. It flew well on a Fuji 40 - I loved it. After a 10 year lay-off I bought the Ripmax ARTF version, which I electrified and flew to death, so I bought another which, after flying with the electric gear from the previous ARTF, I then replaced with an Irvine .46 - even better. That one now is now deceased, and this time will probably be replaced by a Chris Foss 'build it yourself' Wottie."

"I had one and it was a very nimble model... Maybe mine was exceptionally nimble as, when I joined the wings, I accidentally had the halves upside down and ended up with about 1" anhedral!"

"I built my Mk.3 with extra-large control surfaces and ran an Irvine .61 two-stroke. It flew ballistic! A dead stick too far from home shortened the life when it came down in the only place in the field with rocks sticking out the ground." 

Let's not forget the XL and, this, the Xtreme, seen here with a 50cc petrol engine.

John Woodfield with a small selection from his vast collection of stunning old timers.



ELYSIUM FOR SLOPE SOARING

After last month's inspiring trip to the Alps, Simon Cocker encourages us to try coastal soaring

words » Simon Cocker | photos » Simon Cocker & John Woodfield

I am addicted to YouTube; the phenomenon is officially gripping, just like model aviation. It is captivating and absorbing, the process of being consumed by YT is a time warping experience. I will often check out a link sent to me to view a model glider video clip of just seven minutes, yet 90 minutes vanish. As YT users will already know any subject matter can prick your interest, no matter how diverse; life's fascinations are not confined to just aviation. Last night I learned how to wood turn beautiful bowls and vases using a knurled tree root blended to a pigmented clear casting resin and then a documentary about the US Navy's new Ford class aircraft carriers. Finally, I watched the flight of the first model turbine version of the Antonov An-225 Mriya, which was a stunning example of the type and built to the same scale as my PSS version. But then I spotted a clip about the new Rossi Jetman vertical take-off wing... It never ends!



Bird of Time. These boys had a relaxing time flying it over Hells Mouth.



John Beech with his high viz Bird of Time. Airbrakes were added for flying from the Cim Farm coastal site



John Woodfield shows us the unique curves of the delightful Fillions Champion. 111-inch wingspan from a 1946 free flight design.

RELAXED FLYING

Just as I decided to call it a night YT offered the next list of videos, each with a pop-up image to tempt you to open its content. A bright yellow see through glider was being presented to a sunny seascape from the edge of a Cornwall cliff and I was suckered in to see more. It was a Leprechaun vintage style, rudder/elevator floater flown in a sublime fashion by John Woodfield, who presented four minutes of beautifully filmed relaxing video. This clip had received 287,529 views at that point in time, which illustrates the level of interest in this style of cliffside soaring. The simplicity and purity of the pretty model combined with its natural propensity to soar so slowly enabled John to enjoy circuits close to the slope and then to execute a single-handed capture by its curvaceous nose. The model maintains flight while arrested in John's hand for a few moments before it is released to float on once more.

I felt immediate synergy with this scene - it was just so inspiring that I had to quell the strong urge to rush out to buy a laser cut kit and build one of my own the very next day!

Last year, while on the Welsh cliffs of the Llyn Peninsula, I spent a glorious gentle evening with a group of chilled out model aviators who were basking in the low rays of the summer sun while a lazy wind wafted up the rocky cliff face to greet us. I was a little disappointed to realise that all my gliders were inadequate to handle the conditions; they were simply too heavy to fly safely, so remained rooted to the ground for fear of them dropping into the sea if I tried my luck. I had left all my electron assisted sailplanes behind, so convinced was I that my trusty old thermal sniffing and lightweight Multiplex DG300 would be up to the job.

Paul Jubb was coasting gracefully along the cliff edge with an open structured vintage style rudder and elevator model, which I assumed he had purloined from one of the elders. It flew so majestically in the 5-10mph breeze that I became a little mesmerised by its lack of pace, but the way the ancient aircraft pirouetted around in a stall turn and hopped over the fence to pass in front of our noses was pure joy. No other models could

manage to stay aloft in the wispy lift so Paul had a captive and envious audience, all of us wishing we had a similar type of characterful model to join him on this perfect occasion.

I should mention that usually Paul is keen to thrash his moulded models on the big air days, as we all do, so this scenario once again proves that you have to have a wide variety of aircraft to contend with the ever-changing wind and weather conditions. To my surprise I discovered that Paul had built this model from scratch for just this eventuality and he graciously offered his transmitter to me so that I could sample the experience. Recently retired from a busy career, Paul returned to fill in some of his early life yearnings and he confessed that this was one of a number of projects on his long list.

I used to enjoy long boating in my younger years, where you learn to adapt from the speed of normal transport to the snail pace of a chugging diesel. I dropped into canal boat mode, added the third dimension and steered the old glider up, down and around Hells Mouth, lightly dabbing the creaky tiller/rudder to nudge the old timer to the next turn point. I really loved it, so I guess that must mean that I too am getting old...

JOHN'S VIDEO DELIGHTS

When I saw the YT video presented by John Woodfield I was immediately transported back in time to this sublime experience on the picturesque Abersochs cliffs and those ten minutes of Tx time came flooding back with feelings of fondness and inner peace.

The Leprechaun that John had built was scaled up to a sufficient size to offer a wing loading of just 8oz./sq.ft. and it has ample presence in flight. I then found a series of further short videos posted by John, beautifully and thoughtfully edited, showing numerous variations on the theme of vintage rudder/elevator open structure, lightweight models, each with a slightly different flavour and appeal to waft about in light breeze conditions. His lilac covered Southerner is built from a Belair laser kit and has an extended nose to compensate for the removal of the diesel engine and to keep ballast down to a minimum in this section. HobbyKing supply the acres of transparent film that John consumes.

It is John's wife who calmly captures the smooth video footage; she has a steady hand and an excellent eye for recording the interesting aspects of the flights. The models



John designed this 96-inch span canard, which you can watch flying on his YouTube channel. Very manoeuvrable.

Looks windy but this model is quite slippery.



Lovely Super Sinbad floating along the Perranporth cliffside in a waft of breeze - idyllic!

are kept in reasonably close visual range to maintain the viewer's attachment to the scene being played out; focus is constant and there is never sickly induced shaky camera syndrome, all of which keeps you hooked on the sunny seascape settings. There is some lovely air to surface footage from John's Salto, which reveals the full extent of the beauty of this area - the turquoise sea below is simply magical.

John and his wife both moved down to Perranporth in Cornwall to find peace and harmony. Due to John's early retirement from the Police force he has chosen to use cliff soaring as his therapy and full-time pursuit. The building side of his obsession is as consuming as the flying aspect of the sport so that there is always a 'next model' under construction. During the course of his modelling career so far, John has built approaching 500 models of all types including scale sailplanes and a wide selection of PSS types. When John was an infant his father nurtured and encouraged his modelling enthusiasm and he recalls attending the Lakes gliding holidays, which sealed his lifelong commitment to this serene aspect of the sport. He has kindly provided some photos which illustrate the natural splendour of cliff soaring so evocatively and which I share with you here.

John's 11,100 subscribers to his YouTube channel mean that he has friends from around the world who visit the area in the summer to fly with him on those halcyon days. I do hope you find the perfect weather window to immerse yourself in 3D heaven beside the sea this year and that you become as addicted as the rest of us.

SCALE GLIDER FESTIVAL

The Scale Glider Festival was hosted by the Clwyd Soaring Association between the 6 - 8th September 2019.

Arriving at the picturesque Clwyd slope events is always a joy due to the warm Welsh welcome from Ruth and Martin Rees and all of the chatty members of this well-established club. The close proximity of the car park relative to the flying area also keeps a lovely convivial vibe in the camp.



Dave Worrton about to fly a 4m span Libelle in the underwhelming lift at the Horseshoe Pass.

In fact, from rigging at their regular site up at the Horseshoe Pass to the launch point was just 25 metres. The wind shifted to their roadside take off area by lunch time, which meant a 120-metre walk, but no one complained! The topography here is undulating and certainly not overly exciting, with ample interference from other hills ahead, so the lift was underwhelming, and we all struggled to maintain flight.

The fickle wind persisted, and it started blowing tangentially to the slope face and bringing bouts of precipitation to deflate our resolve. We agreed to decamp and divert to a more favoured slope in the area overlooking Llangollen, where the remaining proceedings unfolded over the weekend. The drive up to this slope is quite steep and narrow in places, so be aware when you plan your visit to this year's event. Parking beside the road on the grass verge became a little sparse but nevertheless we all squeezed in. The walk across two fields to the slope edge was worth the extra effort and rewarded by a stunning vista and a breath-taking flying arena. The slope face is steep and smoothly consistent in its rapid decent to the valley floor 274m below, generating buoyant lift throughout the day.

The landing area was more than generous and free of immediate hazards. There is a barbed wire fence bordering the rear boundary of this field and also at the front where we launch our aircraft. The wind was charging across the valley with sufficient intent to rule out any flying from the adjacent

hang-gliding club, so we were blessed with the full and free use of the slope. Launching in this healthy breeze enabled the safe despatch of all gliders as the forward fence is positioned in lift and non-turbulent air, so no mishaps ensued. I did almost fly my 1:3.5 scale LET DG-1000 into this fence as I opted to launch from the promontory set back from the fence, with assistance from the FES. Dave Worrton gave the 5.33m span model a gentle push, while the folding propeller unit was intended to whisk the model away. The DG-1000 began its climb with the reassuring sound of propeller blades biting hard into the dense Welsh air when suddenly the whole spinner/propeller assembly disconnected from the motor shaft, leaving the aircraft helpless and devoid of energy. It was hanging on the verge of a stall, so I dived at the fence for essential airspeed, the safest option as there was not enough space to touch down and stop in time. The DG-1000 kissed the grass before skimming over the top rung of the barbed wire, accompanied by shrieks of alarm from the audience. Schambeck scale spinners are held to the motor shaft with two 3mm grub screws, which is perfectly adequate provided that corresponding flat spots are first ground onto the shaft and a tiny drop of thread lock is introduced for future security...

Steve Fraquet is one of the regular attendees to this event. He campaigned many old timer sailplanes from the depths of his burgeoning van. Every few hours another glider would appear, the path from the slope



From Somerset, Steve Fraquet is a charming character and a wonderful model aviator.



Steve Fraquet's Petrel gets a Worron heave into lift over the Llangollen valley.

to the car park area wearing out rapidly in his haste. I especially enjoyed the spirited displays of vintage flavoured aerobatics from Steve's sturdy old Petrel.

I had recently purchased a 5m span Rhonadler from Chris Williams, a rare opportunity as I just happened to log on to Scale Soaring Classifieds at the precise minute the model was posted for sale. Like the rest of the modelling community I usually miss the chance to own one of Chris' masterpieces, so the moment was all the more poignant as I was standing above an ideal slope, with perfect weather conditions and poised with a stunningly pretty vintage sailplane. I felt privileged to be the pilot and owner of the Rhonadler as she sailed effortlessly away into the heavens; these are moments that become embedded in your soul and Elysium is easily achieved with the euphoria given freely by nature. Chris made this model a resilient version of the type for the purposes of aerotowing and for mild aerobatics, and I enjoyed opening the taps to execute rolls and loops. The energy build up is gradual and short lived so manoeuvres have to be conducted quickly due to the dramatic decay of airspeed, however they look quite neat and not snatched thanks to the modern wing section (HQ 35/12 to the tip), which Chris has employed on the outer 75% of the wing span. The centre section (Gottingen 535 mod) uses a scale thickness that is heavily under-cambered and prevents the Rhonadler from ever reaching its VNE.

Our hosts for the active flying elements of the day were the ever-helpful John Minshell and Dave Worron, who flew the only PSS model at the event, a 108" span B-52. The model was my original prototype from the nineties, which soared beautifully in the plentiful lift. PSS is welcome at this event and should the wind direction be from the North West again this year, I shall bring along a TR1 and large Venom to add another dimension and interest to the proceedings.

John's H-Modell DG-600 broke up in the air preceding a high-speed loop and was sadly destroyed. We discovered that the carbon extension spar had sheared off at the wing root. Inside the spar we discovered the



Left: Jeff Mortimer, retired GP, with an upgrade to a Ventus 2c at 4.5m span from Topp Modelle.

Below: Launching over the fence is no problem as the lift is working with us. But watch that the wings don't misalign on release!



material to be hard balsa and the carbon was simply a cover, which may have been damaged following a previous incident at Milson where a ground loop on take-off took its toll. As I have reported before, carbon suffers micro tears that are invisible at first and often inside the structure. They slowly work their way out until the carbon simply snaps like a twig; this was another example of the failings of this material in extreme

conditions and circumstances. The 7m span H-Modell ASH-25 uses this method and the outer wing panels are known to break off due to the spar stub snapping off at the root. Vince Cockitt experienced this occurrence in flight over the sea on the Isle of Guernsey with his ASH-25 but luckily, he safely landed the model and retrieved the errant outer wing panel. The message is clear: if you own an H-Modell airframe you should check or



Left: A rare sight in Wales these days as a B-52 cruises the valleys.

Below: My mighty DG-1000 loses its prop and spinner, which is visibly departing at this moment. The aircraft only just escaped disaster.

“New friendships were forged, and the spirit of slope scale was infectious and inspiring...”



Above: Chris Williams designed Rhonadler 35 at 5m span has proved to be a capable scale soarer - and it's just so pretty...

Right: Steve Fraquet gets the Rhonadler nicely over the fence, with airspeed to spare.



simply reinforce the carbon wing spar stubs. The fix involves cutting open the underside of the spar stub to excavate the balsa, then filling the void with laminations of 3mm fibre glass board secured with 24-hour Araldite.

Flying at this Festival was encouraged without restraint, save for a cap on the number of aircraft in the air at any one time to prevent mid-air collisions. There was enough space for six sailplanes, particularly as all pilots were courteous enough to communicate with one another to maintain a calm use of the active air space where close in slope passes and aerobatics were conducted. I really enjoyed the low-key style of the event, with not a hint of a competitive element. We all had fun, banter and outstanding camaraderie. New friendships were forged, and the spirit of slope scale was infectious and inspiring - exactly the outcome the Clwyd Club had intended. Do get in touch at: flyersanonymoust@aol.com ✈



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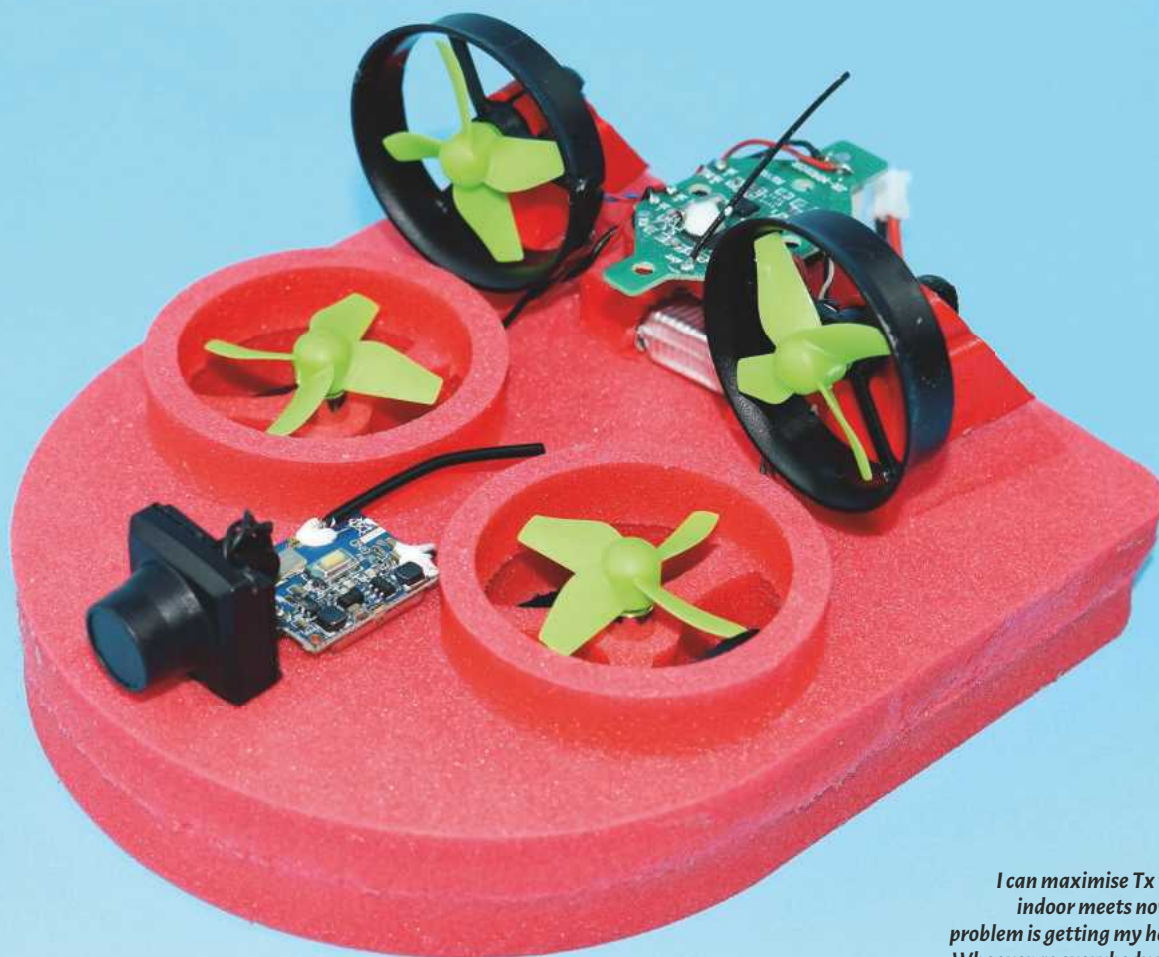
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I can maximise Tx time at our indoor meets now. The only problem is getting my hands on my Whoover as everybody wants a go!

RECYCLE YOUR MICRO DRONE

Shaun Garrity suggests a fun use for old micro drones whilst waiting for an indoor flying slot

words & photos » Shaun Garrity

I have no idea how many micro drones have been sold over the years, but it must be many hundreds of thousands. Hubsan were one of the first manufacturers on the market, with inexpensive examples appearing in model shops, toy shops and even motorway service station bargain bins to feed the demand.

Horizon Hobbies, seeing this new craze, quickly introduced the Blade Inductrix. Becoming an instant success with R/C modellers, it wasn't long before fans of this miniature revolution started bunging tiny 5.8 GHz video cameras and video transmitters on them and indoor micro drone racing was born.

Again, quick to see a commercial opportunity, Horizon started selling the Inductrix FPV, a camera equipped, FPV (first person view) drone. A raft of companies sprung up to satisfy the

demand for upgraded parts and custom frames etc. and the Tiny Whoop phenomenon, as it became known, had most definitely arrived.

As with many modelling purchases, improved versions quickly come along and eventually your original purchase is invariably consigned to the junk drawer, never to see the light of day again.

But it doesn't have to be the end of days for these poor little things because now, for under £8.00, you can repurpose them and have a new toy to entertain you.

DRONEJUNKIE

Owner Jem started the Drone Junkie company after an accident caused a serious back injury and prevented him from working in his previous career. A self confessed 'big kid' and FPV fan (especially using micro drones) he knew he had to get back on the horse quickly, so he decided to

test the water with his good friend Neil Cody and hold an FPV drone racing event to gauge interest. It was an outstanding success; he told me the three days spent in bed recovering after was worth it...

Needing to generate an income he started Drone Junkie, a web-based business. Since 2015 he has focussed on providing a wide range of products supplying the Tiny Whoop enthusiast and racing community.

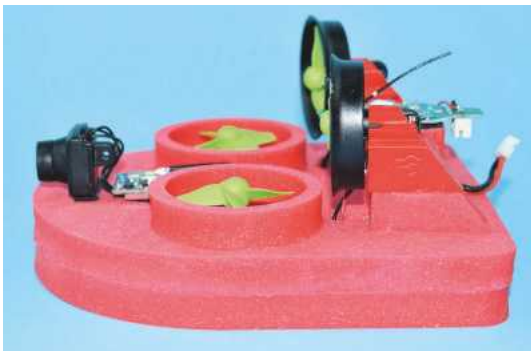
TINY WHOOVER

One of the problems we experience at our popular indoor flying events is the number of modellers that turn up, so we run a slot system. This is a sensible way to ensure everybody gets a fair share of the available time but means you can be waiting a while for your next go. Now, if only there was an FPV ground based R/C model, you could double up on your fun having races around



Pre-cut foam Whoover kit. Use an adhesive such as UHU Por to glue the few bits together.

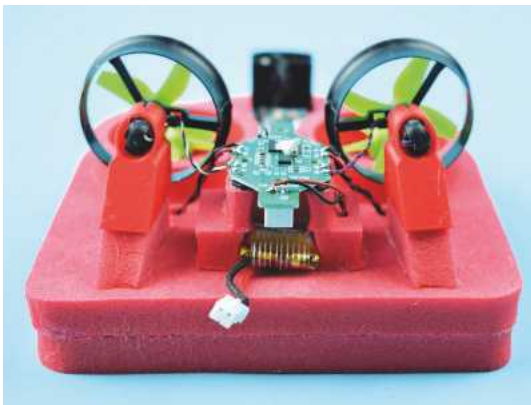
“...it doesn't have to be the end of days for these poor little things because you can repurpose them.”



Side view shows the included 3D printed rear motor mounts and the general location of all the parts.



Above: Just one of the many suitable mini drones for a Whoover conversion. I used an inexpensive Eachine Eo10 to great effect. Left: The motors on the Eo10 control board are soldered on so these will need temporarily and carefully removing to install on the Whoover (or Tiny Wing). The ducts and battery box are cut off the frame to be reused.



A selection of foam blocks are available to build your battery box and combined controller/receiver mount. If doing it again, I would put the circuit board a little higher as it's a bit of a fiddle to plug the battery into the connector.



Front motor wiring on the Eo10 needs extending but may not be necessary with other drones. The central wire with a connector is the power cable for the camera and video Tx.



To run Whoover over carpets this optional Mylar slip mat keeps friction to a minimum.

“Like the Whoover, the Tiny Wing is designed to repurpose old mini drones...”

the sports hall while the aircraft fly above...

Enter the Tiny Whoover hovercraft, which is an inexpensive kit that can use the electronics from a cheap toy drone.

Jem notes, “After attending a few shows I realised I needed to find a way to get people who have never flown to NOT hit the ceiling as soon as they had control of the sticks. I wanted a way to lock them to the ground in FPV so they could see what it is we love so much about the genre before getting them airborne.

One of the early Tiny Whoover videos we posted gained a wave of hits on social media and the genre was born. It turned out it was so much fun it was copied and cloned a number of times (yes, I'm a little miffed, more because they did it so badly) but I should really see it as a compliment. I was surprised to find out that tiny Whoovers were very popular in Japan - I never expected it to have global appeal.

I have since formalised a new game - WhoovBall - that was first demonstrated at the last UK Drone & Tech Show held in the NEC, Birmingham.”

You don't need to use an Inductrix if you just want to steer the Whoover line of sight. A cheap non-camera equipped drone such as the Eachine E010 will work a treat. However, if you have a spare, lightweight, all in one camera this could be added to give you the full FPV experience.

I also believe Jem can now supply a Mylar slip-mat that fixes under the Whoover so it can be used on carpeted surfaces and not be affected by the additional friction.

Assembly time is quick and a full build video is available on the Drone Junkie website to walk you through it. Have a look at mine to see how I did it.

TINY WING

Like the Whoover, the Tiny Wing is designed to repurpose old mini drones with a duct size of 33mm and a propeller size of 30mm.

Jem says, “Tiny wing isn't an aircraft and doesn't fly like an actual wing. It still feels like a drone but imitates the look of a wing. We have tried this in FPV and personally I prefer to fly line of sight. Some of you may not agree but looking at Tiny Wing flying is just mesmerising!

Tiny Wing uses the innards from your Tiny Whoop style drone to fly and includes two 3D printed mounts, which allow the ducts from the donor frame to fit straight in with 6mm motors installed.

Although info is available to configure a more sophisticated flight controller the simple one supplied with the Inductrix or Eachine E010 will work fine. Build instructions are on the web site.”

Again, this is currently available for under £8.00.



This must be the simplest kit on the market - three pieces! Tiny Wing isn't an aircraft and doesn't behave like one but certainly changes the look of your mini drone.



One drone will do for both models as there are two ducts and a battery box spare from the Whoover build. But you'll need to do some soldering when swapping things over. I didn't want to do this, so I've ordered another E010.

REMEMBER SLOT CARS?

I know this isn't remotely aircraft related but it's worth a mention as this new concept offers a brilliant racing experience that can provide another distraction while waiting to fly indoors - 1/43rd scale Drift Racers.

Taking slot cars to the next level and beyond, 'Dr!ft Rc' cars are vehicles that you control from your smartphone (Apple or Android) through an app which is free to download. You can drive these cars in any personal space without the need for a pre-designed racetrack, which makes the

experience more exciting. Use your office desk, on the floor at home or at work - or wherever you are - and at the same time develop the skills of a professional driver.

That said there are a number of incredibly detailed pre-printed tracks available and it's highly recommend getting one to hone your skills. This is only a scant overview of this amazing product.

Have a look on the Drone Junkie website, if all this has fired your interest, for full specifications and details: www.dronejunkie.co.uk ✈

DR!FT cars are something else and are sure to become addictive, especially when raced together. That's the last time I'll mention things that don't fly (or at least hover) in any of my articles... well maybe!



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SOPWITH CAMEL kit by Balsa USA. 1/4-scale, still in box and complete. These are £375 new, selling for £300. Buyer to collect. 07768 991562 (Cambridge).

REALFLIGHT G3 R/C simulator. With disks, controller and all leads. Works fine with Windows 10. 07486 565598 (S.Wales).

EDGE 540 by Precision Aerobatics. Spans 2.120m, with a DA50 two-stroke petrol engine, all HS servos, Futaba R6008 FASST Rx, carry bags, spare props and full set of spare wings. Only flown a few times, then stored. Cost over £1600 to build, selling for £850. 07917 1129267 (Notts).

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TOP FLITE DC-3 kit, 82.5" span Gold Edition. Bought as a project but I will never get around to it so am selling in the hope of finding this great kit a good home. Whoever buys it and builds it just promise to send me a picture - £300. 07340 260444 (Somerset).

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SELLING UP. Cirrus Moth, Fairey Gannet, Minimoa, Phantom, Cub, original Acrowot, Cambrian Spirfire, Extra 300, Easy Street and others - £1000 the lot. Plans and lots of other items too. 07845 914507 (Kent).

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BALSA USA 1/3-scale Cub plans. I have a crashed Balsa USA Cub I want to repair, but has anyone got the plans to sell? Call Michael on 07867 481687 (Co.Durham).

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WUNBESIX

Next month's free pull-out Pro-Plan is for Wunbesix, a 73-inch electric powered, tailless sports model designed by Mike White. The Jedelsky airfoil section is simple and quick to build, and is sufficiently efficient for a sport model, making Wunbesix a surprisingly good performer. As for the name, we'll let you mull that over for the next few weeks; suffice to say that it is perfect for a fixed wing model...



FMS PITTS SPECIAL

David Ashby assembles the V2 version of the FMS Pitts Special kit, which has been thoroughly revised and redecorated in a classic colour scheme. This snazzy Pitts is moulded from EPO foam and supplied 'ready to fly', with four 17g metal gear servos, a 50A Hobbywing ESC and an on-board Reflex gyro too - a 32-bit 3-axis unit that's compatible with most radio systems.



SCALE AT OLD WARDEN

At the time of writing all events at Old Warden, home of the Shuttleworth Collection, have been cancelled until the end of June. But, fingers crossed, this year's ModelAir Scale Weekend is still on the calendar for 25-26 July. To give us something to look forward to, Alex Whittaker takes a fond look back at last year's Scale Weekend.

COVID-19 & RCM&E

Next month's issue of RCM&E will look a little bit different as our publisher, My Time Media Ltd., implements steps to try and protect the company from the worst effects caused by the Coronavirus pandemic. For RCM&E this will involve a reduction in pagination to 100 pages and there will be only one free pull-out plan - Wunbesix, as featured above. Our thanks in anticipation for your ongoing support at this difficult time.

RCM&E

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PARTING SHOT



BIG BOEING'S CLOSE SHAVE

Dario Villafañe got close to the action when this giant five metre span Boeing airliner just managed to miss a bird strike whilst displaying at the 'Vuela Termas' festival in Uruguay - see top picture.

Dario, from Buenos Aires in Argentina, writes: "The Boeing 767 was built by a group of model builders who are called 'El Taller del Tata' (The Workshop of the Tata). They are friends who meet every week to share a workshop and eat roast beef. The Workshop leader is 'El Tata', Cliver Ripani. They are members of the club 'Agrupación Aeromodelista Pucará', near Buenos Aires. The pilot of most of their models is also a renowned aircraft model builder in Argentina, Sergio Testa.

The characteristics of the model are as follows:

Wingspan: 5m

Length: 6m

Turbines: 20kg x 2

Fuel: 2 x 5 litres

Servos: 16 x 12kg

Construction time: 2 years and 9 months"



Photo: Dario Villafañe

Camera: Nikon D7200

Aperture: f/5

Focal length: 195mm

Shutter speed: 1/640

Lens: 55 - 300mm f/4.5-5.6

ISO: 100



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SPECIFICATIONS:

Laser 67

Wingspan	Length	Wing Area	Engine Req
67 in (1.71m)	TBC	TBC	20cc*

*Or Electric Equivalent

Laser 73

Wingspan	Length	Wing Area	Engine Req
73in (1.85m)	69.3in (1.76m)	1,084sq in	30-40cc

*Or Electric Equivalent

Laser 88

Wingspan	Length	Wing Area	Engine Req
88in (2.24m)	83.5in (2.12m)	1,291sq in	50-76cc*

*Or Electric Equivalent

Laser 103

Wingspan	Length	Wing Area	Engine Req
103in (2.6m)	93.7in (2.38m)	1,771sq in	80-120cc

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SPEC CHECK:

- Power System: Inner running Brushless 3060 KV1900
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- Length: 1050mm/41.3in
- Flying Weight: Around 1750g
- Propeller/Fan: 70mm 12-blade
- Servos: 9g Metal digital x 8
- Speed Control: 80A
- Assembly Time: 15 – 30 minutes
- Wing Load: 101.7g/dm² (0.23oz/in²)
- Wing Area: 17.2dm² (266.8sq.in)
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