All-new express steam, coming soon

Top Link

Issue 6
Winter 2002–3

Who was Cartazzi

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Journal of The A1 Steam Locomotive Trust

Accelerating Tornado

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DEDICATED COVENANTS

Below is a selection from the list of Dedicated Covenants available, updated to take account of recent 'sales'. If you don't see what you want, just ask. The list shows components in need of sponsoring at prices to suit most pockets, starting as low as £150 cash or £7.50 per month. The right-hand column shows the cost in cash or per month. You can get together with one or more other covenantors to share the cost of any item. To sponsor a part, contact Alan Dodgson at **enquiries@a1steam.com** or 01325 460163, giving your name and contact details (phone/e-mail/address).

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Buy your bit of history – from £10 per month!

Back cover: Peppercorn A1 60163 *Tornado*, seen in Darlington Locomotive Works on 4 October 2002, the evening before the trust's Annual Convention. *(photo: R. J. Morland)*

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Issue 6: Winter 2002–3

Editor: Gerard M-F Hill

JOURNAL OF THE A1 STEAM LOCOMOTIVE TRUST

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Cover picture: Forging the radius rod ***(photo: Fastline Photographic Ltd)***

Below: Here seen from Potters Bar golf course on 11 August 1962 is 60146 ***Peregrine*** with the up [southbound] Scarborough Flyer.

(photo: Roy A. Smith)

EDITORIAL

Please accept my apologies if *Top Link* 5 seemed a little late in reaching you, but I thought the pictures from the Convention were well worth waiting for.

This issue contains a History feature on Kings Cross in 1949 and a centrespread from 1953. Know Your Drain Cocks returns to tell you everything you ever wanted to know about the Cartazzi axle but were afraid to ask. We've gone on the trail of Mr Cortazzi himself, and – among other news – there's a report on pages 7 and 8 of final fitting of the axle.

The most important pages in this edition are pages 17–18 – they may not look exciting, but they are the key to all the excitement we plan to create in the not-so-distant future. Do read them and fill in the form that comes with this issue.

The boiler may be the big thing, but meanwhile other components are still being manufactured, machined and fitted. On pages 10–11 is a report on the forging of a major motion component. Forging is a seldom-seen but remarkable process. If you are now wondering why large parts like this are not just cast, this is something I intend to return to at another time. Some forged motion parts are featured among the Dedicated Covenants, at the back of this issue.

The Safety Valve has been lifted this time by the subject of the second tender, with two covenantors raising concerns and offering suggestions. As all of you will have views on this, I imagine, I have in this case printed my reply. Luckily, tenders can be uncoupled, so it should be possible for *Tornado*'s appearance to satisfy all points of view at different times each year.

The Big Picture this time is a fine piece of serendipity: Maurice Henderson happened to be in the right place at the right time. People like trains that carry a headboard, but first you need a locomotive to put it on. For us, that means bringing in more recruits to make it happen. Our website is doing just that, and we are also very grateful to the trade press, and *Steam Railway* in particular, for giving space to the A1 Project. We can all help by mentioning it in conversation. We shouldn't be shy about it: we have a genuinely unusual and exciting project.

There are opportunities on page 9 to give a little of your time to help. *Top Link* 7 will feature volunteers and the many ways we can really help the project along.

With this mailing you should also find – apart from that important form about financing the boiler, that we ask you to fill in – leaflets to give away and another form, for the Spring Day Out. This year the Editor hopes to be there too and looks forward to meeting as many of you as can make it. Finally, my heartfelt thanks to all those who have sent pictures and contributions. Please keep them coming!

Gerard Hill

NEWS

SPRING DAY OUT

With this issue comes the form to book for our Spring meeting on 5 April on the North York Moors – real LNER country. We are arranging on-train dining and a works visit. To travel by coach from Newcastle or Darlington (about £16.50), contact Alan Dodgson.

ANNUAL CONVENTION

Just confirmed as 4 October.

JOHN RUSHWORTH

Remember the cover of *Top Link* 4, showing John Rushworth reaming bolt-holes for the coupled-axle hornguides?

John Rushworth seen on the cover of *Top Link* 4. *(photo: Fastline Photographic Ltd)*

The caption said he was framed, and so he is. The editor is delighted to report that, to say 'Thank you', David Elliott – at Ian Howitt's suggestion – ordered a large print of the cover picture and had it framed for Ian to present to John.

WEB CATCHES MORE

Since October 2002 the A1 website, run by Paul Ambler, has allowed people to download an electronic prospectus and this has been a big success: 239 visitors downloaded it in December bringing a significant increase in new covenantors. See Contacts *(page 2)* for details of how to gain access to the covenantors' area.

FANCY A GOOD TALK?

Every couple of weeks the trust is asked to supply a speaker to travel somewhere in Britain to give a presentation of the A1 Project. If you belong to a group that might appreciate such a talk, get in touch with Bob Alderman *(see Contacts on page 2)*. If you feel you could present a talk on the project, talk to Bob about what's involved.

ENGINEERING WORK

Following the high level of activity at Darlington to prepare the engine for the October 2002 Convention, the work rate has returned to normal – an average of two days a week with Ian Howitt and his team, plus our volunteers, who put in sterling efforts each Tuesday.

NEWS

Right: The set-up for locating the Cartazzi hornblocks, showing the LH rear hornblock secured by temporary bolts and dowels. The axlebox is mounted on the dummy axle with the Cartazzi wedge and spring guide above, and the leading hornblock is located with the use of temporary bolts, with the weight taken from above via a G-clamp. *(photo: David Elliott)*

Frames

The main area of activity has been the fitting of the Cartazzi hornblocks and hornstays. In theory this is no more difficult than fitting any other component attached to the frames. However, the Cartazzi is an unusual arrangement and the process was rather more difficult than first imagined, because of the various degrees of freedom given to the Cartazzi axle. This is how we set it up.

The axleboxes were attached by way of accurately turned location discs to a piece of 2½″-diameter bar, which represented the axle. This in turn was set up level, at the nominal height of the axle, with the axleboxes equidistant from the locomotive centreline and the correct distance from the rear coupled axle. The hornblocks were offered up and small holes drilled through, to take temporary bolts to hold them in place.

The first problem we found was that the angles on the horn faces did not seem to correspond to the angles on the axlebox faces. This was because the outer rear frames of the locomotive were very slightly out of parallel. This was corrected partly by heating and straightening the RH outer frame and partly by machining slight tapers on the hornblock bolting flanges. The front horns also had shims fitted between the frames and the hornblocks.

The use of shims, we felt, required approval from the VAB. In the end, our main contact Bob Bramson gallantly offered to come to Darlington one Saturday to see the assembly, as the complexity of the Cartazzi arrangement was proving difficult to grasp over the phone! At the same time it was agreed to increase the nominal clearance of the axleboxes in the hornblocks from the 0.025″ shown on the drawing to 0.050″.

Most Cartazzi-fitted LNER engines have visibly greater clearances than shown on the drawing, so – given the potential for damaging roller bearings if the boxes jammed in the hornblocks – more clearance was felt to be advisable.

Once we were happy with the position of the rear hornblocks, each was located by specially machined dowels, pending final bolting. The 0.050″ clearance was achieved by temporarily clamping a 0.050″ shim between each axlebox and the leading hornblocks.

The infuriating part was that, every time a small adjustment was made in one plane, the whole axlebox/dummy axle assembly moved in several or all of the other ways it could move. Thus any adjustment had to be followed by checking and correction of axle level, axlebox height, axle parallel to trailing coupled axle and axleboxes equidistant from the centreline of the engine.

With the leading hornblocks finally in the desired position, further dowels were fitted to locate them. Next came the problem of drilling and reaming out the holes to the finished sizes to take the

Left: The Cartazzi hornblocks are finally in place, secured by fitted bolts, and the fabricated hornstay is now held in place by two long bolts at the bottom of the hornblocks. *(photo: David Elliott)*

36 fitted bolts. Previously we have used a magnetic Rotorbroach drill, kindly supplied by covenantor Colin Vickridge soon after we set up in Darlington.

However, the small gap between the inner and outer frames precluded use of the Rotorbroach, and we had to resort to a classic Ian Howitt jury-rig. This consisted of a large, compressed-air-driven, slow-speed drill, drilling from the outside of the hornblocks and frames. The holes were taken out in three stages, starting at 1/2″ and working up to 15/16″. The holes were machine-reamed to the nominal 1″ diameter for the driven bolts to be fitted.

As you can imagine, the pressure required to push a 15/16″ diameter drill into steel plate is considerable, coupled with the need to keep it perpendicular to the plate. This was achieved by using a hand-operated jacking screw attached to the windy drill, which engaged in a piece of steel plate temporarily clamped to the fork-lift truck. The fork-lift was carefully positioned to form a suitably large mass for the drilling machine to react against. This worked well, but it was very slow as the Works compressor (kindly donated by HMYOI Deerbolt) was not big enough to keep the drill going for more than 15 seconds at a time, followed by a 4-minute blow-up. This was solved by Ian bringing in his large compressor, although even this could be winded by prolonged use of the drill.

Once the hornblocks were permanently fitted, the bolting faces for the hornstays were hand-fitted back to parallel and the hornstays faced off to fit.

Baffled by Cartazzi? See p. 19!

Motion

The valvegear forgings are well under way at Hesketh *(see pp. 10–11)*. Once the final fitting of bearings has been achieved, the coupled wheelsets and frames will be reunited so that coupling and connecting rods can be fitted.

Now that the actual distance from front of middle cylinder to centreline of leading coupled axle has been determined, the inside connecting-rod drawing has been completed. This will enable Ufone to machine the forgings for the connecting rod and strap, and make the various nuts and spacers which hold the big-end assembly together.

Wheelsets

On 29 January the VAB and Timken were to witness final assembly of cannon/axleboxes onto the roller bearings.

Cab

The new cab sides are temporarily fitted to the roof and front, and North View Engineering have modified the roof ventilator to meet Network Rail's new 13′ 0″ height limit. Volunteers have been countersinking rivet holes ready for finally riveting the cab together.

Doncaster and Crewe

The trust will be manning a stand at the open days at Doncaster and Crewe Works. The dates at Crewe are 31 May–1 June, and 150 Years of Doncaster are celebrated on 26–27 July. If you are going to be there, perhaps you could help man a stand for an hour or two (or more)? If so, contact Alan Dodgson *(see the Contacts page inside front cover)*.

On-train marketing

Steam Dreams are allowing us to travel on their Cathedrals Express, so we need volunteers who will leaflet and talk to passengers about the A1 Project while travelling behind main-line steam. If you can help, get in touch with Alan Dodgson *(see contacts page)*. On-train efforts brought several new covenantors on a run with the B1 in November 2002.

Other volunteers

Top Link 7 will feature volunteering, what people already do and how you will be able to help. At present, the engineering team, under Tony Roche, is reviewing health and safety issues; Alan Lusby and Graham Nicholas are preparing a quality manual for all aspects of the trust's activities; and Mike Wood has been busy getting the works cleared and organised. We're getting in shape.

Left: The weird and wonderful Cartazzi wedge. Unlike a radial axle, its various profiles are all straight lines – much less trouble for the workshop. *(photo: David Elliott)*

Readers who saw the article in *Top Link* on Walschaerts valvegear will know of the radius rod. It joins the radius link to the combination lever. It may look small on a diagram or even in photos of A1s, but it is all of 7′ 9″ (2.85m) long.

Believe it or not, it is made from a round bar 28½″ long and 9″ diameter. It doesn't sound enough to make a rod nearly 8 ft long – so Steve Fountain, Chief Photographer of Fastline Photographic Ltd, and our reporter visited Hesketh's in Bury to record a fascinating process.

What is this radius rod? Well, it's forged – just how, we'll come to in a minute – and then machined. When finished, the rod has fluted sides to reduce weight. It is forked at the front (to take a pin and the top of the combination lever) and has a slot near the back, to fit into the middle member of the radius link. It has another slot at the very back, for the lifting link of the reversing gear.

To make this short round bar into a long rod, you take a furnace, a one-ton hammer, a swinging crane between the two, and four highly skilled craftsmen. The furnace is fired by diesel oil to a temperature of about 1200°C and its noise dominates the works. It stands not far from an open door, surrounded by an orderly clutter of hundreds of handling tools of various shapes and sizes.

The crane carries the rod, a pair of tongs clamped firmly on one end, so the other end can be thrust into the furnace or laid across the anvil under the hammer. Sometimes the material has to be held at the other end, to work on it where before it was clamped. Changing ends is made to look ridiculously easy.

In charge is the Smith, deciding the sequence of events, always lining up the work; the Driver delivers hammer blows easily and accurately by a single lever; the Blacksmith Striker helps manipulate the rod, cleans scale from the anvil and selects tools; the Striker helps operate the crane, work the tools and a lot more.

That makes it all sound simple, but in fact they seem to need between them at least twice as many pairs of hands as they have. Once they begin, they have to work quickly, quietly, against time. Time in which the heat flows from the work, as it cools from red towards grey, before once again it is thrust into the furnace for more heat.

Somehow, extraordinarily, the rod takes shape. First, hammer blows to this side, then a quick turn through 180° for blows to that side; then back again; a turn through 90° for blows to top, then another 180° for blows to the bottom. Now at this end, now that.

All the time, quick attention is paid to keeping the rod straight. Each plunge of the work into the furnace is a moment for wiping away sweat, selecting tools for the next session and checking the drawings on the bench. Suddenly, a

Left to right: Jim Hardy, Striker; Derek Leightonton, Blacksmith Striker (holding a stopper); Dave Bradley, Smith; Dave Fletcher, Striker. *(Photo: Fastline Photographic Ltd)*

quick word: it is finished. The forging is ready for cooling, heat treatment and final inspection, before shipment for machining. Already, the next bar is in the tongs, and thrust into the furnace for a good soak in that scorching 1200°C.

Jacking system

Taylor's of Leeds commissioned Lloyds British at Rotherham to recertificate the Matterson jacks and their lifting beams. They also gave the new lifting beam for the back of the engine a higher safe working limit (SWL).

We always felt the jacks were heavily over-engineered compared to modern ones, and design checks by Taylor's confirm this.

The original certification of 16 tons limited us to 64 tons. With 20 tons per jack, a total of 80 tons, we can lift the completed locomotive off its bogie and wheelsets.

We used this opportunity to have the three lifting beams shot-blasted and painted yellow to match the jacks.

Hydraulic press

Many parts – rod bushes, the Cartazzi bearings, valve chest liners, piston rods onto crossheads – need to be pressed into place. Up to now we have hired a press each time one was needed, but the board recently approved purchase of a 50-ton hollow ram and pump. It will soon pay for itself.

The new rear lifting beam as delivered to Darlington Works following its certification to 40 tons SWL, after shot-blasting and painting. *(photo: David Elliott)*

One day in 1953 Maurice Henderson was in Durham to photograph the cathedral. About 12 30 he walked up to the station in time to see The Flying Scotsman pass southbound through the station, headed by 60143 *Sir Walter Scott* of Gateshead shed. The plume of grey from the chimney shows the regulator has been shut, to lose speed for the 30 mph limit on the viaduct.

His friend crouches by a pillar on the right; the only other spectator pauses in lighting up, to give the locomotive his full attention. The gleaming train is a mixture of 'blood and custard' and plain colours.

Notice the wandering profile of the platform edge! Durham still has its platform canopies, but all those telegraph wires have gone – and those semaphore signals.

The train's second headboard – with a crown above EIIR, flanked by two pairs of pennants – was used for a short period around the time of the coronation.

The top headboard is a cast plate of British Railways type. From 1923 to 1949 locomotives on East Coast named trains carried a sheet steel 'board' – a design of North British Railway origin – with, for example, 'FLYING SCOTSMAN' painted in black on white. In 1949 came cast plates.

Adding the definite article on top of the casting made for a much larger (and heavier) headboard – three lines were also used for The Heart of Midlothian and The Scarborough Flyer – and fitting or removing one must have been hazardous. Did anyone fall off doing it? Did the lamp irons bend under the strain?

Did someone notice? From May 1949 a new train ran non-stop between London and Edinburgh. On its headboard, The Capitals Limited had 'THE CAPITALS' on one line. The Queen of Scots also got a two-line headboard. Later pictures of ECML named trains show three-line headboards still in use but mounted just above the buffer beam. No doubt this was the fireman's choice, but it also helped the driver: it seems the high-mounted headboards caused a partial vacuum around the chimney, preventing the exhaust from clearing properly.

(photo: Maurice Henderson)

Works visits

As long as no hazardous work is going on, covenantors are welcome to visit the Darlington Locomotive Works outside the opening times given on the Contacts page. Ring David Elliott on 07790 012410 (mobile) to check whether the works is going to be open and that your visit is possible.

This and that

We have been given a half-ton electric hoist: this will save volunteers' valuable time previously spent hauling on chains. The main (east) door has been trimmed, painted and refitted, and will soon be draught-proofed. A pallet-rack store is to be provided for parts awaiting fitting. Straightforward tidying continues.


DURHAM

CHAIRMAN'S COLUMN

Although it is already the end of January as I write this column, I still want to start by wishing you all a happy, prosperous and successful new year – and of course I also wish that for our project.

You may remember from the last issue of *Top Link* that the report of the 2002 Annual Convention covered what we are doing to dramatically accelerate the building of *Tornado*. In this edition we are updating you on our progress in fund-raising, including loans, a bond issue, an equity stake in the operating company and an application to the Heritage Lottery Fund.

In addition, in order to progress these discussions, we need to ascertain what level of support we, the covenantors, are willing to give, either through

- offering to guarantee part of any loan, or
- taking up the bond issue.

I therefore urge you all to read very carefully the article on the next two pages of this issue and then to complete the enclosed form, whatever your decision. We have already received some £25,000 of commitments towards the fund, almost 10 per cent of what we need for the boiler.

I ask you to do whatever you can: 2003 is going to be a momentous year for the A1 Project – let's get off to a flying start!

Mark Allatt

ACCELERATING TORNADO

As the time comes to start the procurement of the boiler, the project enters a new phase in the acquisition of components but also a new phase in funding. There is a simple reason for this.

As those covenantors who were at the 2002 Convention will be aware, we recognise that while many parts, large and small, in the frames and running gear can be bought at a rate which matches the trust's income, this is not true of the boiler or the two tenders.

The boiler, all-welded, will in effect be one piece of metal, bought from one supplier at one time, and probably paid for all at once or in a small number of stage payments over less than a year.

We must not order the boiler until we know we can pay for it; and the boiler supplier will not accept an order unless we demonstrate that we can pay. The budgetary estimate for the boiler is in the region of £250,000: how do we amass such a sum?

We have two choices: either we stop all work and expenditure, and wait two or more years for the money to accumulate, or we look for new sources of funds. Whichever we do will also apply to the tenders and other remaining expenditure on the locomotive, and this brings in another question.

Are we content that, at present rates, we wait until 2009 to finish the locomotive? Or do we wish to get it into service quickly? The board has chosen this latter course, and we are looking for fresh sources of money. The total is £1.25 million, currently estimated to be enough to complete the locomotive.

Broadly we have three options, any of which could involve support by covenantors: sale of bonds, a commercial loan, or sale of equity in one of the subsidiary companies. Whatever the source of funds, the ownership of the locomotive by the trust will not be compromised.

The current covenanted income of the trust is in the form of unconditional gifts. By contrast, bonds have to be redeemed, loans have to be repaid, and equity implies a need for dividends. It is a simple fact that, in one way or another, these kinds of money cost money.

We are describing them all here because we believe that you, the covenantors, may wish to be more involved, above and beyond your current generosity, and that you will require choices to match your individual circumstances.

In addition, the board of the trust needs to know where best to direct its attention in order to attract funds from existing covenantors, funds that could make a difference in our discussions with various financial organisations.

These are the possibilities:

Bonds: These would probably be in multiples of £100, redeemable over a period from five to ten years hence. They would attract annual interest but this would have to be claimed within a limited period: the bondholder would have the option not to claim interest, and thereby make a gift of that to the trust. Similarly the bondholder could forego repayment of the bonds themselves at the due time. Interest payments would be taxable; bond repayments would not.

Bonds are attractive because they are affordable, but we would need to sell at least 2,500 of them to pay for the boiler, and a further 10,000 to complete the locomotive.

Commercial loans: These are available from banks. The trust would have to demonstrate its ability to repay any loans, which should not be too difficult, but it would also have to offer security for the loan.

The trust has no security it can offer, but some covenantors at the convention suggested that they could offer security on property that they own. Such offers would have to meet the detailed written requirements of the bank that provided the loans, and this would involve paperwork for us all and administration for the trust.

Loan guarantees are attractive because they involve no cash outlay for the provider, but because of the administration we would probably not contemplate a guarantee for less than £10,000. The minimum figure could be even higher than this.

Equity: Shares could be sold in one of the subsidiaries of the trust, probably in £1 shares, with a minimum take-up of, say, £100. Such a sale would be offered in the light of revenue predictions for the company, and dividends would be expected by the shareholders. Such dividends would be taxable. We would not be able to predict whether shares would be saleable, or whether their value would rise or fall.

So that the trust may assess the level of support for each of these possibilities, please be so kind as to fill in the enclosed letter, even if you have no interest in any of them. Thank you.

Dates for your diary

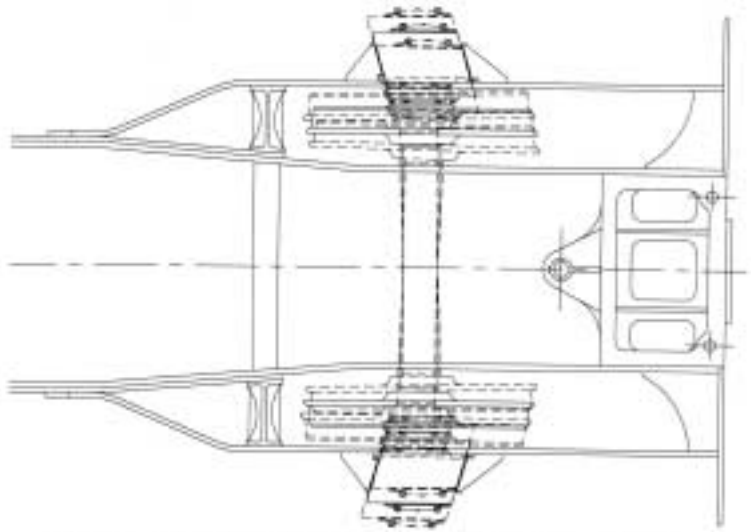
5 April 2003
Covenantors' Spring Day Out

4 October 2003
Annual Convention

People are always pestering me – well, several people asked – oh, all right, somebody wondered about the Cartazzi axle: whence the name and how it works. Very early locomotives had a rigid wheelbase and ground their way round curves with the aid of some sideplay (end-float) in the axleboxes (bearings). Bissell trucks, used from the 1850s, had a triangular frame fixed to a heavy pin some way ahead of the axle, like the drawbar of a car trailer. They imparted some 'steering' action and let the wheelset move sideways – at a cost in weight and space for the ashpan.

The answer was a radial axle, which allows side movement (3″ or so) to let the trailing axle follow the driving wheels round curves, while its axleboxes slide sideways along a curved path that mimics a Bissell truck swinging from side to side. Engineers argued over the ideal radius for the arc traced by the axleboxes.

The diagram shows the arrangement of the angled hornblocks and axleboxes which make the wheelset describe roughly an arc as it moves from its central position. Radial axles on some tank engines – such as the Adams Radial and LNWR designs – had a guide system giving a true arc of a circle, like a pivoted truck, but the Cartazzi arrangement uses short flat surfaces on the hornblocks and axleboxes to approximate the arc of the circle. This is much easier to machine than a true arc.

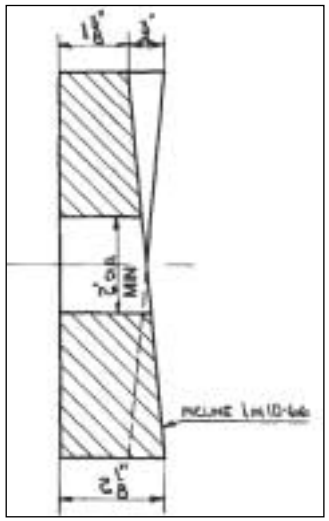


(© The A1 Steam Locomotive Trust)

The movements of radial axles were otherwise uncontrolled. On poor track or at speed there was nothing to stop such axles swinging constantly from side to side. Enter F. J. Cortazzi and others. When the track straightens and the side-force at the railhead is removed, self-centring of the axle is achieved either by springs (Adams, Webb) or inclined slides using the weight of the engine (Cartazzi).

The centring action comes from sliding wedges between the top of each axlebox and the underside of the spring guide. The sliding surfaces are in the form of wedges working in opposite directions and perpendicular to the angled horn faces so that, when the locomotive is on straight track, they rest in the lowest (neutral) position. As the wheelset moves sideways, the wedges work so as to lift the rear of the engine (see the section through the lower bronze wedge). The resultant of the vertical force of the weight of the locomotive provides a horizontal centring force.

The design load for the Cartazzi wheelset is 18 tons 10 cwt. Acting on the wedges, this provides a theoretical centring force of 1.735 tons, ignoring friction. However, the bronze lower wedges tend to wear quickly, causing the neutral centre 'point' to become wider as mileage increases. Wear reduces the centring action, as does friction, so lubrication is important. On Gresley's pacifics the angle of the slides was 1 in 7.1. Eventually all LNER pacifics standardised on 1 in 10.66, which gave less centring force but an improved ride.



(Section through Cartazzi wedge © The A1 Steam Locomotive Trust)

Cortazzi's design met both requirements of a carrying axle: it let the wheelset move sideways to ease negotiation of curves and it provided a centring force to pull the rear into the curve and re-centre the wheelset on straight track. Ivatt atlantics had a simple hornblock arrangement with sideplay and no centring mechanism. It worked, but the ride on these short-wheelbase locomotives was described as 'lively'! The longer wheelbase of a pacific needs more steering by the carrying wheels to reduce flange wear and the risk of derailment. A conventional pony truck achieves this. Properly maintained and used on good-quality track, the Cartazzi arrangement was (and still is) an effective design.

David Elliott and Gerard M-F Hill

Who was Cortazzi?

Francis James Cortazzi was of obscure, apparently Italian, origins. It seems he was related by marriage to the Hornbys. Hugh Hornby, whose Liverpool address he used after he went to India, married Louisa, daughter of Luc François Cortazzi, British consul in Smyrna; and John Cortazzi married Marianne Hornby.

Nothing is known of him before 1857, when he was elected a member of the Institution of Mechanical Engineers. He was Assistant Running Superintendent for the GNR at Doncaster at that time, and apparently acting as assistant to Sturrock when he proposed the use of inclined slides to control the side movement of radial axleboxes. This gave the benefits of a pony truck at a saving in space and weight.

Early in 1859 Cortazzi became Running Superintendent at Peterborough when C. R. Sacré resigned. In 1860 he was appointed Locomotive Superintendent on the Great Indian Peninsula Railway, Bombay. His idea was used there and elsewhere in India, on the 2′ 6″-gauge Gwalior Light Railway, for example.

The IMechE Register Books show that F. J. Cortazzi died in 1869, but oddly he got no obituary – not even a death notice – in the *Proceedings*. His subs were up to date, so probably he died in India of a fever, like many British expatriates. Bell's *Biographical index of British engineers in the 19th century* has no entry for him.

At some point, people started writing his name as 'Cartazzi'. In Britain his invention was used by the GNR, the company for which Gresley worked until its absorption in the LNER in 1923. Gresley used Cartazzi's axle on trailing carrying axles, but the Midland Railway used it on the leading coupled axle of the unloved Flat Iron. This Deeley 0-6-4T combined it with helical springs, though its other coupled axles had laminated (cart) springs. Not surprisingly, it tended to derail.

In the 1930s a spate of derailments by Indian pacifics was investigated by a team led by William Stanier. Lack of side-control was found to be the main cause, aggravated by poor track and lack of maintenance; wear on the Cartazzi slides was implicated as a contributory factor.

When Gresley commissioned a New York firm to design a booster engine for his P1 2-8-2, they tried in vain to persuade him to use an American trailing truck of the type that they were used to. In the process of redesigning the booster to fit the P1, they came round to the view that Cartazzi's design was "undoubtedly about the lightest form of suspension that could be worked out".

Grateful thanks go to Keith Moore, Librarian of the Institution of Mechanical Engineers, and Peter Townend, our vice-president and sometime Shedmaster, Kings Cross, for information found in this article.

The Editor welcomes letters or e-mails from covenantors, especially if they are succinct and polite, but reserves the right to edit for length and content.

Sheffield, Yorkshire
by e-mail

Dear Gerard,

I understand that a second tender is to be provided for *Tornado* and that this will have the same profile and livery as the first tender. I am very concerned at this as I believe *Flying Scotsman* never looked right with its second tender.

If *Tornado* is to have a second tender I believe it should be made to appear as though it is ***not*** part of the locomotive, perhaps by making it look, as much as possible, like a part of the train. This could be achieved by building it to the same profile, and using the same livery, as the proposed support coach. An alternative would be a coach fitted with a water tank.

I would be interested to know the views of other covenantors on this.

Regards,
Gerry Bates

Gerry Bates is right that a second tender is planned, but mistaken in thinking that any decisions have yet been made on its design, still less on its profile or livery. However, about two weeks later another covenantor wrote to me with remarkably similar thoughts:

Higher Broughton,
Salford, Lancashire

Dear Sir,

It was with some concern and not a little alarm that I read in *Steam Railway* magazine no. 276 about the idea to pay £300,000 for two tenders for *Tornado*.

Would it not be possible to borrow or hire the tender from *Blue Peter* when needed? Our own tender could be constructed by covenantors in the extra time thus provided.

A second tender could be replaced with a converted Mk II coach, altered to carry both oil and water for long trips. Two tenders never looked right even behind *Flying Scotsman*, and I believe we should aim to start *Tornado*'s career debt-free if at all possible.

To borrow or hire the tender from *Blue Peter* might also be an opportunity for a demonstration of good relations between our organisation and NELPG, no bad thing I hope you will agree.

Yours faithfully,
J. Evans

Another suggestion was to convert a freight vehicle, but I think none is meant for use over 75 mph, and to build and certificate a new design would, it has been assumed, be too costly. But the Bates–Evans ideas may have occurred to others, so – after consulting the board and the engineers – I replied to both writers on these lines (opposite):

THE SAFETY VALVE

Darlington Locomotive Works

Dear Mr Evans,

I am replying to your recent letter expressing concern and some constructive suggestions about *Tornado*'s second tender. You are worried about cost and suggest using the tender from *Blue Peter* or converting a Mk II coach.

We have good relations with NELPG and it might well be possible to hire the tender from 60532, but this would pose some basic technical and capacity problems, which would require expensive and extensive surgery.

Blue Peter has steam brakes on engine and tender, and the latter is piped for vacuum brakes on the train. We intend to equip *Tornado* with air brakes throughout to suit main-line requirements, with a secondary vacuum system for use on preserved railways. The front of *Blue Peter*'s tender would have to be substantially modified to carry buffers and conventional drawgear to enable it to run behind the main tender.

Blue Peter's tender would give us another 5000 gallons and a large (empty) coal space, but not the range of 275+ miles that we are looking for. We hope the second tender will carry about 8000 gallons of water, weighing over 35 tons, far in excess of the load capacity of a Mk II coach. It will not carry fuel: the main tender's 10 tons of coal/2000+ gallons of oil will suffice for 350 miles or more.

As an alternative to the *Flying Scotsman* solution of a second 8-wheel LNER tender, we are considering a specially designed tender which could be disguised as a passenger vehicle. Provided it could be designed, built and certificated for an affordable price, it has a number of attractive features, including space for tools and equipment, enabling us to dispense with a support coach for some runs.

As we need not always run with the second tender/water carrier, it could be hired out to operators of other locomotives, including *Blue Peter*. We are keen to work with other owners, and indeed shared patterns with *Blue Peter* after the damage it sustained in the Durham incident some years ago.

Off the main line 60163 will run with a single tender, pulling Gresley and Thompson coaches, like the A1s many covenantors remember. For their sake we want it in steam soon, or some of them will no longer be here to see it; and, for *Tornado* to earn its keep, it must have as few restrictions as possible on what work it can do.

On the main line, this is a new century – no water troughs, no stand-by locos, few turntables – and 60163 needs to run as far and as fast as diesels do. A second tender is needed and we will look for the best solution.

Yours sincerely,
Gerard M-F Hill

"I'm off to Kings Cross to collect engine numbers – want to come?" This offhand remark by a school friend as we packed up our books to go home late one afternoon in autumn 1945 was the start of it all! Why not? I thought. After all, the station was only a five-minute bus ride away and homework wasn't such an enthralling prospect. What were 'engine numbers' anyway?

What a magical place Kings Cross was way back then – *real* magic and not the ephemeral Harry Potter kind. The smoky atmosphere, the number and variety of locomotives as they came and went, albeit somewhat drab and rundown after six years of war-winning effort, was bewildering. I didn't really appreciate what I was seeing, but then none of us at the end of (what was then) Platform 10 did. After all, this was the way it had always been and would be for ever, wasn't it?

I was hooked. The LNER was making strenuous efforts to return locomotives to something like their pre-war splendour: 'garter blue' and 'apple green', revelations to me, were reappearing – and even new types were rumoured. This included additions to Class A1, then a class of one: Thompson's rebuild of *Great Northern*. I knew nothing of the controversy raging around *that*; writing down numbers was all that mattered. I now had my first railway book, *The Locomotives of Sir Nigel Gresley* by O. S. Nock. It introduced me to the wonders of LNER motive power and it created an instant (and lifelong) admirer of the great man's works. My other indispensable volume was Ian Allan's *ABC of LNER Locomotives, 1947*, revised renumbering edition, which listed simply "A1 Class Pacific 113 *Great Northern*".

The first Peppercorn A1 left Doncaster 'plant' in August 1948. Construction, there and at Darlington North Road Works, was so rapid that my 1948 ABC was soon out of date, listing A1 nos. 60113 (now reclassified as A1/1) to 60116 only. This class was noted as "A1, development of A1/1 for new construction". I still treasure that book, with my gummed-in paper insert extending the list to include the numbers of locomotives still to come, for recording my anticipated 'cops'.

One day in February 1949, standing on York Road platform at Kings Cross, I heard steam escaping from open cylinder drain-cocks in Gasworks Tunnel, that now-familiar sound heralding the arrival of a locomotive from 'Top Shed'. Always exciting, this time it was different. Before my wide-eyed gaze, a glittering vision in the shape of unnamed 60120 slowly and majestically emerged – my first 'real' A1!

Resplendent in LNER apple green, albeit in British Railways guise, 60120 was barely two months old. My hurried 'snapshot' with a very basic camera is not too sharp, but it captured the moment. With the exception of the spires of St Pancras on the horizon, nothing else in my photograph now survives and that once-exciting atmosphere is now coldly clinical.

However, that thrilling sound will once again be heard in Gasworks Tunnel for soon 60163 *Tornado* will emerge into the sunlight to become a legend in her own lifetime. We shall have many different feelings but I shall feel like that boy back in 1949, reliving the magic moment! As a postscript, I still have my 1949 ABC which listed A1s up to 60153, and I had neatly extended the numbers in the margin – up to 60164. Might this yet become a self-fulfilling prophecy, perhaps?

Brian W. Collins

Peppercorn A1 60120 as caught new on '127' film at Kings Cross, sans nameplates and indeed sans name, it was later named *Kittiwake*; an unused A4 'bird' name. Allocated to Kings Cross, 60120 is in apple green with 'British Railways' in Gill Sans on the tender, Doncaster style for new A1s until May 1949, when express blue was introduced. Note on the right the (permanent-way?) inspector in suit and hat. Behind some examples of colour-light signalling, an N2 0-6-2T lurks on the suburban side. *(photo: B. W. Collins)*

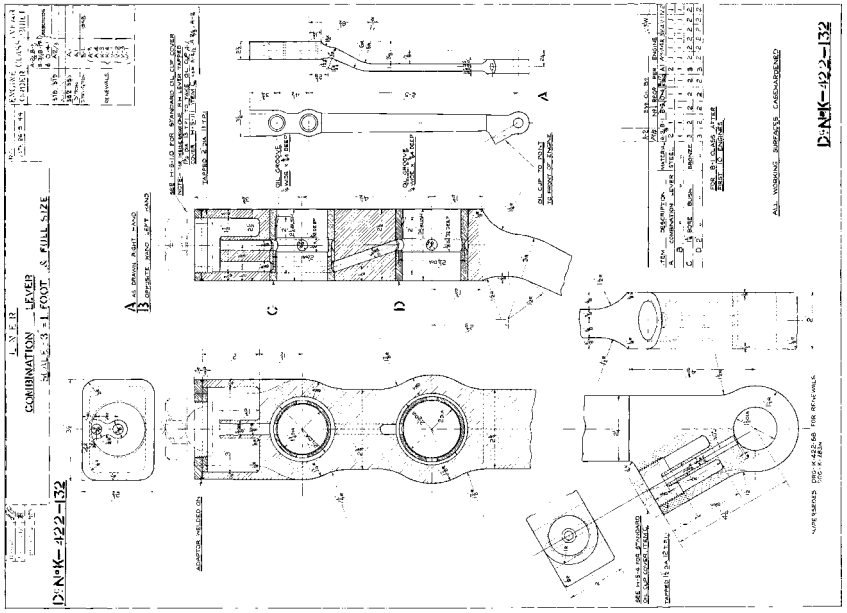
DEDICATED COVENANTS

Hesketh of Bury, featured in A Visit to a Forge *(pp. 10–11)*, have made a number of forged components for us recently. Some of them are now being sponsored as Dedicated Covenants. but there are other forgings still available. One of these is the inside combination lever, as seen below in LNER drawing K442-132.

What does that do, then? The combination lever – a feature that distinguishes Walschaerts gear from Stephenson – joins the front of the radius rod to the front of the union link. It combines the fixed input from the crosshead with the variable input from the radius link to give the valve movement required by the driver.

And how much does it cost? Just £200 – really very affordable! Of course, if you have a little more spondulix to put in to the engine, you can sponsor forging of something larger: a connecting or coupling rod, for instance, is only £1,800.

Most of the reverser parts featured in TL5 are still available. The full drawings may be found on the covenantors' section of the A1 website. The TIF files can be viewed using Microsoft Photodraw, Imageview or other raster-imaging packages.



K442-132 covers all three combination levers. *(by courtesy of National Railway Museum)*