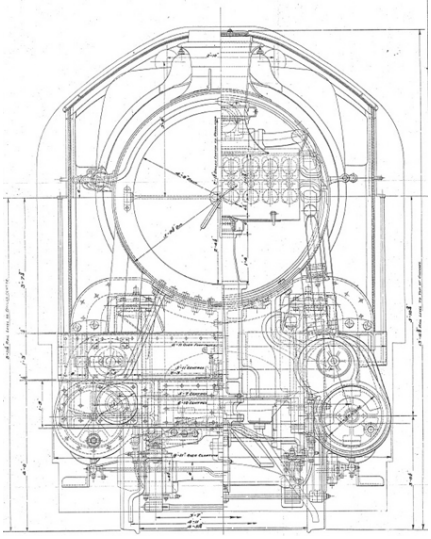
August 2020



4709
The Night Owl

The first 47XX in Devon for a long while

After weeks of COVID-caused delays, the chassis of 4709 inched its way out of the Llangollen workshops and into the daylight for the first time late last week, en route to a new home in Devon.

Limited headroom meant that the 10+ tonne chassis had to be moved out of the shed, to be craned onto the low loader for its long, slow journey south.

Out in the open, suspended from the crane, there was just a hint of the finished size of this giant 2-8-0. It will weigh around 83 tonnes when complete, with the tender accounting for another 46 tonnes.

Now firmly in the care of Leaky Finders' Rory Edwards and George Balsdon at Hele near Exeter, work on 4709 is expected to ramp up quickly in an effort to make up time lost to the COVID lockdown.

The project's Chief Engineer, Paul Carpenter was delighted that 4709 had finally reached its new home and that work could re-start for the first time since "...what feels like the beginning of the year. It's been months and while we've managed to complete a number of small projects in that time, we were always going to be a long way behind once the lockdown was lifted."

Waiting at Leaky Finders are a wide range of 4709-related jobs that can be commenced and progressed immediately.

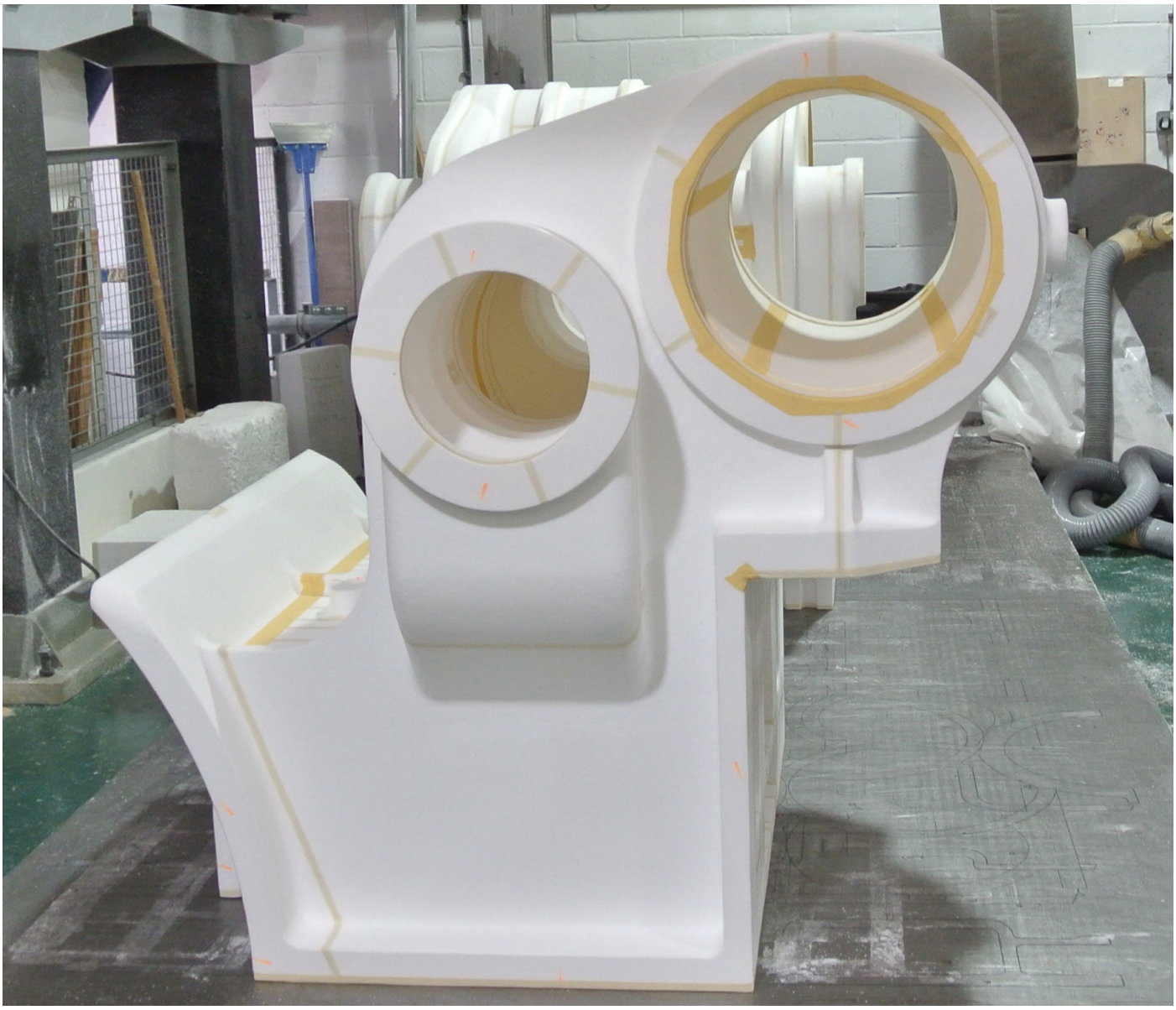
Joining 4709 soon from Tyseley will be the wheelsets and pony truck. "The cylinder castings have also been impacted by the lockdown, but we're hoping to have that part of the project back underway by the end of August."

Once the cylinders are complete and in place, the critical cylinder and hornguide alignments can start. "Who knows, we might even have a rolling chassis by the end of the year," adds Paul.

4709's move was handled by a haulier well known in the preservation sector; W J Balsdon Heavy Haulage, who are also scheduled to shortly collect an additional container of 4709's components from Llangollen as well as the aforementioned wheelsets and pony truck from Tyseley.

Gone! After more than a decade, 4709 has moved on.

4709's cylinders break new ground for GWS



Held up. Delayed. Postponed. Rescheduled. Suspended. Whatever your word for it is, the casting of 4709's cylinders has been a source of frustration for Chief Engineer, Paul Carpenter and his team. The work was due to start nearly six months ago, but a slight engineering delay let Bradley Manor's cylinders nip in front of ours in the queue and suddenly COVID–19 arrived and everything stopped.

Not only is that a hassle because we're building a giant freight 2–8–0, but so much depends on the final castings, including the critical measurements and dimensioning of the cylinders, horn guides and eventually, 4709's motion. In our case, there's another consideration; the casting process will be the first for the GWS that uses sacrificial polystyrene patterns to create the sand mounlds, rather than the historical wooden types, which were used for the cylinders on the Saint and Steam Rail Motor.

Paul Carpenter explains; Traditionally, patterns for metal casting have always been made from wood and represent the history of a complete industry. Patternmaking requires skill, knowledge and demands massive experience on the part of the patternmaker, invariably built atop a rigidly controlled apprenticeship.

In more recent times and with the ever widening application of CAD–based design, a number of locomotive groups have experimented with the use of sacrificial polystyrene patterns. This offers superb accuracy, a radical speeding–up of the patternmaking process as well as a significant cost saving.

Once the design and 3D modelling of the component is complete and approved, the CAD data is downloaded to a 3D routing machine, which sculpts the pattern from solid block of polystyrene.

In the case of 4709's cylinders, the complexity of the completed casting will be such that it hass impossible to produce the pattern as a single component. The solution has been to produce a number of sections, which have been glued together to produce a perfect replica of the required cylinder block, together with all of the vital casting and machining tolerances in place.

From an engineering perspective, the technique has several clear advantages:

- All of the internal ports and passages can be cast as an integral part of the finished job
- Core boxes are no longer required

Once assembled and complete, the polystyrene pattern is utilised in a similar fashion to the traditional wooden pattern and encased in casting sand, ready for casting.

The essential difference is that where the wooden pattern would have been removed from the rammed sand prior to pouring metal, the polystyrene pattern is left in place. The molten cast iron is then poured into the mould in the conventional way but in this case, the polystyrene melts, then burns as it is replaced with the molten metal.

Clearly, care must be taken in the casting process to allow the gases from the burning plastic to escape, or the finished casting could be defective, with pockets of trapped gas leading to any number of flaws. To prevent such occurrences, a consumable volume is added to the pattern to allow these gases to be released.

It is clear that the polystyrene pattern will be lost as a result of the cast, but being an almost virtual pattern, any number of identical patterns can be fabricated using this technology, all at a very low cost.

In the case of 4709, the cylinder blocks for 4709 have taken a little longer to reach the casting stage because the original GWR cylinder block design has had to be modified in three areas:

- Reduced saddle height to accommodate the current Network Rail loading gauge for mainline running
- Reduced width over the cylinders to increase route availability
- Slightly reduced cylinder bore to ensure sufficient strength despite the reduced width

The castings are now due to be poured late in August. Meanwhile, thanks to Bob Meanley, who produced the redesign and Elliot Powick who provided the 3D CAD drawings.

Hot off the laser

Parts removed from the donor engines for use on 4709 include the rockshafts and rockshaft brackets. These transfer the movement of valve gear located between the engine frames to the piston valves on the outside of the frames. In service, the rockshaft sits in a bronze bearing within the rockshaft bracket.

Unfortunately, the valuable bronze bearings were removed from the donor engines in the early days at Woodham Brothers scrapyard, leaving the exposed surfaces of the shaft and bracket to corrode for decades in the marine air of Barry docks.

Grit blasting the damaged surfaces of the rockshafts and rockshaft brackets revealed the metal loss was severe. Remaking these parts would be extremely costly because new foundry patterns or forging dies would be required. If the original parts were to be salvaged, more metal needed to be added.

The problem was how can new metal, which is at least as strong and ductile as the original material be permanently bonded to the damaged parts?

One solution could be to weld on to the surfaces of the components using a conventional electric process, but the weld metal is unlikely to have properties as good as a forged rockshaft.

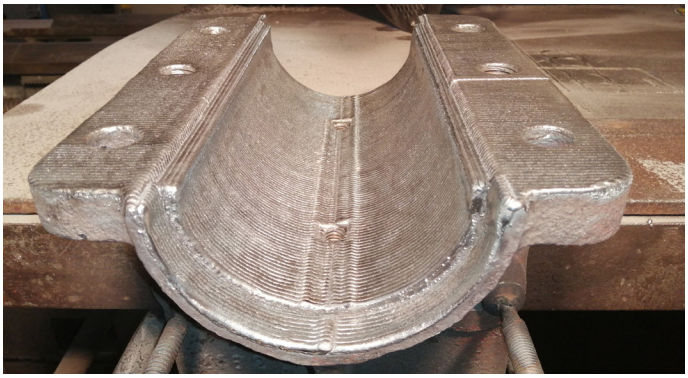
In addition, the high level of heat input from a conventional welding process would cause thermal stresses, which could easily distort the part or result in premature failure of the component in service.

An alternative, but much less common, heat source for welding is a high-power laser, which offers intense but very localised heating. The relatively small heat input minimises distortion and gives stronger and more ductile weld metal.

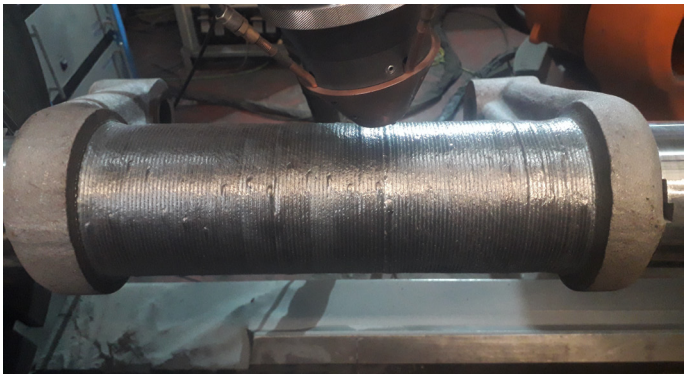
The metal to be applied, which is specially formulated to give optimum weld metal properties, is fed into the laser beam as a powder. The laser head, together with the metal powder feed, are on a robot arm driven by a computer, which is programmed with the complete welding sequence. The accuracy of the process is such that features in the original part, like threaded holes, can be left completely undamaged.

Potentially, this is a ground-breaking process for steam locomotive component repair.

Laser welding of rockshaft brackets and rockshafts has been completed successfully. Machining of the rockshaft brackets is currently underway with the rockshafts to follow.



***Above**; Rockshaft bracket top after laser welding.*



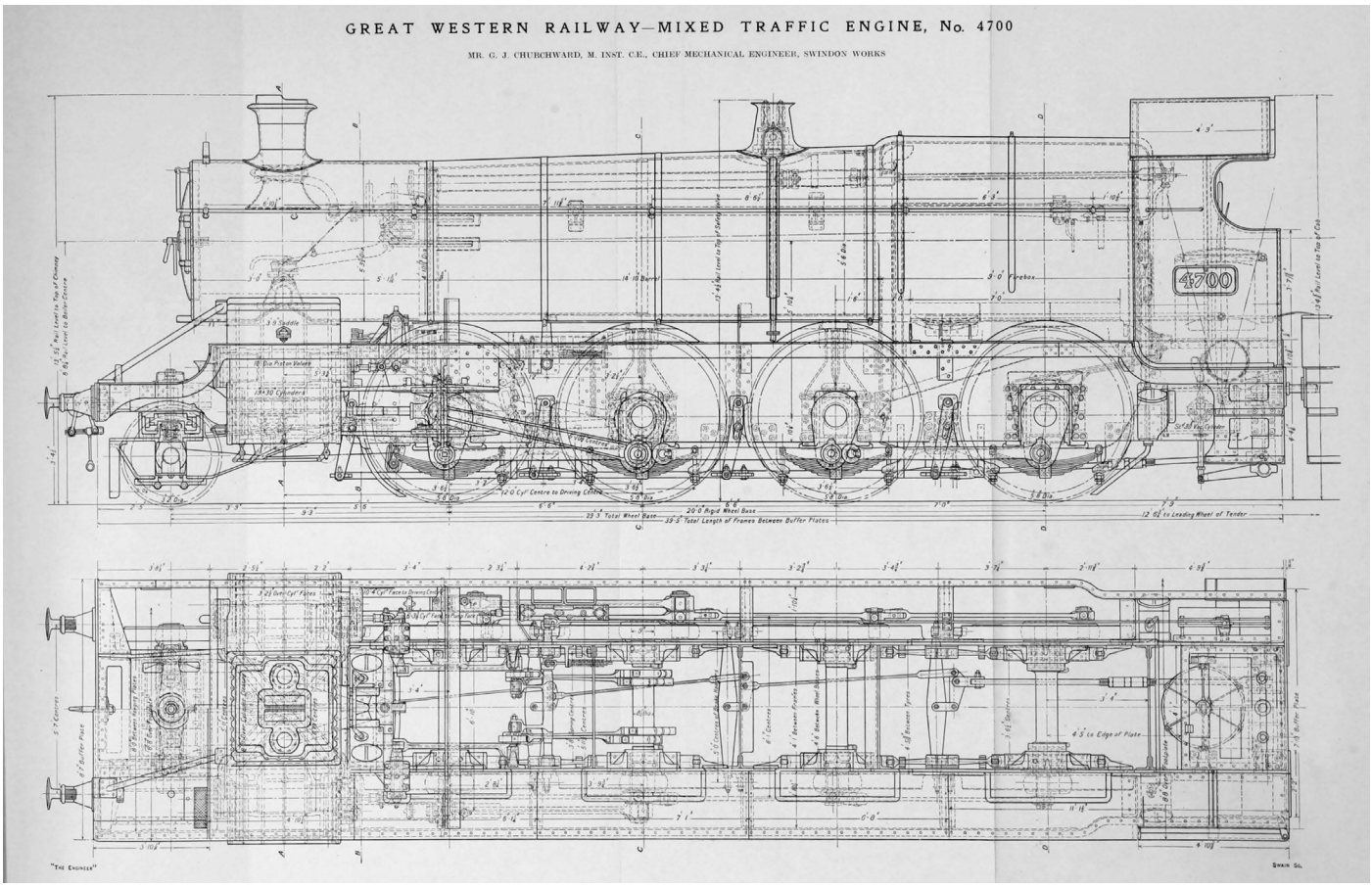
***Above**; Rockshaft bearing surface after laser welding.*

Waking up...

It's been a while and if we 'fessed-up to say that some of us had almost forgotten what 4709 looked like, you'd hardly be surprised. So, to ensure that we're all on the same page, Rory and George at Leaky Finders have been given a lengthy list of things to check, measure, do and get underway.

The horn ties were corrected at Llangollen but should be finally checked again.

The running boards will then be mounted, with an allowance being made where necessary to accommodate the fitting of the cylinders, once delivered from the foundry.



The GWS is currently compiling a set of all available 47xx drawings, which will be copied and issued to all engineering members of the 4709 team. The GWS is also considering how best to develop an efficient system such that key players will have electronic copies of all essential documentation for main line running.

But, we're getting ahead of ourselves. First up on Leaky Finders' list will be a thorough check of everything about 4709's chassis, including the overall dimensions, correct alignment of the running board brackets, measuring all the holes and the accuracy of the horn ties. This will serve to confirm that all holes are drilled as per the GWR drawing and any discrepancies are then noted for rectification.

Next is the pony truck stretcher. Preparations are necessary and a quotation provided before work can commence.

Hard on the heels of the pony stretcher is the vacuum pump bracket, which will similarly have to be estimated and approved before construction can begin.

Moving on from new manufacture, the Leaky Finders team will then move on to the overhaul of the motion parts currently in our store and the refurbishment of the other donor parts, so vital to this (re)build.

That'll keep them busy for a while.

4709
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Donations

When complete, 4709's motion will be part donor-sourced and part new. As mentioned in the last newsletter, the donor locos have been very generous, but we still require 8 rods, the largest of which are the coupling rods themselves.

The quotes are in and we're looking for just over £90k, to forge and machine these vital components, ready for fitting to 4709's new cylinders and rolling chassis.

If you've had any involvement, or interest in railway preservation, you'll know raising money is one of our most important activities. We also think that there isn't a better way to ask for donations than to lay out the options and let you – the donor – decide how much and how often sending us money is the most preferable. To get 4709 in steam by 2023/4, we'd like to ask for a minimum donation of £25. One-offs are great, but a regular commitment gives us the ability to plan and know our funding is (and will be) in place.

Yes! I'd like to donate

☐ Once-off donation of £

*Cheques and POs should please be made payable to the Great Western Society Ltd, 4709 project**

☐ Banker's order to make regular payments

Name:
Address:
Post code: e-mail:
GWS membership no.:

To: The Manager, Bank:
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*Please pay to National Westminster Bank a/c 06710646, sort code 54-30-33 for the credit of the Great Western Society Limited, 4709 Project**

The sum of £ In figures:
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Gift Aid can boost your donation by 25p for every £1 you donate. It is claimed by the Great Western Society Limited from the tax you pay for the current tax year. Your address (above) will identify you as a UK taxpayer.

I want to **Gift Aid** my donation of £ and any donations I make in the future, or have made in the past four years to the Great Western Society Limited. I am a UK taxpayer and I understand that if I pay less Income Tax and/or Capital Gains tax than the amount of **Gift Aid** claimed on all my donations in that tax year, it is my responsibility to pay any difference.

NB! If you pay income tax at the higher additional rate and want to receive the additional tax relief due to you, you must include all **Gift Aid** donations on your self-assessment return, or ask HMRC to adjust your tax code.

Please contact the GWS if you wish to • change this declaration, or • change your name and home address, or • no longer pay sufficient tax on your income and/or capital gains tax.

* This order is in addition to any other standing instruction in favour of the Great Western Society.

Please complete and return this form to Richard Croucher, 4709 Project, Great Western Society Limited, Didcot Railway Centre, Didcot, Oxon, OX11 7NJ, or by e-mail to richard.croucher@ntlworld.com