WHISTLEBLOWER

THE NEWSLETTER OF THE FARNHAM & DISTRICT MODEL RAILWAY CLUB

March 2019 Edition

EDITORIAL

Thanks to the members who responded to my request for articles. The fruits of this are in the article on 1:1 Electrics by David Mulvey which I found both informative and entertaining, so I hope you enjoy it too. Please keep the articles coming.

I would imagine most of you will have seen the email from Richard. Amongst other messages is a proposal for organising a repeat trip to Miniatur Wunderland in Hamburg. It is brilliant and I can highly recommend it. Contact Richard if you are interested.

Lastly, there won't be an April 'Whistleblower' as I will be on holiday.

Julian Evison (Editor)

CLEAN UP

The people who use the hall on Thursday have been unhappy at the state of cleanliness in which we leave the hall on a Wednesday evening. Please make sure everything is swept away – wires, wood shavings, track pins, etc. must not be left behind!

“HOW TO BUILD A PERFECT MODEL RAILWAY”

I am sure some of you will have seen a recent article on the BBC website about a model railway in Scotland called 'Alloa'. For those that didn't, it was a refreshingly positive article portraying the hobby in a good light with none of the usual stereotypes. Here is a link: https://www.bbc.co.uk/news/uk-scotland-scotland-business-47163833

ELECTRICS FOR 1:1 SCALE – David Mulvey

Once upon a time, long, long ago and far, far away, there was an industrial city called Birmingham. Sit comfortably, readers, because we are going back to 1989 and in our imagination, fortified by anything we might happen to remember from Train Simulator, we will be sitting in the left hand seat of a class 86, in charge of a passenger train from Birmingham to London. Before we take the controls though, let’s have a quick look at how to do heavy duty electrics for 1:1 scale, armed with a sheaf of Railway Modeller “Shows You How” booklets (as they say on telly, don’t try this at home!!).

If you have time to spare, and can wait in Birmingham for seventeen years, you can get there from Paddington on the Blue Pullman (see video, ref 1 in URL list at end). Note especially the Great Western colour light signals on leaving Paddington, the steam trains coming the other way and the classic GWR infrastructure particularly at High Wycombe

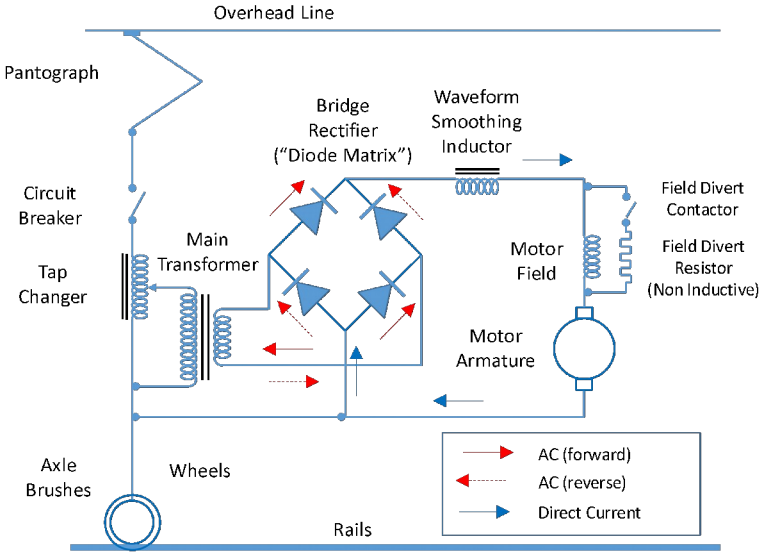
and Princes Risborough.

But now it's 1989 and we are at Birmingham New Street (see video, ref 2).

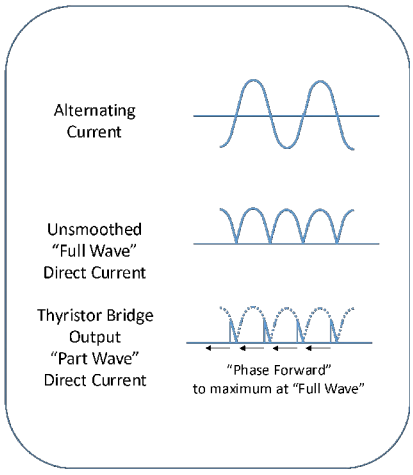
It's 9.20 in the morning and we are on the station concourse. We can hear the Solari displays clattering - the 09:18 to London has just departed and so most of the displays have to move one to the left. Our train is the 09:48 to London Euston, stopping at Birmingham International and Coventry plus, unusually, an unadvertised stop at Rugby. Normally it would leave from platform 3 but today it's on the other side of the island, 2a and 2b. We make our way downstairs and along the platform, taking care to avoid the large number of BRUTE trolleys parked at various awkward angles.

The train is already in, consisting mainly of Mark 2e and 2f coaches. As always, first class is at the front, platform 2a. No Mark 2 buffet cars or full brakes ever built, so we have a Mark 1 buffet car and no less than two Mark 1 BGs at the head of the train for the parcels. InterCity is at its peak so everything is in "raspberry ripple" livery including our locomotive for today, 86 256 Pebble Mill.

But before we get in the cab, let's quickly go through how AC locomotives of that era worked. Fortunately as modellers it's all quite easy to pick up, especially for anyone at David H's recent talks, because the 81s to 87s ran off a big version of the mains and had DC motors just like our models. Same principles for both if we're talking "analogue control" - no DCC on a class 86. To help visualise how this all works, here is a picture which shows everything we'll be looking at.



Summary Diagram of Class 86 Power Circuit



Waveforms

So, just like Greenfields, we need a rectifier to convert AC to DC (this is the "diode matrix" David H mentioned). Works the same for 1 amp or 1000 amps – just follow the arrows on the picture. Unlike models though, we can't limit the current with a resistor (not if we're serious about delivering 3,300 hp at the rail). So we can do one of two things: (a) use a

variable transformer just like those old Hammant & Morgan controllers with a wiper on a transformer winding or (b) do something clever with the rectifier which we will come to in a minute. But first let's sort the basic rectifier out.

In the 1950s a far-sighted British Railways engineer called Stanley Warder managed to persuade his senior colleagues that it was time to move to 25kV electric supply at industrial frequency i.e. "big mains", as the French were doing in their northern steel producing area around Thionville. This was a bit of a leap of faith as the rectifier technology wasn't really there at the time. In those days the leading edge solution was the mercury arc rectifier, based on a massive tank of mercury into which you dipped electrodes and struck an arc which was supposed to conduct in only one direction.

Quite a few substation mercury arc rectifiers of the day consisted of a kind of spooky flickering blue octopus made out of glass (ref 3). Although, to be fair, similar equipment for locos did have a metal tank, having a lot of mercury sloshing around as you went over dodgy pointwork was not good news. Plus, such rectifiers were known to backfire i.e. conduct when they shouldn't. Without additional protection to trip the power, this leads to a short on the main transformer – serious bad hair day.

Classes 81 to 84 had to be built this way but fortunately by the time class 85 was being built, the semiconductor diode, first in germanium then very soon in silicon, had become able to withstand the required reverse voltages and pass the necessary current when conducting. After that, traction designers never looked back and classes 86 and 87 had solid state silicon rectifiers.

Add a waveform smoothing inductor (model controllers use a capacitor but in 1:1, inductors are easier) and that's the rectifier done. Now for the variable transformer. This is something like a very large old H & M "Power Master" and is known to electrical engineers as an on line tap changer (see ref 4 for detailed explanation and animated diagram). Just like the Power Master, this varies the effective number of turns on one of the transformer windings to adjust the voltage at the rectifier.

This piece of kit lives in the (oil-filled) transformer tank and, as ref 4 explains, can be designed either to work on the higher voltage side (good insulation needed, low current so less wear on the contactors switching the current) or on the lower voltage side (insulation not such a bother but high current, tough on the contactors). Both types were used in classes 81-85 but by the time classes 86 and 87 came in BR seem to have opted for the high voltage one (as shown in the picture at the end).

The tap changer is motor-driven, controlled by electro-mechanical equipment responding to the driver's power controller (see ref 5), which lets the driver notch up and down one notch at a time or run up and down automatically. Just like the Power Master, everything is protected by an overload cut-out, which for most members of classes 81-87 was a device referred to as an air blast circuit breaker (big puff of air to blow out the birthday candles if an arc arises as the breaker opens).

We recall that any motor also acts as a generator, so when it's motoring it generates a voltage, known in the trade as the "back emf", which opposes the supply voltage, reducing the current. Zero speed, zero back emf, big current - which is why a motor, large or small, can overload if you stall it. In normal operation, though, as the loco accelerates, the back emf increases and so the current decreases. To counteract this, the driver has to notch up, keeping a close eye on the traction motor current to avoid overloading the motors or causing wheelspin.

In other words, imagine you're operating a chunky O gauge loco. You have an ammeter. You start slowly and as the loco speeds up, you turn up the black knob of the trusty Power Master in stages, increasing the voltage to keep the current in the yellow band as the loco goes faster and faster. Maybe best to ask if you can go and do this on Weydon Road rather than try it on Haydon Square…

Eventually, however, we get to the point where the full supply voltage is being applied, the Power Master knob is fully clockwise and the tap changer can't move any further. After this the current will gradually fall as the speed rises until the "balancing speed" is reached and no further acceleration occurs. Unlike Triang Jinties, however, 304.8 mm scale locos have one more trick up their sleeves.

Model motors usually get their field from a permanent magnet. For 1:1 scale, having tried very large red-painted horseshoes, around 1880 it was decided it would be better to generate the magnetic field ("excite the motor" in the jargon) with an electric current, and this became the method of choice for rail traction. As was standard practice by the 1950s, on most members of classes 81-87 the field was connected in series with the motor armature so the same current flowed through both.

Because the voltage generated by the motor is proportional to field strength, if you could divert some of this current away from the field to weaken it, you should find that the back emf decreases and hence the motor current increases again. On classes 81-87 (except 87 101 which we will come to in a minute) this is done by using contactors to switch in "field divert" resistors to maintain the motor current within the selected range until the minimum permissible field strength is reached.

Tap changers are good, but because they are electromechanical devices they need a lot of looking after. This can be a bit tricky as it means taking them in and out of the transformer tank without getting oil on the floor. Also, because electromechanical control can only move in steps, you get sudden increases in motor current as the tap changer notches up, which can lead to wheelspin (remembering that with a 3,300hp BoBo we are trying to transmit in excess of 800hp per axle). So wouldn't it be nice if we could make continuous changes rather than steps? Enter the thyristor.

The thyristor is just like a diode except you have to turn it on to make it conduct in the forward direction. If we replace the diodes in the rectifier bridge with thyristors, we can choose when we turn them on. We start at the back end of the cycle and we can "phase forward" the turn-on time to let in more current (see "Waveforms" on the picture at the

end), till we get “full wave” (like the unsmoothed diode matrix output which Greg showed us on the oscilloscope at David H’s talk).

We can now use negative feedback to maintain the current at a precise level (just ask the N gauge team very nicely if they would do us a 741 op-amp on a piece of Verroboard with a couple of resistors and capacitors, and job’s a good ‘un). As well as eliminating jerky current steps, this has the big advantage that now the driver doesn’t have to do minute by minute current control - no more finely-crafted notching technique, just pull the power handle forward like you would with a diesel.

Not only that, but we can also be cleverer with the motor field. Let’s alter the motor connections so that rather than having the field and the armature in series, we make the field current independent of the armature current (Sepex, i.e. separate excitation, in the jargon). We can now click and collect another thyristor bridge from RS, get some more Verroboard in, and control the field how we like. In combination with armature current control, this means that wheelspin need no longer be an issue.

All this came in with 87 101, which was a successful experimental locomotive, and also the six APT power cars 49001-6 for which ASEA provided the power equipment which, unlike some of the other features of APT, virtually never went wrong. Since then, power electronics has moved on; the invention of fast switching power transistors (IGBTs) allows the use of AC induction motors which are more reliable and require much less maintenance than DC machines – but that’s another story.

As with a steam or diesel locomotive, various auxiliary equipment is required in addition to the main traction power system. On an electric loco, unlike a diesel, we can draw as much power from the line as it can provide, so given a capable transformer, power is ultimately limited by the traction motors.

Other than wheelspin, the key factors are insulation and temperature. We can limit the voltage to the insulation rating but we do need to keep the temperature down. So, any loco with traction motors needs large traction motor blowers. Might not hear them clearly on a diesel but on an electric loco you certainly do. Other useful items are an oil circulation pump and cooling fans to keep the transformer from getting too hot, main and auxiliary air compressors and a big battery.

So now it’s time to make our way to the end of platform 2 where the loco is waiting, with the pantograph down, ready for us to take over (see ref 6, letters refer to the Class 86 cab layout).

Mashing can on desk, coat on hook, quick check round, then with the reversing lever (U) in position ‘O’, insert the master key. If we were on depot we might need to wait for the auxiliary compressor (driven off the battery) to build up the air to allow us to raise the pantograph and close the circuit breaker, but the loco has already been in service today and a quick check of the main reservoir pressure gauge (C) is reassuring so it’s time to press PAN UP (S).

As the circuit breaker closes we hear all sorts of things start whirring; most likely the main compressor has decided to top up the main air reservoir ready for us to move off and other auxiliaries such as the transformer oil pump and cooling fans may feel they have to join in. We check the signal aspect on one of those searchlight signals characteristic of New Street – green. The platform supervisor chases up a late passenger, the last of the doors slam, the platform supervisor raises their hand, right away from the guard. We check the signal aspect again – green.

Reversing switch to FWD and a loud “rurrhh” as the traction motor blowers kick in. New Street is on the level so no need to do a full hill start and we have air braked coaches not vacuum, which is good. Nonetheless, following best Train Simulator practice, we hold the loco for a moment on the straight air brake (A) and on releasing the train brakes (N), we wait a few seconds to allow the pressure wave to make its way down the train pipe so we don’t get snatching in the last coach as we move off.

Then a quick toot on the horn, release the loco brake (A) and holding down the driver’s safety device (Y) we move the main power controller (X) first to HOLD then NOTCH UP, back to HOLD and repeat, watching the ammeters (H) and the notching indicator (J) closely. Not too many notches at first so as not to provoke wheelspin, may hear a “zing” from the transformer then we’re on the move!

Through Proof House Junction, Midland lines descend to the right, build up speed through Adderley Park, passing Stechford, Lea Hall, on to Marston Green then time to slow, ready to stop at Birmingham International. Then more on the video (ref 2): Coventry (1:55), Rugby flyover (2:30), Kilsby tunnel (2:58), Linslade tunnel (3:21), Tring cutting (3:25), Watford tunnel (3:54) and Primrose Hill tunnel (4:26) before reaching Euston. Note also the BR hats (1:59), the immaculately dressed “gripper” (2:51), Travellers’ Fear (3:04), and a passenger using the very latest (first generation) mobile phone (4:11).

Don’t forget there is a down gradient to think about just before the final stop at Euston so do consider easing off and “bringing your train under control” at about Kilburn High Road. Enjoy!

References

1. Let's Go To Birmingham (1962) - London to Birmingham @ 960mph!
https://www.youtube.com/watch?v=NmPzB0qTy4M
2. Birmingham to London in 5 minutes.
https://www.youtube.com/watch?v=vv640aRwFS8
3. Mercury Arc Rectifier - Manx Electric Railway - Laxey I.O.M.
https://www.youtube.com/watch?v=yjMZ5qtyCUc
4. Wikipedia: Tap Changer
https://en.wikipedia.org/wiki/Tap_changer
5. Train Simulator 2015 Tutorial: How to Drive the Class 86/87
https://www.youtube.com/watch?v=NDJQXK3fj3w
6. Driving Cabs: Electric Locomotives & Electro Diesel – Class 86
http://www.dawlishtrains.com/driving-cabs-electric-loco.html

Further Reading
AC Electric Locomotives of British Rail Brian Webb and John Duncan 1979
(David and Charles Locomotive Studies)

ASTOLAT – David Harrington

There was some chat in the Clubroom the other week about the meaning of “Astolat”. Nobody seemed to know. So this is what Wikipedia has to say:

> Astolat is a legendary city of Great Britain named in Arthurian legends. It is the home of Elaine, "the lily maid of Astolat", and of her father Sir Bernard and her brothers Lavaine and Tirre.
>
> The city is called Shalott in many cultural references, derived from Alfred Lord Tennyson's poem "The Lady of Shalott". It is also named Ascolat in the Winchester Manuscript and Escalot in the French Arthurian romances.
>
> Chapter nine of Sir Thomas Malory's book Le Morte d'Arthur identifies Guildford in Surrey with the legendary Astolat:
>
> “And so upon the morn early Sir Launcelot heard mass and brake his fast, and so took his leave of the queen and departed. And then he rode so much until he came to Astolat, that is Guildford; and there it happed him in the eventide he came to an old baron’s place.”

CLUB DIARY – Andrew Wrobel

Recent changes in yellow. Running starts at **14:00** in the Hall.

'Run'g pm' = Priority for use of Hall, AND tidy/vacuum Club Room + Lock-up

DIARY 2019			
Date	***Run'g pm***	***Workshops 18:00 60-90mins***	***Event / Layout at Exhibition/Show***
Wed 06 **Mar**	0	Card buildings Part 1 [Demo/Hands-on] (Noel)	
Sat 09 & Sun 10 Mar	n/a		**Haydon Sq.** E.1(0): Basingstoke and North Hants MRS, Aldworth Science College, Basingstoke, RG22 6HQ
Wed 13 Mar	N	Card buildings Part 2 [Demo/Hands-on] (Noel)	
Wed 20 Mar	00	**GPC (General Purposes Committee) Meeting at 14:00** Scenery Part 1 [Tutorial] (David H.)	
Sat 23 & Sun 24 Mar	n/a		**Wickwar** (N): The London Festival of Railway Modelling, Alexandra Palace
Wed 27 Mar	P4/009	**NO WORKSHOP** Hall from 12:00 for P4 group	
Wed 03 **Apr**	0	Scenery Part 2 [Tutorial/Hands-on] (David)	
Wed 10 Apr	N	Scenery Part 3 [Tutorial/Hands-on] (David)	
Sat 13 & Sun 14 Apr	n/a		**Aldermouth** (0) [J.Edwards's layout]: Crawley MRS, Tanbridge House School, Horsham. RH12 1SR
Wed 17 Apr	P4/009	Trees Part 1 [Tutorial/Hands-on] (David/Terry)	
Wed 24 Apr	00	Trees Part 2 [Tutorial/Hands-on] (David/Terry)	
Wed 01 **May**	0		
Fri 03 open 1pm, Sat 04 & Sun 05 May	n/a		**Haydon Sq.** E.1(0): Bristol Model Railway Exhibition, Thornbury Leisure Centre nr. Bristol, BS35 3JB
Mon 06 May (Bank Holiday)			00 Gauge Open Day, Hall & Club rooms
Wed 08 May	N		
Sat 11 May	n/a		**Kinlochlaggen** (N) [Mike Le Marie's layout]: Loddon Vale MRC, Swallowfield
Wed 15 May	P4/009		
Wed 22 May	00		
Sat-25 & Sun-26 May	n/a		**Wickwar** (N): Railex, Stoke Mandeville Stadium, Aylesbury, HP21 9PP
Mon 27 May (Bank Holiday)			0 Gauge Open Day, Hall & Club rooms
Wed 29 May	Any		
Wed 05 **Jun**	0		
Sat 08 Jun	n/a		**St.Mary's** [J.Evison's layout]: 7mm NGA 40th Anniv'y Exhib'n, Town Hall, Burton on Trent, DE14 2EB
Wed 12 Jun	N		
Fri 14 to Sun 16 Jun	n/a	Awaiting formal confirmation	**Wickwar** (N): GCR (Great Central Railway), Quorn Station, LE12 8AG
Wed 19 Jun	P4/009		
Wed 26 Jun	00		