

# AUTOCAR

1903 North Eastern Railway Electric Autocar Trust

Newsletter No.18 — Winter 2012/2013



# The North Eastern Railway 1903 Electric Autocar Trust

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- Front Cover:** **The new power unit, photographed from the other side to the photo in the last issue. (Dave Moore)**

## January 2013

Welcome to the 18th issue of our newsletter. The progress continues, with the underframe now at Loughborough, together with other key components.

There's little mention of the autocoach elsewhere in this newsletter, but work on it is continuing. Members have taken several doors and drop-lights away to work on at home (where it is rather warmer than recent temperatures at Embsay...) and a good sort-out and tidy-up allowed us to plan our next few months work.

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### New Members

A warm welcome to Mr J Carr of Denby Dale, Mr R Siddall of Leyland, Mr C Clift of Knaresborough, Mr & Mrs P Welburn of Scarborough, Mr M Wade of Hebden Bridge, Mr P Johnson of New South Wales, Mr C Jagger of Leeds and Mr G Burn of Copmanthorpe.

#### Newsletter back issues

Some earlier back copies are available to download from our web-site, if you prefer hard copy, back copies of the newsletter are available from us at £3 each (including postage).

# Chairman's notes

*Stephen Middleton*

Happy 2013 to everyone. Thank you to all who contributed to the underframe appeal. The underframe is now in Loughborough where it will be strengthened and adapted to take the engine, fuel tanks, battery boxes, brakes and control gear. All being well we will see it back at Embsay as a running chassis in around twelve months. It was pointed out that this is the first UK made diesel electric standard gauge engine since 1989! The priority now is to concentrate on the trailer autocoach, because once the underframe is back I imagine we will not have the time or interest to work on anything other than completing the autocar. Exterior panel beads have been ordered and it should be a good, simple job.... if it was not for all those doors. If you can help and are fit and able, do please come along.

Many visitors wonder what the interior of the autocoach would have looked like. I did too, until I saw the answer at Beamish. Their NER clerestory coach, in traffic on selected weekends, has first and second class compartments beautifully restored. It's a useful model for us.

2013 should see a boost to our educational efforts. Woodworking machines are in the new enclosure at Embsay and ready for wiring in. I would like to place information boards covering skills such as woodwork, painting, roofing, maintenance etc. together with relevant history boards. Can anyone help with this?





**This page:**

**Two views of the interior of Beamish's NER clerestory coach. (Stephen Middleton)**

**Opposite page:**

**The autocar's chassis is unloaded at Loughborough. (Peter Van Houten)**



# Engineering Progress Report

*Stephen Hoather*

Since the last report we have made solid progress, with a number of visible milestones to show for our efforts. In October the underframe was lifted again off the motor bogie to enable the side bearers on the bogie to be modified to suit the “new” underframe. When it was lowered again the centre castings mated correctly, with clearance at the side bearers. The buffers are still a few inches high, and this will be adjusted by making a new adapter plate when the weight of the body and engine is on the underframe and we know the deflections of both the primary and secondary springs. We will then also need to adjust the side bearers, and only when this has been done will we know whether the clearance problem with the brake rigging is a real issue, but we are confident that the clearance will be adequate without modification.

Having finished this phase of work at Embsay, detailed planning of the move to Loughborough began. It was originally intended to offload by crane, but the weight of the motor bogie and relative weakness of the underframe precluded this, so a special length of track was made and the underframe winched off the end of the lorry, as the photographs show. The move was successfully completed on 27 November.



The trailer bogie currently with the underframe is a temporary one, as the one we use will need an overhaul and fitting of lifeguards before use. The bogie transoms are badly corroded and probably need replacing.

Whilst this was going on, Cummins were awaiting the silencer and cooling unit for our power unit, and these were delivered in November. We arranged a visit to their factory for our engineers to inspect the unit before the final invoice was paid, and this proved useful in establishing some contacts which will be valuable if we hit problems in designing the control system – we need to integrate the Cummins engine management system with 1970s HST load control electronics (which were originally designed by Brush) and 1950s traction motors (designed by English Electric). The power unit has now been delivered to Loughborough, another significant milestone.

The aluminium doors for the engine housing have now been cast, and are embossed “NER” as the photos show. The housing itself has now been dismantled for painting, and in the New Year it will be reassembled at Adey’s and fitted with the power unit before being delivered as an assembled package to our workshop in Loughborough for fitting of the ancillary equipment and testing.



I mentioned last time that we still needed a Brake Application unit which we were hoping to recover from a class 31 or 37 diesel loco. A flash of inspiration shortly afterwards reminded me that these were also fitted to AC electric locos, and we have recently collected one from a class 87 being broken up. We have also been promised a second one in due course for our Driving Trailer. All being well, this means we will shortly have all the brake components we need for both vehicles, although some of these have yet to be recovered from the donor vehicles.

Looking forward, the next step is to finalise design of the underframe strengthening plates together with the fuel tanks, battery box and brake rigging to enable these to be made and fitted at Adey's. After fitting the complete engine housing, the underframe will be moved to another site in the area for wiring and piping to be fitted, and it will then be tested on a preserved line in the Loughborough area. We estimate this will be autumn 2013, after which the completed and tested underframe will come back to Embsay for the body to be fitted towards the end of 2013.

No physical engineering work has yet been done on the trailer, but I found a drawing of the underframe at the NRM (NER 4464D of 1903). Stephen and I checked this against the vehicle and confirmed it was correct, but it shows the arrangement as built, with air brakes, gas tanks (for lighting) and laminated drawgear springs – there is clear evidence at both ends of the coach that these were originally fitted. The brake rigging was completely altered when it was converted to vacuum, but I have been unable to find a drawing of the conversion despite searching the records at the NRM and the Ken Hoole archive at Darlington. Dave Cullingworth has established from NERA that the brakes were converted about 1929, but the NRM drawing list for this period lists only those drawings of which they have a copy, it is not a complete register of all drawings produced.

When we are nearly ready to start on the trailer, I will arrange for an “as is” drawing of the brakegear to be made, but this will not be needed for some months.

**Photos on page seven: Dave Moore**



**Top:**

**Another view of the power unit, with the silencer and cooling unit still to be added.**



**Bottom:**

**The cooling radiator and motor upside down, ready to be fitted.**

**Both: Dave Moore**



Even a fairly straightforward vehicle like the autocar must have a vast array of control functions to operate itself. All power and control functions have to be defined and thought about, and continually reviewed as the project progresses. This covers everything from turning on a tail light, to how the modern diesel engine is controlled. There's another one of those 'too large for the back of a fag packet' diagrams here, and this shows a simplified sketch of how the vehicle operates electrically. From this top level drawing, the design progresses into further detail in all areas, and more detailed decisions are made as the process continues.

The diagram opposite builds upon the diagram in the last newsletter and gives more detail. There are many ways to achieve an end result, so different options to implement the different functions are considered, compared and evaluated during this rolling process. Eventually the design becomes firm enough to take further into more detail, so back to the diagram.

At the centre of the design is the power unit. The diesel engine and its traction and auxiliary alternators, and the pair of traction motors, now have to be linked up with both a heavy current power system and a low current control system. These tend to be unseen and unappreciated in many vehicles – the mechanics of the project are much easier to understand because they are large and obvious, whereas the electrical power and control equipment usually requires study of diagrams to comprehend their finer points. This description attempts to describe and explain what these hidden features do, and how it makes the autocar and its autocoach trailer work.

The first thing a diesel electric requires is a battery to start the diesel engine. Because we are using the modern Cummins engine, this requires a 24 volt type, just like a lorry. This allows the engine to be started on its starter motor and then be controlled by its engine management computer. This unit is really the engine 'governor', but covers many other functions on these current emissions compliant engines. I know that in the course of time I will be asked many times why on earth an old

vehicle renovation like the autocar should even need to use electronics at all, why it has been complicated by this modern plague and why it could not have been kept 'simple'? Well, the use of a modern engine dictates this, all these types of engine (either for railway or road vehicles) require electronics to control them and these are imbedded in the vehicles the engines are installed in. To fit a modern engine in anything other than a computer microprocessor controlled vehicle with digital datalinks, makes the job awkward by current standards.

The intention here is to have just enough electronics (that are easy to maintain) for the equipment to work, without going too seriously high tech. Automotive experience shows how much trouble state-of-the-art car ECUs can cause, and the best plan is to stay one or more steps back from current practice. Electronics have been used to control diesel electrics since the early 1970s, though this has often gone unseen, and computers have been used since the mid 1980s. The use of early vintage analogue (no computer) electronic control technology is an appropriate compromise in this situation. The older analogue electronics tend to be easier to support and maintain than the later microprocessor based equipment, with no software to complicate matters either.

On a diesel electric traction system, not only is the transmission electric, so is the control of the vehicle in general. Thus, the driver's controls are all electric, and all the internal vehicle functions are electrically operated. The vehicle is fitted with a battery to supply all of these needs, and also the more mundane requirements such as internal lighting. This takes the form of a large 96 volt lead acid battery, along the lines of most of the BR diesel electric traction. This battery is charged continuously from the auxiliary alternator 3 phase supply with its own charger. This provides a 110 volt dc electrical supply for use throughout the two vehicles, which operates everything from the lighting to the vehicle controls. This battery has enough capacity to keep the two vehicles lit for some time whilst they are parked up with the engine stopped and with the handbrakes on. Sustaining this DC power throughout the working day is critical, and the power for its charger comes from the auxiliary alternator under the control of an Automatic Voltage Regulator (AVR). This is a modern electronic

unit which ensures the 3 phase auxiliary power is regulated correctly for the loads it powers, one other important unit being the Radiator (Cooler Unit) fan motor. This auxiliary system creates a variable AC voltage linked to engine speed, so the fan will run fastest at top revs. This type of auxiliary supply suits the diesel electric system well, and has been used since the mid 1970s.

The high power traction 3 phase from the main alternator is rectified into DC for each traction motor using silicon diode rectifiers. Each traction motor is then supplied through a high current switching contactor, with the direction of movement being set by the reverser contacts. These are actuated by compressed air solenoid valves. The precisely regulated DC current for the traction motors is controlled by the main alternator's excitation current, this being supplied by the load regulator. Again, this is an electronic unit similar to the type employed on HST power cars, but adapted to operate with the modern Cummins engine control system.

Again, why so much electronics on this ancient vehicle? Answer: the engine cannot work without them. The driver's power controllers provide the required electronic throttle signal for the modern engine control, there's no push rods or air control on this project! The precise function of controlling this traction supply according to the driver's tractive effort demand within the engine's capacity is all controlled by the load regulator in conjunction with the engine governing system. It sounds complicated, but this all happens automatically and the traction power settles out the level set by the driver.

Once the vehicle is in motion, the two traction motor gearcase speed probes recognise the passing gear teeth and generate a Speedo signal for all three drivers' desks. The Wheelslip Protection Unit (WSP) takes care of this and other speed related functions, including the correction of slipping/spinning powered axles on a greasy rail, and thus prevents motor and rail damage. It's all a bit modern for the autocar, but these systems have been commonplace for the last 40 years, and are of great value. Systems like wheelslip detection are the sort of thing that could

only have been dreamed about by the autocar's designers in 1902.

Most of these somewhat less than modern electronics are housed in control modules, within a Rack Frame. It has been a bit of a task to make the electronics look old fashioned, but by painting it all black we have tried to not draw undue attention to it.

The vehicle electrical schematic diagram details the electrical configuration of the power and control apparatus, and acts as a reference guide for wiring the vehicle and for troubleshooting.

Next: The engine & cooling.

## **Underframe appeal**

*Marcus Woodcock*

Thank you to all those who have responded to the Underframe appeal donation form enclosed with the last newsletter, we are now over two thirds of the way to our target of £6000, having raised £4062.70. Please keep the money rolling in for this worthy cause - you will soon be able to ride on it! With the rise in second class postage to 50p I have decided not to post out any receipts unless specifically requested, however, a list of donors will be published in each newsletter to confirm receipt of your cheque.

Thank you again to the following donors, R Stagg, G Phelon, D Yates, J Waterworth, D Castle, A Austin, E Hudson, A Robinson, P O'Connor, B Watt, R Chapman, P Jary, B Dyson, A Masheded, D Thomas, G Wells, J Saville, J Kempton and R Semmens.

### **Publicity Update**

We attended Leeds exhibition at the end of October and attracted interest and donations. Thanks to Michael Savage & Stephen Middleton for manning the stand and transporting it.

We will be represented at Scalefour North on the 20th/21st April, though we're currently uncertain whether we'll have the full stand.

## Letters

We had a letter from Alan Winter, who also enclosed a picture he had painted showing the autocar (and Aerolite). This is on the back cover as this issue's endpiece. The NER East Yorkshire station is fictitious, though Alan said his composition was influenced by Scarborough and Malton.

Alan writes:

*Dear Stephen,*

*Thankyou for your lovely [Christmas] card, clearly the work of a talented artist, and for your very kind comments about my own work...*

*...I am pleased to see the good progress that is being made on the railcar. Unlike the replica steam locos that are currently popular it is a historically important artefact. When it is complete, what protection is in mind to ensure its continued preservation should the Trust founder? Sadly the NRM seems incapable of looking after such valuable exhibits.*

*Best wishes,*

*Alan*

Stephen replied:

*Dear Alan,*

*Thankyou for your kind letter and permission to reproduce your lovely painting. You raise several interesting points. I think that the autocar and trailer have a sound future for several reasons. Firstly, we had to prove a ten year viability to win HLF support. We applied to the HLF with our recruited partners, Beamish and Embsay & Bolton Abbey Steam Railway, both having an interest in using the artefact. Finally, unlike a steam loco, there will be no heavy ten-yearly bills. It is a relatively simple machine to maintain and its costs should be well taken care of by income. The engine is new and parts will be available for a long time.*

*Kind regards,*

*Stephen Middleton*

