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IN THIS ISSUE

Vol. 222 No. 4602 21 December 2018 - 3 January 2019

ON THE COVER...

Brian Baker in charge of Paul Hicks's LNER 3401 Bantam Cock at Echills Wood Railway at Kingsbury Water Park, Warwickshire (photograph: Brian Baker).

Ruby E. Jeffery

It is with regret that we announce the death of Mrs Ruby E. Jeffery, former Chairman of Live Steam Models Ltd. She passed away after a short stay in hospital on Friday 30th November 2018.

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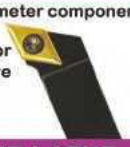

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"Evening Star" and the Twilight of Steam

The 9F Class represented the last in a series of successful BR Standard Classes designed by R. A. Riddles and his team.

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Unlike the rest of the Class, that had all been out-shopped in un-lined black livery, Evening Star was turned out in the old Swindon tradition of fully lined B.R. passenger green livery with copper capped chimney.

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Mike Pavie

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The model is the subject of a single batch production of 50 models in 2019. Once the batch is sold there will be no further production until 2022 at the very earliest. The model represents excellent value at £13,995.00 + £195.00 p&p.

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Merry Christmas

Lord Braybrooke's Collection

Many of us will be familiar with the Audley End Railway, which runs in the grounds of Audley End House near Saffron Walden, Essex. It is a one and a half mile long 10¼ inch gauge line which runs through the woods and over the river Cam within the grounds of the house. It was established by Lord Braybrooke in 1964 and officially opened by Sir Stirling Moss. The motive power consists of several steam engines and a handful of Diesel powered engines. The line is observed along its entire length by a huge collection of small toy creatures, mostly teddy bears, but I suspect this is of less interest to most of us than the motive power.

Lord Braybrooke also had a private 5 inch gauge railway in his garden as well as an extensive collection of steam locomotives of various gauges and many other railway and steam models.

Many of the locomotives will form part of Dreweatt's Transport Sale, to be held on the 12th of March 2019. These will include a 7 ¼ inch gauge model of No. 6230 *Duchess of Buccleuch*, a 5 inch gauge model of an LMS *Duchess of Atholl*, a 10 ¼ model of GWR No. 4005 *Polar Star*, built by David Curwen, and a 5 inch model of LNER No. 4468 *Mallard*, this last estimated at £15-20,000.

I am sure the catalogue, once it is released, will be of great interest in itself. More information may be found at Dreweatt's website at www.dreweatts.com.

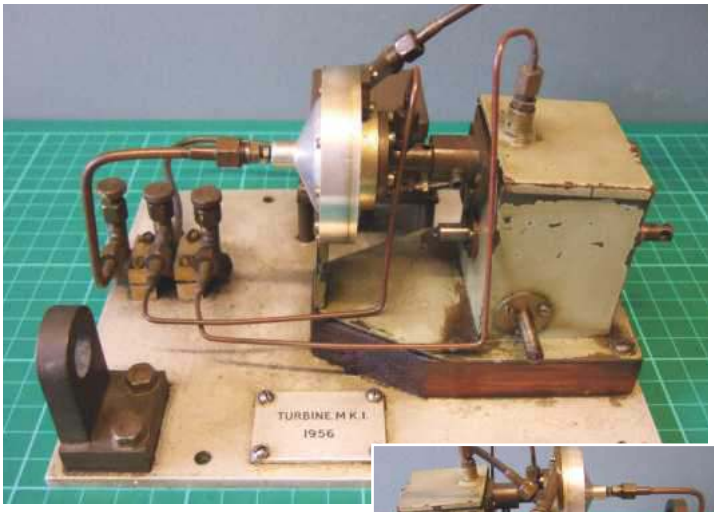
Mystery Turbine

Ian Gurton has written to us as follows:

'I have been following Mike Tilby's series on Steam Turbines and I was wondering if either Mike or any of the readers could identify a model turbine that given to the St Albans and District Model Engineering Society by a visitor to our stand at the St Albans steam fair.

Christmas!

All of us here at *Model Engineer* wish all of you out there a very merry Christmas! As we shall not see you until next year we will also wish you a happy and productive new year. Furthermore, this is an opportunity to thank all of our brilliant contributors who have kept us well supplied with such interesting and varied reading matter over the last twelve months. Keep up the good work! If you feel inspired to join their number please don't hesitate to contact me. Every model has a story and every model engineer has something of interest to tell the rest of us about and this is what *Model Engineer* exists for. So, try putting pen to paper – you may be surprised, as many have been, at how easy it turns out to be. One of your New Year Resolutions, perhaps?



'The model is mounted on an aluminium plate which is 6 by 7½ inches and, judging by the number of unused holes, was used for some other purpose. The bracket with a large hole on the left-hand side would not appear to have any purpose.

'The model itself is very well made and the only identification is an engraved plate with *TURBINE MK1 1956* on it.

'The turbine drives a gear box with a main output shaft and a worm driven side shaft; this shaft drives an eccentric which in turn drives a ratchet lubricator pump. The oil is fed via three regulating valves to the turbine bearings and a drip feed to the gear box.

'One further point is that the turbine and gearbox unit are mounted on a wood base while the lubricator is spaced up from the base by pillars.

'It runs well on air although it has yet to be steamed.

'Can anybody identify this - was it a published design?'

If anyone has any ideas I should be pleased to pass them on to Mr Gurton.

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

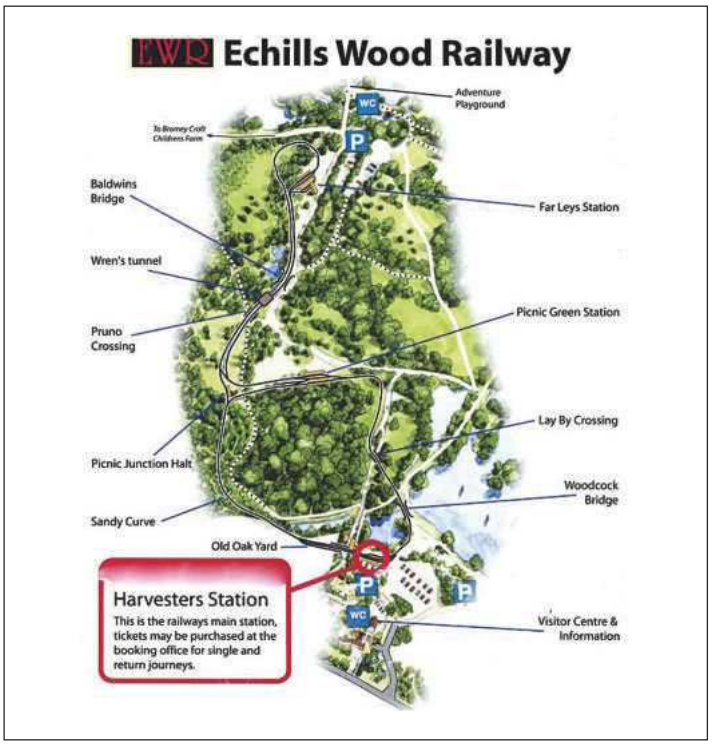
The Echills Wood Railway Standard Gauge Weekend

Brian Baker recalls a memorable rally at Echills Wood.

If you haven't been to the Echills Wood Railway, at Kingsbury, then you have missed a real treat. If you can combine your visit with one of their themed rallies then your cup will surely overflow. This year they organised a Traction Engine Rally in May, with a Narrow Gauge Locomotive rally in September and this report relates to the Standard Gauge Locomotive Rally held in July.

Echills Wood Railway is 7¼ inch gauge and runs amidst the scenic lakes and woodlands of the Kingsbury Water Park, Warwickshire, created as the result of gravel extraction used to create the extensive motorway network in the area. Originally constructed at the Stoneleigh Showground, the railway had to move in 2004 to its current site, when the decision was taken to rebuild the showground. Today a visit to Stoneleigh reveals the only trace of the old railway as two asphalted over tracks across a concrete site road.

The new railway, built with some reclaimed material from Stoneleigh and lots of new plastic sleepers and rail, began operating in 2006 and by 2010 had been extended to 2 kilometres, or 1¼ miles to us oldies. The map shows the railway leaving Harvesters Station, passing Old Oak Common yard, passing Picnic Junction, before joining the double track section, passing through Wren Tunnel, before running into Far Leas Station. On the return journey the



This is a map of the EWR.

After unloading, locomotives and stock wait here in the preparation area, where trains are assembled and steam locomotives wait before moving onto the steaming bays for 'lighting up'. After a run, it's also the area for that special part of any rally, a 'chat'.

The main steaming bay occupies one half of the large turntable and each bay can hold two large tender locomotives.

railway skirts the 45 acre lake normally used by Tamworth Sailing Club and Kingsbury Model Boat Club, before completing the circuit at Harvesters Station.

Located within the beautiful setting of Kingsbury Water Park, it is inevitable that it would be busy and, on a summer Sunday, the railway may move upward of a thousand passengers and some of the visiting locomotives became involved in the public running.

It was clear that a lot of thought had been given to the organisation of the rally and EWR members unloaded locomotives and stock, supervised the railway operation and fed and watered every one in an easy smooth way that belied the effort that had been put in to it. On Saturday night over 140 visitors and members sat down to a splendid meal, produced on site, with a mouth-watering selection of sweets to follow.

Leaving the turntable ready to join the main line is this splendid GWR No. 16 Brunel, *built by Tony Newbury and painted by its current owner, Chris Wilson.*

Melvin Bright brought Evening Star *from Essex for a great weekend's running.*

Len Steele took a rest from restoring an old motor bike to run this Southern Railway Bulleid Q1, designed for war time production.

This beautiful LSWR 4-4-0 was not on the list I was given, so no owners details, but too good not to photograph.

Paul Pavier brought this LNER V2 2-6-2 No 4843, Kings Own Yorkshire Light Infantry *from Wales and was clearly enjoying the fine weather, waiting for the 'off' in Harvesters Station.*

Also waiting for the 'off' at Harvesters is John Holdroyd's LSWR B4 dock tank Cherbourg.

Malcolm Fuller has been a regular visitor to EWR with this USA 0-8-0 shunter (yes, it counts as standard gauge).

This LNER V2 is in BR livery, Richard Priestly's The East Yorkshire Regiment *No 60809 ('The Snapper') and enjoyed running on three days of this event.*

LNER A4 No 4467 Wild Swan*, which won a medal at a recent Model Engineer exhibition, and Chris Jones are about to set off on their first lap of the day.*

It made my day when the owner of this locomotive, that I used to own, brought LNER 3401 Bantam Cock *to the EWR and then allowed me to have a drive. Paul Hicks is now running this locomotive and is a member of the Edinburgh Club.*

Ian Dixon has a rather nice LNER A3 but chose to bring his very impressive USA Mikado 2-8-0, which performed passenger hauling duties faultlessly over the weekend.

Outside of this rally, during 'normal' Sunday running, a much greater variety of motive power operates the service and this narrow gauge Garrett is typical of what might be operating.

Ready for passenger hauling on Sunday was this unusual pairing from Harrow and Wembley Club, consisting of BR Standard Class 7 70007 Coeur de Lion *and LNER A3 60052* Prince Palatine *in BR livery.*

The railway is fully signalled and has three operating signal boxes, along with some automatic systems. Here is the interior of Harvesters Station Box.

The theme was standard gauge and the railway operation was given over to the great variety of motive power available from the 49 visiting locomotives. My pictures give details of some of those who attended and ran and I am sorry not to have included a picture of every one attending. ME

My thanks to the EWR members for making this the best rally I have attended so far. If you would like to visit the railway, there are full details of its operation on its website, **www.ewr.org.uk**

The Great Orme Tramway

PART 1

Graham Astbury takes a trip on a unique tramway in North Wales.

Introduction

The Great Orme Tramway is a 3 foot 6 inch gauge cable hauled funicular tram system running in part along public roads in Llandudno, North Wales, rising to the top of the Great Orme which is a rocky outcrop rising to 679ft above sea level. The tramway is in two sections and the first, the lower section was built in 1902 with the remaining upper section being built in 1903. At the top of the lower section is a station, aptly name 'Halfway Station' where all the passengers disembark and walk to the bottom of the upper section where there is a second tramcar waiting to take them to the summit.

This tramway is unique in the UK in that it is a funicular railway running along public roads. A funicular railway or tramway is one where there are two cars connected together by a cable, so that as one car ascends, the other descends (**ref 1**). Although on first sight it appears similar to the San Francisco street car system, it is completely different in that the cars are permanently attached to the hauling cable, rather than having jaws which grip a continuously moving rope. Although the concept of a balanced system of a funicular seems straightforward, the mechanism of the Great Orme Tramway is far from simple.

Victoria Station at the bottom of the lower section.

Car 5 climbing up from Victoria Station at the bottom.

History

Llandudno became a fashionable Victorian holiday resort in the later part of the 19th Century and became home to many wealthy Victorians. Prior to this, the town was really a mining village as there were many copper and lead mines in the Great Orme dating from the Bronze Age (**ref 2**). As the mining activity gradually decreased the fashion for 'sea bathing' started to become popular and Llandudno was seen as a fashionable holiday destination. A large crescent of houses and hotels was built along the curved bay to accommodate the many visitors – Llandudno was seen to be a rival to Brighton as a fashionable Victorian resort. There had always been a church on the Orme since the 6th Century (St. Tudno's – hence the name Llandudno translating roughly from the Welsh as 'Parish of St Tudno') and there were farms and houses part way up. Thus the locals had always had to walk up or use a horse and cart – not particularly easy when the initial gradient was around 1 in 4 and the average gradient over the first half mile of road was 1 in 6.

With increasing visitors, it was decided by a group of six local businessmen that some sort of cable hauled railway would be a profitable venture for the visitors to go to the top of the Orme for the long distance views – being able to see Ireland and the Isle of Man on a clear day. By 1897, the group of businessmen proposed that a cable hauled funicular tramway be built and a Parliamentary Bill was passed, with some caveats and conditions, in 1898 (**ref 3**). Construction started in late 1901 with the first section starting close to the current station, passing up the public road to the haulage engine and winding gear installed at Halfway Station. This lower section rose through 400 feet over a distance of 875 yards, giving an average gradient of 1 in 6.5. The initial gradient leaving the bottom station was steeper, approaching 1 in 3.9 (**photo 1**). The initial haulage engine was steam powered.

In 1903 the second upper half was built on a slightly different basis, as will be described later, and rises 150 feet in a distance of 827 yards, so Halfway Station isn't half way up the Great Orme nor is it exactly half way along the total length of the tramway. Initially, due to cost considerations, there were no roofs or verandas on the stations but, as the profits rolled in, the track at the bottom of the lower section was re-aligned and slightly extended over the winter of 1903/4 to its present location where Victoria Station was built (**photo 2**). Sheds were

built to house the tramcars at Halfway Station and the top of the upper section. Since it can be exceptionally windy in winter at the top of the Great Orme, it had been the case that the car at the top had been blown over by the wind, so the sheds were built not only to protect the tramcars from the winter storms but also to allow maintenance of the cars. All the cars are of the same construction seating 48 passengers and take one crew. Each car weighs around 6½ tons and with all the passengers, another 3½ tons is added, giving a static load on the haulage cable at the steepest point of less than 3 tons. Taking account of the dynamic loading when accelerating and braking, there is still a large safety factor in the haulage cable as the breaking load is around 60 tons.

Apart from a couple of minor shunts, the tramway operated accident free until 1932 when there was a fatal run-away and collision of one tram. Initially when the tramway was first opened, the inspector at the time insisted that proper emergency brakes were fitted to each car. This took the form of two spring loaded jaws which were held open by the tension of the haulage cable. If the cable snapped, the jaws closed onto the central conduit in the track to stop the car. There was a snail action cam which made the jaws grip the track tighter as the load increased, thus stopping the tram in less than its own length. This mechanism was very successful – in fact too successful – in that when there was a slight upset in the haulage tension in the cable due to poor handling of the steam engine controls, the emergency brake would operate and stop the cars.

In the period of operation from 1902 to 1906, the emergency brake was operated several times (**ref 4**). It then took some hours to free the tightly gripping jaws and re-start the tramway. As this nuisance tripping of the brake severely reduced the revenue earning capacity, the emergency brake was disconnected unbeknown to the directors of the Tramway. The Tramway ran without an emergency brake from this time until 1932 when there was a failure of the draw-bar connecting the haulage cable to car 4. The car ran away down the steepest part of the track, turning over and colliding with a wall. After the incident the original Great Orme Tramways Company went into liquidation due to a passenger suing the company, which had insufficient reserves to meet the costs.

After some discussions, the Tramway was taken over by a new company – the Great Orme Railway Company – and the new owners had re-designed emergency brakes fitted to the cars on the lower section. Rather than being held off by the tension in the haulage cable, they operated if the car's speed exceeded 25% above the normal speed of 5mph. The emergency brakes acted directly onto the concrete between the rails. They were tested with a fully laden tramcar and were deemed to act properly. The inspector passed them as fit for service providing that they were tested each year before the start of the season - a practice still continued to this day.

The Tramway continued with these new brakes, which were no longer subject to nuisance tripping caused by the steam engine, until 1957 when it was decided that the cost of bringing the coal or coke to the boiler house was just too high and electric traction

The lower section winding drums.

was installed over the winter of 1957/8. Three-phase slip-ring induction motors were fitted instead of the steam engines and this ensured that the speed of the cars would not exceed that attained by the synchronous speed of the motors, so the risk of nuisance tripping was eliminated. The slip-ring motors allowed the speed to be controlled by varying the resistance in the rotor circuit, resulting in very smooth starting and stopping. This system is still in use today.

The lower section

The bottom station is Victoria Station, named after the Victoria Hotel which originally stood on the station site. Rather than start the description at the bottom, it would be best to start the description of the workings from the top of the lower section in Halfway Station. As the Tramway is a funicular, the weights of the two cars (Nos. 4 and 5) are balanced by their cables. In the system on the Great Orme, each car has its own cable wound onto its own drum, with the two drums locked together on a common shaft (**photo 3**). The cable on the right-hand drum is fully unwound and slightly slack as that car is at the bottom of the tramway at Victoria Station resting against the buffers and the top car is actually further inside Halfway Station than where the passengers disembark. The shaft driving the two drums is powered by a 125hp eight pole three-phase slip-ring electric motor, driving through a double reduction gearbox, and can be seen in **photo 4**. The loose vee belts also visible are used for testing the over-speed trip every year before the start of the season at Easter.

The input speed of the motor is a maximum of 730rpm and the drum rotates at a maximum speed of about 25rpm (ref 3) giving a nominal speed of 5mph. The speed is regulated by control of the resistance of the rotor circuit but, if necessary, or under emergency stop conditions, by the use of the band brake bearing on the central part of the winding drum (**photo 5**). The over-speed trip is fitted on each of the

The traction motor and gearbox for the lower section.

The band brake for speed regulation.

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The emergency brake under the bottom of car 4.

The view from the front platform of car 4.

lower section cars, Nos. 4 and 5. When the over-speed trip operates, it releases a set of teeth beneath the car which bears down on the concrete of the surface between the rails. These are visible in the view of the front bogie of car 5 in **photo 6**. There were originally three early cars used for goods, which have long since gone, and the only reference to these ever existing is the coupling still in place on the front of the cars. The original coupling with its chain for attaching the early cars Nos. 1 to 3 is visible in photo 6.

The two sets of rails are just interleaved as can be seen in photo 6. Looking at the left of the track, the wheel runs on the left-hand rail. The next slot is the open conduit in which the draw-bar runs to connect to the haulage cable. The next rail on the left of the pair is actually for the other car, with the car in the photograph being on the right-hand rail of the pair. The flanges of the wheels on both cars run in this gap between the inner rails. This can be seen more clearly in the view from the front platform of car 5 about to descend from Halfway Station in **photo 7**. The control panel for the car is shown in **photo 8**, complete with its rain cover. Despite the photographs being taken in glorious weather, it does rain quite a bit in Wales – it was the best summer that Wales had experienced for 25 years when I visited.

The first complication of the Tramway is that the 'driver' of the tram does not drive it at all. The 'driver' is actually an 'observer' and operates the appropriate buttons on the control panel which indicate to the winchman in the central control room at Halfway Station when to start, slow down, or stop. However, pressing the emergency stop overrides all the manual controls and stops both of the trams immediately. The observer also has telephone communication with the winchman and both Halfway Station and Victoria Station. All the control functions and the telephone are connected to the winchman's controls by the use of an inductive loop running within 100mm of the rails. This system is powered by two 12 volt batteries housed in a box under the seat at the upper end of each car.

When the tramway was originally built, it had an overhead wire with a trolley pole to connect a signalling system to the control room at Halfway Station. This was disconnected when the system was uprated in 1990 but the trolley poles on the cars still remain and give an illusion that the cars themselves were originally electrically powered by themselves rather than being cable hauled. The overhead wire support posts still remain in part on the upper section but the overhead wire has been removed.

When the observers of both cars are ready to depart, they both indicate to the winchman that they are ready. The winchman releases the band brake on the winding drum and starts the traction motor which moves the cars along the track. The observer has no direct control of the winding motor but he does have the ability to apply the emergency brake if necessary. The observer can also apply a brake acting on the wheels by using a conventional screw-down hand-wheel operated brake. If someone is on the track or in the way of the car, the observer can sound a horn and request the winchman to slow down or to stop in a controlled manner. When the road is clear, the observer signals that the road is clear and the winchman restarts the cars.

The winchman's view of the controls is shown in **photo 9** where the main motor controller is at the bottom right hand side of the photograph with the ammeter and speedometer above the car position indicator. The indicator shows that car 4 is at the top – visible as the small red diamond above the scale. The hand-wheel just left of centre operates the band brake visible between the drums. The panel at the left is the indicator board with the status of the cars is shown, along with the telephone and a digital speed indicator. At the top of the picture is a closed-circuit television screen to allow the winchman to see the stations and various other parts of the track. The upper section has a similar set of controls in the same control room but facing

The control panel in car 4 – complete with rain cover!

The winchman's view of the lower section controls.

The passing point on the lower section.

the other way to control the upper section.

As the car descends further towards the bottom station, the lower car clearly comes up the track towards it and therefore a passing place is provided and can be seen in **photo 10**. Further down in **photo 11** there is a set of points which are inspected each morning before running. Where the normal frog of a conventional set of points is located there is a large gap which is filled with a suitable plate when the trams are not running. This is removed each morning and the position of the points is confirmed as being set for the car which is at the bottom.

Car 4 always goes down the right-hand loop of the passing place and car 5 always uses the left-hand part. Note also in photo 11 the modern traffic light and the tram-light beneath – the technology is completely modern and up to date! The passing place is not quite half way up the lower section – looking at the winding drum (photo 3), it can be seen that as the drum is rotated, the cable pulling the car up from the bottom will wind in less cable than is paid out by the descending car for the same number of turns of the drum so, when they meet, there has been less cable wound onto the drum than has been unwound from the other drum, so they pass just below the half way point.

As the two cars pass at the crossing, the ascending car takes one route and the descending car takes the other route. It can be seen from photo 11, the track below the passing place ceases to be interleaved and becomes a single track all the way to Victoria Station. This can be seen in photo 1 and is required as the road is too narrow for two separate lines to run. When the track was built, not only would it have required even more extensive alterations to the road to fit the double track in, it would have cost more to have two conduits laid in the public road, so it was decided that a single track could be put in at the lower section as it would not have to cater for two haulage cables in the same conduit as it would if there were only a single track above the passing place.

When the car descends through the points at the bottom of the passing place, it switches the points over so that when that car returns up from Victoria Station, it takes the same side of the passing place. This is to avoid the cables becoming crossed and entangled with each other. The conduit running along the road is only wide enough for one haulage cable and this is guided by deep-groove rollers or sheaves under the road but within the conduit. These rollers are fitted along the track with the spacing varying according to the tightness of the curves. There are covers to provide access for lubrication and maintenance or repair all along the road. Finally, the car passes across a road junction and enters the narrow final section with reverse curves to terminate at Victoria Station.

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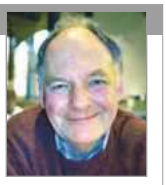
●To be continued.

Inspecting the points to confirm they are set correctly.

Steam Turbines Large and Miniature

PART 8

Parsons and low velocities



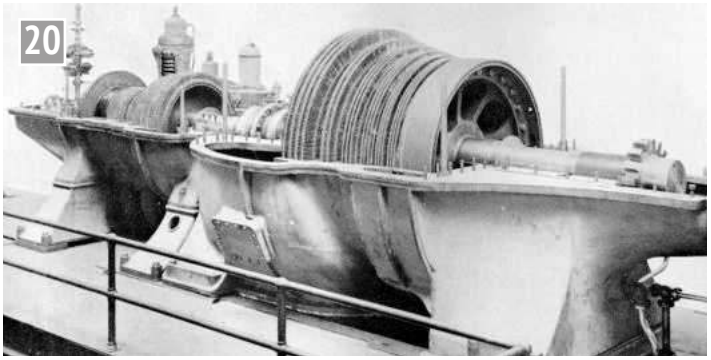
Mike Tilby explores the technology, history and modelling of steam turbines.

Continued from p.787
M.E. 4600, 23 November 2018

Parsons versus de Laval turbines

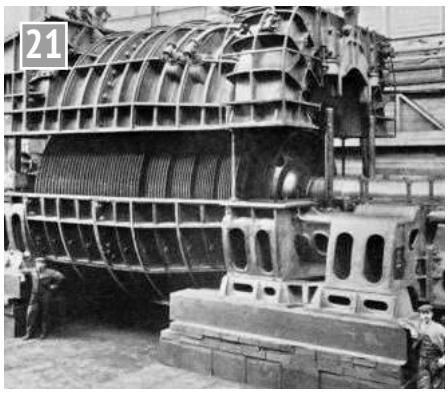
So far, in looking at the innovations made by engineers to create efficient steam turbines, I have focused on de Laval-type single-stage turbines. These were described first because they are the simplest steam turbines and because miniature turbines that have been built and tested by model engineers have most often been of this or of a very similar type. It was stated previously (article 6, M.E.4598) that attempts to build full-size de Laval-type turbines with power outputs much higher than 300hp faced major problems. The following examples show that turbines of the type invented about the same time by Sir Charles Parsons did not face such a limitation.

As was mentioned previously (article 5, M.E.4596), in 1910 Parsons turbines were installed in Lots Road power station. Each of those turbines was rated at 6000kW but, when required, could produce 9000kW which is roughly 12,700hp (**photo 20**). At about the same date, Parsons turbines where being used to power warships and large passenger liners where power output in a ship could reach about 80,000hp (**photo 21**). About 1960, new Parsons turbines were installed in Lots Road, each with an output of 30,000kW (40,000hp). The last example is Drax power station in Yorkshire, commissioned in 1973. At its heart were six Parsons turbo-generators, each with an output of 660MW or 885,000hp.



Parsons turbines arranged in tandem, installed in Lots Rd power station in 1910. Top halves of casings have been removed. The high pressure turbine is to the left. Dummy pistons can be seen at left and right-hand ends of the high pressure and low pressure turbines respectively.

In de Laval-type turbines running on steam at 200psi, it was not possible to achieve the most efficient blade velocity (i.e. half the steam velocity). Therefore, if steam pressures and temperatures were made any higher there would clearly be no hope of achieving high efficiency. To see the significance of this, let's look again at the above examples. The first Parsons turbines installed in Lots Road power station were supplied with steam at 175psig and 250°C. In the late 1920's they were replaced with new Parsons' turbo-generators running on steam at 300psi. This is illustrated by **photo 22** which shows a pressure gauge from one of those machines. It was rescued from the scrap heap by my Dad in about 1958 when those turbo-generators were themselves being replaced after 30 years of service. In 1960 I had another tour round Lots Road to see the new turbines and I remember that I was standing on steel decking half way up one of the huge new boilers when I was amazed to learn that the working pressure right next to me was 950psi! These were the first so-called membrane-wall boilers to be installed in the UK but even in 1960, 950psi was not a particularly high pressure. At Drax steam is supplied at 2,345psi and 565°C.



Low pressure Parsons turbine for the Cunard liner RMS Mauretania launched 1906.

Pressure gauge from a Parsons turbine in Lots Road power station, installed about 1930 (photo by Duncan Andison, Izel Photography).

Importance of temperature drop

These examples illustrate a world-wide trend towards the use of higher steam pressures and temperatures. This trend has been expensive and challenging to achieve, so why did anyone bother? The underlying reason arose from the pioneering work of Sadi Carnot in the early 19th century (see article 5, M.E.4596). He had concluded that steam engines work by converting caloric (heat) into mechanical power in a process whereby caloric in the steam (or other working fluid) is transferred from a higher to a lower temperature. He also concluded that even if an engine could be perfectly efficient, only part of the caloric would be converted into work and the rest would be unavoidably wasted. The amount wasted decreases as the drop in temperature undergone by the steam (or other working fluid) is made greater and the maximum proportion of internal energy (enthalpy) in the steam that could ever be converted to work in a perfectly efficient engine is given by:

$\eta = (Th - Tl) / Th$

where η is the efficiency, or proportion converted,
Tl is the low temperature and
Th is the high temperature.

The lowest temperature to which the steam can be cooled is determined by the local environment and, in the case of Lots Road, it was the temperature of water drawn from the River Thames to cool the condensers. Now you might think that with cooling water at about 15°C and steam at 250°C, the maximum efficiency is (250 - 15)/250 = 94%, which seems pretty good.

However, in such calculations, it is no good using a temperature scale in which zero is the convenient but arbitrary melting point of ice. Instead, the zero point must be the temperature at which there is no heat energy at all in the working fluid. This temperature is called *absolute zero* and is equal to -273°C. Units of temperatures measured on this scale are called Kelvins, after the physicist Lord Kelvin who collaborated with Joule on research into thermodynamics.

On this scale, water at 15°C has a temperature of 288K and steam at 250°C is 523K. Thus the maximum possible efficiency for the first turbines at Lots Road was actually: (523 – 288)/523 = 45%. A similar calculation for Drax gives a figure of 65%. This illustrates why engineers are so keen to use the widest temperature range possible (also why gas and steam turbines are used together in combined cycle installations).

To exploit low exhaust temperatures means using an efficient condenser in which a good vacuum is maintained and Charles Parsons realised that turbines were ideally suited to handling the very large volumes of steam that result from expansion down to low pressures. This contrasts with compound reciprocating engines where there is a limit to the sizes practicable for low pressure cylinders. This ability to derive power from low pressure steam is why, in the early days of turbine evolution, many ships had a Parsons turbine which produced additional power using the exhaust steam from the main reciprocating engines (e.g. the *Titanic*, where the single huge turbine generated about a third of the ships propulsive power).

Design of Parsons's turbines

Having seen the general importance of the steam turbines developed by Charles Parsons, let's look at their design. A key feature is that steam is allowed to expand in a large number of stages and so, in each stage, the drop in pressure and temperature is small. As described previously (see part 2, M.E.4590, fig 8), this is achieved by passing the steam through alternating rings of fixed and rotating blades. Such a multi-stage design has numerous advantages:

1. With small drops in pressure the behaviour of compressible steam resembles that of an incompressible fluid, the behaviour of which was much better understood.
2. Small drops in pressure means lower steam velocities and this enables more efficient ratios of steam to blade velocity at reasonable rotor rpm.
3. The lower steam and rotor velocities reduce the losses due to friction within the turbine.
4. Lower rpm reduces problems of high centrifugal forces in the rotor and also could avoid the need for gearing to reduce output rpm.
5. Due to the above factors it is possible to attain good efficiencies with very high steam pressures.

Another key feature of Parsons turbines is the principle of 50% reaction. As described previously (part 2), this means that the steam expands by equal amounts in the stationary and moving blades. This again contributes to keeping steam velocities low because the velocity increases in two smaller steps instead of the one large increase seen in an impulse turbine. Also, friction between steam and rotor is minimised because the maximum steam velocity is attained just as the steam *leaves* the rotor whereas in the impulse turbine it has maximum velocity as it *enters* the rotor. Parsons reasoned that 50% reaction would result in the lowest possible losses and his adoption of this principle is another example of his intuition since, over a century later, this remains the design of many large turbines.

Design challenges

Numerous technical difficulties had to be overcome before Parsons turbines could (a) be made efficient, (b) be built in large sizes and (c) operate on very high steam pressures. Major difficulties arose from the fact that the pressure decreases as steam passes through each ring of blades. This means that steam tends to leak past the blade ends (**fig 30**). This leakage occurs all around the rotor and all of the time and so it has to be minimized. A second consequence of having pressure drops across each ring of rotating blades is that these blades, and hence the rotor, are acted upon by a force that tends to push the rotor towards one end of its casing. By contrast, in an impulse turbine, the entire pressure drop occurs in the fixed nozzles so there is no major pressure difference across the rotor discs.

Steam leakage past blades

Charles Parsons and co-workers made a number of inventions to minimise leakage past the blade tips. Firstly, he adopted very small clearances between the blade tips and the cylinder. This called for very exacting standards of engineering. e.g. the blade tip clearance on a rotor 3 feet in diameter could be just 20 thou. However, as turbines were built in increasing sizes, these small clearances led to a number of problems. For example, if the rotor was out of balance or if it became slightly distorted or if the bearings wore to a significant extent, then tips of blades on the rotor would rub against the casing. Similarly, tips of blades on the casing could rub against the rotor. The resulting friction heated the blades which made them expand so the rubbing increased. This could cause catastrophic stripping of blades where detached blades would damage further rows of blading.

Some causes of blade rubbing can arise during start-up of a cold turbine. For example, being lighter in weight, a rotor could heat up, and therefore expand, faster than its more massive casing. This reduced the blade clearance. In addition, unequal heating of the rotor could occur since hot steam rises to the top of a stationary cold ≫

Blades with thinned tips from a Parsons turbine rotor.

Blades with shroud for end-tightening from a Parsons turbine cylinder (i.e. casing).

turbine. Unequal expansion causes a rotor to bend slightly so a large turbine must be warmed up gradually over a period of up to several hours whilst the rotor is turned slowly by external means.

One invention that greatly reduced the effects of rubbing was to make the blades with thinned tips (**photo 23**). If a thin tip rubbed against the casing the tip was worn away slightly but without generating much heat so the consequences of the rubbing were negligible.

Another major problem was eventually traced to a previously unknown property of cast iron. It was discovered that at steam temperatures for which cast iron was thought to be perfectly serviceable, a slow chemical change occurred in the metal which caused it to swell slightly. For turbines, this caused serious problems which were difficult to diagnose since they only occurred after a turbine had been in service for some time. Eventually the problem was overcome by using steel for all parts exposed to highest temperature steam but making complex castings in steel was more difficult.

It was known that large blade tip clearances caused reduced efficiency but it was impossible to run turbines reliably if the clearances were very small. A major breakthrough came with the adoption of so-called 'end-tightened' blading. In this design the blades were surrounded by a ring known as a shroud. Thin projections from the edge of this shroud formed the seal with a face machined in the casing (fig 30 and **photo 24**). This meant that the small clearances preventing steam from by-passing the blades became axial rather than radial and therefore were no longer affected by side-ways distortion or vibration of the rotor. Also, the axial clearance could be adjusted while the turbine was running by fine movement of a thrust collar at one end of the main shaft.

Labyrinths and dummmies

Of the numerous other innovations that underpinned the development of reaction turbines, two in particular deserve mention. Both relate to the needs to balance end thrust on a rotor and to allow steam to occupy the high-pressure end of the turbine casing without leaking through the shaft bearing. Traditional packed glands of the type used for reciprocating piston rods were not practical at high shaft rpm.

One invention that Parsons used initially in his first turbine (see article 1, M.E.4588, photo 5) was to have a double-ended rotor with high pressure steam entering in the middle and expanding in both directions. In this arrangement, axial forces acting on each half of the rotor balanced each other and the steam at each end of the rotor was only at atmospheric pressure.

The second invention is the labyrinth seal. This can have various designs, one of which involves of a series of many brass rings projecting inwards from the casing and alternating with similar rings projecting outwards from the shaft (**fig 31**). The clearances between tips of the rings and shaft or casing were very small but any slight rubbing was inconsequential because the edges of the rings were thin. As steam passed through the gap for each ring, it expanded to a lower pressure, losing enthalpy in the process. i.e. it was repeatedly wire-drawn. This formed a very effective seal that was essentially frictionless.

Invention of the labyrinth also permitted another approach for balancing the end-thrust that acts on a single-ended rotor. This is the so-called 'dummy' or 'dummy piston' which is basically a disc, or group of discs, at one end of the turbine rotor. One side of the dummy piston is exposed to high pressure steam and the other side is open to the atmosphere. The dummy is designed so that the force on it resulting from the unbalanced steam pressure is equal and opposite to the axial force exerted on the blading of the rotor. Leakage of steam past the dummy is prevented by a labyrinth. In photo 20 the smooth-looking section of the rotor at the right-hand end is the dummy piston. This is, in fact, covered with thin labyrinth rings that are too fine to be seen in this photograph. An early example of a dummy piston can be seen in the Parsons turbine at the Fornsett Industrial Museum (**photo 25**).

Rotor length and diameter

To accommodate many stages in one turbine would necessitate the rotor being

Fig 30

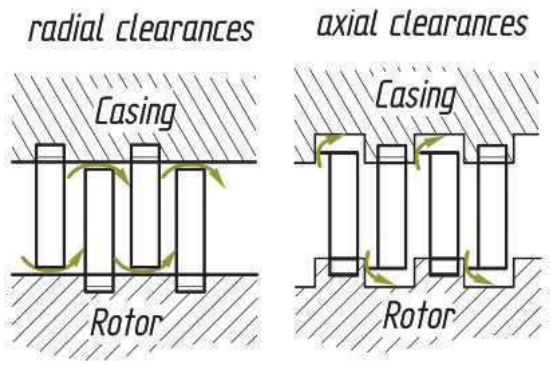


Diagram showing steam leakage past plain blade tips (left) and end-tightened blading (right).

Fig 31

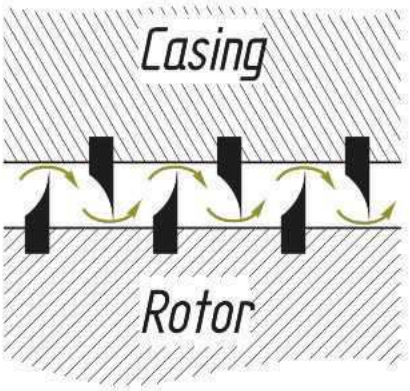
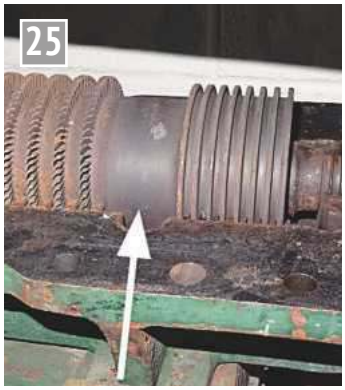


Diagram of a labyrinth seal.
Arrows denote leakage of steam.



Dummy piston in a small Parsons turbine built in 1908, now in the Forncett Industrial Steam Museum, Norfolk, UK
www.forncettsteammuseum.co.uk
Arrow shows where high pressure steam entered the rotor before moving into the blading to the left. The smooth rings to the right are an early design of dummy piston and labyrinth seal (photo provided by Bill Starling).

Turbines of SS Queen *(built 1903). The high pressure turbine in the centre exhausted into the two low pressure turbines. Each of the three turbines powered a separate propeller. The cylindrical objects at the extreme right and extreme left are the condensers.*

very long and this would lead to problems associated with loss of rigidity. To overcome this problem Parsons used separate high pressure and low pressure turbines. These could be joined in tandem (photo 20) or be adjacent to each other (**photo 26**).
Another issue is the fact that as the pressure of a given weight of steam decreases, its volume increases. If the exhaust is to a vacuum, this volume increase is very large indeed. As discussed above, exhausting to a vacuum/condenser is essential for good efficiency and it is also necessary to enable recycling of the pure boiler water.
With a few special exceptions, the mass flow rate of steam has to be the same in all stages of a turbine. Therefore, the volume flowing through a turbine increases as the steam moves along the rotor. This increase in volume must be accommodated by an increase in velocity and/or an increase in cross-sectional area of the passageway through which it flows. Steam speed and blade speed must be kept in an appropriate ratio, and a large increase in velocity would mean a change in the blade angles and loss of overall efficiency.

Parsons avoided this by increasing the cross-sectional area of the space through which the steam passed. He achieved this by increasing the length of blades and increasing the diameter of the rotor (see photos 21 and 22). By using separate high and low pressure turbines, the low pressure turbine could be built with a larger diameter rotor. Lastly, to handle very large increases in steam volumes, a single high pressure turbine could be arranged to exhaust to two low pressure turbines (photo 25) or to a double ended low pressure turbine.

Centrifugal force

The low rpm of Parsons turbines meant that, unlike de Laval, he did not face the challenge of designing highly stressed rotors. However, as Parsons turbines became ever more powerful the problem of centrifugal stress did eventually become critical. This is because, as the designed power output of turbines increased, so did the rotor diameters. As described in article 6 of this series, stresses in a rotor increase with diameter as well as with rpm. The largest diameter of a Parsons turbine is at the low pressure end and it is there that centrifugal stresses become limiting in large machines. Therefore, considerable precautions are taken to ensure the steel for rotors is of sufficient strength.

Parsons developed procedures by which a billet of steel had to be forged according to very strictly controlled high temperature treatments often lasting a couple of days. Despite this, a disaster occurred in 1923 in a Parsons turbine in Shanghai when a rotor exploded killing several people. After lengthy investigations it was discovered that the cause was a flaw in the centre of the carefully forged billet of steel and this caused the rotor to fracture. Sir Charles Parsons was greatly shocked by this accident and, against much opposition, he insisted that every rotor should have a hole drilled through its centre from end to end so that the structure of the metal could be checked.

Relevance to model turbines

In describing some aspects of Parsons reaction turbines the present article has, I hope, mentioned some interesting engineering innovations that are not as widely known as those upon which reciprocating engines are founded. Also, I hope it has become apparent that, although the Parsons design of turbine is extremely important for full-sized machines, it is not at all appropriate for a working model. This is mainly because of the design complexities resulting from the pressure drop across each ring of rotor blades.

In full-sized turbines it was recognised early on that efficiency improved as turbines increased in power and one factor behind this trend is that, in proportion to the total steam flow, the leakage of steam past the blade tips decreases as blade length increases. This is because, when blade lengths are short, the total area of the clearance gap between blade tips and casing or rotor is a greater fraction of the total blade area. This factor is a significant limitation for full-size turbines and so it must be even more of a limitation for miniature turbines.

Nevertheless, although Parsons turbines seem unsuitable for a working model, any survey of steam turbines would be incomplete without a section describing them. Also, and most importantly, the problems that have been discussed here are highly relevant to understanding other designs of turbines which will be described in the next articles and which definitely are relevant to past and possible future model turbine designs.

●To be continued.

The previous article included an erratum that was triggered by a comment from a reader who pointed out that part 6 appeared to imply that the circumference of the imaginary ring of metal decreased while its radius increased - clearly impossible. The confusing sentence appears to have been: '*So, as our imaginary ring of metal in the disc is stretched radially, its circumference tends to decrease slightly and this has the effect of further increasing the level of hoop stress.*' The key words in this sentence that should have been emphasised are '**tends to**'. The text was not meant to refer to change in geometry, the key thing being that the Poisson effect will act to cause an increase in an important stress. With stress in the radial direction the metal will tend to shrink in directions perpendicular to that direction, i.e. axially and tangentially. Although axial stress will lead to very slight reduction in the thickness of the turbine disc, the increased stress in the tangential direction will increase hoop stress and so increase the risk of disc failure.

Building Signals for 5 inch Gauge PART 5

Doug Hewson adds realistic detail to the running lines.

Continued from p.798
M.E. 4600, 23 November 2018

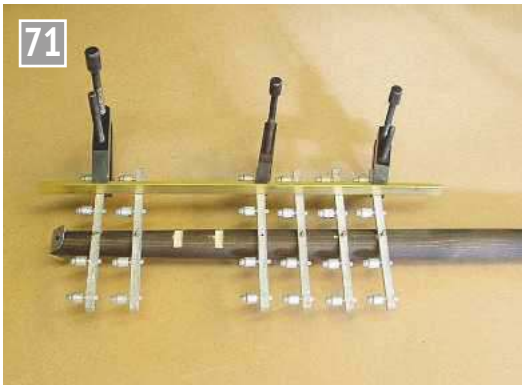
We now come to building the Midland and the LMS signals for our railway. The first one was the very first signal which I built for the railway and I have to say that it was built in rather a hurry for one of the stands at the Midlands Exhibition. I have to admit that being the first signal I made for this section, it is not as it should be, really, as I made it with the usual cranks and rodding. I had obviously not studied the signal properly. Anyway, it has now been with us for at least thirty years or more and has had one complete re-build during its life time! Not, I hasten to add, that it had a tree fall on it or anything like that, it was just succumbing to old age.


67


68


69

70


71

Photograph 67 shows the signal here with Dave Kinsella just setting back into Peak Forest Sidings with a tank train with Mark's Gresley 2-8-0. It is signalled to run into the loop next to the yard. The signal is looking a bit dog eared now but it is still working very well so we are rather reluctant to move it. We will get round to re-painting it one day. The little hut at the base of the signal houses the point motor and the grey connection box houses the four signal solenoids. You will also note that Dave's locomotive has the correct headlamp code for a 'Through Goods not stopping at intermediate Stations'. I just love all this railway furniture we are now gathering around or railway as it makes it all look a bit more realistic.

Figure 1 is the drawing for the Up Home signals at Peak Forest with the signal on the

immediate left being the one for the Branch Loop; next is the Branch Up Home signal, following that is the Up Main Home Signal and the Call On arm below it and then finally the Up Signal for sending trains though the station 'Wrong Line' if an engine has stopped for water at in the Up Platform road, or for any other reason.

Photograph 68 is the view from slightly further back than the view in photo 67 and it shows that everything here is pure Midland Railway. There is the Chinley Junction Signal Box, our signal is still in the foreground but now we see Chinley Junction with all of its telegraph poles (rather too many in this case though!); There is also the new Midland Water Column in the yard, half concealed just behind the right-hand signal arm. On this signal the only arm which is worked from Belle Isle Box is the right-hand arm as it is part of the main line signalling. All of the others, and the branch line signals, are worked from Peak Forest Box. To get any of these signals off you have to remember to pull the Gate Lock lever to unlock the points and signals, even though we still have no gates here.

I thought that I had better finish off the Chinley Junction signalling first, so this (**photo 69**) is the Home Signal just in front of the box, which is an LMS one on the main line. The Distant Signal in this case is 'slotted' so it all works correctly from Bell Isle Box. However, you might notice that it has the corrugated arms on it, so it is still unadulterated by BR at the minute. I made a special little press tool for making these arms but I am afraid I can't find a photo of it.

This (**photo 70**) is the sign made for the Junction as some people (well, members!) still don't seem to know where it is so Peter Bartrop and John Wood had some very nice little signs cast to tell people where they are.

Back on the bench now and this is just one of the telegraph poles which I made to go outside the 5 inch gauge signal

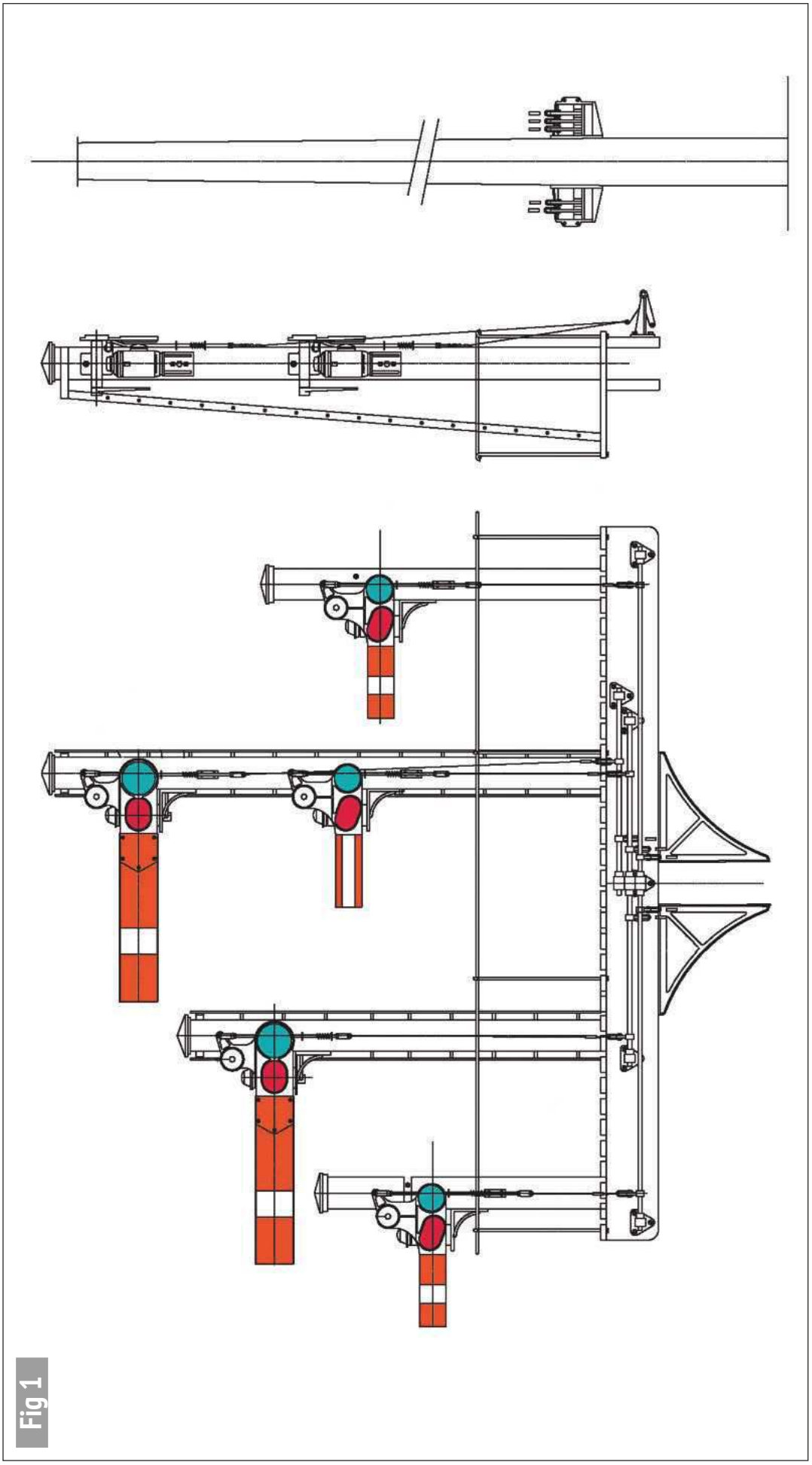


Fig 1

box as part of the furniture - or clutter, as I call it (**photo 71**). These arms were cast in white metal with the pots already on. I also had a strip of four pots made so that I could fit loose ones where necessary, like the two bottom rows I swapped; as you will see in photo 69, we do get the odd one break but they are very cheap to replace.

We now come to the replacement of our Peak Forest Signal Box. This was no mean feat I can assure you (**photo 72**). We had plenty of money in the kitty so we decided to commission a new one from a friend of mine to save time – or so we thought. (The same chap who turned all the telegraph poles for us). As it turned out we still had quite a lot of work to do on it, unfortunately, as he had left it bit rougher that we would have liked. However, the photo shows Steve, Graham, Malc and Ballan removing all the wiring and dismantling the old Peak Forest box and getting ready to install the new one. I went home and re-built the frame with a ten-lever extension (**photo 73**). We gave ourselves six weeks over Christmas 2007 to do the lot, including all the re-wiring. Well, we didn't want that job hanging over us forever! The photo shows the new levers which I made in a day but by this time I had made lost wax castings for all the fittings so I already had them in stock knowing that this job was pending. Well, I had already had to extend the

lever frame in Belle Isle Box by another eighteen levers, so I made these at the same time. Fortunately, the lever frame fitted in the box! All I had to do then was file a taper on the levers and round the bottoms off. At least this time I didn't have to add the arms on the point levers as we had electrified all the points well before then.

Photograph 74 shows the completed lever frame which I had all done in about a couple of weeks, including all the interlocking wires which you can see in the foreground. In fact, I think I spent all one Boxing Day re-wiring the lever frame. Well … I was following a train of thought!

Photograph 75 shows the transfers which Dave Noble made for the levers with the interlocks marked on them. This is actually Belle Isle Box as I neglected to take this kind of photo in Peak Forest Box. This time, I also made the frame so that it was much easier to dismantle in case of a microswitch failure. We only had to use one relay in the system to cope with all the wiring around the other end of Stowmarket station where the wiring could not be done with just the microswitches. I altered the frame to five lever lots so that I could make up five lever cassettes to fit snugly between the frames and they could be removed easily. The levers are all colour coded, the same way as a full-size box of course, which means red for Stop Signals, yellow for the Distants, black for the Points, Red with a vertical white stripe is for the interlock between the two boxes and the brown lever in the middle is for the Crossing Gate locks. The gates are intended to go at the end of Peak Forest Yard just outside the little signal box. The whole lot needed completely rewiring as all of the interlocks and signal numbers had to be changed. Knowing what was coming up I had all this worked out so this also saved a lot of time. (Anyone want to see the interlocking table? No!) All I had to do then was to make ten more little handles for the levers.

●To be continued.

PART 51

Garrett 4CD Tractor in 6 inch scale

Chris Gunn makes the uprights which form part of the canopy support.

Continued from p.779
M.E. 4600, 23 November 2018

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.

By the time I had got this far, my stainless bars were ready to collect, so collect them I did, and I was able to make a start on the uprights. I started with the centre upright, shown as upright 'B' on the drawing, and I cut a couple of uprights to the length shown on the drawing, less the length of the socket fitted to the engine. All I did at this stage was to drill a hole for the pin that would unite the two sections. In case you are wondering why I did not just turn the end of the upright down to fit the socket, I felt there was a good chance that the end could get bent when it was off the engine but it was unlikely that the 16mm diameter would get bent.

I decided to drill the ends and fit a replaceable pin then, if one did get damaged, it would be a simple matter to change the pin. Once the 'B' uprights were done, I made the 10mm diameter pins and installed them on the engine. Then I was able to take a measurement off the floor, and as I knew the floor and the boiler were level, I could determine the length of the rear upright, or 'A' as shown on the drawing. I felt this was a safer way to establish the length, bearing in mind the potential variation in the tender height from the drawing. Another pair of

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Drawings, castings and machining services are available from A. N. Engineering: Email: **a.nutting@hotmail.co.uk**

uprights were cut and dealt with in the same way and fitted to the engine as well.

I placed the front strap and blocks in position on the engine and then put a straight edge across the two existing supports. I could then determine the length of the front supports, which are uprights 'C' on the drawing. Once these were turned I could pop them in position and line them all up to check they were all correct, which they were.

Now that the straight uprights were all to length, the next step was to mill the flats on each upright and drill the holes that would secure the roof stiffeners, and also the holes to hold the cross braces. This was done on the Bridgeport and I located the rods in pairs in the tee slots on the bed of the miller. The slots are ⅝ inch and the rods 16mm, just a couple of thou over, and this was enough to stop the rods falling into the slot. I cut the flats first using a small carbide tipped end mill, as the stainless was on the tough side. The cutter was happy enough when flooded with coolant and I cut a flat 0.2 inch deep. **Photograph 453** shows the milling operation in progress.

Once the flats were milled in a pair, I then put a drill chuck in the spindle and used my edge finder together with some slips to centre the drill chuck in the slot and then, once centred, I used the same edge finder to find the side of the rods, as shown in **photo 454**.

I worked my way down the rod drilling the three holes in the spade end, as shown in **photo 455**, and then further down to drill the hole for the cross braces.

I used a centre drill to start the hole in the round bar and that was successful, even without putting a flat on the bar to start with. The cross-brace holes were counterbored to make a flat seat for the bolts and spacers I would be using. All six bars were dealt with and then I changed the setup to allow the holes on the opposite side to be counterbored. I sat the flat on a couple of flats on the edge of the table, lined it up with the table edge, and clamped it to the bed as can be seen in **photo 456**, then I counterbored all the holes.

Once I had flats on the three pairs of uprights, I fitted them back on the engine and then I used a couple of pieces of flat bar and some small 'G' clamps to set all the uprights square. Once this was set up correctly, I set about making the stiffeners that run from the rear of the horn plates to the centre upright.

I started off making a pattern using a piece of gas welding rod, which was easy to cut and bend to the right angle. After I had made my pattern, I cut a couple more pieces of the 16mm bar, leaving them a couple of inches over length, just in case. I faced off the bottom and drilled the holes for the locating pins. Then I held one end in the bench vice in the appropriate spot, heated the bar to red and, using a piece of tube about two feet long, gave the rod a good tug but I did not make much impression on it. I found a bit of tube twice as long and warmed it up again, perhaps a bit hotter, and this time it did move and I managed to get the first bend at the correct angle. I made the second one to match and then checked them against the engine.

So far so good and now it was time for the second bend - always the hardest in my experience as the bar must be bent in the same plane as the first. I set it up in the vice again and went through the same procedure. It took a couple of attempts to get the second bend right but I did it. I was aware though of a slight twist in both of them, both in the same direction, which makes me think I did not set the bar up correctly before the bend. I was able to correct the twist with yet more warming up and

Milling a canopy support.

Edge finding a canopy support.

Drilling a canopy support.

Counterboring a canopy support.

Milling another canopy support.

Counterboring another canopy support.

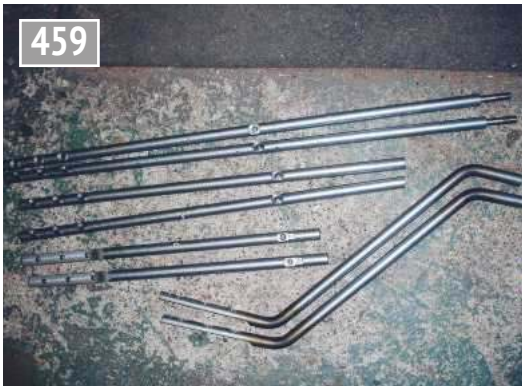
heaving on the end of my tube and this was good timing on my part, as it was pretty cold outside.

Once I was happy with the bends, I cut them to the right length, then had to set them up on the miller to mill the flat and drill the holes. This time I had to clamp the support on the edge of the bed on some packing, so I could run a cutter down the side of it as shown in **photo 457**.

Once the flats were cut, I could clamp them with the flat down on strategically placed clamps and packing to avoid the holes and then the holes were started with a centre drill, before finishing off the holes and counterboring them as shown in **photo 458**.

That concluded the milling and drilling of all the supports and the complete set is as shown in **photo 459**.

The next step was to clamp a piece of flat across the top of each pair, and the supports were adjusted until they were parallel. I then measured the centre distance between the holes that would support the cross braces. Once the dimensions were established, I sketched the dimensions down for each pair, and cut my 20 x 6 stainless flat bar to the appropriate lengths, and marked out the holes. I found that this bar was on the tough side when I tried to drill in, so I did the drilling in the Bridgeport, using a copious supply of coolant, and the holes were then no problem. Next, I set the stays up on the Bridgeport and thinned the width of the stays down between the holes leaving a boss where each hole was located. **Photograph 460** shows the work in progress.



Completed canopy supports.

Milling the cross braces.

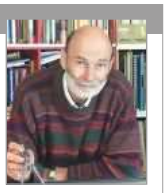
Once the milling was done, I had to clean the edges of the bars up and radius the bosses. The disc sander was used to clean the edges up, take the corners off, and then the bars were finished off on the linisher.

I assembled everything next and I had to slot a couple of the stays to get everything to go together so I put temporary bolts in place. The drawing shows uprights that have been forged to create a pad for the bolts to pass through but I did not go to these lengths - I simply counterbored each side of the hole in the upright as described earlier. However, this necessitated making some collars to step the cross ties out enough to miss the outside diameter of the uprights. These were made from the 16mm offcuts and the offcuts were simply drilled and parted off. It would not be difficult to make up some spacers that would better simulate the pads and I may well do this when I have some spare time. **Photograph 461** shows the spacers being parted off.

Parting off a set of canopy spacers.

●To be continued.

ME Vertical Boiler - Fittings PART 20



A project aimed at beginners wishing to develop their skills or those requiring a robust vertical boiler for the running or testing of small steam engines. **Martin Gearing** begins the task of turning out a handful of boiler fittings.

Continued from p.837
M.E. 4601, 7 December 2018

Fig 52

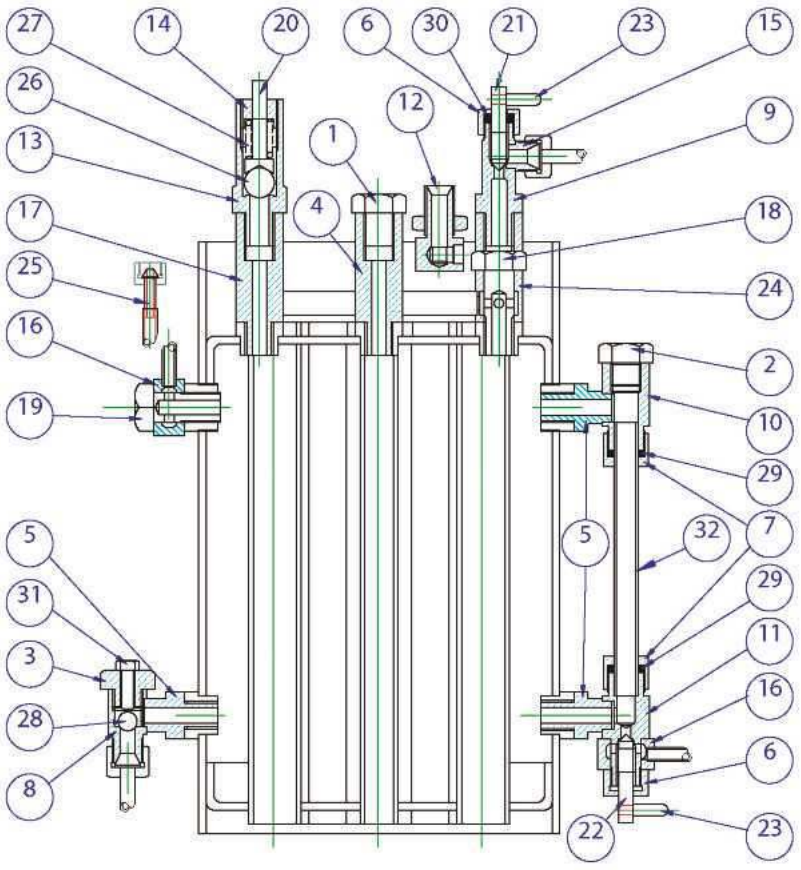


Fig 52 - Boiler Fittings Location and Reference

Tolerances:
Non functional (i.e. parts not a fit or match) ±0.1mm
Functional (i.e. parts having to match) ±0.02mm

Overview

You now have created a boiler hand pump and a vertical boiler, proven to be capable of withstanding the stress of producing steam. If you're anything like me - all you really want now is to see how well it will run an engine on steam being produced by the boiler! Before that can happen, and any steam can be produced, we require all the 'bits that fill up the holes' at the top and around the side of the boiler to be made. There are seven items required and when made all the holes will be 'filled'. In order of importance they are:

- Safety valve. *To release any excess pressure preventing material damage to the structure of the boiler.*
- Water level gauge. *To enable seeing the amount of water inside the boiler whilst operating under pressure.*
- Pressure gauge. *To give an indication of what pressure is contained within the boiler when operating.*
- Clack valve. *To allow water to be added whilst the boiler is working under pressure, (whilst doing so the level being checked by observing the water (level) gauge to prevent overfilling).*
- Main stop valve. *To control the amount of steam being permitted to enter the engine.*
- Filler plug. *The name rather gives its purpose away!*
- Super-heater. *To make use of heat that would otherwise be wasted - improving the overall efficiency.*

Table 6		
Item	**Description**	**Material and Blank Size**
BF 1	Filler Plug	10 AF Brass
BF 2	Gauge Glass Plug	10 AF Brass
BF 3	Clack Valve Plug	10 AF Brass
BF 4	Filler Extension	10 AF Brass
BF 5	Mounting Stub x 3	10 AF Brass
BF 6	Spindle Gland Nut x 2	10 AF Brass
BF 7	Gauge Glass Gland Nut x 2	10 AF Brass
BF 8	Clack Valve Body	10 AF Brass
BF 9	Stop Valve Body	10 AF Brass
BF 10	Gauge Glass Top Body	10 AF Brass
BF 11	Gauge Glass Bottom Body	10 AF Brass
BF 12	Cap Exhaust Fitting	10 AF Brass
BF 13	Safety Valve Body	½ inch AF Brass
BF 14	Safety Valve Adjuster	From Ø10 Brass
BF 15	Stop Valve Outlet Stub	From Ø10 Brass
BF 16	Banjo x 2	Ø12 Brass
BF 17	Safety Valve Extension	Ø12 Brass
BF 18	Superheater Banjo Bolt	10 AF Stainless – 303
BF 19	Pressure Gauge Banjo Bolt	10 AF Stainless – 303
BF 20	Safety Valve Spring Guide	Ø6 Stainless – 303
BF 21	Stop Valve Spindle	From Ø6 Stainless – 303
BF 22	Blow Down Spindle	From Ø6 Stainless – 303
BF 23	Spindle Operating Lever x 2	From Ø6 Stainless – 303
BF 24	Superheater Header	½ x 1 inch Brass
BF 25	'U' Tube Cone Adaptor	From Ø6 Brass
BF 26	Safety Valve Ball	Ø7/32 inch Stainless ball
BF 27	Safety Valve Spring	6 Turns Ø3/16 inch 24SWG Stainless wire
BF 28	Clack Valve Ball	Ø5/32 inch Stainless Ball
BF 29	Gauge Glass 'O' Ring	BS 008 x 2
BF 30	Stop Valve Spindle Seal	BS 006
BF 31	Clack Valve lift Set Screw	M3 x 12 Stainless
BF 32	Gauge Glass	Ø5 Glass Tube

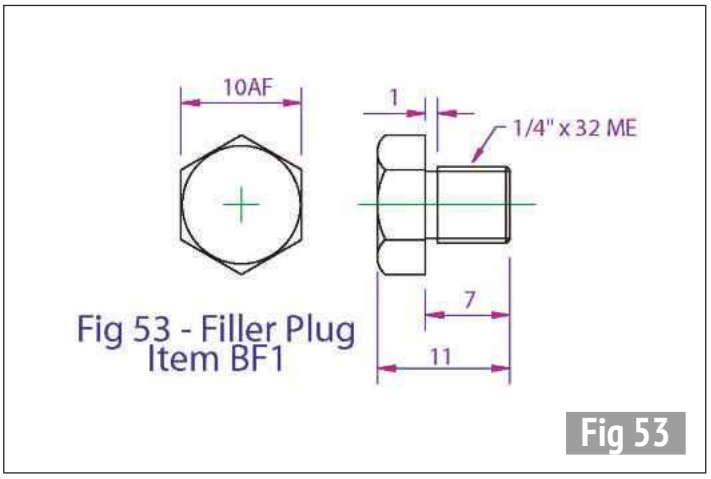


Fig 53 - Filler Plug Item BF1

Fig 53

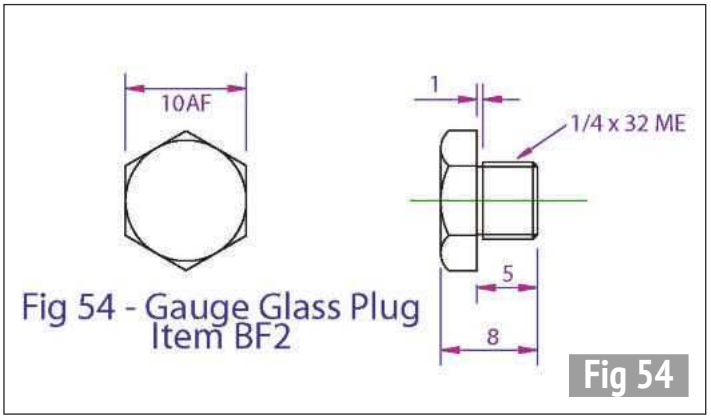


Fig 54 - Gauge Glass Plug Item BF2

Fig 54

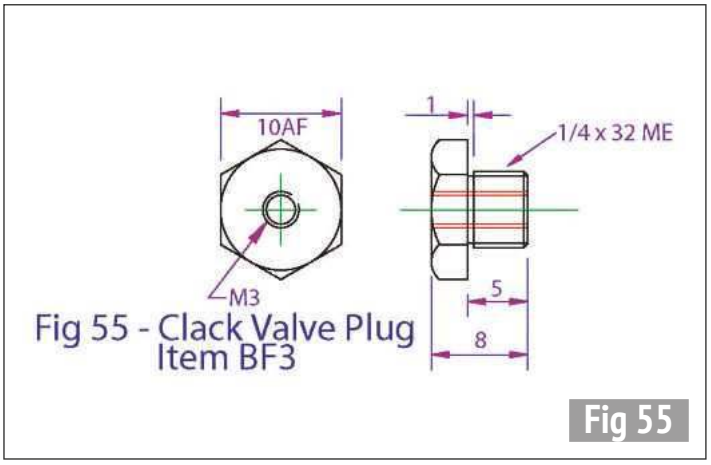


Fig 55 - Clack Valve Plug Item BF3

Fig 55

An overview of the various fittings and where they go is given in **fig 52** and a list of the materials required is given in **table 6**.

Rather than making all the parts to complete each one of the seven components individually before starting another, I've organised the 30 individual parts required into groups, machining similar materials together that go to make up the seven complete fittings, with the aim of keeping to a minimum having to repeat identical setups. A large number of parts are made from 10mm AF brass so we will start with a few of those.

Filler, gauge glass and clack valve plugs – Items BF1, BF2 and BF3

10AF Brass (**figs 53 to 55**)

These are most easily made in a batch.

Hold the brass in a three jaw chuck with 10mm protruding. Face off and turn 6.35mm diameter x 7mm. Using a 1mm wide parting tool set with its left-hand edge against the turned face, undercut 0.5mm (1mm on a diameter dial) into the 6.35mm diameter. Thread ¼ x 32 ME x 7mm (8¾ turns). Chamfer the hexagon 30° x 0.5mm. Part off 11.5mm overall. Put to one side – this will become the filler plug.

Repeat as for the filler plug except that the turned portion/thread length is 5mm (6¼ turns) and it needs to be parted off 8.5mm overall. Put to one side – this will become the gauge glass plug.

Repeat as for the gauge glass plug except for centre drilling, drilling 2.5mm diameter x 10mm deep and threading M3 x 9.5mm deep (19 turns) before parting off. This will become the clack valve plug.

Screw the plug into the ¼ x 32 ME threaded mandrel last used for the hand pump valve plugs and hold in the chuck. Face off the hexagon to 3mm thickness measured from the mandrel body and chamfer the

hexagon 30° x 0.5mm. Repeat these operations for the gauge glass plug.

For the **filler plug only** (7mm thread length) face off the hexagon to 4mm thickness before chamfering 30° x 1mm. As this plug will be the most used, the extra length of hexagon is to reduce the chance of the hexagon becoming 'rounded'. Put to one side.

In an effort to keep the number of basic tools to a minimum, I have one tool ground with a 45° chamfer half way across its width on both sides to allow chamfering on both side of a flange. Having it ground this way makes resharpening less fraught as the two angles together make for a 90° right angle – which is easy to judge by eye. Also it saves time, as by rotating the tool post 15° (in the direction required) with the same tool it is able to produce a 30° chamfer.

Filler extension – Item BF4

10AF Brass (**fig 56**)

Hold the brass in a three jaw chuck with 35mm protruding, face off, centre drill, drill 3mm diameter x 20mm deep, withdrawing frequently to clear the swarf. Turn 6.35mm diameter x 7mm. Using a 1mm wide parting tool set with its left-hand edge against the turned face, undercut 0.5mm (1mm on a diameter dial) into the 6.35mm diameter. Thread ¼ x 32 ME x 7mm (8¾ turns). Chamfer the hexagon 30° x 0.5mm. Part off 30.5mm long overall.

Screw into the ¼ x 32 ME mandrel and hold in the chuck. Face off, bringing the length between the mandrel and end face to 23mm. Centre drill, drill 5.5mm diameter x 10mm deep taking care as the drill breaks into the 3mm hole drilled in the other end. Thread ¼ x 32 ME x 10mm (12½ turns). Turn 10mm diameter x 13mm. This should just remove all traces of the hexagon - if not go to the bottom tolerance of 9.9mm diameter. Machine a 30° x 0.5mm chamfer where the diameter meets the hexagon and a 45° x 0.2mm chamfer (0.4mm on a diameter dial) on the end face (**photo 117**). Remove from the mandrel and put to one side.

●To be continued.

Fig 56

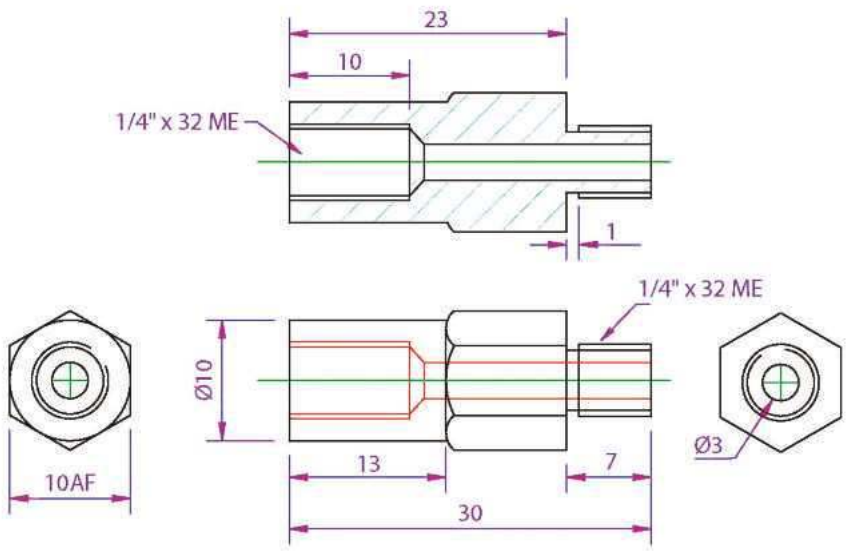


Fig 56 - Filler Extension Item BF4

NEXT TIME

Don't put away the 10mm AF brass just yet as we have a lot more parts left to make from it.

Extension parallel section turned.

MODEL ENGINEER

Incorporating Mechanics, English Mechanics and Ships & Ship Models

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June to December 2018

Lowestoft Model Engineering Exhibition 2018

Julie Williams reports on the delights to be found at this year's LOWMEX.

Traction engine and Lorry line up. (Photo by Vernon Readhead.)

Quite simply, the Lowestoft Model Engineering Exhibition (Lowmex) is the biggest and most varied exhibition of its kind in East Anglia. That sentence really says it all - and it is not an idle boast. For the past five years a sub-committee of Halesworth and District Model Engineering Society (H.D.M.E.S.) have presented a spectacular display of various models from their members and other supporting societies - and this year it was even bigger.

I could try to impress you with the statistics – over 300 tables displaying models of all types; free standing exhibits; demonstrations; independent exhibitors; outside rides and the chance to get up close and personal with working engines and their owners/handlers (**photo 1**). However, whilst some of that can be experienced at most model engineering exhibitions, it is the variety, the niche areas and the sheer number of these different exhibits which make this exhibition a bit different, a bit special. The Daleks (**photo 2**) made by Chris Harper and Jamie Fenn are a perfect example. They - the Daleks - had cloned themselves during the year and they lurked in an alcove in the main corridor. Some of our smaller visitors were very concerned when the Daleks went for a trundle … but they needn't have worried; they were quite safe as the Daleks couldn't negotiate the ramp! I am glad to say that there were no exterminated visitors – this time! There is a rumour from the Time Lord that K9 might join them next year.

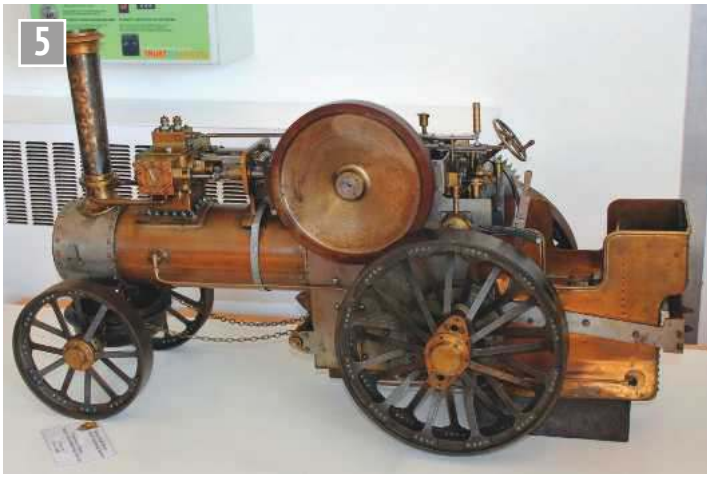
Gary Edwards displayed a few of his models (**photo 3**) showing that impressive models can be made from everyday items like spoons, knives and drinks cans. There were some delightfully delicate models made from broken watches (**photo 4**). Marion Rackham displayed her collection of Timeless Creatures, her latest one is the seahorse, as well as other delicate items.

The Daleks. (Photo by Vernon Readhead.)

Gary Edwards' models. (Photo Vernon Readhead.)

≫

Marion Rackham's models made from watch parts. (Photo Kevin Rackham.)



Horace Neath's Vulcan. (Photo by Vernon Readhead.)

The Castle by Brian Hammond. (Photo by Vernon Readhead.)

Norwich Boat Club. (Photo by Vernon Readhead.)

There was a unique model on display in the cafeteria (**photo 5**). Horace Neath, who is in his 90's and one of our older members, went to an auction four years ago and bought a box of 'stuff' for £100. They were parts for a 2 inch scale Vulcan traction engine. The Vulcan, originally a locally built full sized engine, is now long forgotten. Horace has been making scale steam models for decades …

… but the only model that Brian Hammond has ever made was finished and exhibited this year. It is an impressive castle made, literally, brick by plaster of Paris brick and constructed as all real castles are (**photo 6**). It is formed in two pieces and takes two men to lift each part.

What was the first model that you made? People come to model engineering by many routes; model aircraft, model boats, radio-controlled vehicles and we shouldn't forget the part that Thomas the Tank Engine and rail layouts have played over the years. They were all there; they were all represented.

From the general (**photo 7**) - a superb display from Norwich Gt. Yarmouth and Lowestoft model boat clubs - to the particular (**photo 8**) like Mick Butler's exhibits which included a Steam Launch and other marine engines. (Norwich BC also caters for r/c model trucks which hooted and trundled around the site all weekend.)

At just the right height for children, the rail layouts kept children engaged for ages (**photo 9**). The photo shows The Cuban Sugar Mills layout from the Waveney Valley Model Railway Club. If the children became fed up with that, there were wargaming models nearby to re-engage them.

Outside the weather was glorious, for a change, so the Langley Model Squadron with their Tethered aircraft (**photo 10**) could give flying displays whilst Terry Utting and Malcolm Colby were able to display their large model aircraft and aero engines in the open area inside. Terry has just finished a 1909 Bleriot (**photo 11**).

Still outside there was the club's portable track with Don Black's 7¼ inch gauge Hunslet, *Lady Hamilton* (being driven

Mick Butler's Steam Launch and engines. (Photo by Vernon Readhead.)

A railway layout fascinates the youngsters. (Photo by Brian Sinfield.)

Terry Utting's model of Bleriot's airplane of 1909. (Photo by John Wilkins.)

in **photo 12** by Vic Churchill), giving rides to anyone who wanted one. Several of the club's traction engines and steam lorries were strutting their stuff as well.

Back inside, the most popular room again this year was the Steam Punk room. The exhibition is worth visiting just to see the expressions on children's faces as they enter this fantasy room. It was never empty.

Each year the Lowmex exhibition has made a small profit, which has been donated to S.O.L.D. (Special Objectives for Local Disabled) and this year has been no exception. We are proud to help support such a worthwhile local charity, albeit in a small way. This year we were also able to help another local charity, The Lowestoft Thursday Club which is a voluntary organisation that organises social events for adults with learning difficulties. The volunteers of this club organised the snacks, teas and coffees at the exhibition, keeping any money they made for their club.

And where was Thomas? He had hitched a ride on a big brother (**photo 13**), a GWR Deans goods engine, sitting next to a brass GER Y14 0-6-0 tender engine. Both engines were part of the display by the Ipswich Model Engineering Society.

ME

Lowmex (www.lowmex.co.uk) will happen again in 2019 on Saturday and Sunday, 19th and 20th October. We look forward to seeing you there!

Aircraft used in flying displays. (Photo by Brian Sinfield.)

Vic Churchill driving Don Black's Lady Hamilton. *(Photo by Brian Sinfield) .*

Thomas *hitching a ride! (Photo by Julie Williams.)*

PART 29

Lathes and more for Beginners

Graham Sadler makes the third of three simple but useful items – dividing equipment.

Continued from p.849
M.E. 4601, 8 December 2018

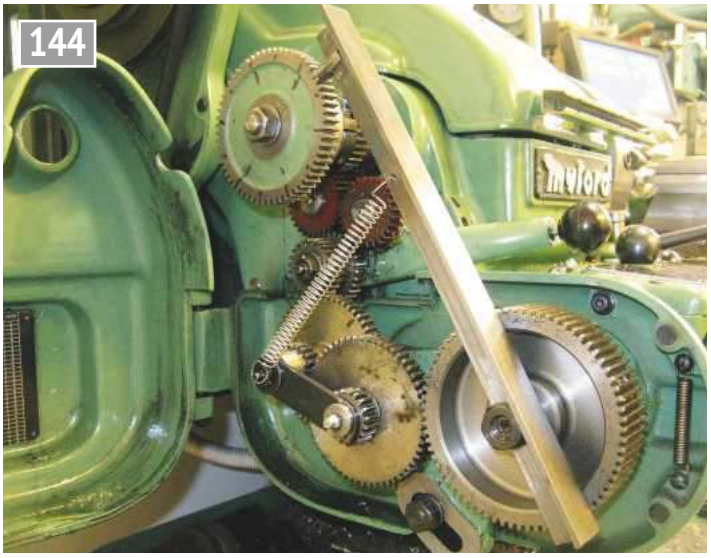
ERRATUM
In the previous part (M.E.4601) figure 31 appears to have slipped, losing the text at the start of the arrow coming in from the bottom of the picture. The missing text should be: 'Drill 8.5mm, csk. at 90 degrees inc. Cap screw to be below face'.

Simple dividing equipment

When we made the die holder, we used a bit of flat steel to jam into the bull wheel; this was crude, but was okay in this situation. I was considering making a fitting to be mounted on the edge of the headstock with a spring loaded detent but it's over complicated and I don't like drilling more holes than absolutely needed in my lathe. Instead I will detail the one I made a long time ago, very rarely used now as I undertake virtually all of my dividing using the miller with a *dividing head*, a dedicated spin fixture featured in *Engineering in Miniature* magazine (March and June 2013) or a rotary table.

This system uses a standard Myford gear mounted on a holder fixed to the outer end of the lathe spindle with a simple arm pivoted to a useful point on the fixed standard gear box or gear train assembly (**fig 32**).

Begin by measuring the exact diameter of the end of your lathe spindle. Mine was 0.868 inch. Using a piece of steel 50mm diameter x 43mm long, face both sides then rough down the spigot to about 17mm diameter and 21mm long. Grip by this to bore the pocket so it will be a good fit on the spindle. The bore must have a flat base to make the finished gear mount square to the spindle. If you want to check the fit, move the tool well to the right without touching the cross slide then remove the complete chuck and work to test it. You may need to remove the gear guard to try this. Be very careful until it's refitted!

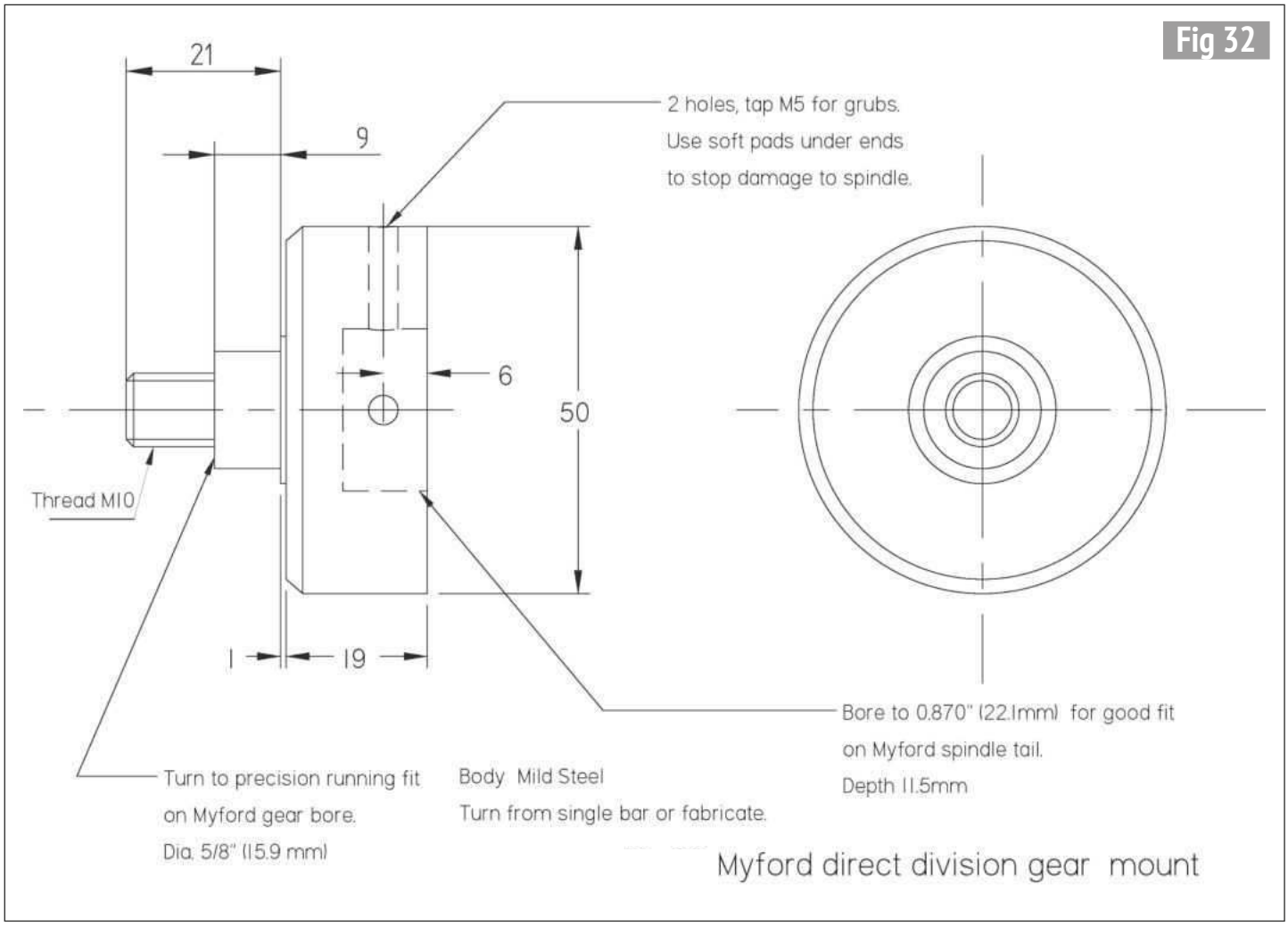


The set up for dividing in the lathe.

When satisfied, grip in the outside jaws of the three jaw chuck and finish turn the boss to ⅝ inch diameter to be a good fit with a Myford gear - note the 1mm clearance. Reduce the diameter at the end for the M10 (preferred) or M8 nut. Add an optional pin into the spigot to ensure no movement of the gear. I suggest you fishtail this before fitting with low strength Loctite then use a small fine file to adjust its width to be a tight fit on the gear keyway. Drill and tap for the two grub screws and put a small tight-fitting thin slug of brass or aluminium in the bottom so the lathe spindle is not damaged by the pressure of the grubs. Fit a 60-tooth wheel and mount on the spindle.

The detent lever for the gearbox machine is a bar of steel about 250mm long, with holes at about 180mm centres drilled 10mm diameter to match the lead-screw gear securing nut where it is fitted (small adjustments may be needed for non-gearbox machines). Swing onto the gear and mark the tangent point. A block may need to be screwed onto the arm to carry the detent. I drilled a 5mm diameter hole so it almost touched the edge of the steel arm then filed from the edge with a thin file to convert this into a short slot. File an equal point on a bit of steel bar so it is central to fit in the gear. Leave this a bit fat at first so adjustments can be made after brazing into position.

Assemble and check the fit of the detent in the gear and adjust as required (**photo 144**). It must fit both sides of the gear tooth or the lathe spindle could rotate to fill the gap and thus lose accuracy. It must not touch the bottom of the gap between the



gear teeth. Any fit will do - it doesn't need great accuracy of shape as it will always fit in the same position on the gear. Drill a hole in the edge of the bar to fix a spring onto some fixed point on the gear quadrant to hold the detent arm in place. In use, a marker pen can indicate which gear slots you will be using for the required divisions - and check it, as it's easy to miscount! For my detent arm, you will see that I used a piece of angle. Why? It's what I had in stock at the time!

●To be continued.

NEXT TIME: We'll make a rather more sophisticated boring tool holder to replace the boring bar we made earlier.

City of Stoke on Trent in 2½ Inch Gauge PART 3

Robert Hobbs creates a longed for Pacific from an historic set of castings

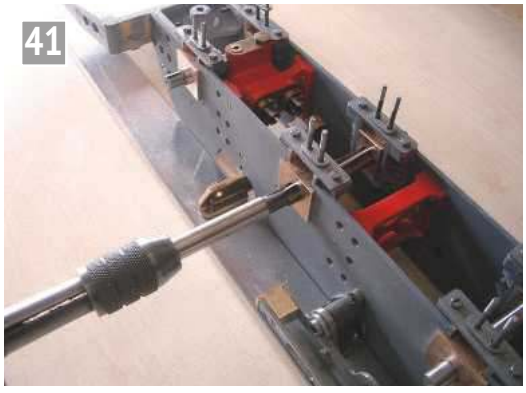
Continued from p.801
M.E. 4600, 23 November 2018

We left part two of this series with most of the fabrication complete on cylinders, Walschaerts valve motion, connecting/coupling rods and wheels. The next step was to machine the main bearing blocks, the eccentrics, assemble the main frames with the stretchers and install the cylinders, link girders, motion and the running boards. The stick of bronze supplied for the wheel bearing blocks was milled in pairs to the required profile and sized to suit the main horns (**photo 39**). The blocks were then milled to length and fitted in the horns, then, with the assembly carefully secured with a tool maker's clamp, the holes for the spring rods were spotted through the keeper plate (**photo 40**). This procedure was repeated for all six bearing blocks; at this stage each block, keeper and horn station was stamped with reference numbers to avoid fitting problems later on during assembly. The spring rod mounting holes were carefully drilled and tapped. The positions of the oil holes were marked out and the reservoirs drilled using a centre drill to form the oil cup. The blocks were fitted in the frames and the centres for the axles were accurately marked, the blocks drilled and reamed to size. **Photograph 41** shows the blocks in the frames; the middle blocks needing a clean through with the reamer to allow free rotation of the axle. The eccentrics were turned from one inch steel bar in the Myford, the off-set being machined by placing a three sixteenth inch thick spacer under one jaw before drilling the pivot hole. Two eccentric straps were made from flat bar stock and the third from a casting. The blanks had been roughly profiled in the mill, split, joint machined flush, drilled and tapped before setting up in the small, four jaw independent chuck in the Myford (**photo 42**). The blank was centre drilled and opened up to my largest drill in stages before finishing in size to suit the eccentric with the boring bar as shown in **photo 43**. The slot for the eccentric rod was cut using a slitting saw mounted in the Myford chuck, running at a slow spindle speed, with the eccentric strap securely clamped to the carefully aligned tool post (**photo 44**). The oil reservoir and oil hole were drilled using a centre drill to start in the pillar drill and the completed eccentrics and their straps are shown in **photo 45.** The cylinder blocks were bolted in position on the frames and the girder frames fitted with the main pivot support blocks, also with a packing piece to support the running boards, (**photo 46**).

The running boards were cut from galvanised steel sheet, folded with a quarter inch flange and marked off to suit the fixing points in the front and rear brackets. The running boards are left over length so they can be trimmed to suit the cab installation later. The main running boards and the

Milling the main wheel bearings.

Spotting through for the spring rods.



Bearings in situ*; reaming ready for the centre axle.*

Drilling an eccentric strap blank.

Boring an eccentric strap.

Slitting the eccentric rod end.

My enjoyment from this super hobby of ours derives from my time in the workshop...

The completed eccentric straps.

The cylinders fixed in position.

The running boards viewed from the front.

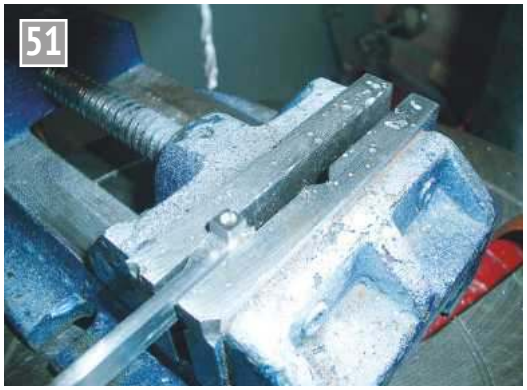
lower front boards are shown in **photo 47**. **Photograph 48** shows the underneath of the main frames prior to fitting the wheels and motion. The bearings for the coupling and connecting rods were straightforward machining operations, from brass stock, the repeatability being helped along by the DRO set up on the Myford lathe. **Photograph 49** shows the lathe set up for the bearings. The coupling rods and the connecting rods with the bearings pressed in position are shown in **photo 50,** the bearing bushes being reamed to size after being pressed in place. The oil holes for the rod bearings were marked out and initially drilled with a centre drill, the oil hole being opened up and drilled through the bearing; the burr left on the inside being carefully cleaned off with the reamer. **Photograph 51** shows the oil hole being drilled in the pillar drill.

The wheel assemblies, the girder frames and the coupling/ connecting rods are shown in position on the main frames when viewed from above in **photos 52** and **53**.

Looking up from below.

The set-up for machining the side rod bearings.

The rods complete with bearings pressed in.



The oil hole being drilled in the pillar drill.

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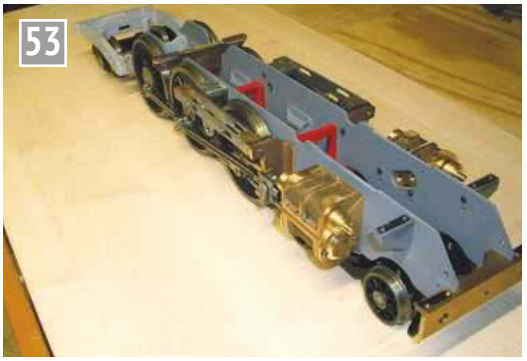
The chassis taking shape.



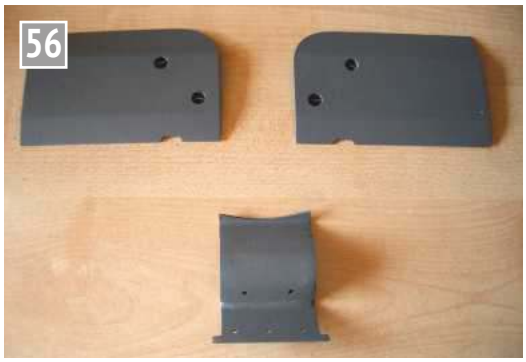
The assembly viewed from the front.

Leaving the machining for a while, attention was turned to the sheet metal aspect of the project. Running boards were drilled to suit the front support brackets and the spacing for the six splashers was determined and cut out to suit. The splashers were cut from sheet steel strips using my bench guillotine, the tops being rolled to suit the side profiles and flanges being formed on the leading and trailing ends**. Photograph 54** shows the loosely positioned splashers on the running boards. **Photograph 55** shows the newly acquired bench guillotine which continues my practice of adding to my workshop equipment with each project, allowing this and future projects to proceed with ease and flexibility. There is insufficient bench space in the workshop to have the guillotine permanently mounted on the bench so it is held securely in the vice when cutting.

The two smoke deflectors were cut to size using the guillotine and the rounded corner finished off with the six inch disk sander, the hand holes being positioned, drilled and finished on the inside with a grab bar and a dome casing. **Photograph 56** shows the primed smoke deflectors and the fairing unit that is positioned between the main frames just in front of the smokebox door.

The cab roof was marked out and cut from brass sheet with the guillotine with the corners being finished on the six inch disk sander and rolled to suit the cab profile; this is shown in **photo 57.**

A trial assembly of the splashers.



Smoke deflectors in primer.

A recent acquisition, a bench guillotine.

The cab roof.

Cab side sheets.

The cab sides were produced in a similar manner to that used for the roof section with the windows being cut out in the vertical mill. The two cab sides were clamped to a sacrificial flat piece of timber and carefully aligned with the mill table, the window apertures being cut out with a slot drill using the longitudinal and cross feeds to obtain the correct size. **Photograph 58** shows the cab sides and the dummy running boards; the rivets - two in each side - are retaining the spacer blocks used to obtain the correct width of the cab. The spectacle plates are shown in **photo 59.**

The smokebox was cut from sheet brass and rolled to size using my twelve inch slip rollers - which had been purchased for an earlier project - and soldered on the lower seam, which would lie in the saddle casting. The smokebox ring was machined from aluminium stock to suit

the smokebox diameter; the access hole covered by the door was bored out on the lathe, the dart assembly was turned in the lathe whilst the door hinges were fabricated from sheet steel, the door being machined from a bronze casting. This sub assembly is shown in **photos 60 and 61**. The primed smokebox with the rivets in position and the holes drilled for the chimney is shown in **photo 62.**

This almost completes the sheet metal work for now. In the next part we will continue with the boiler, which will be fabricated from sheet steel, brass and copper. **Please note: the boiler is not intended to function** as my projects are for display only; my enjoyment from this super hobby of ours derives from my time in the workshop and the fabrication/ machining of locomotive parts and resolving the problems involved as they occur during construction.

Photograph 63 shows my Christmas present from Eva my very understanding wife. When not with Eva I am playing in the workshop or sailing one of my radio controlled yachts, which are raced at Gosport Model Yacht and Boat Club. The International One Metre yacht is just that (**photo 64**) however the International 'A' Class is another thing altogether being approximately 1.8 metres long and 2.5 metres high. This is my favourite radio controlled yacht class and is shown in **photo 65**. Walking the length of our lake, which is 300 metres long, on a Sunday with 12 races clocks up 5 to 6 miles and really helps keep me fit. Just to end on this time, **photo 66** shows the world famous lakes at Gosport.

●To be continued.

NEXT TIME: I will tackle the last major part of the locomotive - a dummy boiler.

Spectacle plates.

Smokebox ring temporarily assembled.

Smokebox ring with cast door and hinges in position.

The smokebox, with chimney holes, in primer.

My wife's sense of humour!

International 'One Meter' racing yacht.

A 1.8 meter yacht: my favourite class.

An aerial view of the Gosport racing lakes.

More on Balancing

PART 3

Duncan Webster revisits the subject of wheel balancing and considers some more complex cases.

Continued from p.795
M.E. 4600, 23 November 2018

Inside cylinder locomotives

All the same principles apply to inside cylinder locomotives so I don't propose to labour the point, however there is one issue that deserves a mention. Most British locomotives had the coupling rods displaced 180 degrees from the connecting rods, presumably to balance each other out. A side view of this arrangement with the crank at 90 degrees is shown in **fig 9**. The 'wiggly' line is meant to be a schematic of the crank axle. I have set the force in the connecting rod at half that in the coupling rod assuming drive equally divided between two axles. The forces and radii are typical of a full size locomotive working hard.

The wheel is rotating counter-clockwise, the connecting rod force F is to the left, the coupling rod is in compression so is exerting a F/2 force to the left, and the wheel is exerting a force W to the right on the rail, so the rail is exerting a force on the wheel to the left.

Taking moments about the axle, the force at the rail is

$$W = \frac{F \times 10 - F/2 \times 10}{40} = 1.25 \text{ tons}$$

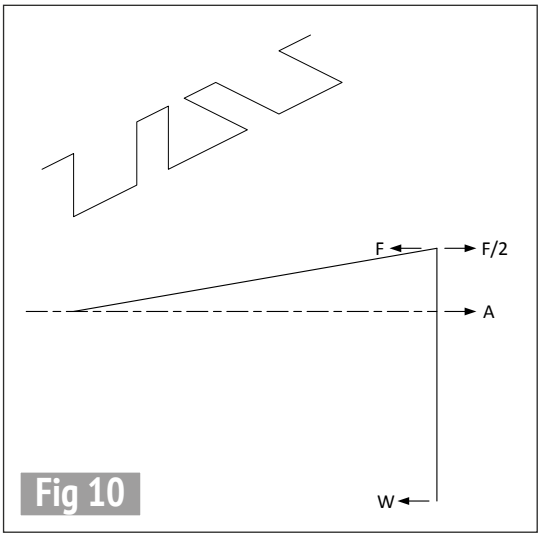


Fig 10

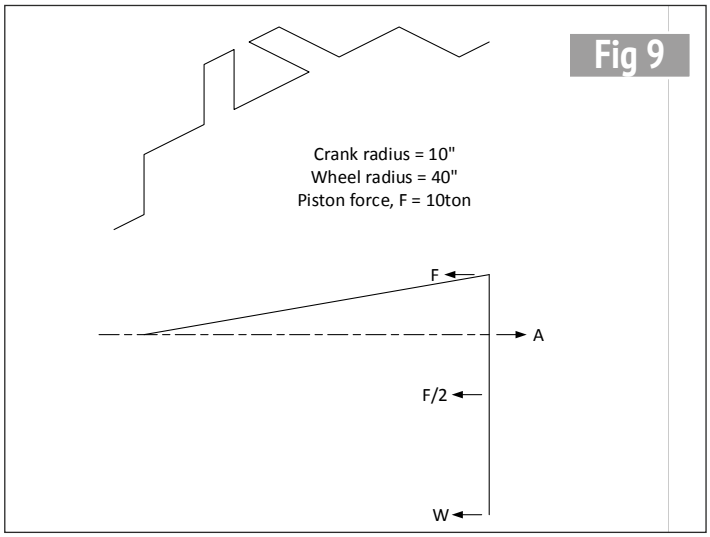


Fig 9

The force at the axle is

$A = F + F/2 + W = 16.25$ *tons*

Note this is pushing back on the axle, so forward on the axlebox.

If you do the same force balance on the rear axle you find that the rear wheel set is pushing backwards on the frame with a force of 3.75 tons, so acting on the locomotive frame we have 16.25 – 10 – 3.75 = 2.5 tons which is 10 tons * 10"/40", so all is as expected.

If the rods were arranged so that the coupling rod was in line with the connecting rod as shown in **fig 10**, the axlebox force is reduced to

$A = F - F/2 + W = 6.25$ *tons*

which gives the front axleboxes a much easier time. The rear axlebox is pushing the frame forward with a force of 6.25 tons, so again acting on the locomotive frame we have 6.25 + 6.25 – 10 = 2.5 tons. Okay... you need bigger balance weights, but no bigger than with an outside cylinder locomotive. At least one of the old designers spotted this, but for the life of me I can't remember who. Unless I were building a Gold Medal winning model (not much chance of that), I'd do the second way. The front axle of a divided drive four cylinder locomotive will suffer from the same effect; I haven't worked out the numbers, but the piston forces are only half the equivalent two cylinder locomotive.

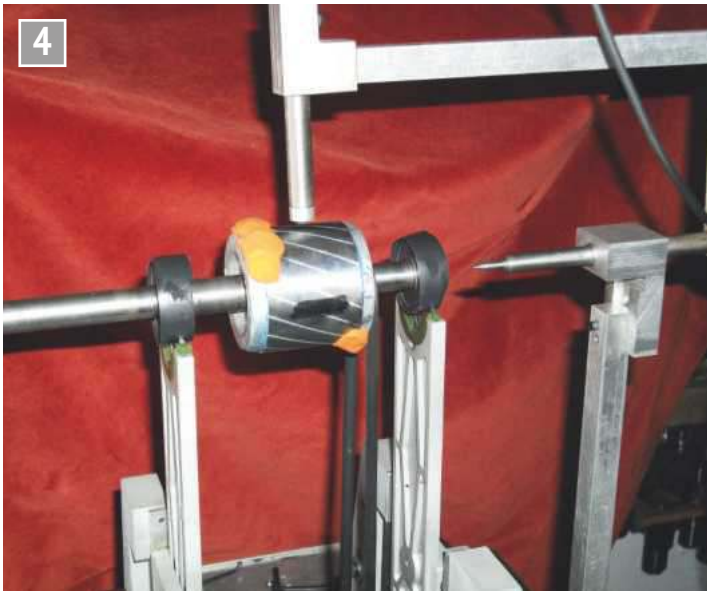
These sums have been simplified by ignoring the axlebox forces caused by the piston on the other side, but I doubt that would change the conclusion.

There is an advantage in inside cylinder locomotives in that as the cylinders are closer together, the residual reciprocating unbalance will cause less nosing. This cannot have been considered worthwhile, as there were few if any such locomotives built for operation on the mainline after the 1930s.

Shuttling

As I mentioned in Part 1, the unbalanced reciprocating forces give rise to fore and aft oscillation of the locomotive. I have since found this is called 'shuttling'. The LMS conducted tests with a Black 5 where the balance weights were set to balance 30% of the reciprocating mass in one

John Pace's balancing machine. (Photo by John Pace.)



The pen mark is an opto-sensor. (Photo by John Pace.)

case and 66.6% in another. In the first case there was unacceptable shuttling, in the second the wheels left the rails and caused severe damage at high speed. This is reported in **ref 1** (see part 2, M.E.4600, 23rd November); unfortunately, again, the photos are not good enough for reproduction. The LMS thus settled on 50% for the Black 5s. Other CMEs were of a different opinion, balancing between 40% and 75% of reciprocating weight.

For a given force, the residual shuttling effect will be less pronounced on a heavy locomotive. Lots of full size locomotives had spring loaded locomotive to tender couplings so that in a fore/aft direction the tender mass was added to the locomotive mass. I have never seen this in a model, but as stated in Part 1, we don't suffer the same magnitude of problem.

Balancing lathe

It might be of interest to delve into how these work. Every time you get a new tyre on your car the wheel is balanced using a dedicated balancing machine, but I don't think they would be much use to us. The one in **photos 3** and **4** was made by *M.E.* reader, John Pace for balancing model gas turbine bits.

The bearing pillars are mounted on flexible supports which can just be seen in photo 3 so when the shaft is rotated the bearing supports can move horizontally. This movement is detected by sensors and displayed on an oscilloscope.

When doing a locomotive wheelset, it would be tempting to arrange the supports in the plane of the balance weights, then adding weight to one end would not affect the other, but I'm not sure how!

The rotor is driven by a flat belt from a small electric motor. As shown in photo 4, a black felt tip mark on the rotor is detected by an opto sensor and, by moving the sensor round the axis, it can be aligned with the peak or trough of the displacement (shown in photo 3). Plasticine weights are then added to get it in balance before starting to remove metal, obviously opposite the plasticine. I guess this is an incremental process.

An alternative method is to use force transducers to stop the bearings moving and display the force instead, but Mr. Pace assures me that this is much more sensitive to stray vibrations.

When doing a locomotive wheelset, it would be tempting to arrange the supports in the plane of the balance weights, then adding weight to one end would not affect the other, but I'm not sure how! A 'starter for 10' might be to make a frame to support the wheelset between centres then hang the whole frame on links, but restrain it with stiff force sensors so that adding/removing weights to one wheel doesn't affect the forces at the other. As I said before, I'm not going to make one.

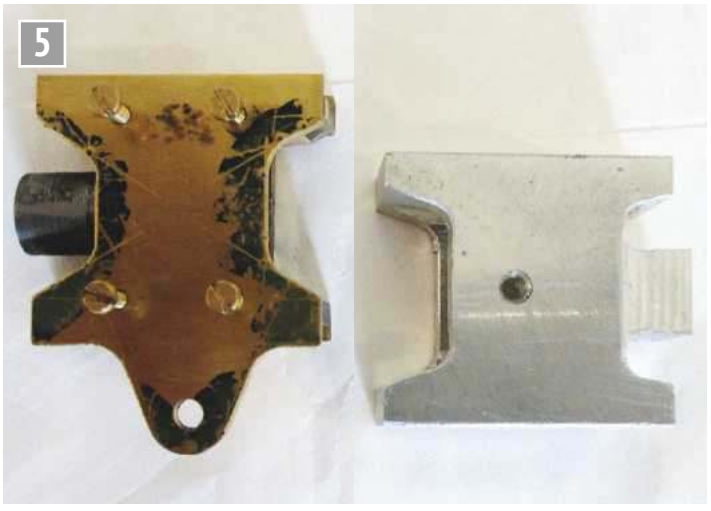
Conclusions

So where does this leave my little locomotive? I've already made some aluminium crossheads; **photo 5** shows old and new (not quite finished), reducing the mass by a factor of roughly three and, following the comments received via forum and postbag, I'm going to make aluminium pistons and make them thinner, so reducing weight by a factor of roughly five. Next step is to think about making the rods lighter, but that is another story. Will it make any difference to how it runs? I doubt it, but it has been a very interesting learning experience.

Acknowledgments

Thanks to Tim Stevens for proof reading this and making some useful improvements.

ME



Old crosshead - and new in aluminium.

Midlands Model Engineering Exhibition 2018

PART 2

John Arrowsmith looks back over the competition classes at this year's show.

Continued from p.859
M.E. 4601, 8 December 2018

Class 10: Marine models – scale over 50% scratch built

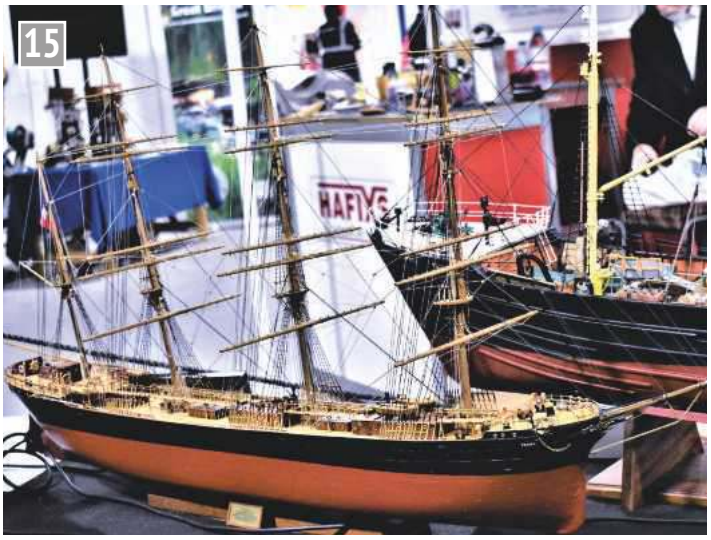
Three certificates were awarded in this class to some well-made and totally different models. Very Highly Commended was the *Parma*, a four masted barque rigged iron hulled ship built by Trevor Orton (**photo 15**) and a Highly Commended certificate was presented to Mike Nicholson for his picket boat (**photo 16**). The fishing boat *The Girl Pat* was Commended and was part of the Kingsbury Water Park display.

Class 11: Marine models - kit (standard or modified)

A Very Highly Commended certificate was awarded in this class to Graham Farrow for a well detailed example of a Grimsby steam trawler, the *Boston Mariner* (**photo 17**).

Class 12: Model horse drawn vehicles

There were only three entries in this class but the quality was excellent. First Prize and the Lenham Pottery Trophy was awarded to Eric Keggans for his example of a Royal Mail coach circa 1830. Well finished with lots of fine details, it was a worthy winner (**photo 18**). The Second Prize was presented to Patrick Hall for his ⅛ scale model of a Sussex waggon circa 1850. A set of drawings accompanied the model so that judges could check out the fine detailing (**photo 19**). A horse drawn sling cart gained a Very Highly Commended certificate for Brian Young.



This four masted Parma *iron hulled ship gained a VHC certificate for Trevor Orton in Class 10.*

Class 13: Scale aircraft models

There were no entries in this class either but there were some good examples within the exhibition.

Class 14: Young engineers

The number of entries in this class surpassed anything seen in recent years. Eighteen young people exhibited their work for the judges to consider. The work displayed ranged from the extremely high-tech CNC Lathe to basic boat building with a great deal of variation in between.

First Prize and winner of the Stuarts Models Shield was 17-year-old Angus French with his entry of a CNC lathe. Built from scratch along with all the electronics it was an impressive piece of work. To

A well-made picket boat was awarded a Highly Commended certificate in Class 10.

This Grimsby steam trawler won a VHC certificate in Class 11 for Graham Farrow.

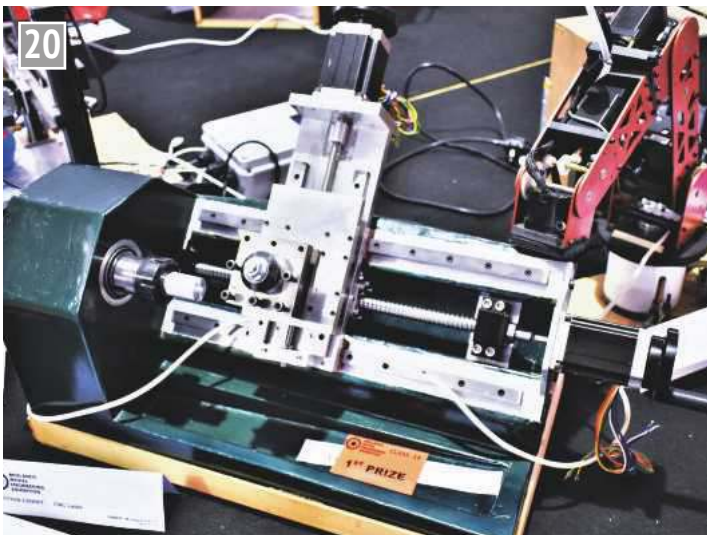
This Royal Mail coach circa 1830 built by Eric Keggans was awarded First Prize in Class 12.

A Sussex waggon gained the Second Prize in Class 12 for Patrick Hall.

overcome the basic needs for a rigid and substantial base, Angus used a type of epoxy cement which made for a very strong structure (**photo 20**). Because of the high standard of the work being exhibited, the judges awarded joint Second Prizes for very diverse exhibits. The representation of a Foden steam lorry in 4 inch scale built by 15-year-old Daniel Bell using components from a scrapped mobility scooter was a fine model in every way. Accompanied by a full set of notes and photographs it was a very good introduction to model engineering. The joint Second Prize winner was 12-year-old Matthew Kenington with his oscillating engine built from bar stock and his own modified drawings. This little engine showed some excellent surface finishes and details and again was accompanied with a full portfolio of his notes and photographs.

For the remainder of the class, four Very Highly Commended certificates were presented along with six Highly Commended certificates and five Commended certificates. One of the VHC's was presented to Rosie Turner for her unfinished model of a *Chitty Chitty Bang Bang* car. This difficult body shape is coming along very well and for a 12-year-old is remarkable work (**photo 21**). Ryan Philo's Tractor was another VHC model again with good detail and finish (**photo 22**). A couple of workshop equipment pieces by Tom Williams also gained VHC certificates with his double ended die holder and centre finder punch being useful items which were well made (**photo 23**). Among the HC winners was the scratch built lorry by 11-year-old Lucas Hall which had full R/C gear including a tipper mechanism (**photo 24**).

The Commended winners were a group of young people from the Halliford School from Shepperton in London. The five models are based on a simple sailing boat called *Wee Nip*. All these young people in the whole class entry really do enjoy what they are doing and the presentations made by them at the show took a lot of courage and showed the older ones among us that hopefully there is a future in model engineering but perhaps in different ways from the traditional approach. All the senior people involved in their instruction also deserve acknowledgement for their time, patience and resolve in trying to encourage more to do the same.



This superb CNC Lathe built by Angus French was awarded First Prize in Class 14.

12-year-old Rosie Turner is building this Chitty Chitty Bang Bang *car which gained her a VHC certificate in Class 14.*

Ryan Philo's lorry was awarded a VHC certificate in Class 14.

Tom Williams made this double ended die holder as a first attempt at model engineering and toolmaking.

A Highly Commended certificate in Class 14 was presented to 11-year-old Lucas Hall for his scratch built lorry.

First Prize in Class 15 went to Brain Swann's excellent Napier-Railton racing car.

Class 15: Miscellaneous

Three very diverse entries in this class and all to a very high standard with the First Prize being awarded to Brian Swann for his excellent example of a 24 litre Napier–Railton Brooklands racing car. Good attention to details and a period finish made this lovely model (**photo 25**). The Second Prize went to an exhibit brought all the way from Malta by Carmelo Borg. His M41 Walker Bulldog US tank was full of detail and was very well finished (**photo 26**). A Very Highly Commended certificate was awarded to Eric Keggans for a delightful model of an Aveling–Barford DC12 roller, well finished to appear as if it had just stopped after a day's work (**photo 27**). Details even included a packet of cigarettes and the drivers unwashed tea mug!

From Malta Carmelo Borg brought his American M41 tank and gained Second Prize in class 15.

The Aveling-Barford Roller built by Eric Keggans gained a VHC certificate in Class 16.

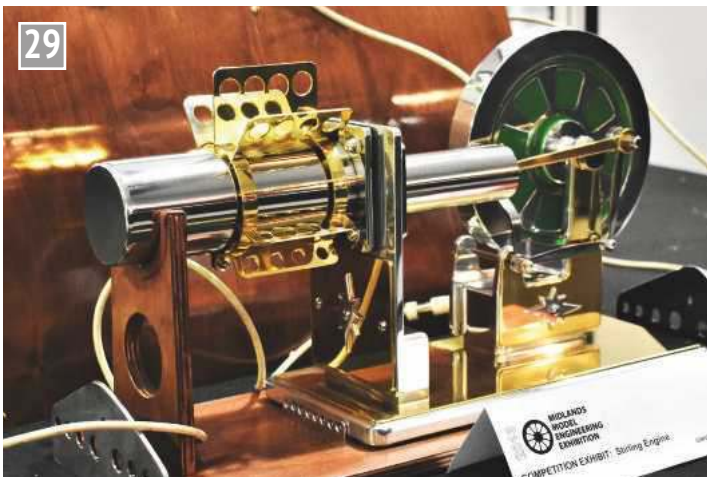
Class 16: Hot air engines

A couple of very nice examples in this class resulted in John Wing being presented with the First Prize for his HAE 01 Stirling engine which was superbly finished and presented (**photo 28**). A VHC certificate was awarded to Michael Green for another beautifully finished and presented Stirling engine with carrying case (**photo 29**).

Well that concludes my notes for the competition classes for 2018. I would like to thank all the exhibitors for entering by saying that without you there would be no Midlands Model Engineering Exhibition and I hope that next year in 2019 you will return with your latest models for consideration, particularly the young engineers. You have set the bar very high this year so let's see what you can do for next year. We all hope that young people from different clubs will get involved and show us what they can do. I know you are out there so don't be shy - your work will be appreciated.

ME

First Prize in Class 16 was awarded to John Wing for this HAE 01 Stirling engine.



Michael Green's Stirling hot air engine and case.

The Barclay Well Tanks of the Great War

PART 43

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

Continued from p.776
M.E. 4600, 23 November 2018

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.

Cab fittings

So now it's back to the locomotive and sorting the boiler fittings within the cab. There is plenty to be getting on with as can be seen in **photo 214**. A general arrangement of the cab fittings is shown in **fig 134**. Note that the figure omits the driver's brake valve and lever as well as most of the steam pipework.

While I was laying out the items for figure 134 I noticed another small error in the offset bend of the reversing lever (*lo siento*!). This should be offset at 3⅛ inches from the bottom of the lever and not 2⅜ inches as shown in figure 92 (M.E.4575, December 2017). This mistake occurred because the top of the bunker is shown at 6⅜ inches above the footplate whereas it should have been 7 inches.

Cab view.

Steam fountain

Photograph 215 and **fig 135** show the steam fountain which screws into the ½ inch x 26tpi bush on top of the Belpaire box. On the left and right are the fireman's and driver's injector steam valves respectively. Centrally, and facing the crew, from bottom to top, are the blower steam, steam brake isolation and whistle valves. To the right of the central column is the take off for the pressure gauge siphon.

The best material to use for this job is 1 inch AF hexagon bronze but good quality brass is fine, as there should be no corrosion problem with zinc-based alloys at this point. Turn up the bits and pieces with stubs that fit into the column and silver solder them all together to make the finished item. Note that the flanges on the two injector valve steam connections do make assembly somewhat difficult, so threaded sockets would be more practical if you're not worried too much about scale appearance. The diagonal orientation of the 8BA threads ≫

Fig 134

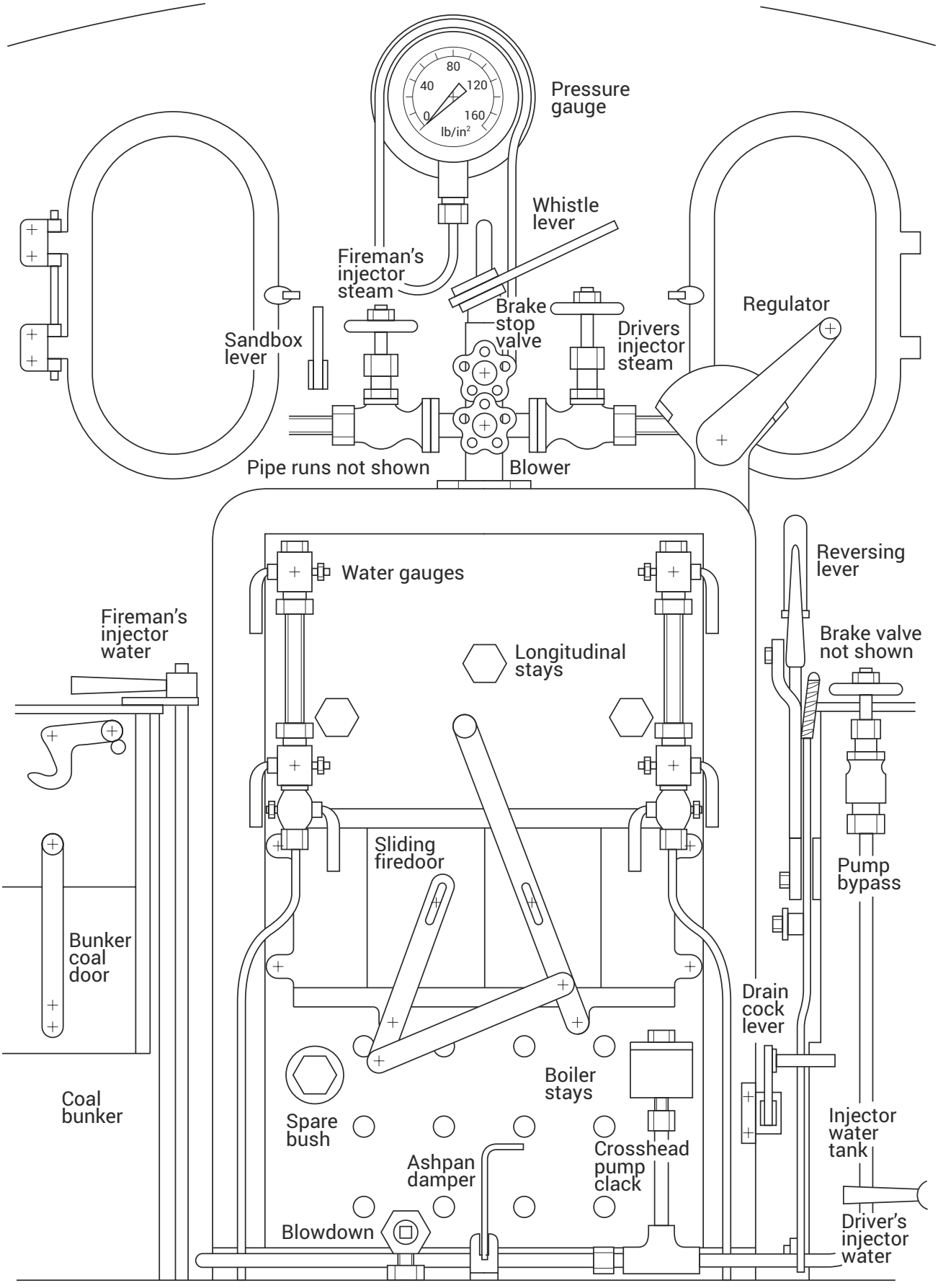
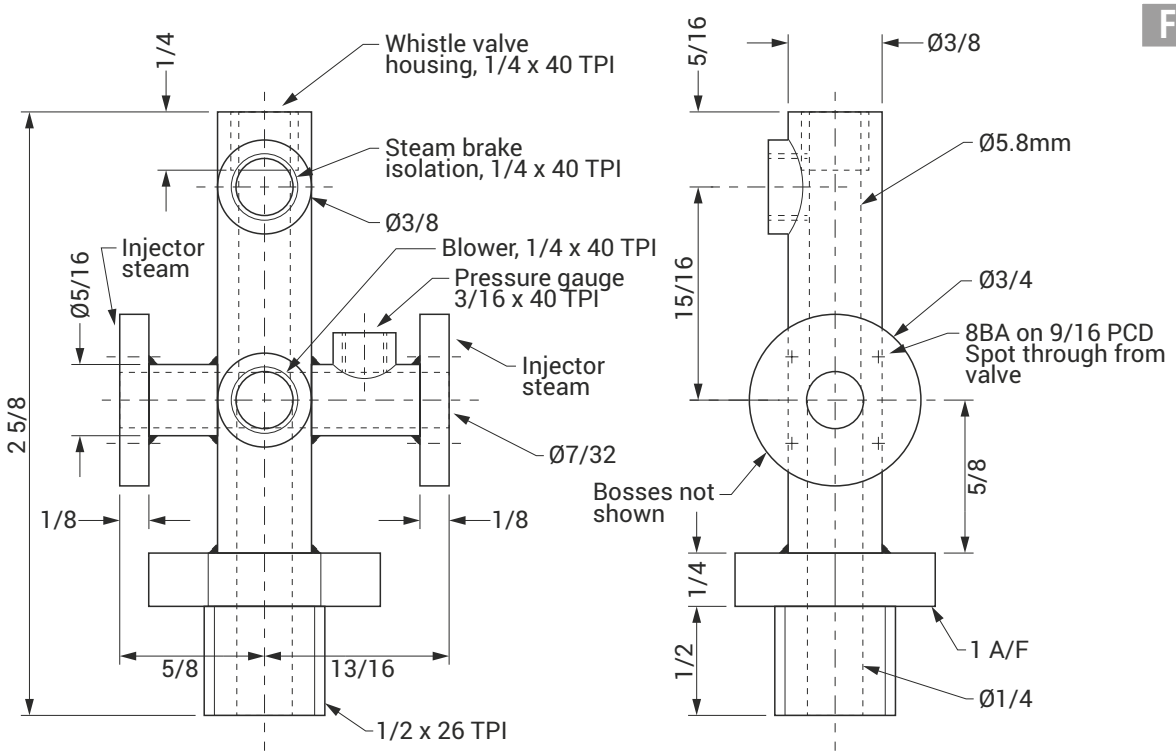

80
40
120
0
160
lb/in²
Pressure gauge
Whistle lever
Fireman's injector steam
Brake stop valve
Drivers injector steam
Regulator
Sandbox lever
Pipe runs not shown
Blower
Water gauges
Reversing lever
Fireman's injector water
Longitudinal stays
Brake valve not shown
Sliding firedoor
Pump bypass
Bunker coal door
Drain cock lever
Boiler stays
Coal bunker
Spare bush
Injector water tank
Ashpan damper
Crosshead pump clack
Blowdown
Driver's injector water

Fig 135



Steam Fountain
Mat'l: Bronze, all joints silver soldered

makes assembly of the flanges somewhat easier. Also note that the boss for steam brake isolation is not required on the original locomotive, *Airservice Constructional Corps No.1*.

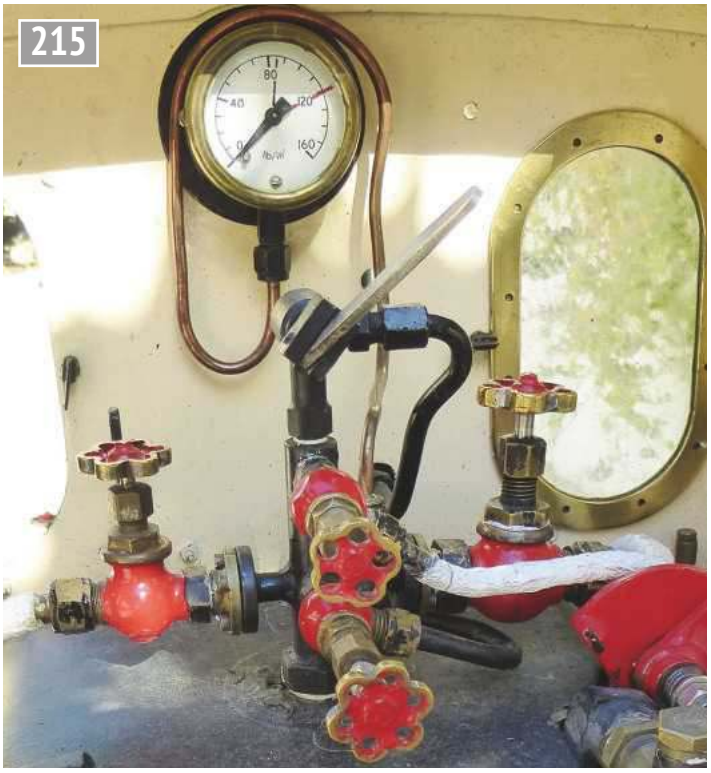
Steam valves

The cab valves on my engine are all commercial items from Stuart Turner but they are not difficult to make from scratch, just a bit time consuming; more of which later. On my original engine I cheated by buying commercial valves just to expedite getting the locomotive on the road. They have functioned perfectly all these years and so, as they say, 'if it ain't broke why fix it?'!

Steam valves should always be fitted so that the live steam supply is under the seat - this way round, when the valve is shut there is no steam pressure on the gland. And note that, for safety reasons, captive valve spindles should always be used; unlike the good old LBSC valves! One thing I discovered during my days working on nuclear steam plant is that an open stop valve should not be opened to a hard stop – it should always be opened fully and then wound back half a turn. This way the 'feel' of the valve handle will tell you if the valve is open or closed. Obviously, this only applies to 'stop' valves and does not apply to a valve used for flow adjustment.

My own designs for these valves are suitable for both steam and water. The two injector steam valves on the boiler manifold (aka steam fountain) are 'straight through' valves and these are a bit more difficult to make than 'angle' valves. The outlet on 'straight through' valves needs to be drilled up into the valve to come out above the seat. And, as mentioned earlier, if connected the right way round there will be no steam pressure on the gland when the valve is closed.

Good, basic designs are shown in **ref 40**. **Reference 41** describes a useful method for ensuring that the valve spindle parts are concentric, although this is not quite so important if PTFE seats are used, as in the designs I will offer next time.



Steam fountain.

REFERENCES
40. John Bertinat, *Notes on Model Boilers*. Model Engineer 4079, October 1998.
41. J Coulson, *Valves - My Way*. Engineering in Miniature. Volume 2, pp 118, 119, 109. 1980.

CLUB NEWS

Geoff Theasby reports on the latest news from the Clubs.

I begin with further enhancement of my credentials as a trainspotter. A member of a social media group told us he drove a locomotive at an industrial site and posted a photo of a central cab, double ended 0-6-0 diesel shunter. 'Is it a YEC Janus?' I asked; he replied, 'Yes, 10 points'.

I also rebuilt the desk microphone I bought in Newark and was rewarded by a horrendous buzzing noise from the transmitter. It may be an earth loop problem, or the proximity of the mic to the radio. Still, basically it works. If I plug it into the stereo, I am the Voice of Doom!

I visited South Yorkshire Air Museum at Doncaster for an Open Cockpit weekend. Great fun. I 'cabbed' the Hawker Hunter, in which there were only about 10 dials to comprehend and contrasted it with a Tornado, which was stuffed full of indicators, screens, displays, etc., to the point where seeing out was difficult, maybe even unnecessary... I bought a copy of P.O. Prune's Picture Parade, featuring the legendary pilot, whose impact on the RAF was such that, even today, the pilots' chat list forum, civil and military, is called https://www.pprune.org (https://en.wikipedia.org/wiki/Professional_Pilots_Rumour_Network). The business end of a Vulcan is being restored with the help of enthusiasts, collectors and eBay and was visited, yea, even unto Debs, who found it fascinating, as I thought she would. There were lots of children about, all asking the same questions: 'What's this, Granddad?' Great stuff!

W. www.southyorkshireaircraftmuseum.org.uk

In this issue; a clean windscreen, an old coach, disturbing the ladies, a suitcase scooter, a working V2, rope lays, Allen keys, a versatile member and a book.

First from the pile is the **Gauge 1 Model Railway Association**'s *Newsletter & Journal* for Autumn. It mentions a Garden Railway Exhibition in Western Cape Province, S.A. lasting for five days in December, associated with the annual Diamond Head Steamup and the Outeniqua Transport Museum. Steve Andrews was given a box of bits, thought to be an LNWR Experiment. After sorting the contents, there appeared to be parts from two locomotives, a 4-4-0 and a 4-6-0. The latter was chosen and seems to be a Prince of Wales, now named 1346, *Trent*. Chris Tunbull makes signals for 'Anglia Roads' of the East Anglian group. Here is a Derby Lightweight at Hobson Central. Note the wiped-clean part of the driver's windscreen - and it is running 'wrong line' (**photo 1**). This Britannia is shown in a very natural setting (**photo 2**). Robert Dean and Stuart Hithersay visited Spur 1 at Sinsheim, whilst Neil Ramsay builds a Giant's Causeway coach, as displayed in the Ulster Transport Museum at Cultra. He 'cheated' by using laser cutting for the complex roof valances. The result is delightful (**photo 3**).The L&Y School of Signalling Gauge 1 layout is described, as

Derby Lightweight G1 N&J. (Photo courtesy of Chris Turnbull.)

David Alexander's G1 Boadicea *in a realistic setting. (Photo courtesy of David Alexander.)*

currently at the NRM. John Perkin models a car from the Société des Tramways du Loir-et-Cher. An item on boiler test codes is illustrated by a photo of the Yarrow HP boiler for H. N. Gresley's 10 000 of 1929. Peter Strange bought an old coach for £22. Full size! Despite masquerading as a derelict garden shed, it was revealed to be L&Y 6-wheeled No. 1784 of 1883 and Peter spent nine years restoring it.
W. www.g1mra.com

Steam Whistle, September, from **Sheffield & District Society of Model & Experimental Engineers,** in *Murray's Thought* regarding, on this occasion, ship to shore power. There are such items as 'power barges' to be moored alongside ships to test their generating capacity. What we radio amateurs call a Dummy Load. A single ship, cruise liner or warship, may generate more power than the port it is visiting. In Norway, it can be significantly cheaper to buy in power from ashore for the duration of stay, than to generate the daily 100 kW required on board.

Model & Experimental Engineers Auckland *Newsletter*, October, shows a spark arrestor made by Ken Pointon. This goes in the top of a balloon smokestack, deflecting the fiery particles which fall back into the smokebox. (I always wondered how those things worked – Geoff.) Several items on various clocks by Edgar and Murray Lane followed.

The Newsletter, Autumn, from **The Gauge 3 Society,** reveals that Guest Editor, Trevor Goodman, one of the 'reserves', having done the job before, recalls attending a GTG in a Rolls Royce. Others had camped overnight so he felt compelled to explain that it was second hand. That's all right then! On another occasion, a radio-controlled locomotive locked into 'full-on' mode and it so happened that the track lay high up in an open garden room, where the G3 ladies were enjoying tea and cakes. When this hissing, smoking vision shot through the room, their collective enthusiasm for Gauge 3 waned somewhat! Ian Driver, now retired and having more time, builds a 'Spam Can' admired since childhood. The tender is from 2mm Plastikard, the frames from 1mm brass sheet and back to Plastikard for the boiler casing. Power is electric using a Pitman 24 volt motor and 30:1 gearbox. Interestingly, the rods are 3-D printed plastic and have so far lasted the season; we shall see how long they continue (**photo 4**).
W. www.gauge3.org.uk

*Coate Express***,** Autumn, from **North Wilts Model Engineering Society**, shows the results of 'starting them young'. Connor Duncan can hardly reach the bed traverse handle on the mill. The next picture is of him asleep between tracks in the shed. All together now… *'Awwww'*. On page 16, Connor writes (it says here) on his introduction to model engineering. A visit by 19 members of the Branch Line Society travelled over all parts of the Coate Water Railway, yea even unto the shed thereof… and it was good. Each member had a map of the railway and crossed off each section as it was 'bashed'. Eventually, all had completed their maps, with the exception of a length no longer present. It was established that the various members had travelled some 1271 miles between them in order to attend and the same again on their return. A person *'anonyme'* bought a used locomotive from a dealer, which was offered with hydraulic and steam certificates and ready to run. On first steaming, water poured out, the valve gear was loose and that was just the start. Correcting the various points took less than a day and it now runs well, but - *Really!*
W. www.nwmes.info/

On 25th October, the Sheffield Tram-Train project began carrying passengers, only about seven years late! It was originally to be dual-powered, diesel and electric, to make it independent of supply, until it was realised that the engines would not meet Euro 6 pollution standards. I therefore made it my business to travel at the first opportunity, which was two days later. I was a week late on the reopening of the KWVR, as I was on the reopening of the Wensleydale Railway, so I'm improving! This led to a discussion on social media enquiring of the differences in using 'Big Railway' tracks and tram tracks. Wheel profiles, basically. Someone asked if there were two wheels on every axle, whereupon he was told there are two wheels on every axle, except wheelbarrows! (He meant for change of gauge but the gauge is the same here.) The date is also significant since the 25th October is the anniversary of the Charge of the Light Brigade in the Crimean War. Light Brigade, Heavy Brigade/ Light Rail, Heavy Rail? - Oh, please yourselves (**photo 5**).

Giant's Causeway coach, note laser cut valances. (Photo courtesy of Neil Ramsey.)

Ian Driver's 'Spam Can'. (Photo courtesy of Ian Driver.)

Parkgate (Rotherham) tram-train at terminus.

Ken Round's new Garratt. (Photo courtesy of David Hayman.)

Norwich & District Society of Model Engineers *eBulletin* for October/ November opens with a picture of a 1/5th scale model of a WWII V2 rocket. Built by Ben Jarvis, it works, can reach a height of 5000 feet and exceed the sound barrier in doing so. Www.ears.org.uk. At the October meeting, attendees had the task of assembling a paper locomotive from a printed kit. They will be judged in December. This should sort the 'tinsnips' from the 'scissors'! A reference to paternoster lifts on YouTube invites me to say that there is one at Sheffield University Arts Tower. I haven't ridden it yet. A jocular item on how to recognise a Real Engineer reminds me that one of my social media friends attracted my attention when she admitted to having a set of Allen keys in her handbag. She's a radio amateur, too! A recent visitor to an event was a black NER 4-4-2 No. 2877, looking somewhat careworn. Very authentic. Photo follows.
W. www.ndsme.org

Bradford Model Engineering Society's *Monthly Bulletin*, November, carries an item on the Great Orme tramway. The winding cable uses a lay called Lang's Lay, which can cope well with being constantly wound and rewound onto a drum. (Gosh, I haven't concerned myself with the lay of a rope since I was in the Scouts in the 1960s – Geoff.) Like many electrically-powered vehicles, the drive motors are 60 years old and in a good state. I am pleased to see that the Tangye engine restored by Rodney Oldfield and Geoffrey Cowton has been completed and painted. Well done both! John Coppin writes on the transport of manure by sea, adding that this practice led to the adoption of a term not used in polite company. Shall we say, 'Egesta'? I'm not sure whether to believe him, though.
W. www.bradfordmes.co.uk

The Link, October/November, from **Ottawa Valley Live Steamers & Model Engineers**, has a picture shewing Ken Round's 2-4-0 + 0-4-2 Garratt substituting for the regular diesel in public hauling. Garratts are useful in that they have their own inbuilt driving truck (sitting on the rear tank) (**photo 6**). President, John Stewart found the Museum of Old Draughting Equipment online, which he found fascinating. (This one? - https://www.youtube.com/watch?v=bm7icew2dhM). He has also acquired a sailing boat, with a circa 1980 diesel engine, a marine conversion of a Mitsubishi KD4. Due to the way it is installed, certain features are inaccessible, like the dipstick. He can feel for it but can't see it. Now, having got it out ... you guessed it! The air inlet appeared to be non-existent but perusing the excellently-drawn diagrams (see above) he found it under other piping, against a bulkhead. In Paris next February there is a retromobile exhibition, illustrated by a young lady extracting a 'suitcase scooter' from the boot of a Chevrolet Impala and riding off to the shopping mall. She'll no doubt have 'fun, fun, fun 'till her daddy takes the T-Bird away'.
W. www.trainweb.org/ovlsme

The Oily Rag, Autumn, from **Taunton Model Engineers** has an article by Tony Gosling on the Centenary of the Great War Armistice. The Goslings took their 1917 British Army Autocar to the Bovington Tank Museum, where there was an exhibition and display. The following week a road run of contemporary vehicles drove to the GDSF, an event which was captured on YouTube. Member John Hancock has died. He followed a number of interests, from the L&B, owning a narrowboat, piloting a glider, running a Triumph Vitesse 2000 and beekeeping. Phew! Ray Rolt contemplates steam-power in O-gauge. Comparing the Hornby models, including the 3½ inch gauge Rocket, he has formulated a design.
W. www.tauntonme.org.uk

Blast Pipe, November, from **Hutt Valley & Maidstone Model Engineering Societies**, informs us that Maidstone celebrates its 50th Anniversary next February. Member, Rob Merrifield has written a book, *The Kaikoura Job*, on the reconstruction of KiwiRail's South Island Main North line after the 2016 earthquake. Palmerston North club say Murray Bold has replaced his five year old 3-D printer, costing NZ$1500 with one from China offering four times the accuracy for NZ$300, including freight.
W. www.hvmes.com

And finally, Norwich MES again: 'Ticket inspectors. You've got to hand it to them...'

ME

Contact:
geofftheasby@gmail.com

DECEMBER

19 **Bristol SMEE.** Members' night. Contact Dave Gray: 01275 857746.

19 **Leeds SMEE.** Meeting night – 'Quiz Night'. Contact Geoff Shackleton: 01977 798138.

19 **Salisbury DMES.** Christmas social. Contact Jonathan Maxwell: 01722 320848.

20 **Sutton MEC.** Club night. Contact Paul Harding 0208 2544749.

23 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.

26 **Grimsby & Cleethorpes MES.** Boxing Day charity run, Waltham Windmill, 11am-3pm. Contact Dave Smith: 01507 605901.

26 **Leeds SMEE.** Public running and Boxing Day steam-up, Eggborough track from 10am. Contact Geoff Shackleton: 01977 798138.

26 **Sutton MEC.** Boxing Day run, 10am-2pm. Contact Paul Harding 0208 2544749.

26 **Worthing & District SME.** Post Christmas steam-up. Contact Geoff Bashall: 01903 722973.

27 **Bradford MES.** Mince pie steam-up, 12:30pm until frostbite sets in, Northcliff track. Contact: Russ Coppin, 07815 048999.

30 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-dusk. Contact Ken Parker: 07710 515507.

JANUARY

1 **Grimsby & Cleethorpes MES.** New Year's Day charity run, Waltham Windmill, 11am-3pm. Contact Dave Smith: 01507 605901.

1 **Romney Marsh MES.** New Year's Day track meeting, 11am onwards. Contact Adrian Parker: 01303 894187.

1 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

1 **Southampton SME.** Frostbite run. Contact David Goyder: 02380 421201.

2 **Bradford MES.** Bits and pieces evening, 7:30pm, Saltaire Methodist Church. Contact: Russ Coppin, 07815 048999.

2 **Brandon DSME.** Meeting at The Ram Hotel, Brandon, 7.45pm. Contact: Mick Wickens, 01842 813707.

2 **Worthing & District SME.** New Year steam-up. Contact Geoff Bashall: 01903 722973.

3 **Sutton MEC.** Bits and Pieces. Contact Paul Harding 0208 2544749.

4 **North London SME.** Videos, slides and photographs evening. Contact Ian Johnston: 0208 4490693.

4 **Portsmouth MES.** Club night – members share their future projects/plans, 7.30pm, Tesco Fratton Community Centre. Contact Roger Doyle: doyle.roger@sky.com.

5 **Tiverton & District MES.** Running day at Rackenford track. Contact Chris Catley: 01884 798370.

5 **Westland & Yeovil DMES.** Frostbite run 11am – 4.30pm. Contact Bob Perkins: 07984 931993.

6 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

8 **Romney Marsh MES.** An evening with Andy Nash, 7.30pm. Contact Adrian Parker: 01303 894187.

8 **Southampton SME.** Surprise event. Contact David Goyder: 02380 421201.

9 **Leeds SMEE.** Meeting night – 'Members' Current Projects'. Contact Geoff Shackleton: 01977 798138.

10 **Worthing & District SME.** Club meeting, Fun stuff from YouTube, 7.30pm. Contact Geoff Bashall: 01903 722973.

11 **Tiverton & District MES.** Club meeting at Old Heathcoat Community Centre, Tiverton, 7.30pm. Contact Chris Catley: 01884 798370.

13 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

13 **Sutton MEC.** Sunday track day from noon. Contact Paul Harding 0208 2544749.

15 **Grimsby & Cleethorpes MES.** Monthly meeting, Waltham Windmill, 7.30pm. Contact Dave Smith: 01507 605901.

15 **Romney Marsh MES.** Members' social afternoon, 2pm. Contact Adrian Parker: 01303 894187.

18-20 **London Model Engineering Exhibition** at Alexandra Palace – see www.londonmodelengineering.co.uk

20 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

20 **Tiverton & District MES.** Running day at Rackenford track. Contact Chris Catley: 01884 798370.

22 **Romney Marsh MES.** Talk: 'On the Narrow Gauge' – Richard Linkins, 7.30pm. Contact Adrian Parker: 01303 894187.

23 **Leeds SMEE.** Meeting night – speaker TBA. Contact Geoff Shackleton: 01977 798138.

24 **Worthing & District SME.** Club meeting – '50 Years Repairing Rolls-Royce', William Pullar, 7.30pm. Contact Geoff Bashall: 01903 722973.

26 **Worthing & District SME.** Club social evening. Contact Geoff Bashall: 01903 722973.

27 **North Wiltshire MES.** Public running, Coate Water Country Park, Swindon, 11am-5pm. Contact Ken Parker: 07710 515507.

29 **Romney Marsh MES.** Members' social afternoon, 2pm. Contact Adrian Parker: 01303 894187.

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Our next Open Day is on 9th March 2019 at Warco House.

Our next exhibition is the London Model Engineering Exhibition at Alexandra Palace, 18th to 20th January 2019

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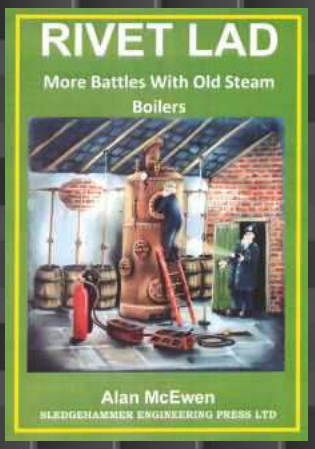

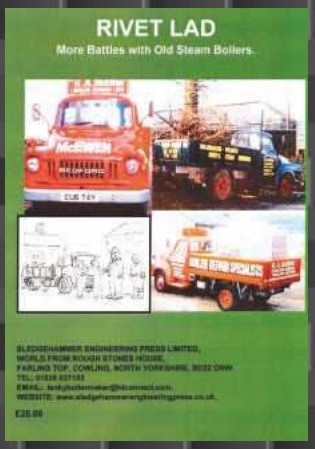

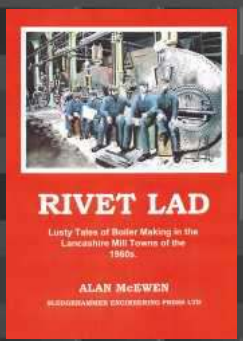

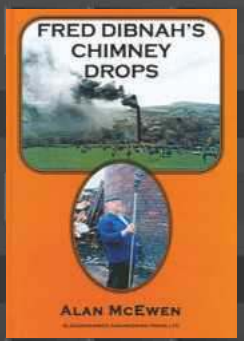

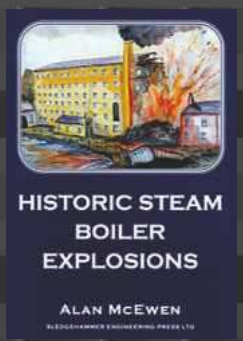

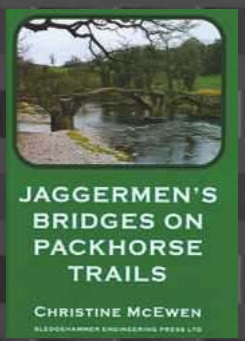

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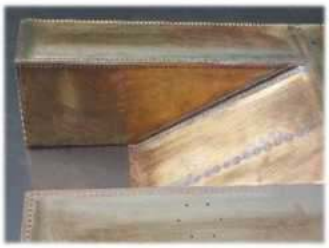
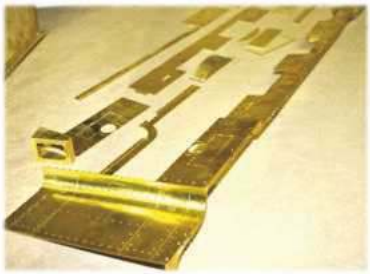

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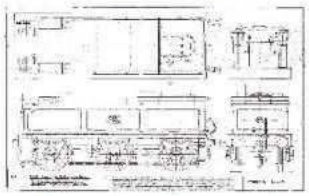


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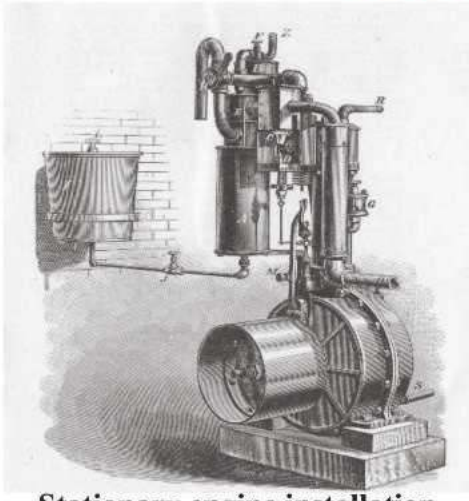
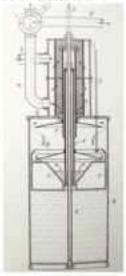


Stationary engine installation

Our model detailed here is based on the four-stroke engine developed by Gottlieb Daimler and Wilhelm Maybach, nicknamed Grandfather Clock or "Standuhr". The first prototype unit ran successfully in 1884.

The history of the "Standuhr" engine goes back to the year 1882, when Gottlieb Daimler and Wilhelm Maybach began work in Cannstatt on a light-weight, high-speed, four-stroke engine. The ignition represented a major challenge if they were to achieve higher engine speeds. Maybach working through patent specifications came across Watson's uncontrolled hot-tube ignition system.



Both men were already familiar with the concept of the four-stroke engine from their time working at Deutz. They chose Otto's four-stroke patent DRP 532 but Daimler based his application for patent DRP 28022 on the principles of explosive ignition and rapid combustion. The experimental engine was compact and light, and therefore suitable for use not just as a stationary engine, but for mounting in vehicles. The engine featured a surface carburettor – developed by Maybach

During the course of 1886 an engine was mounted into a carriage frame – resulting in Daimler's fist automobile and the world's first four-wheeled motorised vehicle with petrol drive. In 1886 the engine was installed in a boat and became popular for this application.

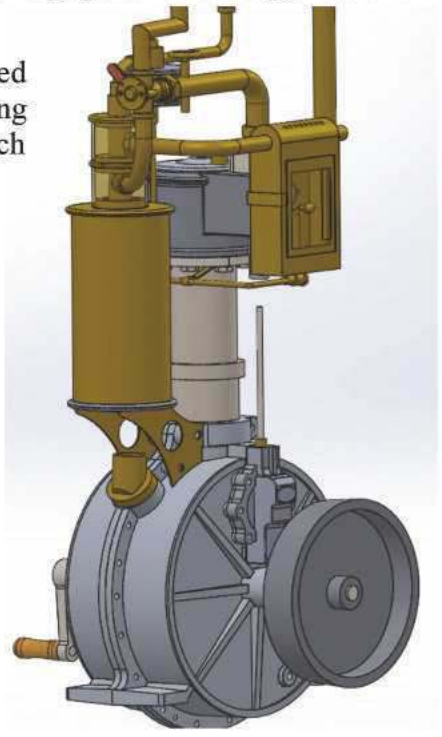
This is an unusual engine from the beginning of the internal combustion engined automobile. At a time when the fundamental construction details were still being worked out. The cam is a disk with groves in it to produce valve events to match the Otto cycle, being directly driven by the crank shaft avoiding the need for gears. Ignition is hot tube. We use a glow plug in our model for simplicity.

Contents *

* may change

Our **drawings** are in book format with over 100 pages. Each part has an individual drawing. There are parts lists, assembly and section drawings to help with construction and some basic construction notes

Offer This kit post free in December and January quote ME12.



The model is 280 mm Tall and has a 20 mm Bore

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Swing Over Cross Slide	150mm
Distance Between Centres	500mm
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Spindle Taper	MT4
Speed Range	50 - 2500rpm
Longitudinal Feed Range	0.07 - 0.2mm/r
Metric Threads	0.2 - 3.5mm
Cross Slide Travel	115mm
Top Slide Travel	70mm
Tailstock Quill Travel	70mm
Tailstock Taper	MT2
Motor	0.75kW (1hp)
Weight	145kg
Dimensions	1150 x 560 x 570mm

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