

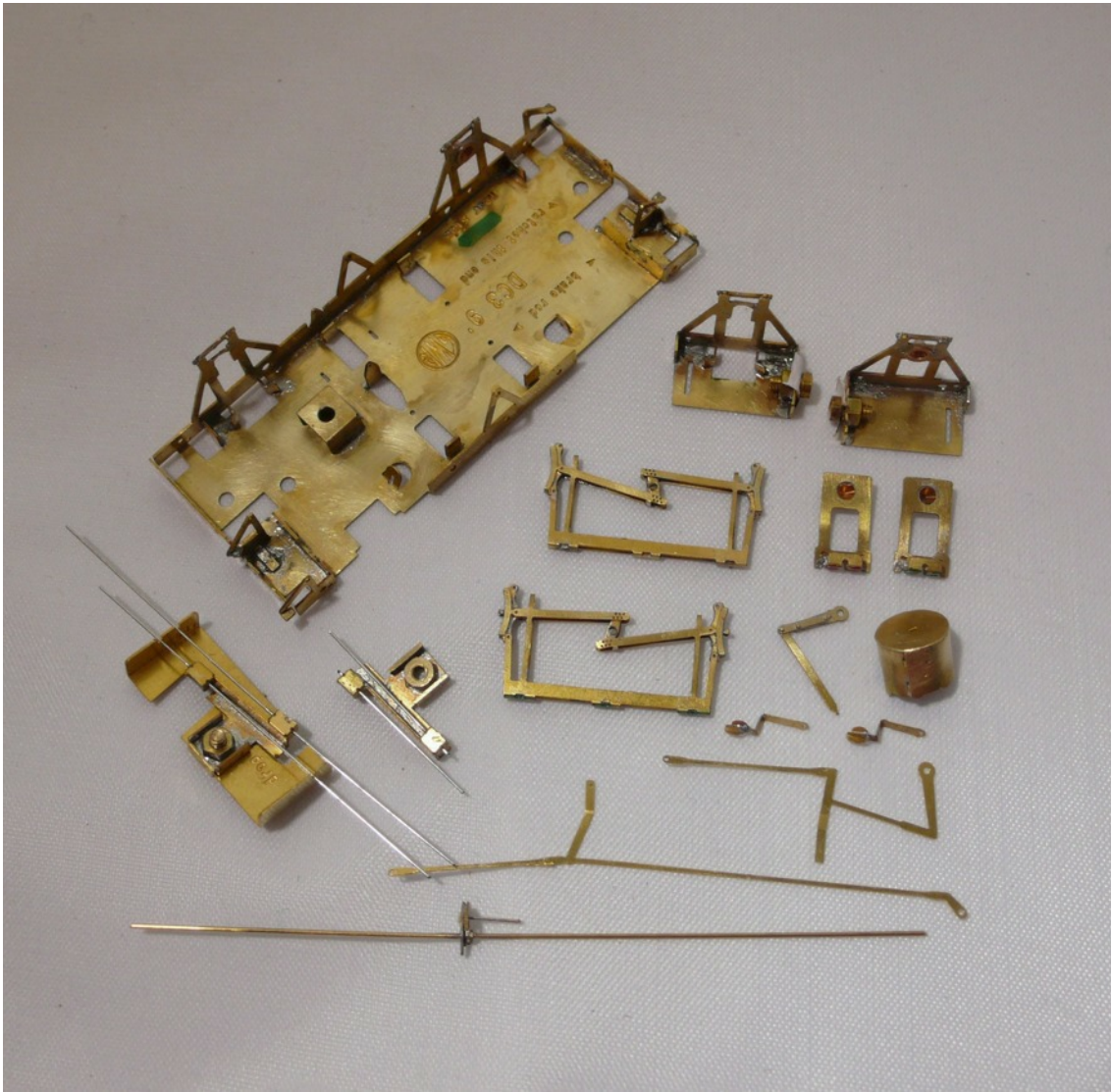
Instruction Sheets

Great Western underframes and solebars

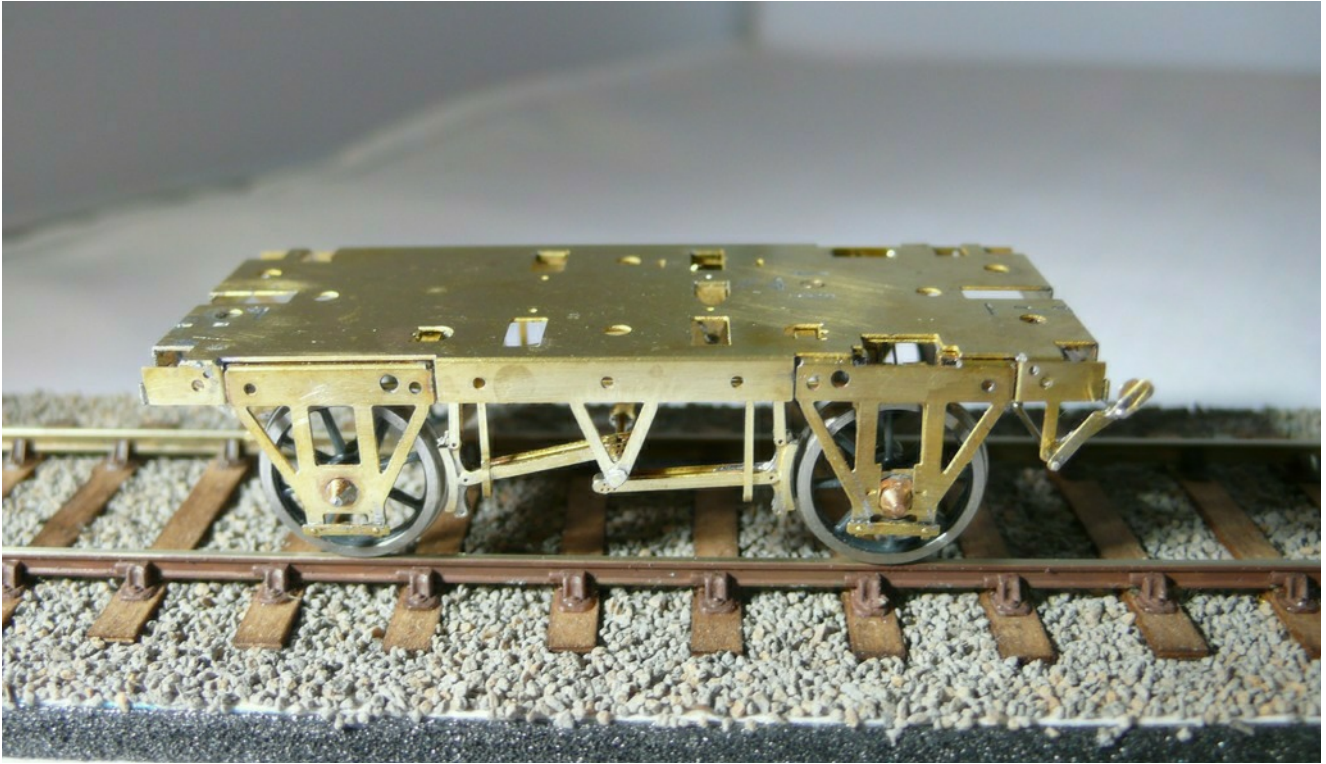
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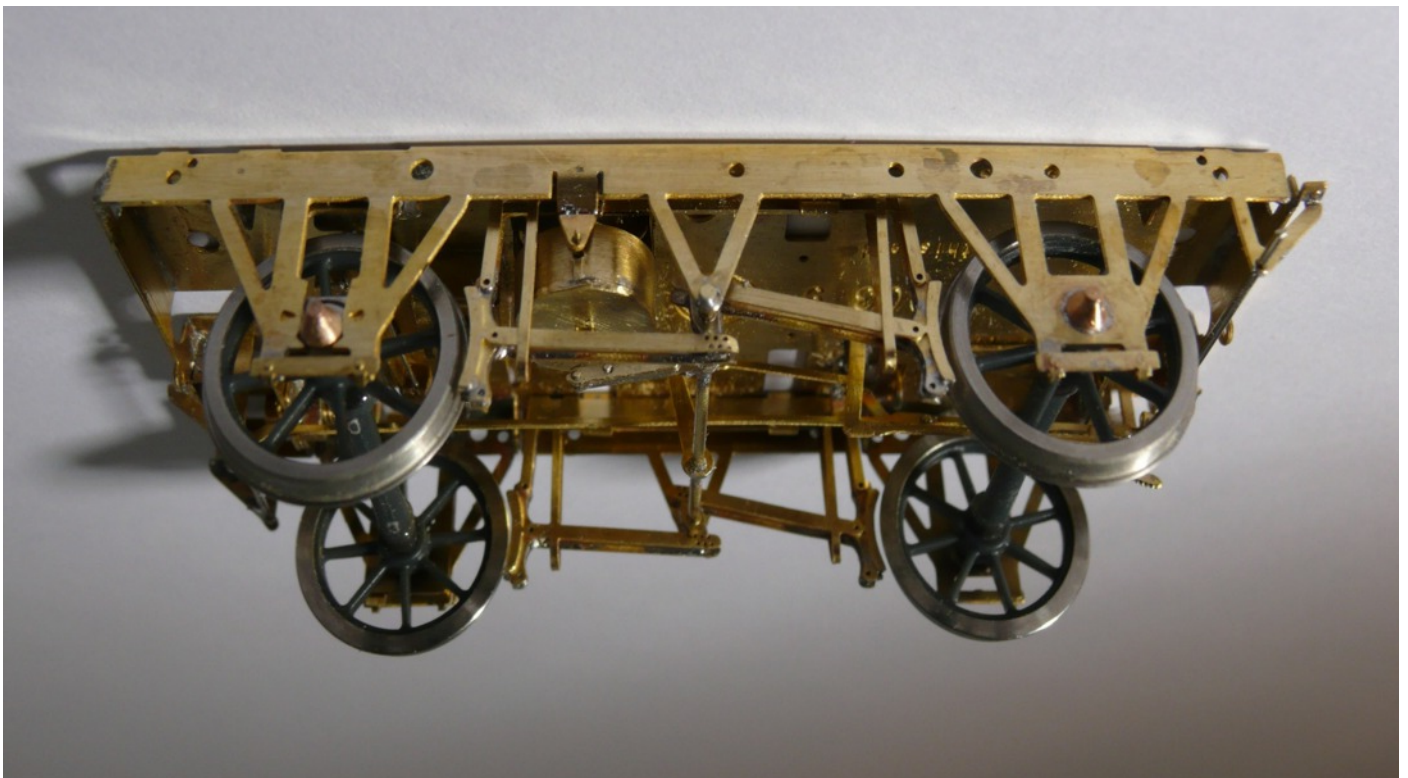
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DC3 vacuum fitted off-set vee set of parts awaiting assembly. Note the fulcrum plate setting jig and finished guitar spring fulcrum plate with the springs cut to length fulcrum plate with the springs cut to length.



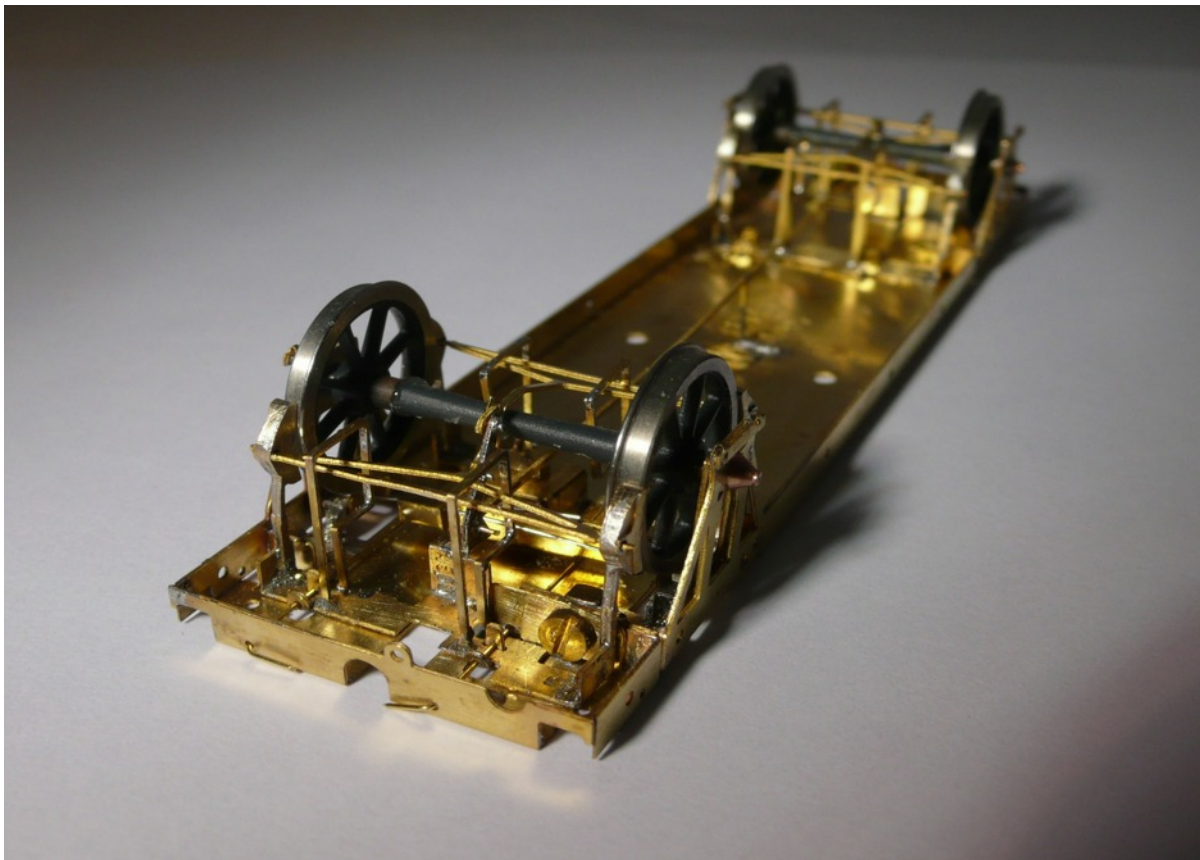
DC3 vacuum fitted with centre vee showing adjustable W-iron



DC3 vacuum fitted with centre vee showing underframe details on the vacuum side. Brake lever on this side has not been fitted as it is set after the solebars and axleboxes/springs from the plastic kit are added. Note the unloaded wheelset below its marks.



AA13 20T Toad clasp braked underframe showing the adjustable W-iron side. The conspicuous sand pipes are yet to be fitted. A bending jig and setting etch is planned to simplify making the sand pipes and fitting them.



AA13 20T Toad underframe showing the end clasp brake detail at the compensated end. Note the 0.3mm keep wires holding the brake modules are still in place. These would be soldered in place at completion to fix the brake modules and the extensions outside the buffer beam then cut away.

Introduction to Great Western Wagon Underframes and Solebars

Underframes

A range of 27 etched brass underframes to enable the fitting of proprietary plastic and metal 4mm kits with accurate and highly detailed brake gear.

Designed primarily for P4 and EM gauges using 26mm pinpoint axles. Standard braked types can also be set up for fine scale 00 gauge provided 26mm pin-point axles are used with EM flanged wheels. The clasp-braked types cannot be used in 00 gauge.

Two adjustable W-irons enable the wheelsets to be inserted WITHOUT bending metal so the wheels can be set without slop.

The compensation is by sensitive transverse guitar string springing at one end – the well established three legged stool principle – for stability.

Two guitar string spring fulcrum plates are provided for different spring rates and can easily be changed over to suit the chosen weight loading. Start with a no.12 guitar string and use the no.11 guitar string for lighter springing, as the alternative. The principle is to fit up the wagon body and underframe with the weight it can actually carry and then adjust the spring rate and buffer height to suit.

Uniquely the ride height is adjustable to bring the buffers to the correct height at the chosen weight loading.

An assembly jig sets the springs in place and allows them to be cut to the correct length.

3' 1½" scale wheels are not supplied. Four waisted pinpoint bearings (Exactoscale 4CW604B or Kean Maygib KM473). Three 10BA x ¼" brass cheesehead bolts and four full nuts will be needed – packs of 10 of each are available at £ 1.20 a pack.

Also needed are 0.3, 0.5 and 0.7mm brass wire for the brake gear, 0.45 brass/nickel silver wire for tie rods and steps, if fitted, and no.12 and no.11 guitar strings.

Solebars

The above underframes use the solebars from the plastic or metal kits but these will need thinning down before affixing to the side of the body. The thinning is a laborious process but it can be speeded up by using a band sander – watch your fingers.

The solebars make this unnecessary. They form into a channel into which slips one of a number of rivet details that carry the rivet details for vacuum fitted or non-fitted and the off-centred Vee of the DC3 underframe. Details like door springs or pin/ratchet handle guides on lever wagons are then attached, a simpler process than with plastic/metal solebars from the kit. The axlebox/springs are removed from the kit's solebars and used with these solebars. The axlebox bumper is formed and attached to the underside of the solebar's channel.

A wide range of numberplates is provided. These start with the numbers on the various wagons depicted in Tourret's GWR Goods Wagons and in other publications, with a number of additions of my choice.

The solebars are located on the underframe sides by 0.5mm wires that are removed after gluing with Araldite. Apart from the S8 Bloater and P19 Python, which are included on those etches, the solebars are separate from the underframes and must be ordered separately.

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Note: All drawings figures 8 to 21, 29, 30 and 32 are 1.25 times 4mm scale, for clarity.

Instructions for the assembly of GW underframes

These etches are designed to simplify the conversion of proprietary plastic GW wagon kits to P4 and EM gauges, to provide them with highly detailed brake gear, compensation and without the need to bend metal to add the wheels or remove them. The standard brake types can also be used with fine scale 00, provided 26mm long axles are used and EM wheels spaced to suit the fine scale 00 gauge. The standard brake etches carry two strips, which when folded up replace the P4/EM fixings for the brake frets. The clasp brakes types **cannot** be used with fine scale 00. The underframe can be dis-assembled for painting before final completion.

Please read these instructions carefully before doing anything

Before constructing any wagon covered by this range of underframes try to seek out photographs of the type that you wish to build to see what the variations are. If you need to build a DC2 cross-cornered vehicle use the DC3 etch, as this is identical. Note however that DC2 china clay wagons were always single ended with the quadrant handles at the non-tip end (see Tourret page 57).

History of GW brakes

The earliest narrow gauge wagon brakes were simple lever one side. The holding down lever had handle guides drilled out for a pin to be inserted as appropriate. It was from this type that signs were erected at the top of inclines saying, "Stop to pin down brakes". These were later replaced by a toothed rack. These brakes operated from one side only.

Iron Minks were only ever single lever although Tourret says that a few were converted to DC3 later.

By the turn of the century as a result of accidents because shunters had often to get to the other side of the wagon, the Board of Trade drew attention to the problem and two sided brakes appeared. The Great Western Manager of the Carriage and Wagon works Mr L.R.Thomas was granted a patent for such a brake in 1897 (page 53 Tourret GW Goods Wagons). I have a drawing of a GW wagon brake of a very similar either-side type, but operated by a ratchet with a 2' long operating handle and a release lever to let off the brake. This drawing is dated 24th May 1901 and is the precursor of the brake Tourret calls DC2.

This is interesting because somewhat later, on 4th December 1902, Mr W.Dean obtained a patent for his brake, which is called Dean Churchward Mark 1 by Tourret. The DC1 brake had a lifting lever between the axlebox and the wheel (see Fig 19 Tourret). The brake block push rods are therefore the reverse of that on all the later designs, a point that a modeller might easily miss.

The DC1 brake could not be used on long or vacuum fitted vehicles and a new design similar to the Thomas and the May 1901 brake (referred to above) was introduced in 1902. Tourret calls this DC2 and states that by 1906 all new four wheeled wagons were DC1 for non-fitted and DC2 for long wheelbase and fitted stock, the brakes being single ended. Tourett (page 55) states that the fitted stock at that time used the carriage type of brake, that is clasp brakes.

I have another drawing dated March 1905 showing these brakes for 9' and 12' wheelbase fitted wagons using the trapezoidal shaped cast coach brake pull frame (as fitted to American bogies), brake shoes on all wheels and with the shorter vacuum lever. These brakes, called clasp brakes, were fitted to Mink A V4 vans and to early W5 Cattle wagons for use on passenger trains at that time. Tourret shows these brakes on a W5 Cattle wagon (plate 506, page 380) and Cheona on a Mica A (plate 62, page 36 Vol2 Cheona Publications). The clasp braked W1 Cattle is available but not the MICA A.

These brakes also fitted to the diagram V9 Mink D's, early Mink C's, the Pythons and the Toad brake vans.

The diagram for the Mink C to V3 shows the short vacuum lever but has the standard two shoe brakes. The diagram for the Mink C to V7 shows clasp brakes and whilst Tourret says that there is no record of V7's having been built, it is clear from photographs that some early V3's were fitted with clasp brakes and that two of these were still around in 1947 and 1949, the numbers being 79112 and 79068 – see Great Western Study Group Pannier No.32.

My November 1906 drawing detailing the cross cornered brake with the longer vacuum lever and offset Vee is what Tourret calls DC3. That drawing has standard two shoe brakes.

About this time DC1 brakes were no longer used on new build and DC3 cross-cornered became the norm. However some vehicles were still built with DC2 until 1910 and later converted to DC3 cross-cornered (see Tourret page 57). These included the DC2 clasp brake types.

Note that DC1 and DC2 originally had a very short brake shaft that was located in the inside by a hanger about 12" away. Many were converted to a through brake shaft with a V hanger on the opposite side but they still had brake blocks only on one side.

DC1 and DC2 non-fitted and vacuum single-ended wagons continued in use until May 1939 when the Ministry of Transport instruction to have all vehicles "right handed" came into effect. Many had been converted to cross-cornered with the addition of DC3 parts long before, but in May 1939 some 3384 single-ended were yet to be converted and were probably scrapped.

DC2 continued to be used for china clay wagons with end tipping doors and brakes both sides.

DC3 was the norm from 1910 until the exemption from the Ministry of Transport ran out in May 1939. One alteration made to DC3 during the First World War when a device called the Hayward adjuster was fitted to make it easier to adjust the brakes.

DC3 was for non-fitted and vacuum fitted wagons. However the V hanger on the vacuum fitted brake was offset by 4", thus upsetting the symmetry of the brake push rods. At some point during the fitting of DC3 brakes the offset Vee hanger was dispensed with. John Lewis's articles in the Great Western Journal refer to this change but no date is given. It is difficult to judge from the Tourret and Cheona photographs of vacuum fitted wagons whether the Vee hanger is off centred. With a good side view it is always very clear because of the uneven push rods. On the 3/4 view photographs it is quite difficult. If the wagon is non-fitted then the Vee is central. My view is that the Vees on all **new** DC3 vacuum fitted wagons from 1910 to the 1930 MOT deadline were offset, but it was the later conversions from DC2 vacuum, which were built with central Vee hangers, that were not offset. Is that the logical explanation or am I wrong?

Another change also took place. The vacuum cylinder in the early DC2 days was offset 13½" and thus had a short operating lever. After November 1906 when DC3 was introduced, the centres were changed to 18¾" and the longer lever can easily be seen in photographs.

By 1930 single lever wagons had to comply with Ministry of Transport regulations and instead of scrapping old wagons, some were fitted with a single brake shoe on the opposite side (Tourret Fig 356 on page 359). It must be noted that in this conversion the brake shaft did not cross the wagon and an additional internal hanger was fitted for the 1930 side. I have a photograph of Iron Mink 11152 taken at Didcot which shows the 1930 modification (it is not visible on the Cheona vol.2 plate 24 photograph of the same Iron Mink as it is taken from the wrong angle, but it is visible in plate 22 on the previous page). Cheona Vol.2 plate 20 shows another Iron Mink 57440 with the 1930 modification.

Obviously not all had a single brake shoe for, whilst Tourret does not comment, he shows a photograph of a 1930 conversion (Tourret plate 497, page 371) with brake blocks on all four wheels. It is clear in that photograph that the operation was independent on each side, as the brake shaft does not join up across the wagon.

The W1 Cattle wagons were originally lever operated from one side and these, if they lasted until the 1930's, had the 1930 modification added. Most W1's were converted to DC3, as were the W5 wagons but a few were DC1; they are not covered by this range of underframes. Some early W5 fitted with clasp brakes were originally DC2, later converted to DC3. The later wider W8 wagons were DC3.

The final development was the introduction of the Morton brake in 1933. The Board of Trade in 1911 had ruled that by 1939 all brakes had to be right-hand either-side brakes, where the brake could only be taken off on the side where applied. The alteration to the single lever wagons in 1930 also met that rule.

Some early Morton's used pinned handle guides but most had ratchet guides. 9' Morton brakes were fitted to 16' and later to 17' 6" long underframes. The underframes of the 10' Morton was only ever 17' 6" overall. All three types are covered by these etches.

The drawings for the Morton brake indicate that the "vacuum cylinder, arms, push rods, brake blocks shown in chain dotted lines, are not required when wagon is fitted with hand brake only." On the drawing this refers to the brake blocks on the near side as notated on these etches. Thus when a hand brake only is fitted, the brake blocks and push rods are on the off side only, that is the side with the clutch. There is a note to this effect on the etch. Looking through Tourret one can see some hand brake versions with what look like brake blocks on all wheels although most are with brake blocks on just one side. A second set of brakes is included for the offside for the vacuum fitted versions.

These notes have been compiled from NRM drawings and from GWR Goods Wagons by Atkins, Beard and Turret and published by Turret Publishing. For more detailed information see GWR Goods wagons, Turret's small books of additional photographs entitled GWR Wagons before 1948 Vol.1 and Vol.2 published by Cheona Publications and the OPC books on GW wagons by J.H.Russell.

The articles in the Great Western Journal by John Lewis on GW vans and open wagons is very relevant; numbers 10 (page 393) through to 14 (page 579) for the modern Minks and numbers 62 (page 355) to 70 (page 353) for the early wooden vans. Opens were covered by numbers 35 (page 140) to 42 (page 115).

Essential modifications made to these wagon underframes

These wagon underframes conform with the various GW drawings and to measurements taken at Didcot, but there are two essential modifications on some vacuum fitted stock. The original vacuum cylinder brakes had a fixed cylinder with the piston moving from the underside. Obviously the piston surfaces were open to the track and were easily worn. From DC3 onwards the vacuum cylinder was self contained but rocked on fulcrum hangers and was set at 18 $\frac{1}{4}$ " centres from the V hanger. Because in these underframes the built up vacuum cylinder is set vertically, the centre has been brought in to 18 $\frac{1}{4}$ " so that the operating lever is of the correct length at 19" and at the correct angle.

On GW wagons the brake (Vee) shaft diameter is 2 $\frac{3}{4}$ " and the cross shaft across the ends is 2". It was not possible to use these at scale diameters without making the Vee, the various rods and links too large to accommodate them. Consequently they have been set at 0.7mm for the cross shaft and 0.5mm for the brake shaft at the ends. If you decide to drill out for and fit 0.9 and 0.6mm then that is your responsibility.

Note. Measurements taken at Didcot and presumably on other preserved railways should not be used without confirmatory data from elsewhere. Didcot told me that their job is to keep the stock running and not concern themselves with underframe authenticity. Mechanical parts are taken from wherever they are found to keep the stock running. I learnt an expensive lesson when I measured the W-irons on several vans at 17 $\frac{1}{2}$ " and assumed that this was the standard GW dimension. W-irons in GW times were 16 $\frac{1}{8}$ " with some slightly wider, so obviously at some point these vans were changed, possibly in BR times. Looking carefully at my photographs showed that to be so. The etches were all changed.

Underframe types covered For line drawings see figures 8 to 21 plus 29, 30 and 32. These are drawn 1.25 times full 4mm scale for clarity. Reduce by 0.8 times to return to 4m scale size

WN4400	9' DC1 and DC1 cross-cornered.
WN4402	Non-reversible brake shoes for DC1
WN4410	9' DC2 non-fitted and vacuum fitted. O13 brakes both sides included
WN4420	9' DC3 non-fitted and vacuum fitted with centre Vee.
WN4430	9' DC3 vacuum fitted with offset Vee.
WN4435	9' DC2 and DC3 vacuum fitted clasp braked Mink A to diagram V4
WN4440	9' Single lever with pin and ratchet lever guides, includes the single brake block 1930 modification.
WN4442	Non-reversible brake shoes for DC2 and Lever
WN4450	9' Morton 16' o/a non-fitted and vacuum fitted, with ratchet lever guides.
WN4455	9' Morton 17' 6" o/a, non-fitted and vacuum fitted with ratchet lever guides.
WN4460	10' Morton 17' 6" o/a non-fitted and vacuum fitted, with ratchet lever guides.
WN4470	11' W1/W5 Cattle lever, DC2 and DC3 non-fitted and vacuum fitted. Lever version included with pin and ratchet lever guides.
WN4472	11' W5 Cattle DC2 and DC3 clasp braked vacuum fitted.

WN4475	11' 6" W8 Cattle DC3 (see later note about using Cooper Craft parts or Dapol C39 kit, said to be W8)
WN4480	12' MINK B/C DC2 and DC3 non-fitted and vacuum fitted.
WN4482	12' MINK B/C DC2 and DC3 clasp braked and vacuum fitted.
WN4490	20' w/b MINK D diagram V9 with clasp brakes DC2 and DC3.
WN4494	18' w/b MINK D to diagram V9 with clasp brakes DC2 and DC3.
WN4497	18' w/b MINK D to diagram V11 with DC2 & DC3 standard brakes.
WN4500	30' MINK G to diagram V22 – DC3
WN4510	FRUIT D to Y11. Morton lever
WN4420	Open C to diagram O8 DC3
WN4530	10' MICA X5/7 16' o/a DC3
WN4540	10' MICA X8 16' o/a Morton
WN4550	12' Felix Pole N27 non-tipping Loco Coal DC3
WN4560	20T AA13 TOAD brake van
WN4560SP	Sand pipe building jig for Toads
WN4570	16T AA3/16 TOAD brake van
WN4580	P19 Python DC3 clasp braked - includes solebars
WN4590	S8 Bloater fish van DC3 – includes solebars

Door springs and flat tie rods are included where needed.

Cattle wagon roof supports

WN4473	Replacement support for top rail of Cooper Craft W1/W5 kit and profile to assist in lowering roof profile. Replacement strapping included.
WN4474	Replacement support for top rail for Cooper Craft W1/W5 when built as W8.

Solebars

WN4600	16' solebars for DC1
WN4610	16' solebars for DC2
WN4620	16' solebars for DC2 and DC3 (skeleton etch – no numbers)
WN4630	Pair of 16' solebars for DC2 and DC3 with 52 numbers for range of wagon types.
WN4640	16' Solebars for Lever wagons like Iron Mink
WN4650	16' Solebars for 9' Morton
WN4655	17' 6" Solebars for 9' Morton
WN4660	17' 6" Solebars for 10' Morton
WN4670	18' 6" Solebars for W1/5

WN4675	18' 6" Solebars for W8
WN4680	21' Solebars for MINK C
WN4720	25' Solebars for Open C
WN4730	16' Solebars for MICA X5/7 and X8

Note: Solebars are included on the etches for the S8 Bloater and P19 Python

Spare parts

WN4800	Pin and ratchet handles guides
WN4810	Set of DC1 to DC3 ratchets
WN4820	Bearing plates
WN4830	Pair of W-irons for standard brakes
WN4835	W-iron for pin /ratchet lever guides, compensated end only
WN4840	Pair of W-irons for clasp brakes
WN4850	Set of assorted brake levers
WN4855	Set of long brake levers for 18 foot underframes like the Mink D's
WN4860	W-iron set for EM to remove the compensation

10BA nuts & bolts

WN4890	Pack of 5 – 10BA x 1/8" CH brass and full nuts
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Dean Churchward variants

If you are building a Dean Churchward braked vehicle, you must decide which variant before you start.

DC1 variants

The original brake was single-ended and to build that version you need to remove the cross shaft end bracket from the other end, leaving the two cross shaft hanger brackets at one end only.

Some later versions were cross-cornered and, if that is the version you are building, you need to remove the non-brake side cross shaft end bracket, leaving the brake-side cross shaft end bracket and the other hanger bracket diagonally in place.

The other decision is whether to use the non-brake side Vee or the press down support hanger near the brake side Vee. Originally these had an internal support hanger but many were converted and a second Vee added on the other side.

Roger Tourret told me that straight lever handles were fitted to one side of DC1, yet his drawings of DC1 cross-cornered are swan necked both ends. The straight lever handle has not been included.

Some of the early DC1 had non-reversible brake shoes and these are available on a separate etch.

DC2 variants

The original DC2 brake was single-ended, non fitted or vacuum. The only decision with the DN4410 etch is whether to use the non-brake side Vee or the press down support hanger near the brake side Vee. The internal support hanger was only used on the early DC2 wagons, most used two Vees, see Tourret p53. Many early wagons were converted and a second Vee added. Some later vehicles were converted to cross-cornered using DC3 parts. If that is what you want to build, then use the DC3 etches.

The O13 China clay wagon used DC2 brakes but this wagon had brakes on both sides and the ratchet was unusually fitted on the off side, whereas all DC2 had the ratchet on the near side. Both Vees used.

Use of the terms "near side" and "off side" are explained in the general construction comments on page 10.

DC3 variants

Because the original vacuum fitted vehicles had the Vee off-centred by 4", there is a separate etch for the vacuum fitted version. Later conversions of DC2 vacuum fitted to DC3 vacuum fitted kept the central Vee those wagons were built with, so those conversions probably never had the Vee offset. The later DC3's built around the 1930s were built with a central Vee.

Other brake types

Lever

Brake blocks on one side only with a half set for the 1930 modification. Use the separate internal hanger as the brake shaft was split, each side being independent. Pin or ratchet lever guides are included. Some of the early lever wagons had non-reversible brake shoes and these are available on a separate etch.

Morton 9' and 10'

Brake blocks are used only on the offside of non-fitted vehicles, that is the clutch side, with pin or ratchet lever guides. However Turret has a few photographs of brakes both sides on non-vacuum stock.

Cattle

The etch for W1/W5 has lever brakes with pin or ratchet lever guides and also DC2 or DC3 brakes. The roof profile should be lowered on the Cooper Craft kit. A separate etch (WN4473) is available to provide a replacement or top rail support (so often broken on the Cooper Craft kit) and a jig to guide one when lowering the roof line for the W1/W5. As the roof strapping will be cut away new strapping is included.

The other etch (WN4474) is to provide top rail support when converting the Cooper Craft W1/W5 kit to W8, using the plain ends and roof from the 8' tall Mink A 1007 kit. According to Russell in the GW wagons plan book, the X-strapping needs to be removed from the ends and replaced by diagonal angle bracing. Most certainly W8 was 5" wider than W1/W5 and the 1007 end will give it the right width. However it is still too high, so cut the buffer beam away, lower the end to the same height as the W1/W5 end and glue the buffer beam back in place.

Dapol still offer the C39 Cattle, said to be a W8. This is the old Airfix kit

Clasp brake types - Mink A to diagram V4, Mink C to V3, W5 Cattle, Mink D's to diagram V9, P19 Python and the Toads.

While the general construction like all underframes is as figure 1, the clasp brake gear is completely different. It is shown in figures 12, 22, 23 and 24 and should be self-explanatory, but see later notes.

It should be noted that the etches carry both DC2 and DC3 cross support end brackets and the appropriate one should be kept, see figure 28. Obviously in the early 1900's the clasp-braked wagons were all DC2 but perhaps by the end of the First World War conversions were gradually made to DC3. Many clasp braked wagons, and in particular the Mink D's, lasted until the end of the GWR and some beyond.

Instructions for the assembly of GW underframes

These instructions are common to all wagon underframes. Where there are differences for the various Dean Churchward types these are discussed above. The underframes have fixed W-irons at one end and independently sprung W-irons at the other. The W-irons on one side are removable to allow the wheels to be added without springing open the W-irons. The wheels can therefore be set up to run freely without any slop. The parts of the underframe obscured by the wheels should be painted or chemi-blackened before wheel assembly but no paint must be applied to the back of the two W-irons where the moveable bearing plates slide. Some brake rods need to be added after the vehicle has been wheeled and partly painted, this being particularly the case with the clasp braked types.

Tie rods, if needed, may be 0.45 mm nickel silver wire or the flat tie rods included on vacuum fitted etches.

Parts needed

Cosmetic solebars and W-iron/axleboxes are provided in the plastic kit to which this underframe is to be fitted or white metal/die cast axleboxes and springs. Buffers and coupling hook/chain. Vacuum pipe hose where fitted.

3' 1½" wagon wheels in P4 or EM, preferably Exactoscale as these have the tapered axles that are quite conspicuous.

0.3mm brass wire for linking brake rods.

0.5mm brass wire for cross shaft and for locating the solebars if they are used.

0.7mm brass wire for brake shaft.

Other Parts required

Three 10BA x 1/8" brass cheesehead bolts and nuts are needed. As these are not easily obtainable, packs of 5 of each are available.

Four KM473 or Exactoscale 4CW 604B bronze waisted/reduced head type of "top-hat" pinpoint bearings around which the design was drawn, are needed.

There are 0.15 and 0.30mm washers on the etch that are used if the top hat pinpoint bearings need to be shimmed. That should not be necessary if the specified waisted/reduced head "top hat" pin point bearings and accurate 26mm long axles are used – see later comment.

Tools and other materials required

Apart from the usual tools the following will be required.

A 22mm long pair of bending bars made up from 19mm (¾") aluminium angle (B&Q) with the edge of one leg chamfered 5° to enable a 90° bend to be made. Without this chamfer you cannot bend to 90°, as the brass will spring back. All of my bending bars have been similarly modified.

However the recent range of Eileen's Emporium "Hold & Fold" bending bars, whilst expensive, are superb and are a must to bend the fine edges of the solebars. I have found that the simple bending bars like those above will not bend the solebars easily or satisfactorily. I bought the 8" to be able to bend the Mink D solebars.

0.35 mm, 0.5mm, 0.7mm drills and 10BA clearance drill (1.7mm).

Small broaches/reamers to open up holes as necessary.

A sharp Stanley knife and a "green" hard plastic cutting board to remove parts from the etch.

No.12 (12 thou) and no.11 (11 thou) guitar strings, preferably from the USA and obtainable from your local music shop.

The usual range of soldering irons. A resistance-soldering unit (RSU) is useful but not necessary.

145° solder and Yellow label phosphoric acid flux. If you use Green label (zinc chloride) flux keep the steel tools, rails and steel wheels well away, **as they will rust**. Wash all work regularly in hot water. Do not use liquid hand soap as that leaves a layer of lanolin, which has to be removed before painting.

Carrs No Cleaning 179° Solder Cream is very useful, but this doesn't flow easily unless you use a little phosphoric acid as an additional flux. 179° Solder cream is particularly useful when using the RSU, in fact that is my preferred method of soldering these wagon underframes. I squeeze out a little of 179° cream on to a discarded piece of etch and transfer the cream with a cocktail stick.

An alternative is Carrs 188° Solder Paint, which it has a zinc chloride flux (again watch rusting of steel wheels and tools) so this paste can be applied more easily and does flow. Regularly wash with hot water.

Notes regarding soldering

If you use 145° then try to carry it on the iron to pre-tin both parts. Alternatively cut a very small piece from the reel, perhaps 1mm or less in length, laying it on the bend line, adding phosphoric flux (yellow label) and then a quick flash

with a hot iron or the RSU. Be very careful using the RSU with phosphoric acid flux, particularly for small parts. It is all too easy to dwell too long with the RSU and overheat the joint. This quickly concentrates the phosphoric acid flux, which becomes very corrosive. It **WILL** quickly and **EASILY EAT** into the bend line of that part so that the part is no longer attached. **BE WARNED.** I find it preferable to use the 188° solder paste or the 179° solder cream for these small parts and then they can be soldered with the RSU without difficulty.

Using the RSU with 145° is not without its dangers. 145° has cadmium as one of its constituents and this solder must **NOT** be overheated as vaporised cadmium can be produced which is lethal if inhaled. I believe that vaporisation takes place at around 600°C and that temperature can easily be reached with an RSU. Eileen's Emporium warn not to exceed 350°C as at 321°C cadmium starts to combine with oxygen. Cadmium boils at 767°C. If you are going to use the RSU with 145°/phosphoric acid flux, then it **MUST** be a quick flash and as soon as the solder flows, **REMOVE** your foot from the foot switch. Otherwise use Carrs 179° solder cream, 188° solder paint or 145° with a hot, preferably temperature-controlled iron.

One further point regarding fluxes. Some modellers these days are using PowerFlux or a similar flux that is intended to be used for soldering 12mm copper pipes for central heating systems. It is my view that this flux is quite unsuitable for building etched brass kits in 4mm. It is far too corrosive and small parts like tabs, brake blocks and parts held by half etched bend lines **MAY** simply break away or fall off when this flux is used. If you use such a flux on these underframes then that is YOUR responsibility. **You have been warned.** Yellow or Green label fluxes are quite capable of doing the job provided the metal has been cleaned but **still** do not over heat Yellow label for the reasons given above.

A technique I recently developed is to apply the solder cream syringe vertically along a bend line to force the solder cream into the bend line. I then clean the solder cream off flush with a kitchen roll leaf. When the bend is made the solder cream is trapped and an RSU run quickly down the seam will solder that seam without much visible sign of solder. Another technique, which is not quite so tidy is to run the solder cream along the bend line after the bend is made and then remove much of the solder cream with a cocktail stick whose end has been 45° chamfered. Finally, for small parts, I tin both surfaces having cleaned with the fibre brass brush, and holding the parts together carry a smidgen of solder on a hot iron to make the joint. That too keeps the solder at the joint to a minimum.

Tom Watson, who tutors at Missenden Abbey, has a technique for soldering with 145° solder, which I find certain. The two parts to be soldered must be cleaned with a fibreglass brush and then a little iso-propanol alcohol to remove the dust and residual grease (lanolin) from the parts. Using phosphoric acid flux lightly tin the joining faces of the two parts with 145°, using a hot iron. Then bring the parts together, holding with aluminium hairclips or other devices, apply a little flux to flood the joint and apply a hot iron. It should not be necessary to apply any more solder, the tinning should be enough.

Preparation of the plastic kit

It may not be appreciated that some plastic kits do not assemble with the W-irons directly opposite each other so the axles will not be at right angles. You cannot just build a body and expect it to fit over these underframes.

The width over the underframe sides is 24.6mm minimum so that some adjustment to the body will probably be necessary. It is therefore recommended that the main underframe structure be completed with wheels temporarily fitted before deciding how to build the body. It may need substantial modification before it can be fitted to the etched underframe.

There are several options:

1. Use the kit's solebar and axleboxes but make sure that the W-irons line up with the etch or cut the W-irons away with a scalpel and glue the axlebox and springs to the etched W-irons. If you do this then take care not to get glue on the bearing plate or the internal face of the compensated W-irons as that will cause the bearing plate to foul up.
2. Use the solebar only, with new white metal cast axleboxes and springs glued to the etched W-irons (same proviso about gluing).
3. Use the new etched solebars (see below).

However if there are brake pin or ratchet lever guides to be fitted and maybe door springs, then these can only be fitted if the plastic solebars are separated from the body. The reason is that these parts come over the solebars from above.

Plastic solebars are glued (I use Araldite Rapid) to the sides making sure that the W-irons of the plastic solebars line up with those on the etch. **The underside of the solebars are set level with the underside of the main body**, this being the **datum** of the underframe. It **will** be necessary to thin down the solebars and the W-irons, see later notes. Some

plastic may have to be removed from the inside of the body sides before they will fit over the solebars. On the adjustable side the solebar should be glued only to the moveable W-irons so that the wheels can be removed and the side adjusted after the fitting of the detailed brake gear.

The body fixing can be by 10BA nuts and bolts to the main body using the holes provided. Alternatively it can be glued in place after the underframe has been completely finished.

A typical plastic body with a wheeled underframe will weigh above 20grams. Additional lead or body load should be added to bring the total weight up to about 40/45 grams. Strips of lead can be added inside the main body section or between the floor and sub-floor and permanently glued in place. With unloaded open wagons this maybe difficult to achieve. Do not use PVA adhesive with lead shot. If you didn't already know it, the lead reacts with the acetic acid in the PVA and the whole expands with time, ripping assemblies apart. Ignore the advice on Eileen's Emporium lead shot labels.

Etched solebars

These are a new introduction and are an alternative to using those provided in a plastic kit. The earlier wagons had a rectangular numberplate to the left side whereas the later heart shaped plate was used with the Morton underframes. Both are provided separately and marks are on the etch, to indicate where they go. The assembly of these is dealt with later. It should be noted that these solebars are to the full wagon length (headstock to headstock) less 2mm. With some plastic wagon kits shortening of the solebar may still be necessary.

Use new white metal cast axleboxes and springs or axleboxes and springs cut from the plastic kit's solebar. The solebar is then built separately and fixed to the underframe later using 0.5mm wires to locate the solebar, 0.5mm holes being provided in the solebar and the sides of the underframe for this purpose.

Pin/ratchet handle guides and door springs are soldered to the solebars through slots in the top of the rivet detail fret making the solebars handed.

The WN4620 skeleton solebar has no numbers.

52 numberplates covering a variety of DC wagon types are included on the WN4630 solebar etch and match the available photographs in the Tourret, Russell or Cheona publications. WN4620 and WN4630 are therefore used together as appropriate. WN4630 carries a pair of solebars.

U-shaped fold-up axlebox bumper stops are provided and these have 0.3mm diameter holes in them to match those in the solebar channel edge to facilitate soldering.

Changes from previous design

The springing system has been changed from torsion bar springing to transverse guitar string springs (no.12 or no.11), with a means of vertical adjustment to take account of wagon weight and spring rate used.

The main body now has slots wide enough to go over the Exactoscale coupling hook and spring. The area around the buffers has been widened so that sprung buffers can be fitted to the wagon body and the body can be lifted away from the underframe and not be integral with it.

New DC brake levers have been designed and the 6" discs are now integral with the brake arm making it easier to assemble.

The underframes have been completely re-drawn and now cover 27 different vehicles. These have new brake frets and rods as the spacing between the brake blocks and the tyres has been tightened by 0.3mm. Whilst the new design appears similar to the previous design, the new brake parts are not interchangeable with the old. The early clasp-braked types have been re-designed to make the assembly much easier.

Springing method

The springing system is now a pair of transverse guitar string springs mounted on a fulcrum plate, which is adjustable so that the buffer height can be set to 3' 5½" (13.8mm rail head to centre) to suit the wagon's weight. The fixed axle at the other end keeps the wagon on an even keel – the three legged stool principle. Two fulcrum plates are included so that two different guitar string springs can be made to help arrive at the best combination of spring and weight: no.12 guitar string being the starting spring with no.11 as an alternative. An assembly jig is provided to make it easy to set up and fix the guitar string springs, and to cut them to length.

The bearing plates are of a self keeping design and they can be easily removed as they rest on top of the guitar springs and are not attached to them.

One end has a pair of W-irons with holes for the pinpoints and the other end a bearing plate carrying pinpoint bearings, which slide inside a slot in the W-irons. These bearing plates are positioned by the guitar string springs and their "ears" are located by two fold-up keeps. There are three touching points, the two rivet heads and the brim of the pinpoint bearing, which is soldered to the outside of the bearing plate.

The W-iron has two triangular marks on the outside showing where the bearing should be when set for the wagon to be level. As this will be covered up by the axlebox at some stage you could extend the marks horizontally with a scriber to maintain the reference.

Remember that the inside of the compensated W-irons and the bearing plates **MUST NOT BE PAINTED**. All other parts obscured by the wheels can be painted or chemi-blacked.

General construction comment

ALL BEND LINES ARE ON THE INSIDE OF THE BEND EXCEPT WHERE OTHERWISE STATED.

ALL ETCHES are marked "near side" and this is the side where the single sided brakes are fitted. When the brakes are fitted both sides then the term "off side" is also used to mark the relevant brake frets. The wagon drawings 21 through to 32 are similarly marked and coincides with the marking on the etches.

I KNOW it goes without saying that all metal to be soldered must be cleaned first. These etches are covered with lanolin or something similar to prevent them from tarnishing. Brian Lewis recommended that a Cleaner/Degreaser be used to remove it. I clean up first using Isopropanol (alcohol – from a good Chemist) and then all surfaces to be soldered are very vigorously cleaned with a fibre glass brush, taking particular care to clean the bend lines. You can then just wipe over with phosphoric acid just before soldering to remove the glass fibre residue; Brian Lewis said that is always a good practice.

Before assembling the main body

Make the two bearing plates now. They are best made first as the slots in the main body and the W-iron are much easier to ease and fettle whilst the metal is in the flat. This means marking each bearing plate and the main body or W-iron in some way, perhaps by scratching with a point so that they can be placed in the same W-iron slots again at final assembly.

Making of bearing plates

The bearing plates are the last part to be fitted before completion of the structural side of the wagon underframe. They simply rest on top of the guitar string springs. There is no physical connection.

First form the rivet heads facing outwards; see Figure 1, using the two rivet "pops". Then fold up and solder the seams to firm up the folds. It may be easier if the first bend is made and the seam soldered first as it will now be stronger and will not distort when the second bend is put in.

Solder the top hat bearing in the recess on the outside of the bearing plate, facing outwards. Remove any solder that lies on the brim of the top hat section where it will lie against the W-iron.

Next file the bottom and sides of the bearing plate to remove the cusp and put a very slight radius on the outer edges and on the two sides that face the W-iron. This is to remove any cusp or sharp edge that might catch when the bearing plate moves vertically under spring action.

The bearing plate is self-keeping and is retained by the widened section at the bottom, which drops behind the "bumps" on the keep plates and by the two "bumps" on the bend of the bearing plate that locates the bearing plate centrally about the inside face of the keep plates. With the wheels fitted the bearing plate should only touch the W-iron at the face of the brim of the top hat of the bearing and at the two rivet heads. The "bumps" should be clear and not touch anything.

The outermost face of the four "bumps" might be finished with a little 300/400 wet and dry to remove any cusp and to keep them free of the adjacent surface when the bearing plate has been wheeled **BUT** try without finishing as the bumps are locations and are not part of the working surface of the bearing plate.

Mark the bearing plates so that they are returned to the **same** W-iron that they were fettled to fit.

Mark the bearing plates so that they are returned to the **same** W-iron that they were fettled to fit.

Next carefully fettle the inside of the W-iron slots in which the pinpoint bearing plate is to run. This slot needs to be just a fraction over 2.0mm wide and parallel so you need to file off just a smidgen and no more. **DO NOT REMOVE THE TRIANGULAR STOPS** at the bottom of the W-iron slots, these have been added to prevent the bearing plate from jamming when it is at the very bottom of the slot and disengaged whilst wheeling.

Test the bearing plate by running the pin point body up and down the slot to see that it runs freely without snagging. The top hat brim of the pinpoint **MUST** be touching the brass of the W-iron when you do this. If it does not bottom then repeat the fettling by removing just a little more metal from the W-iron slots until it bottoms on the brim of the top hat pin-point bearing and the bearing moves smoothly. There must be no snagging and the pinpoint bearing must slide freely. Check also that the bearing plate slides for the full length of the W-iron slot. Run a triangular scraper, Swiss file or 400/600 wet & dry paper along the two edges of this slot and the bottom corners on the pinpoint bearing side to be sure that nothing can snag.

Check again that the bearing plate moves freely in the W-iron slot. It must touch the W-iron only at the two rivets and the top hat of the pin point bearing. It should have a soft silky feel to its movement. Maybe the top hat of the pinpoint, where it touches the W-iron, has a cusp. Remove, as that **WILL** cause graunching.

The bearing plate must be free to move up and down the full length of the slot without any tightness, graunching, catching or restriction and the "bumps" must not be touching any metal.

Check the marking, remove and put to one side. Repeat for the other bearing plate and W-iron.

Assembling the Main body — figures 1 and 1A

First task is to open up certain holes. The DC3 Vacuum fitted etch drawing below shows which holes to be drilled before removing parts from the etch. They are typically the same for all other types.

The centre Vee hanger hole and the centre of the brake gear should be opened out to 0.7mm dia.

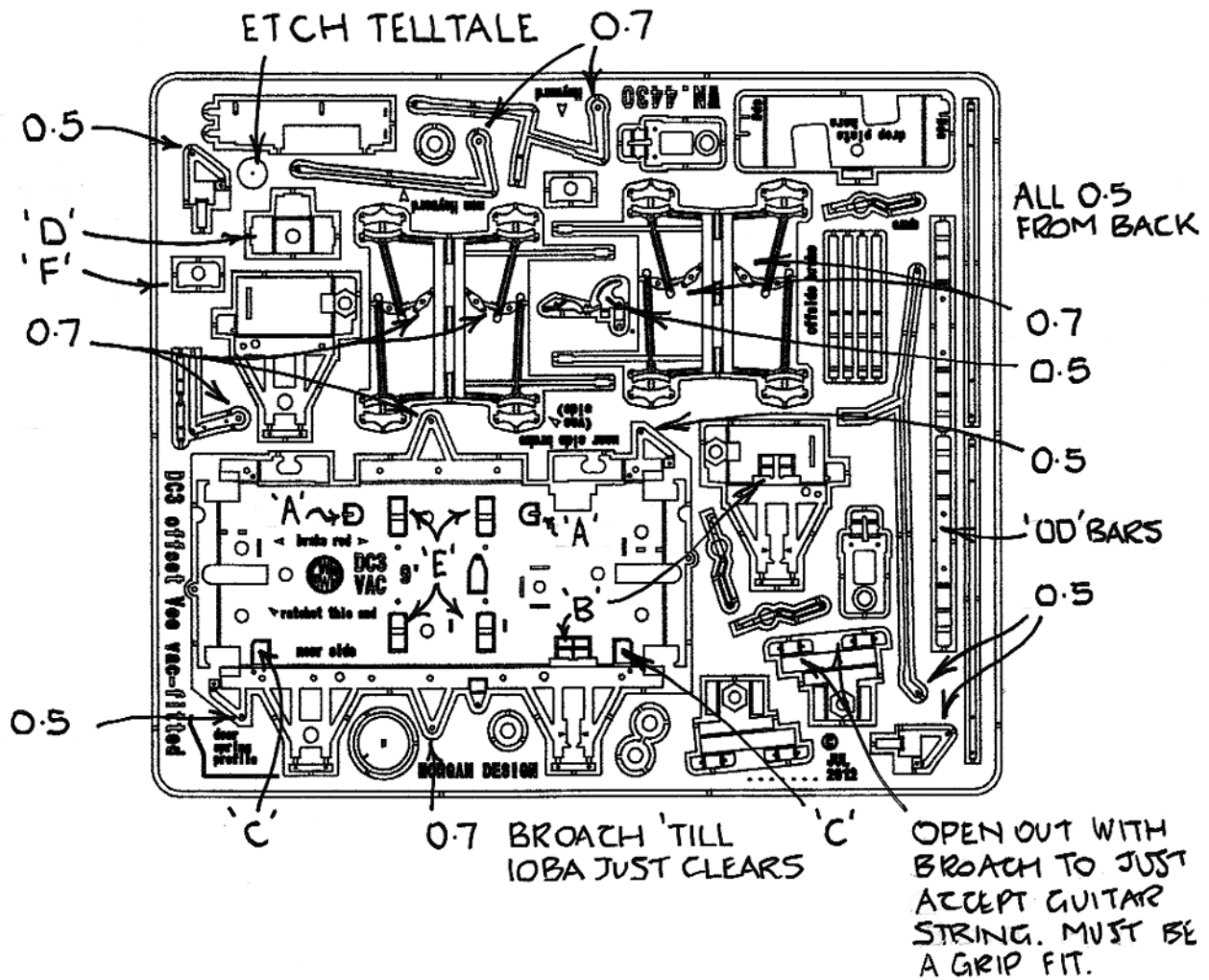
The brake cross rod hangers and intermediate brackets that take the brake cross shaft at the ends will be 0.5mm dia. The associated holes in the brake rods that fit this cross shaft and the larger hole in the ratchet should also be opened out to 0.5mm also. The 0.5mm holes in the brake levers are best drilled from the **back** side of the etch whilst in the flat.

Other holes in various parts of the brake rods, which are not attached to the brake cross shaft, are etched to be 0.3mm so they can be pinned to adjacent parts before soldering. Use fine broach to open to 0.3mm.

On the next page is the drawing of a typical etch showing the holes to be drilled before removing any parts

Space for any notes you may wish to make

A Typical Etch showing the holes to be drilled before removing any parts



The holes for the guitar string springs can be opened out slightly later with a small broach if that proves necessary. The guitar string needs a grip fit so that it cannot slide out when being Araldited.

Lightly broach the hole between the three slots that locates the vertical adjustable part of the springing system so that it just accepts the 10BA bolt thread. This hole locates the bottom of the thread and must not be over-sized as it keeps the bolt vertical. The hole in the adjustment part is etched oversize to ensure that the 10BA bolt sits down properly. That can be dealt with after the part has been fitted.

Remove the main body and the W-irons using a sharp Stanley knife on green cutting board. Remove the holding tags and fettle.

First put in a rivet at each end of the W-iron keeps using the rivet pop mark on the back face and then bend these over so that the rivet is on the front face of the W-iron when bent in position. Apply a little solder cream/paste and a quick flash with the RSU to secure. If you are later fitting W-iron flat ties then cut these keeps away. The ties have rivets on them and they are soldered in place of the keeps later. If you are fitting rod ties then leave the keep plates in place and solder the rod tie behind them using 145° solder.

The compensated W-irons have two arrows indicating the centre of the bearing plate slot. Extend this with a horizontal line using a scribe, as the arrows will become obscured when the axlebox is later glued in place. These are much easier to scribe now rather than later.

Thoroughly clean what will become the outer sides of the underframe and perhaps roughen with dry 300 grade wet and dry to provide a key, as later the solebars will be glued to these faces. The holes in the sides of the underframe are to assist gluing.

Now bend up the body as figure 1. On the earlier Dean Churchward vehicles first rivet the rivet “pop” on the flat part that looks like a step but isn’t, on the ends of the cross shaft hanger bracket but bend this part outwards later after the side has been bent– see lower photograph on figure 7a. Later Dean Churchward vehicles have this cross shaft bracket a little further inboard so this flat part does not exist.

Bend the sides down at right angles using a bending bar, now with one side chamfered so that the 90° bend can be made.

Next bend down the ends using the 22mm long bending bar. Note that the sides are angled 3° to allow the ends to be bent at right angles.

DO NOT SOLDER THE SIDE SEAMS at this time.

Now fold inwards the parts (support tabs) that form the supports for the W-irons. Bend these in at 90° until they drop into their location slots. Because this seam was not soldered it will flex sufficiently for the tabs to drop into their slots. Before soldering hold the support tabs firmly down over the location slots and THEN SOLDER THESE SUPPORT TABS IN PLACE AT THE SLOT END, soldering from the buffer beam side to keep the solder away from the face that takes the W-iron. This is to make sure that the support tabs pull the short sides to a right angle with the main underframe body, and that the face of the support tab is also at right angles to the same. Don’t apply too much pressure as you will distort the tab and twist it. Then solder the outer end of the support tabs and finally down the seams.

Note: On the early versions of the WN4460 10’ Morton the left hand slot for the fold-in tabs is 1mm out of position when looked at with the etch facing you. This has been corrected on the latest versions. Etches with this error have a special note on the etches’ packing, warning of this. The error can be easily put right by filing off the location tab on the left hand fold-in tab and then soldering it in place using a 90° square.

Fold up the two rounded tabs “A” with the central slot, on the adjustable side. These are used with a short length of wire looped around as a keep to prevent the adjustable W-iron from lifting, see later.

Fold up the two small tabs “B” and their right angle strengthening wings that form the keep plates for the bearing plates and set them parallel and square in both planes - solder at the bottom to strengthen.

Fold up the square strengthening plates “C” at the ends of the fixed side and then solder this seam.

Fold the three sides of the vertical adjustment lifting part “D” keeping them square and then set in the three slots on the main body. You could use a longer 10BA bolt and nut to hold it in place vertically whilst soldering. Solder firmly on three sides, keeping the solder on the **outside** only so as not to cause the fulcrum plate to foul when fitted.

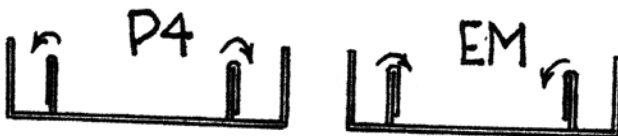
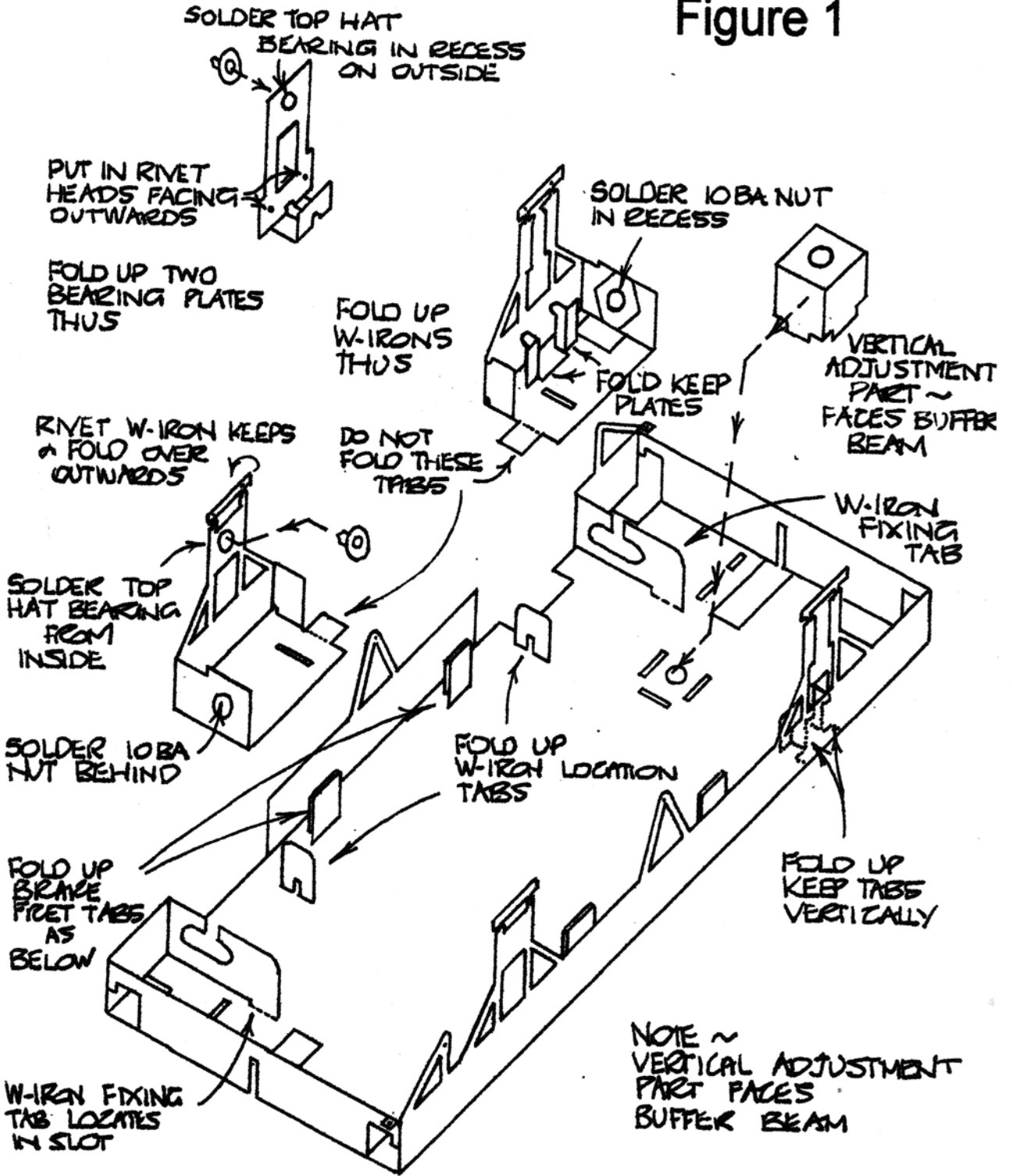
Standard brake gear fret and clasp brake locations

On all wagons except the clasp-braked types, there are two brake gear location tabs “E” either side of the Vee on both sides (except DC1, DC2 and Lever where there is only one pair).

If you are modelling in 00 fine scale then these parts need to be removed and are replaced by folded up flat strips, described later. Clasp braked types **CANNOT** be converted to 00 fine scale neither can the S8 Bloater as these flat strips are not on the etch, due to lack of space.

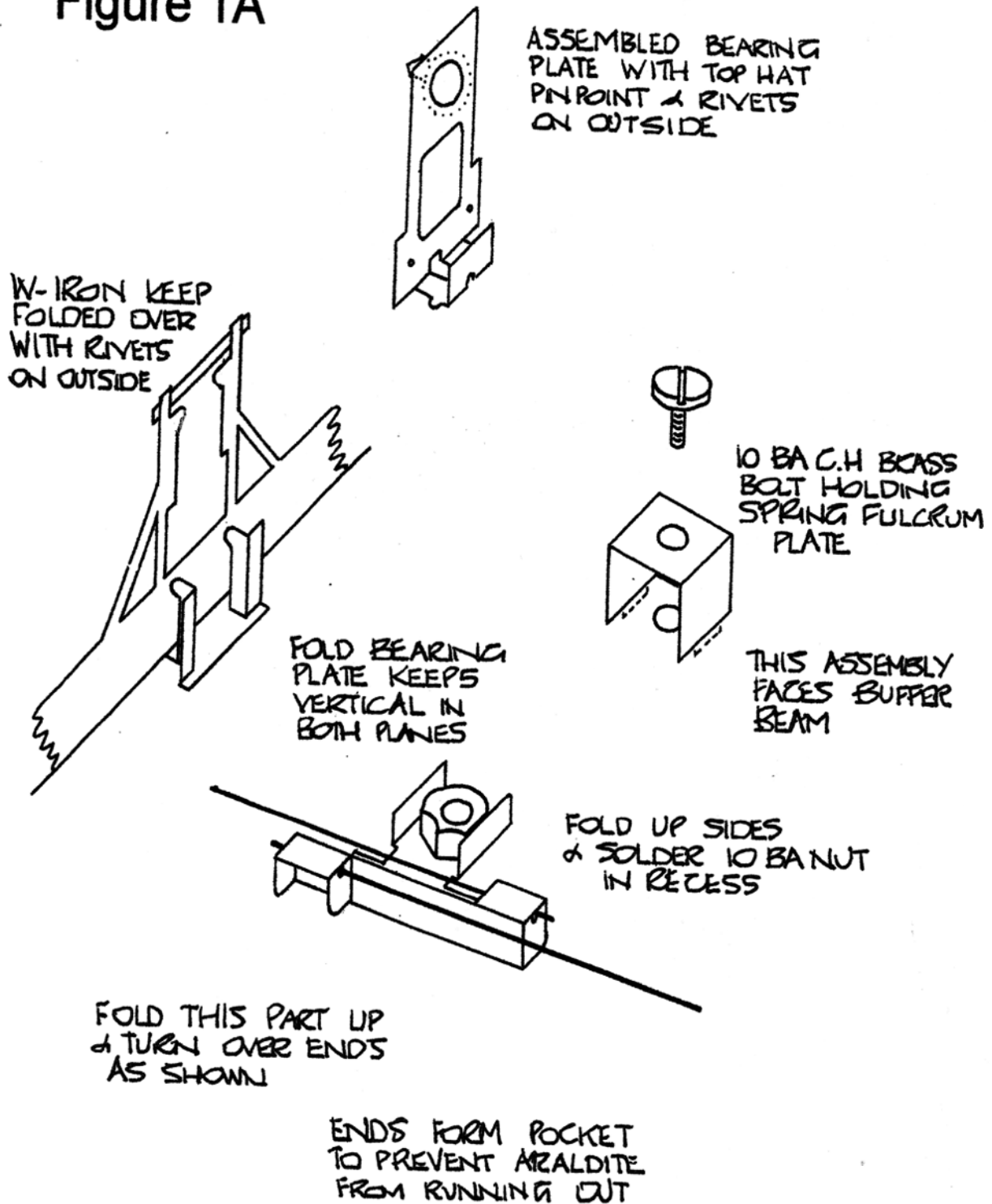
Noting the sketch on figure 1 and the note “E” on page 15, if you are modelling in P4 then fold the second part of the tab outwards. If working in EM then fold the second part of the tab inwards, both doubling back on themselves. Press out only part way from the underside to allow you to get a pair of tweezers and small square nosed pliers to turn the top over either way. It is not really necessary but if you wish, before you close the top, put a smidgen of solder paste between the two parts using a cocktail stick or similar and a smidgen of solder paste at the base bend line. Then close up with pliers and square up vertically with the tweezers and a quick flash with the RSU will solder it. You want no solder on the faces or the outer edges and maybe just a smidgen of solder at the base but not enough to prevent the brake fret from seating properly. I do not solder anything at all as once the brake fret is in place and is held by the brake shaft, everything is stable.

Figure 1



NOTE FOLDING OF BRAKE FRET TABS

Figure 1A



USE ASSEMBLY JIG, BOLTING FULCRUM PLATE
WITH 10 BA BOLT.
INSERT GUITAR STRING SPRINGS OVER LENGTH
THROUGH FINE HOLES & LOCATE OTHER END
IN SLOTS AT END OF SIDES OF JIG.
TURN WHOLE UPSIDE DOWN & GLUE
SPRINGS IN PLACE WITH ARAKDITE.

When the brake is single-sided and if it is a wagon where the second Vee is not being used and will be removed, then fold the inside support down and flash solder at the base. In the case of the 1930 modification a second internal hanger is to be fitted as the brake shaft is split where the brakes are independent of each other.

With the Dean Churchward wagons, remove the unwanted end cross shaft end brackets and Vees to suit the wagon that you are building. Check again before removing these parts. Fit only the needed intermediate cross shaft brackets.

The clasp brake types have pairs of tabs marked "A", "B", "C" and "D" which will later be pushed out to hold the clasp brake frets. They SHOULD NOT be pressed out at this stage as they can be easily flattened doing other work and continual re-bending will break them off.

That completes the work on the main body at this stage.

Assembly of W-irons

Make up the adjustable W-iron (the one with the bearing hole) as the drawing shows.

A 10BA nut has to be soldered in the hexagonal recess in the side. This can be done while in the flat, or after the side has been folded upwards. It is very important that the side when folded is square, that is at right angles to the base and to the W-iron. If it is, then solder the bend line and run a good fillet of solder in the corner. Check that the corner is square and no metal overhangs between the W-iron face and the side. If it does, then file the corner square. The side opposite the hexagonal recess has a further strengthening tab to be folded at right angles.

I prefer to solder the 10BA nut while the W-iron is in the flat. I use two small blobs of 179° solder cream on opposite sides of the recess and holding the nut down with the RSU electrode, flash solder. I then use a 10BA bolt with a paper washer between to hold the nut in place whilst the W-iron is folded up, squared up and all seams then soldered.

Now solder a reduced/waisted head pinpoint bearing to this adjustable W iron. Insert from the **inside** so that the pinpoint bearing is facing outwards. The holes may need opening up just a touch with a tapered broach and then using a 2.5/3.0 mm drill turned by hand remove the cusp produced by the broach to allow the bearing to seat properly.

I use a little 179° solder cream and the RSU, with the electrode held on the top of the bearing to hold it down; only a quick flash to avoid unsoldering the keep plate at the bottom of the W-iron.

Do not fit pinpoint bearings to the fixed W-iron on the main underframe body at this stage. That will be done later, once the bearing plates for the compensated end are made.

Similarly deal with the loose compensated W-iron. Fold up the W-iron and sides at right angles as before in place. Check that the corner has no overhanging metal and that the W-iron face and the sides are square and are both square to the flat base.

Fold up the bearing plate keep tabs and their right-angled strengthening pieces parallel to each other and, when square in both planes, solder at the bottom to strengthen them. Then solder the seams to strengthen the W-iron having soldered the 10BA nut in place. Again you could use my method of soldering the 10BA nut while in the flat, before folding up.

Note: The W-irons with the slots must be finished AFTER the bearing plates have been made.

The W-iron fits over the push up tab ("A" on page 15), which is slotted. The slot is for a looped 0.5mm keep wire should that be necessary to hold that end of the W-iron down. If the W-iron and the support tab folded in on the main body are square then a keep wire should not be necessary.

Fitting bearing spacers if necessary

First add the adjustable compensated W-iron to the underframe body, insert, a rectangular washer ("F" page 15) with the radiused corners uppermost, under the 10BA bolt head. Insert the two bearing plates and a wheel set to see where the adjustable compensated W-iron lies in relation to the sides of the main underframe body. Tighten the 10BA bolt making sure that the wheelset revolves freely. This W-iron should not be proud and should just sit a little inside the sides.

Next put a pinpoint bearing in the hole in the fixed W-iron at the opposite end on the main body and place a wheel set in that position. Note where that adjustable W-iron is in relation to the outer sides of the underframe. It ought to be

just inside the sides and certainly not protruding. Check to see how it compares with the compensated end as they ought to have about the same inset. If there is a considerable difference, then insert a 0.15mm or 0.3mm washer under **that** pin-point bearing to move the wheel set over to equalise the gap. Once you have settled on the need for a spacer, or not, as the case maybe, solder the fixed end pinpoint in place.

Making the fulcrum plates

These bend up with the bend line on the inside of the bend as usual.

The rounded ends in pairs should be folded down to form boxes on either side of the vertical bend as the guitar string spring lies either side of this vertical bend. See Figure 1A. Do not solder the seams to these rounded parts as solder will fill in the very small slot that takes the guitar string spring and it will be very difficult to open up the slot again later.

Solder a 10BA nut into the recess. Clean and chamfer the edges and corners of the section that goes inside the housing so that it will be free to move. Make sure that there is no solder inside, which will prevent the fulcrum plate from moving vertically.

Check that the fulcrum plate fits the three-sided housing already soldered to the main part. It should be a free fit without slop and be free to rise. If it is tight then relieve the sides a little with a file.

Assemble the jig, folding up the ends and the tab at the back. Place the fulcrum plate into the jig and fasten with a 10BA bolt.

Insert two overlength pieces of guitar string into the pairs of holes on the turned down parts, noting that the fit may be a little tight and the slots/holes may need relieving with a fine broach. The guitar string springs should not be slack as they can easily fall out during assembly. The ends of the guitar strings should rest in the slots at the sides of the jig and project out at both ends. If the guitar string has a slight curve then rotate it until the curve lies in a vertical plane and not sideways as that will cause the bearing plate to move sideways and one of the "bumps" on the bearing plate may be forced to touch metal. As both pieces of guitar string will have the same curve then make sure that both curve in the same direction vertically to balance the springs.

Turn the jig over. You can now get access to the two pockets with the guitar string running against the base between the two ends. Glue the guitar string in place with Araldite or other adhesive. You should be liberal with the adhesive as the pocket will prevent the adhesive from running out whilst it is setting. Move each guitar string sideways to pull adhesive into the holes before leaving to set. Give plenty of time to set and when set trim the ends of both guitar string springs flush with the outer face of the jig and cut back the other end close to the "box". After setting remove from the jig and put to one side.

Maybe chemi-black the bearing plates and the inside of the W-iron at this stage but don't paint.

Final assembly

The adjustable and compensated W-irons slip over the single holding down tab and can be held by a short length of 0.5mm wire looped around that tab, if that is deemed necessary.

The rectangular washers placed the correct way round (with radiused corners uppermost) go under the head of the W-iron 10BA bolt to give a clamping action, which will not be present, if the washers are not fitted.

Slackening off the 10BA will give sufficient sideways movement to fit a wheel set.

Make certain that both W-irons sit squarely and parallel with the sides. If there is any overhang at the corner then remove it and flush up the corner. If there is any solder in the join of the holding tab, remove that. Correctly made the W-irons should fit squarely and fit down on the main body part without lifting.

Insert the fulcrum spring carrier into the niche on the vertical lifting part and loosely fix with a 10BA bolt. There is no other fixing for this bolt, as the spring pressure will keep it in place once the bearing plates are in place. The fulcrum spring carrier must be free to move vertically and the edges may need further finishing to achieve this.

Leave the fulcrum plate at the bottom so that the spring pressure is at its weakest and slip the two bearing plates in place. Once the head of the pinpoint bearing is inside the top of the W-iron slot, the bearing plate cannot easily fall out. The bearing plate notch that takes the guitar string spring must indeed pick up the guitar string spring. Do not allow the guitar string spring to lie outside this notch.

Check that the bearing plate/springing is free and moves delicately. If there is still some graunching then it is likely that the guitar string spring is a fraction too long and is catching the inside of the W-iron on the adjustable side as the bearing plate moves. Nip off a very small piece of that guitar string spring to shorten it slightly.

My tests suggest that the two guitar string springs numbers 12 and 11 are the right sizes to use. 10 will be too weak and 13 too strong. These two sizes should, with the vertical adjustment cover wagon weights between 30 and 50 grams, the number 12 string carrying the heavier weight.

The body and the wheels may be removed for painting, but keep the paint clear of the bearing plates and the working faces of the W-irons. If the spring pressure is not correct for the weight that the completed wagon can carry, then by slackening off the 10BA bolts, removing the wheels and bearing plates, the fulcrum plate can be changed over to one with a different spring rate.

Notes regarding the relationship between the adjustable W-irons and the sides

In spite of the testing and shimming that was possibly carried out earlier when the pin-point bearings were soldered in place at the fixed end, you should now note whether the adjustable W-irons do lie close to or flush with the sides and that the shimming, if carried out, was correct. The design gives an overall width over the outside of the underframe of 24.6mm. Using the intended KM473 or Exactoscale waisted/reduced head "top hat" pin point bearings with accurate 26mm long axles, should give the same dimension at both adjustable W-irons and the W-irons should lie close to or flush with the sides when the wheels are set to run freely without sideways slop. They must not lie outside the sides.

Pin-point bearings vary considerably which is why Exactoscale or KM473 are specified as they have been found to be more consistent, but sadly even these are not always perfect in this regard. Axles may also vary in length. If the pinpoints and axles that you use give rise to the adjustable W-irons insetting, then the fixed side **inside** pinpoint will need to be shimmed using the 0.15/0.3 mm washers provided for this possibility. They are unlikely to project outside the sides unless longer axles are used.

If there is a very slight insetting, then the solebar for that side could be thinned accordingly. The reason this is mentioned at this stage is that it is intended that the solebar on the adjustable side is glued only to the adjustable W-irons and not to the remainder of that side. That allows for the adjustable side to be moved or even disassembled should the need arise later.

After compensation is checked and working, where next?

Only when you are satisfied that the compensation is set up correctly and that it and the wheels move freely when the adjustable W-irons are correctly set, should you move on. Leave the wheels in place until you have made up the brake gear frets.

Now make up the brake gear, vac cylinder and other details before finally re-assembling the wagon.

Making the main brake gear — figure 2 (excluding the clasp brakes – see later)

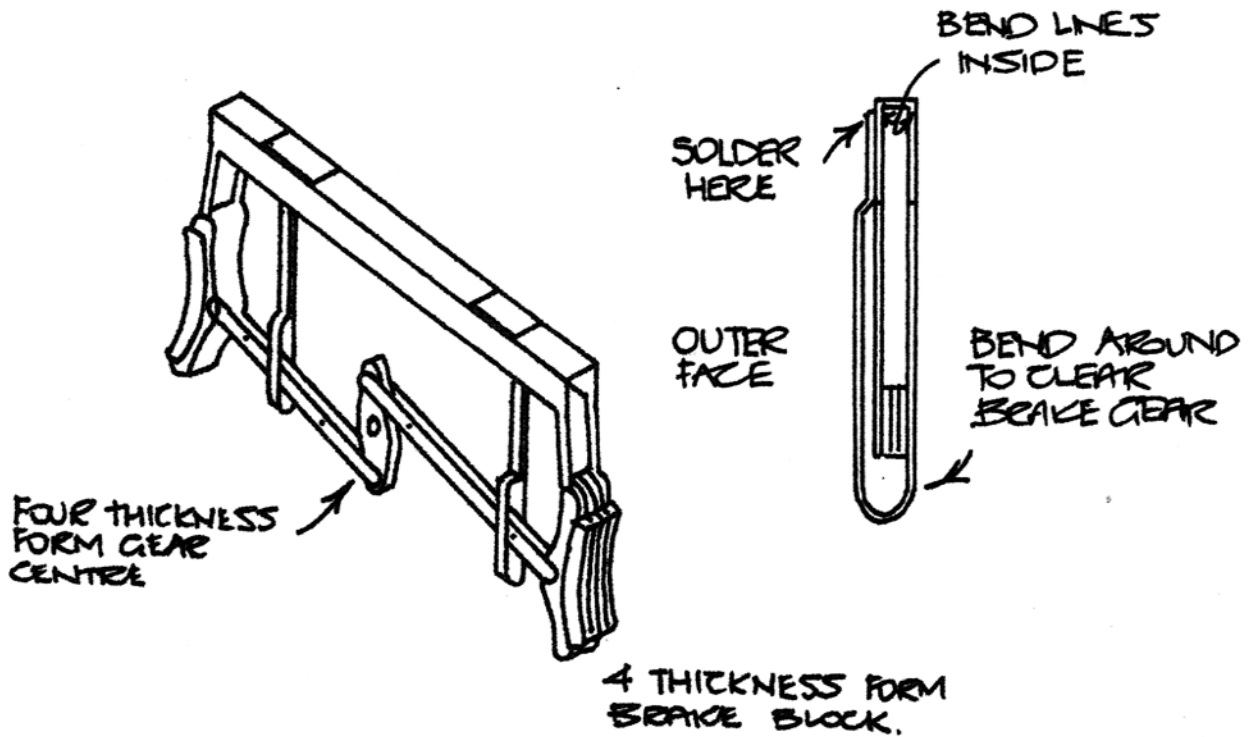
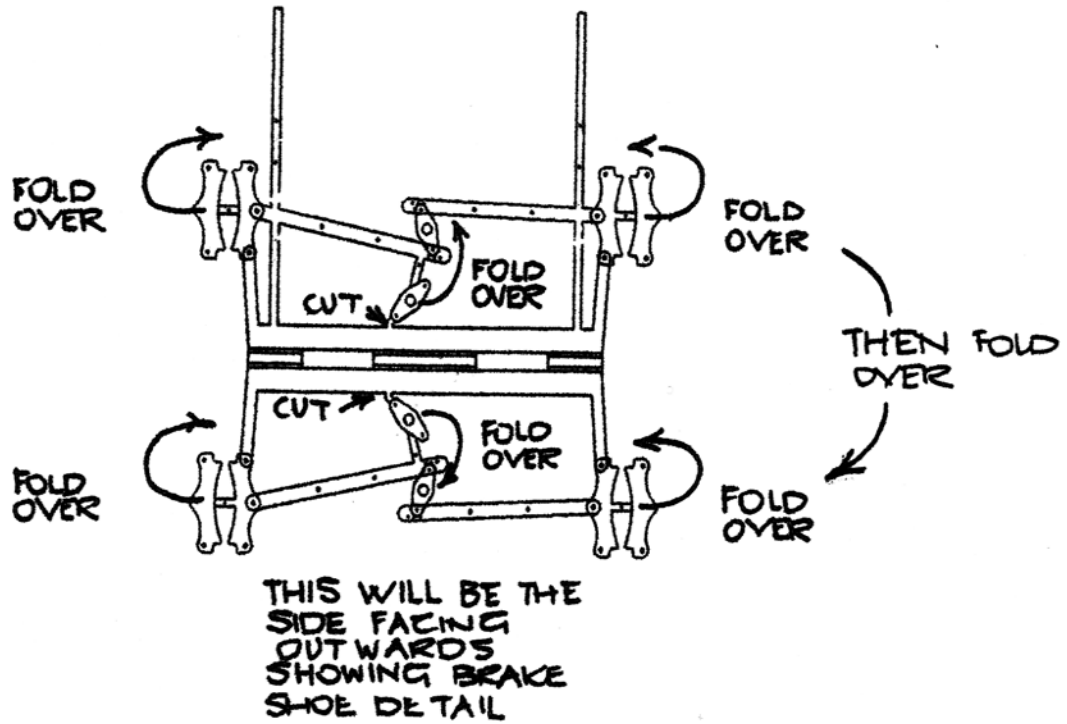
The brake frets on the etch are marked "near side" or "off side" with additional notes if the sides are split into two like the Open C, Mink D to V11 or Mink G. Scratch or colour mark them in some way, perhaps on what will become the outer part of the channel so that you can recognise them again later.

Before you remove the two brake block frets clean up the brake blocks and the central lever on both sides, with a fibreglass brush. You should do no damage while they are still on the fret. Remove them, one at a time noting which side the surrounding frame tells you they are to be fitted. The main body is marked which is the "near side" and in the case of the split sets, from A to D. These frets are quite delicate and need careful handling. Take care to note that the etch facing you is the inside and that turns over to the right to match the line drawings.

There are two ways of approaching the assembly of these frets: tinning the face of the brake blocks and other parts with 145° whilst in the flat, or folding and then soldering using the 179° solder cream or 188° solder paste.

If you are tinning then recognise (see note below) which faces mate together before tinning. With the fret facing you, tin the brake blocks and the lever faces in front of you. Fold over the brake blocks tinned face to tinned face, line up with tweezers and only when lined up solder together.

Figure 2



Note regarding the folding over of the brake blocks

Figure 2 should be obvious. With the etch facing you (detailed side facing you) fold over each pair of brake blocks such that the outer part folds over on top of the part fixed to the fret. Do the same with the central levers that carries the 0.7mm brake shaft.

Note regarding the fold over of brake blocks and other similar parts like the ratchet that has holding tags.

The old etches had a weakening hole half way along the holding tag, which made the fold over easy and accurate. However this method proved to be susceptible to over-etching and has had to be changed to a pair of "vees" either side of the tag, which identifies the bending place. You can see these with a magnifying glass and can identify exactly where the bend has to be made. Once you have identified the bending place, then back off a little with a pair of square nosed pliers and bend up at right angles. The brake blocks or other parts can then be pressed down with the tweezers and the two parts should line up without further adjustment. This note also applies to the clasp brakes.

Carrying on with the assembly

If you are using solder cream or paste, then fold up at right angles, place a smidgen of solder cream or paste with a cocktail stick or small paint brush, complete the folding over, line up if necessary with tweezers and solder with a hot iron or flash with the RSU.

Either way, complete the four brake block halves and then fold over and solder the two central levers.

Now clean the new face of the brake block halves and the central lever with a fibreglass brush and, if you are tinning, tin now the brake block and lever faces that face you, but do not apply too much heat and unsolder the pair. This is one reason why I use the RSU and solder cream as one can hold the whole group together with the electrode.

Now the really tricky bit, folding the two sides up together.

First drill out the centre lever 0.7mm carefully as the solder may have blocked up the hole.

It is not easy to use bending bars because of the double thickness of the brake blocks and centre unless you add a shim to make up for the extra thickness. I have a small vice from a Unimat lathe and that gets used for holding many small parts and for bending them. One way or another make the first bend **without** distorting the fret. Tricky but you must get a 90° bend at the first bend line without distorting the fret. Now run a just little solder on this bend line and solder it without getting solder on the brass either side of the bend line or in the other bend line. This firms up the fret ready to put the other bend in.

Now put in the second bend. Using a stainless steel 6" rule about 1mm in thickness and placing the fret with its back on a metal surface with the new bend line on the edge (I use the base of a 2" square), use the rule to hold down the first completed side firmly while turning over the remainder at the second bend line with a solid chunk of metal (I use the base of a second 2" square). You will now have formed a U - shaped channel at the fret's base. This must be equal on both sides so that the two halves of the brake blocks and the centres meet. If not, square up with small pliers or tweezers taking care not to distort the fret. Using the steel rule inserted in the channel and pressing it down firmly on a steel block will spread the two sides slightly and allow you to see which side needs tweaking to get it all square and meeting properly.

Once you are satisfied that all is square and the two halves meet, then add a little solder paint/cream to the ends of the second bend lines of the channel. Line up the centre by passing a 0.7mm rod through it but remove before soldering. You can now solder the brake blocks and the central lever as one and the channel at the ends. If you are using the RSU do not dwell as you can easily melt the thin fret. It needs to be a very quick flash. Better to use a small hot iron.

When all soldered up, the brake blocks need to be cleaned up and the tabs removed. File the working face of four layer of brake blocks to a smooth radial curve and check that with the wheels still fitted, that they are clear of the tyres by about 0.5mm.

Finally fold up the hangers. These, as the sketch on figure 2 shows, come from the back of the assembly and are folded over below the brake rods in a sweet curve. Line them up front to back and solder to the outside of the channel, cutting away any surplus. Run a file across the bottom of the channel to remove any nibs. The bottom of these hangers take different shapes as the photographs show. Fold up into a simple sweet curve or into squared loops as your choice.

Carefully drill out the centre hole to 0.7mm. They were etched to come out at 0.65mm so that a 0.7mm wire can be used for the brake shaft. Clean up carefully with a fibreglass brush and thoroughly wash with a detergent/old toothbrush/hot water, particularly if you used 188° solder paste. Note earlier remark about not using liquid hand soap because of the lanolin that will be left. Mark with a masking tape label or some other means, which brake fret this is, near or offside, or colour code in some way.

Repeat for the other side.

These whole assemblies drop over the doubled back tabs (“E”) on the base (page 15), either side of the Vee. The main body is marked “near side”. Hopefully you marked the brake frets to identify them from the markings on the main etch. The brake frets do not need fixing down – see later. Note that on a DC3 Vac the brake push rods are offset. On a DC1 underframe the brake rods are the **reverse** of what is normal.

These brake frets are rather delicate but they can be strengthened. The space between the brake push rods are sometimes filled with timber and through bolted. It maybe is worthwhile inserting a strip of 0.3mm Plasticard and gluing it to represent this. The timber was usually level with the top and short of the ends.

The wheels could now be dropped out by slackening off the 10BA bolts. Re-tighten to prevent any damage. The bearing plates are self-keeping with the wheels in place, but taking out the wheels will let the bearing plates drop out. Hopefully you marked them so that they can be refitted to the matching W-iron?

The brake frets should now be put to one side (suitably marked to indicate “near or offside”) until you have finished other details and made and trial fitted a body. However if you are also fitting a vacuum cylinder then that side must be fitted **before** the vacuum cylinder is finally fitted.

When you come to fit these brake frets later they do not need soldering or gluing for, so long as the base channels are properly down and touching the main body, then as soon as a 0.7mm wire is fed through the Veas (or Vee and close support) the brake frets become trapped.

Making the Vacuum Cylinder – figure 4b

Another tricky part is made easier by leaving the circular part on the etch and removing the cylinder after soldering. Take the half etch body and roll it on your knee using a 5/6mm dia. rod. Continue on a hard surface to get it to roll around so that the two tabs and the slot section, when bent at 45°, allow the tabs to be inserted in the slots. Fold over the tabs to secure the cylinder and then tack solder the tabs and re-roll to get a nice circular cylinder. When satisfied solder the seam properly.

Place the cylinder on top of the circular part as figure 4b, with the slot mark on the circular part lined up with the seam. When concentric, tack solder, being careful not to unsolder the cylinder. If satisfied then run solder cream around the inside where the cylinder meets the base and use just sufficient heat so as not to unsolder the rest. Tricky. The base plate is a little over size and after soldering needs filing back flush with the cylinder and then the edges taken off and slightly rounded. Maybe use high temperature solder for the cylinder seam. When complete check that the whole sits in the slots on the main body. Try a fit with the brake fret in place. If you are working in EM then you may need to cut part of the upper section away to get it to fit. I know from the design drawings that the EM version is tight.

The small operating lever usually has two half etch parts that fit as shown in figure 4b. The two outer holes are etched to 0.3mm so that a 0.3mm wire can be used to locate both sides before soldering and the main hole drilled 0.7mm after soldering.

Note that the notch in half the cylinder goes over the brake fret channel and thus traps the brake fret.

Once you have tried a fit, PUT THE VACUUM CYLINDER AND OPERATING LEVER TO ONE SIDE.
DO NOT FIT NOW.

If you are building a clasp-braked wagon, **DO NOT** fit the vacuum cylinder until you have fitted the truss on the vacuum side.

Completing the DC brake gear — figures 1, 3, 5, 6, 7, 7a and 7b

Note that some of the early DC cross shaft intermediate brackets have a rivet “pop” to be riveted. Do this first. This small plate bends outwards in all cases at solebar/buffer beam level. The lower photograph in figure 7a shows how these brackets are bent and figure 1 shows how they are fitted. Then fold out the fixing leg and locate them in the

appropriate slots. They should have been previously drilled 0.5mm dia. Solder to the main body and to the end of the wagon to strengthen the bracket

Also fold out the small plate on the cross shaft end bracket on the main body also bends outwards as the lower photograph shows in figure 7a.

Make up the ratchet plate trapping a piece of 0.3mm wire with a 90° bend to form the horizontal spigot as the figures 7, 7a and 7b show. Solder the ratchet squarely in middle of a 55mm length of 0.5mm brass wire – see photograph and sketch on figure 7. It is much easier to handle once soldered to the 0.5mm brass wire. Insert this assembly between the cross shaft end brackets in the position shown in the photograph in figures 7a and 7b and the figure appropriate to the type of brake gear being fitted. Leave the 0.5m wire projecting from either side. Do not solder the wire at this time but tape ends to prevent it slipping out while other work is carried out.

This ratchet lies close to the intermediate cross shaft bracket and on the inside of it. Note from the photographs which way round the ratchet goes.

Fold up brake levers – figure 3

Fold up the brake levers as indicated on figure 3. You should have drilled them 0.5mm from the back originally (page 15). There are bend lines on the levers to show where the bends are. The first bend is **not** on the inside as my convention but is on the **outside** – see lower photograph on figure 7a. Solder the bends to secure them. Bend back the remainder of the arm to form the handle, secure the bends with a smidgen of solder.

Making pin or ratchet handle guides and Morton brake levers – figure 4 and 4a

The **pin handle** guide was typical of early single lever brakes whereas Morton used the **ratchet handle** guide except in the early days (see *GWR Goods Wagons* - Atkins, Beard and Tourret). Note that the Morton non-fitted have brake blocks only on the offside of the wagon, that is the side with the clutch. Tourret has however photographs with brake blocks on both sides on some non-fitted so check the photographs of the wagon being built.

Fold up either handle guide as figures 4 and 4a. They are delicate and need to be soldered at each bend as they are built, to get strength into them. Figure 4 says “bend holes” but they are “pop” marks on one side only. There is a slot at the edge of an adjustable W-iron and on the W-iron diagonally opposite on the main body, to locate the pin/ratchet handle guide – see Figure 1. Fold over the top section at right angles after fitting plastic solebars (suitably notched). If using the etched solebars then there are slots at the top of the solebar through which the right-angled tail goes and is soldered at the back. Twist the support strap to the W-iron at one end and half twist back at the other end or leave strut flat. Solder later.

First task is to form stop for etched solebar or cut away tab when using plastic solebar, then work from Figure 4.

Form up the Morton **brake levers** to the profile on the etch. You should have drilled them 0.7mm. Solder the bends to strengthen the levers. Fold over the “washers” to the outside of the brake lever to form the distinctive boss. Note which lever goes where. The lever with the cam goes on the offside.

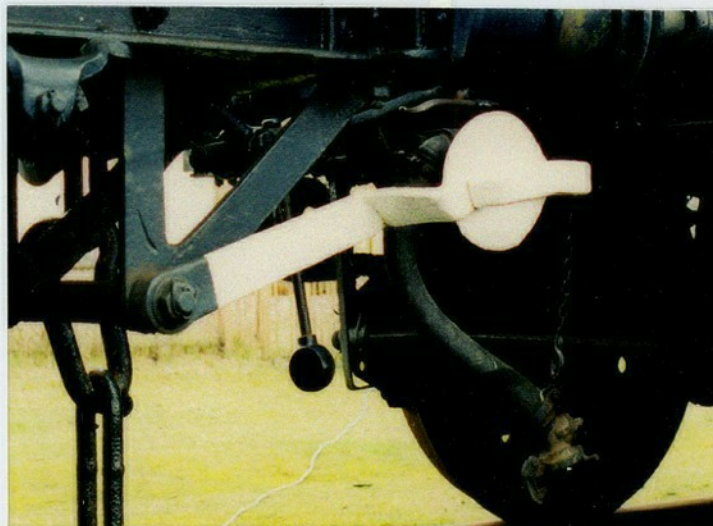
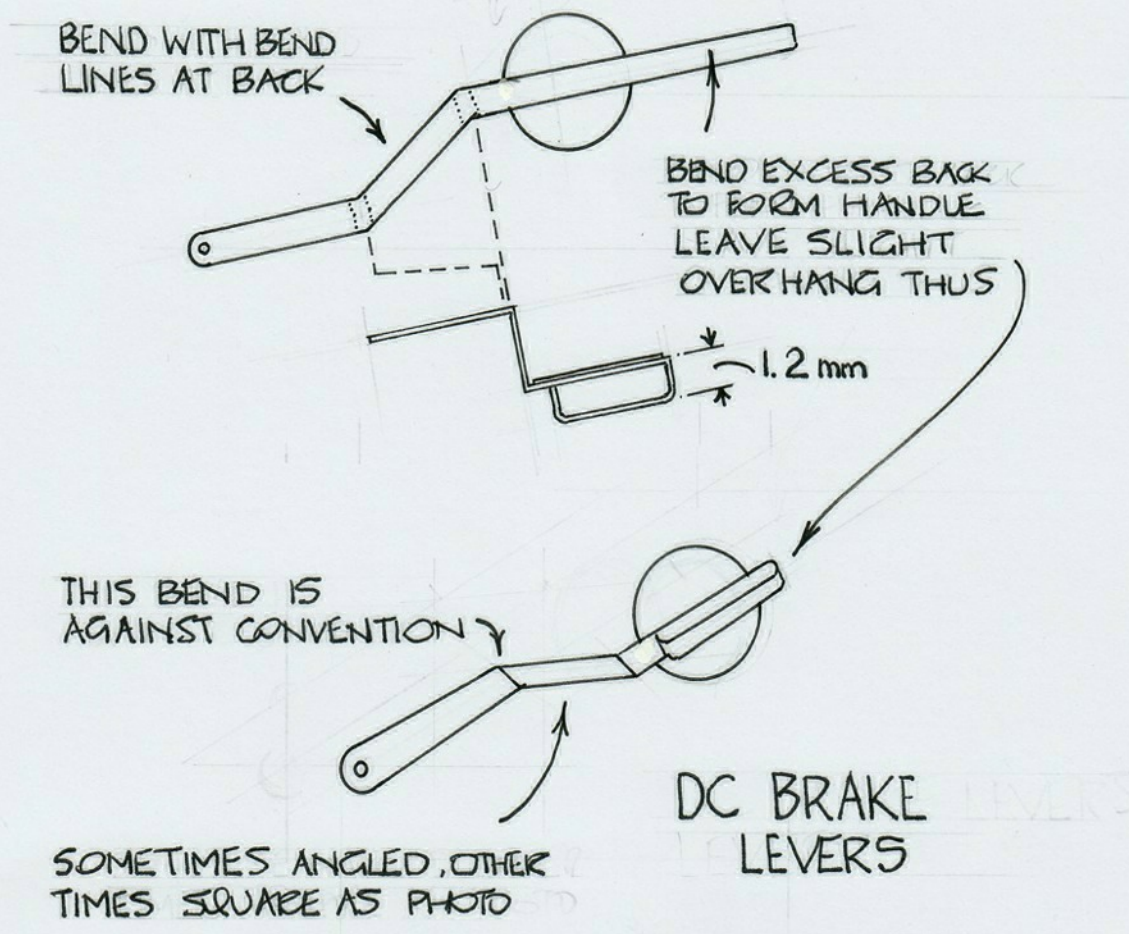
Assembly of the Brake gear in general — figures 2, 5 to 21 plus 27, 28 and 32.

Note: The brake rods on each etch are marked to avoid confusion about where they go. As all drawings are printed 1.25 times full size (4mm scale) the brake rods cannot be laid on directly to see where they go. In most cases it should be obvious. The brake rods were actually produced from these line drawings, so they fit exactly when in the right place. As stated previously the main body is marked “near side” at the left end when the etch is facing you and lying on the bench. In other words it is upside down. When it is turned over to the right, the “near side” marking will then match the “near side” note on the line drawings.

The main brake shaft is 0.7mm dia. brass. If single lever one-side is fitted, either use the other Vee plate or bend down inside cross shaft support. Consult photographs to see whether the other Vee is used. If not then remove it. However, in the case of the 1930 mod, **do not** remove the other Vee but add the extra internal hanger remembering that the brake shaft is split. It does not go right across.

Drop the brake frets over the tabs on the main body, press down so that they bottom. If vacuum fitted, fit the vacuum cylinder now, locating the tabs in the slots in the main body, running a 0.3mm wire through the trunnion brackets and the cylinder. Open up the hole next to the seam on the cylinder, as this will make it easier to pass the 0.3mm wire through the inner trunnion bracket. The vacuum cylinder may need a little metal removed to get it to fit over the channel of the brake fret. (Text continues on page 39)

Figure 3



FIRST. FORM STOP FOR ETCHED SOLEBAR OR CUT AWAY TAB WHEN USING PLASTIC SOLEBAR

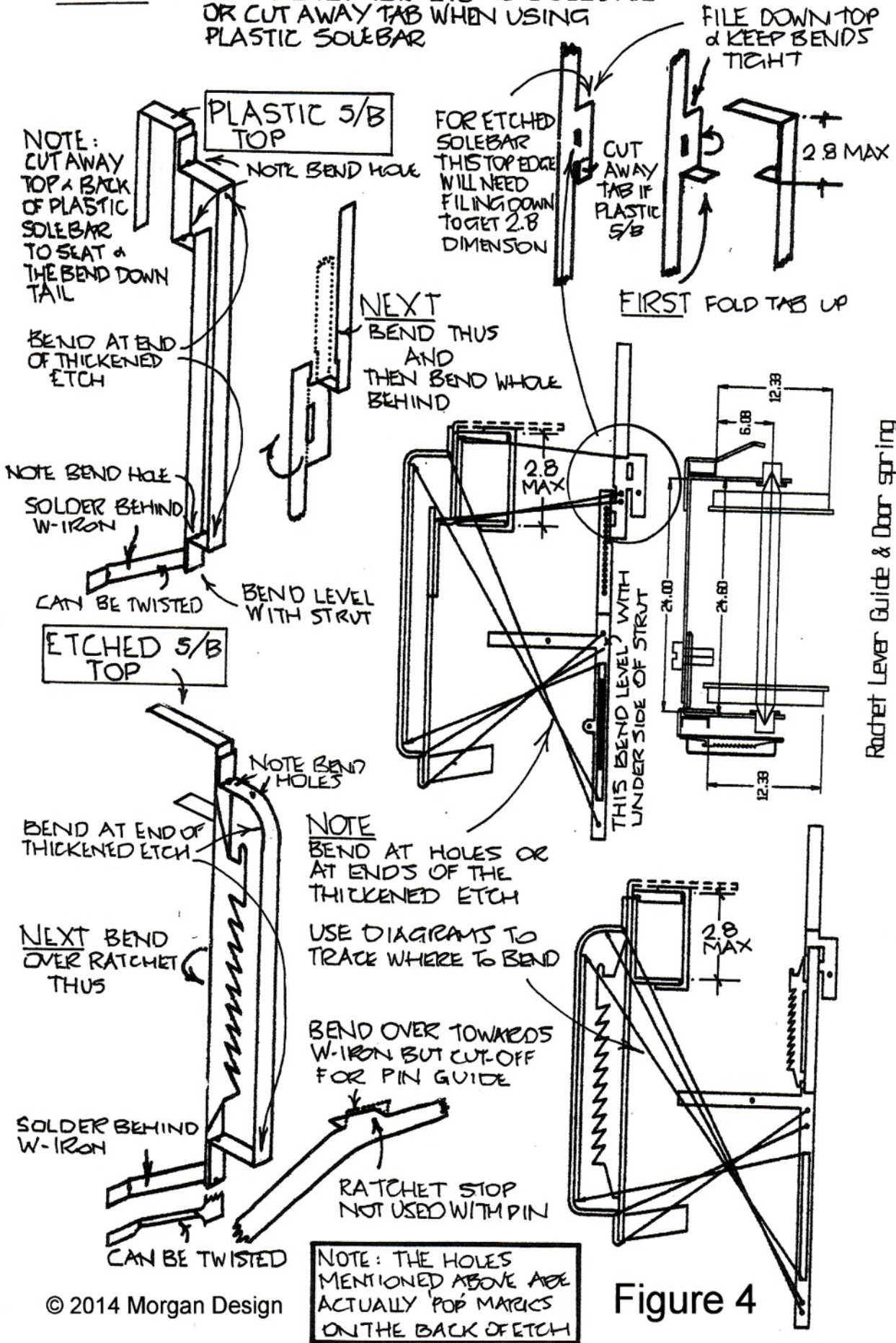
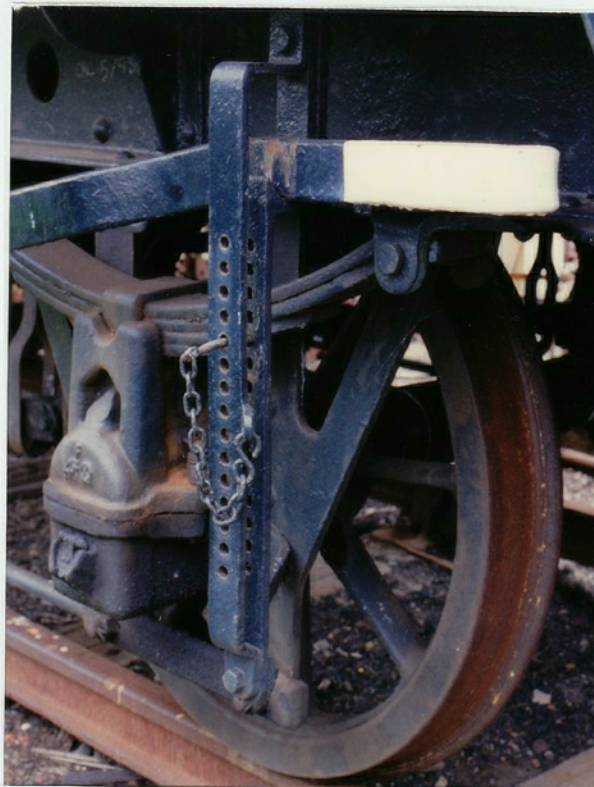


Figure 4

Figure 4a



Pin lever guide



Ratchet lever guide

Figure 4b

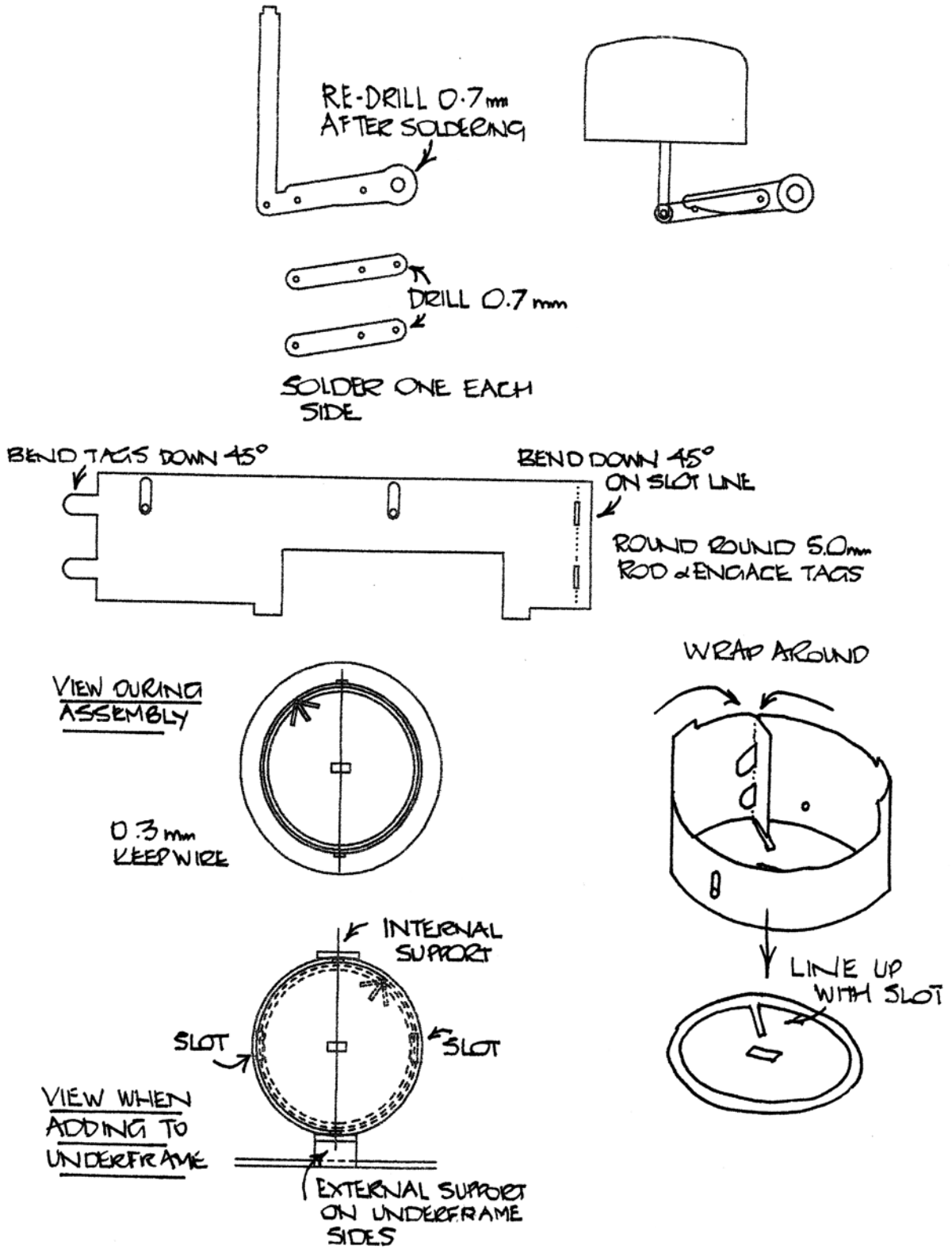


Figure 5

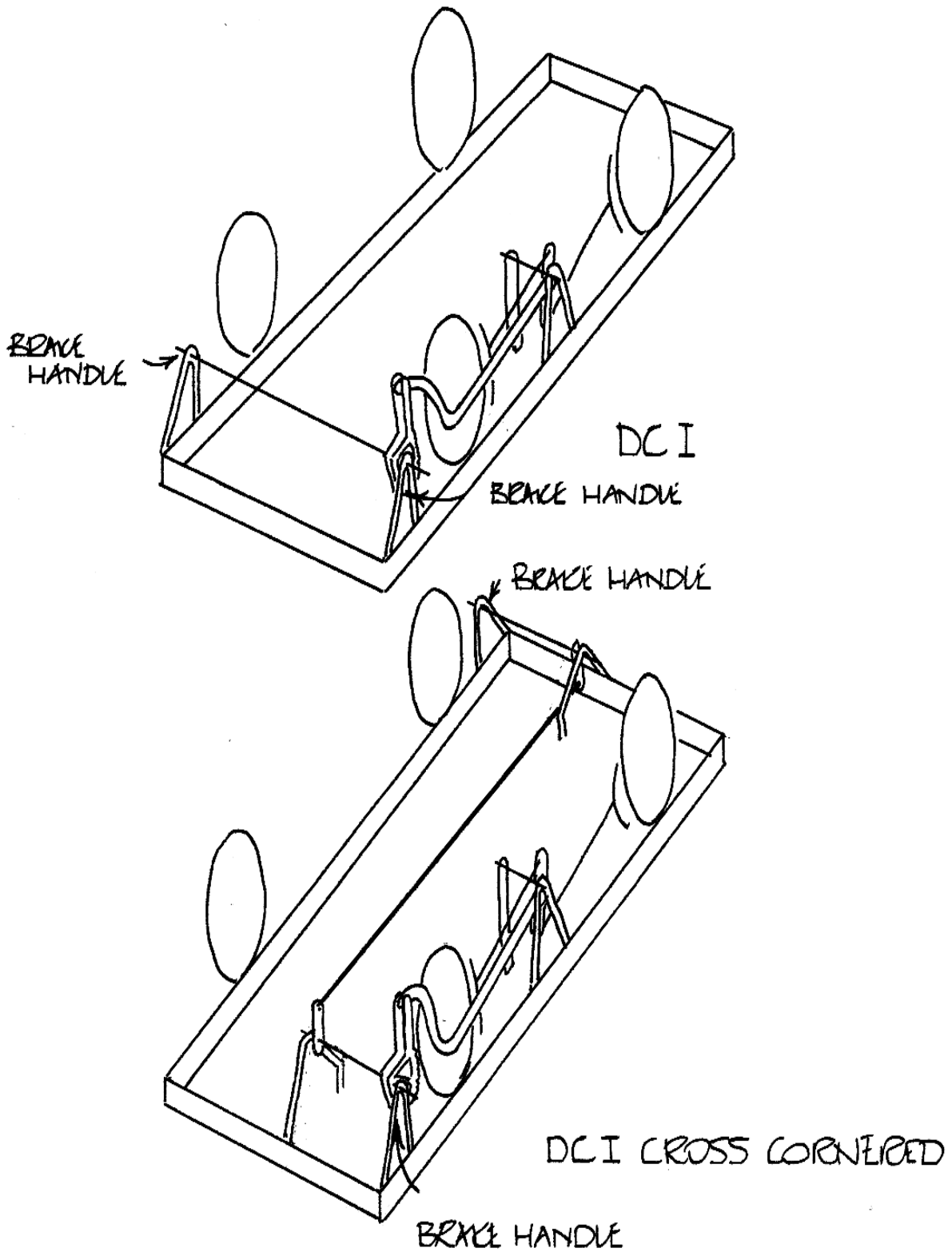
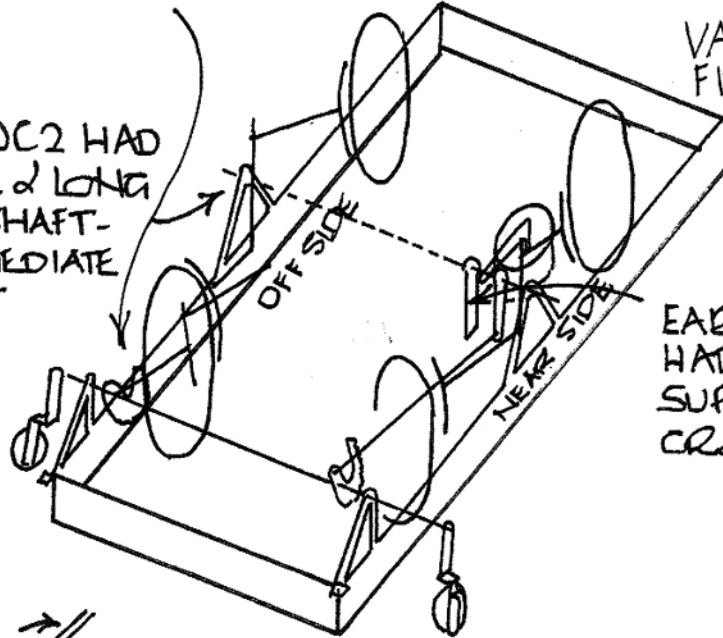


Figure 6

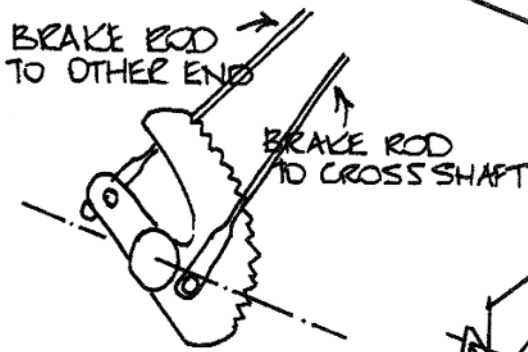
013 CHINA CLAY
BRAKES BOTH SIDES
& RATCHET ON OFF SIDE

LATER DC2 HAD
THIS VEE & LONG
CROSS SHAFT-
NO INTERMEDIATE
SUPPORT



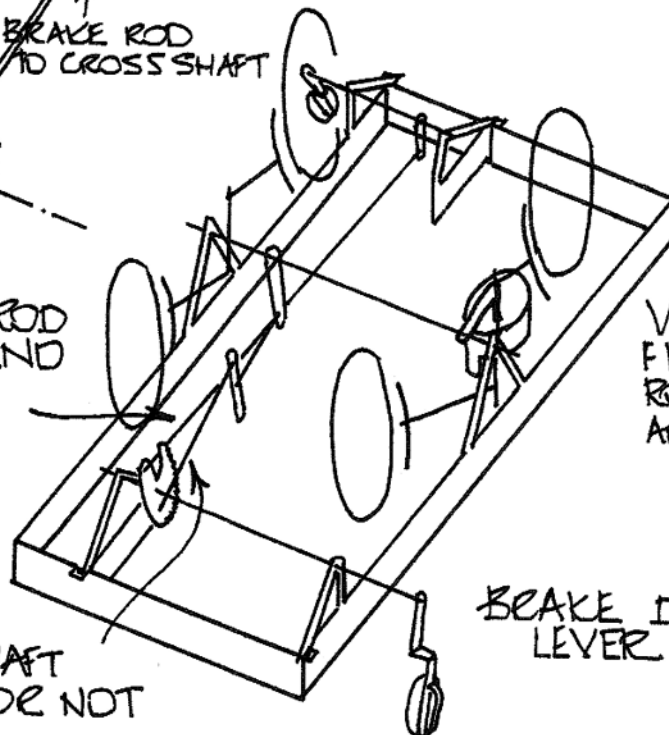
VAC. CYLINDER
FITTED AFTER PUSH
RODS & BRAKES
ARE FITTED

EARLY DC2
HAD INTERNAL
SUPPORT & SHORT
CROSS SHAFT



DC 2

NOTE BRAKE ROD
TO OPPOSITE END
IS WHEEL SIDE
OF RACHET



VAC. CYLINDER
FITTED AFTER PUSH
RODS & BRAKES
ARE FITTED

BRAKE ROD
TO CROSS SHAFT
VIA HAYWARD DE NOT

BRAKE DISC &
LEVER

NOTE OFF CENTRED 'VEE'
ON VACUUM VERSION

DC 3

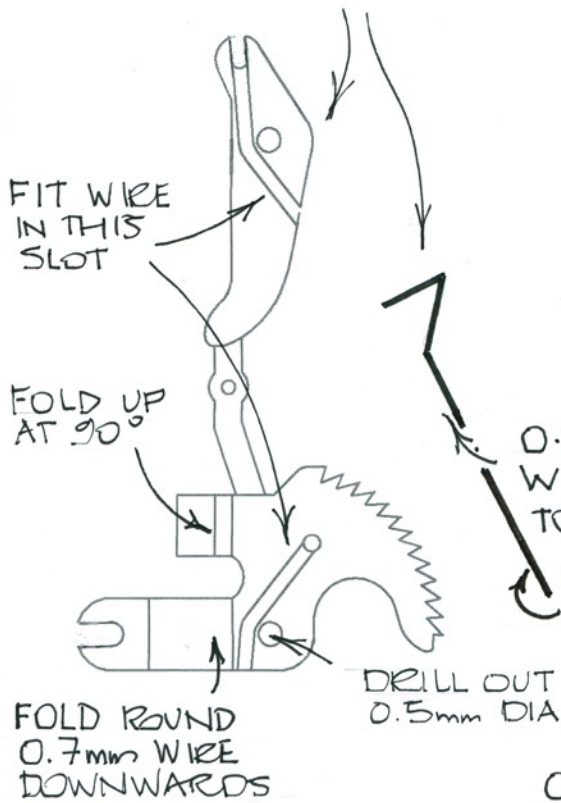
Figure 7

DC3 Operating ratchet viewed from outside of the wagon looking across to the other wheel

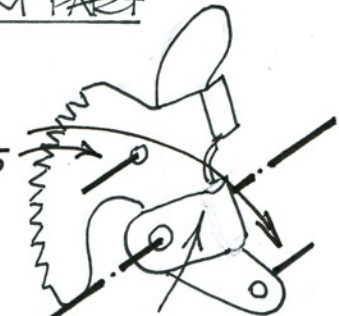


DC 2 SIMILAR BUT WITHOUT BOTTOM PART

FOLD OVER TRAPPING 0.3mm DIA WIRE SHAPED THUS



0.3mm SPIGOTS



0.3mm DIA WIRE SHAPED TO FIT SLOT

BEND TAIL INTO SLOT

DRILL OUT 0.5mm DIA

0.5mm DIA CROSS SHAFT

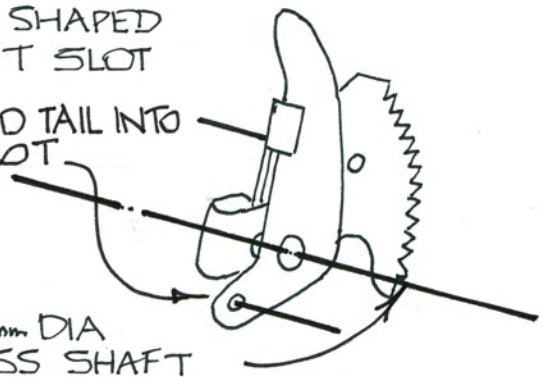
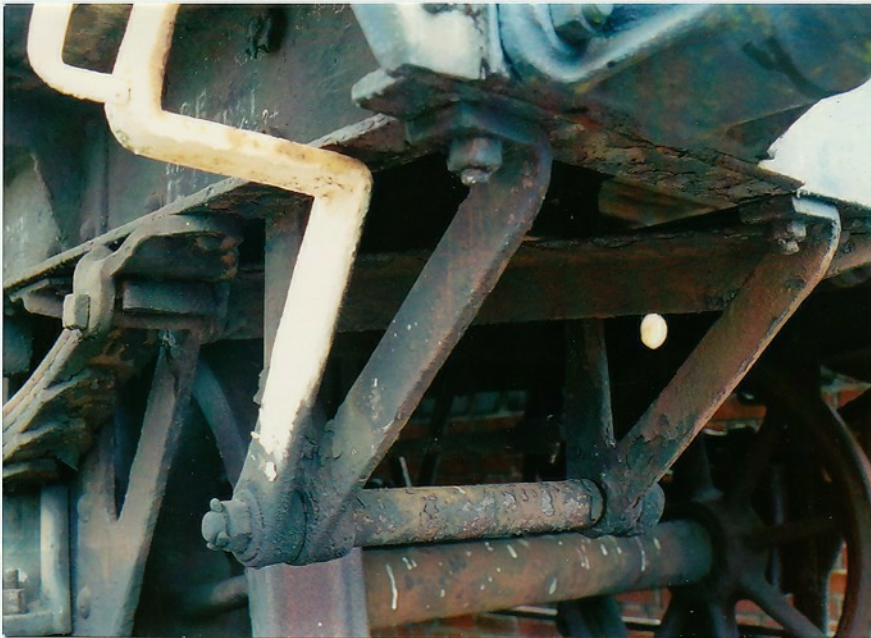


Figure 7a



DC3 Ratchet from slightly towards Vee

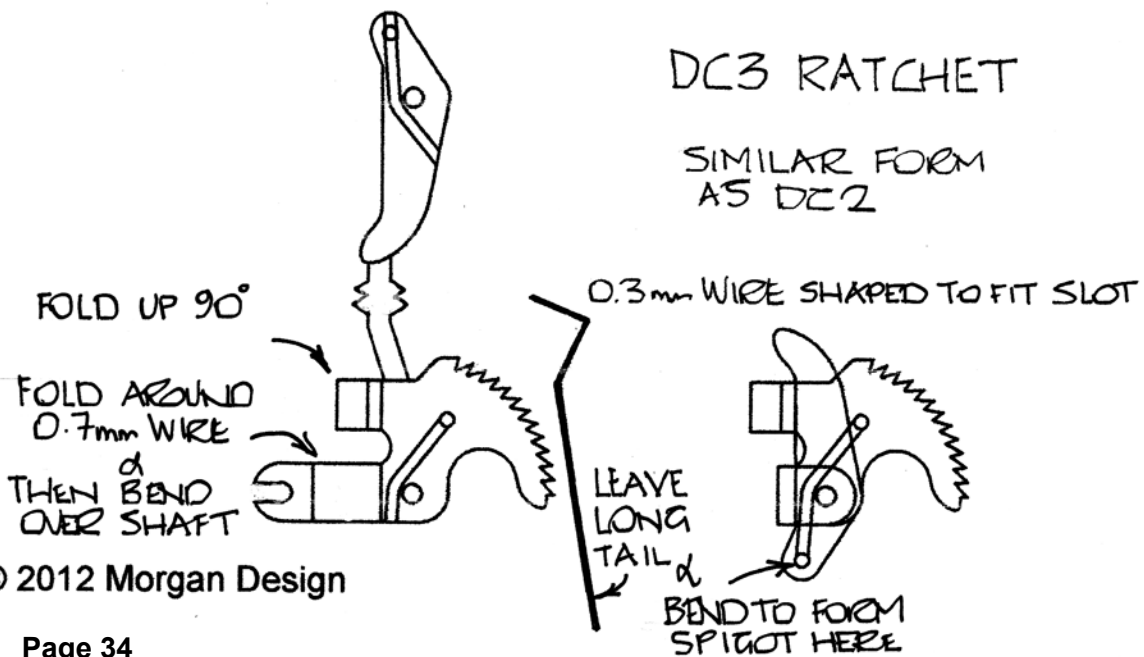
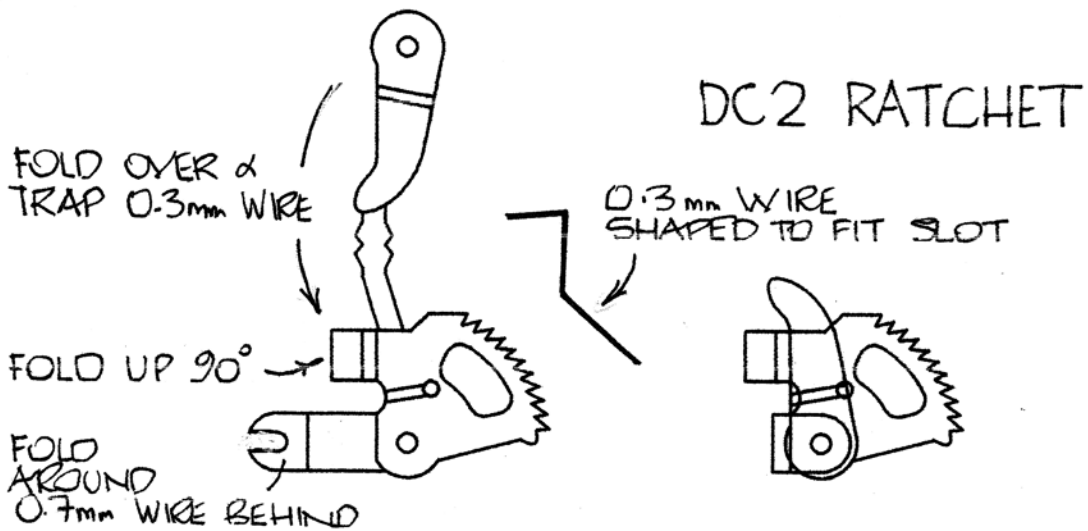
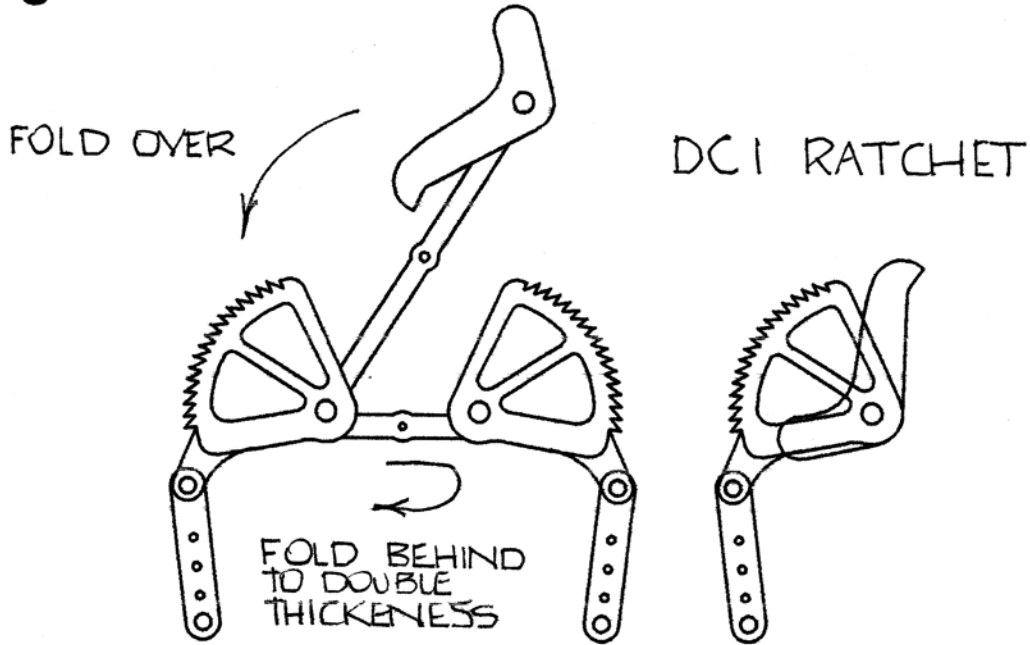
Note upper brake rod to brake shaft far side and lower brake rod to secondary end this side



DC secondary end hanger bracket

Note brake rod to bottom of ratchet at other end should be on the inside of the inner secondary bracket hanger, as figure 6 and not as shown here. This Didcot photograph is not Great Western practise and the distance between the brackets is incorrect. Should be 28".

Figure 7b



Insert the operating lever, the right way round so that it can be picked up when the 0.7mm brake shaft is inserted. Solder the vacuum cylinder in at this stage (**but not if clasp braked – see later in truss section**), as this cannot be done once all the brake gear has been assembled.

With Dean Churchward brakes choose either the earlier non-Hayward or the Hayward adjuster main brake rod introduced during the First World War. Insert the 0.7mm brake shaft from side to side, through the Vee, through the brake fret, picking up the vacuum operating lever and the main brake rod (Hayward or otherwise), before passing through the other brake fret and the other Vee or internal support. Pick up the other end of the main brake rod (Hayward or otherwise) and locate it on the 0.3mm wire projecting from the side of the ratchet on the cross shaft across the end. Tape that cross shaft temporarily until the other brake rod, that links the other end, has been fitted, if it is to be fitted.

Run a 0.5mm brass wire through the cross shaft hanger brackets at the other end to form the secondary cross shaft. Fit the long brake rod that connects the two ends and orientated as the figures 8, 10 and 11 show, on this secondary shaft. Leaving a projection at both ends, tack solder the secondary cross shaft to prevent it slipping out.

The main brake rod (Hayward or otherwise) and the long rod are still loose. Pick up the unattached end of the long brake rod and locate this to the lower end of the ratchet with a 0.3mm wire. Only when all the brake rods, vacuum rod and the ratchet are correctly located and in their respective positions should you tack solder each to the main brake shaft, the secondary cross shaft, the hanger brackets and ratchet joints.

Figures 5 and 6 show how the various types of DC brakes are laid out. Read in conjunction with figures 8 to 21, and 29 and 30.

Each etch has a note stating which end the ratchet is fitted and indicates the line of the main brake shaft.

Only when all brake rods are in place and are correctly located, solder up the various junctions to secure the rods and levers.

Note: Some brake rods will trap the wheels, particularly on the clasp-braked types below and these will have to be left off until completion.

Assembly of Mink D brake gear and other clasp brake versions – figures 8, 12, 14, and 22 to 26

Do not bend up the holding down tabs marked “A”, “a”, “B”, “b”, “C”, “c”, and “D”, “d” on the main body until you are ready to fit the brake modules. It is easy to flatten them whilst doing other things and repeated bending will break them off.

Note that in the case of the V4 MINK A, the W5 Cattle, the V3 Mink C and 20'w/b Mink D all have the intermediate cross shaft brackets integral with the “A” and “D” modules, whereas on other clasp braked vehicles these brackets are separate as is usual. See later note and figure 28.

If DC2 then leave the end cross shaft brackets opposite each other and remove the cross shaft bracket from the other end. Also remove the intermediate cross shaft brackets from brake shoe parts “a” and “D”.

If DC3 then remove the cross shaft bracket that is **NOT** diagonally opposite the near side end cross shaft bracket from the other end, and **leave** the intermediate cross rod support brackets on the brake shoe parts “a” and “D”.

While the main body construction is as before, the brakes are clasp brakes and the construction and assembly is completely different. Figures 22 to 25 shows how the various parts fit.

Each end has two sub-assemblies. They are designed to be made away from the main part on the bench as completed MODULES and added later. At the final stage, after wheeling, the main brake rods are added as these are below the axles. The sub-assembly at the adjustable end has the support stepped inboard to clear the adjustable fulcrum spring plate.

The inner parts, marked “B” and “C” have wider slots for the body tabs. This is to allow these brake frets to be moved inboard 0.3mm so that the wheels can be inserted. They, and the outer parts “A” and “D”, have holed tabs that allow for a temporary 0.35mm wire to be inserted through the buffer beam to hold the clasp brakes in place whilst they are set up and the wagon wheeled. The 0.35mm keep wires can be withdrawn later once the clasp-brakes are soldered at the tabs or kept.

The brake shoes fold over in the sequence shown in figure 22. It is best to fold over the two pairs using a short length of 0.5mm wire to assist in lining up each pair (remove before soldering), squeezing together with flat-nosed pliers, re-aligning with two pairs of tweezers and then soldering together. Then drill out the 0.5mm hole in case it is blocked with solder. Note that the outer brake block has a leg which, when folded over, is soldered to the hanger to strengthen it. Next fold over these double thickness brake blocks to form the four-layer set, again using a short length of 0.5mm wire to assist, checking that the brake block detail is on the outside when the unit is bent up to form a wide channel. After soldering into a four-layer set, re-drill out 0.5mm. Do **NOT** form up into a channel at this stage as it is much easier to add the brake hangers the right way round - see figure 24. Clean up the brake blocks to remove the cusp lines so that they appear as one solid piece of metal.

Fold up the brake hangers (bent lines on the inside of bend) to the form shown on figures 22 to 26, soldering each bend as you proceed (I use 179 solder cream placed with a cocktail stick and a hot iron). Insert these through the slots on the base of the brake fret where they will bottom, **making sure** that they are the right way round as figures 22 to 26. Lie the assembly on its back and solder the hangers from the underside, with a little solder cream placed either side of the triangular stops to each hanger.

Now form up as figure 26 and solder the bend on one side only protecting the base of the brake hangers from heat to avoid unsoldering them. The other bend is left until the brake yokes are fitted as the metal needs to be sprung apart for these to be fitted. Turn the assembly over and trim the underside off flush.

Now deal with the brake yokes, for P4 there is nothing to do to them. If EM then file away the P4 stop adjacent to the EM stop opposite as the sketch indicates. The two INNER yokes with vertical fixing legs are marked on the etch.

The "B" and "C" marked brake frets (the inner ones) use a yoke with a vertical leg to support it. There is a mark on the base of the etch to show where the near vertical support of the inner yoke is soldered to. Note that the inner yoke brake frames are not attached anywhere except by these near vertical supports, the long end floats. Solder each bend to strengthen it.

The "A" and "D" marked brake frets (the outer ones) use the short yokes. These yokes must have the end twisted 90°. They are both attached to the lower hole on the long "S" shaped lever using a short length of 0.3mm brass wire. It is worth considering soldering a 0.3mm brass wire in BOTH holes before forming the module up. It is then easy to attach the yokes and the later brake rods by bending the wire over once the parts have been put in place.

Insert the appropriate yoke through the brake hangers and locate one end into the hole in the brake blocks on the side that the bend was soldered. Bend the other brake block end out to allow the opposite end of the yoke to be inserted and tighten up the bend, then solder the unsoldered bend protecting the close angle from heat. Do not at this stage trim off the ends of the yoke nor solder or glue them. The brake blocks may need adjustment to line them up with the tyres and that will be difficult if you have attached the ends of the yoke.

All brake frets have two tabs that should now be turned up at right angles. These are for the 0.35mm keep wire that holds the pair of completed modules in place whilst wheeling. The wheels have to be in place before the main brake rods are attached.

Fold down the "a/A" and "d/D" body tabs and drop the outer brake modules in place.

Fold down the "b/B" and "c/C" body tabs and drop the inner brake modules in place.

With the wheels put in place, line up the brake shoes and then affix the ends of each yoke. It might not be smart to solder the ends of the yokes to the brake blocks as they could easily unsolder and that would be a disaster. It might be more sensible to glue the ends of the yokes to the brake blocks with Araldite.

Turn out intermediate cross shaft brackets integral with the "A" and "D" modules.

See section above and figure 28. If DC2, then the cross shaft bracket is removed from the end diagonal to the near side cross shaft bracket along with the intermediate cross shaft brackets on the brake shoe part at "a" and at "D".

If DC3 then cut away only the cross shaft bracket immediately opposite the near side cross shaft bracket. The intermediate cross shaft brackets on the brake shoe part at "a" and "D" remain.

These two assemblies have a cross shaft bracket extension on the outside at the "a" and "D" ends. After fitting the brake hangers and turning up the brake block ends and soldering them, fold this part up and turn the bracket part inwards on to the flat part of the of the assembly and solder, protecting the brake hangers from heat, see Figure 24.

Finally turn up the 0.35mm keep wire tabs to complete and then fit the brake yokes as above.

Fitting the Mink D brake rods

Now assemble the main brake rods and the vacuum operating lever on the 0.7mm wire while passing this wire through the Vees. Note that the brake rods have only half a lever at the centre brake shaft. This is to simplify the assembly. The two half lever's centre bosses are placed side by side and later soldered together on the centre line of the wagon. The brake rods are marked on the etch "A" and "B" and they are shown marked as such on Figure 14. The Mink D rods look to be the same but one has a sharper angle at the central brake lever than the other so they **MUST BE** correctly identified.

The "A" brake rod has an enlarged hole in the multi-holed plate that links to the central half lever. This hole (0.35mm dia.) is close to, and in line with that half lever's brake shaft hole. As previously solder a 0.3mm brass wire as a spigot to make fitting the brake rods easier. The DC3 linking brake rod to fixed end cross shaft is also attached to this spigot.

Make up the ratchet plate trapping a piece of 0.3mm wire with a 90° bend to form the horizontal spigot as the figures 7, 7a and 7b show. Solder the ratchet squarely in middle of a 55mm length of 0.5mm brass wire – see photograph and sketch on figure 7. It is much easier to handle once soldered to the 0.5mm brass wire. Insert this assembly between the cross shaft end brackets in the position shown in the photograph in figures 7a and 7b and the figure appropriate to the type of brake gear being fitted. Leave the 0.5m wire projecting from either side. Do not solder the wire at this time but tape ends to prevent it slipping out while other work is carried out.

This ratchet lies close to the intermediate cross shaft bracket on the inside between it and the outer cross shaft bracket, whereas the main brake rods to the yokes and the clasp brakes are on the centre line.

Do not solder any 0.3/0.35 mm locating/fixing wires at this stage.

Connect the brake rod from the 0.3mm wire spigot on the ratchet to the 0.3mm spigot on the multi-holed flat plate of the "A" brake rod that is now placed centrally on the 0.7mm brake shaft.

On the DC3 versions there is the additional brake rod from this top hole of the brake shaft operating lever to the 0.5mm cross shaft at the other end (fixed).

Once the wheels have been fitted the brake rod "B" can be connected.

Only when all the brake rods are in place solder up the various parts to the cross rods and the 0.3mm linking wires or bend them over to secure the rods.

Additional notes on the assembly of Toad brake gear – figures 21,22 and 25,26

While the main body construction is generally as before, these brakes are clasp brakes so the construction and assembly of the brakes is completely different. Figures 21, 22 and 25, 26 shows how the various parts fit. Do not bend up the holding down tabs on the main body until you are ready to fit the brake modules. It is easy to flatten them whilst doing other things and repeated bending will break them off.

Each end has two sub-assemblies. These modules are designed to be made away from the main part, on the bench and added later. At the final stage, before wheeling, the main brake rod is added as this is above the axles. The inner yokes at both ends cannot be put in place until after wheeling.

The yoke brake frame at the adjustable end has the support stepped inboard to clear the adjustable fulcrum spring plate.

The inner parts, marked "B" and "C" have wider slots for the body tabs. This is to allow these brake frets to be moved inboard 0.3mm so that the wheels can be inserted. They, and the outer parts "A" and "D", have holed tabs that allow for a temporary 0.35mm wire to be inserted through the buffer beam to hold the clasp brakes in place whilst they are set up and the wagon wheeled. The 0.35mm keep wires can be withdrawn later once the clasp-brakes are soldered at the body tabs or left in place.

The brake shoes fold over in the sequence shown in figure 22. It is best to fold over the two pairs using a short length of 0.5mm wire to assist in lining up each pair (remove before soldering), squeezing together with flat-nosed pliers, re-aligning with two pairs of tweezers and then soldering together. Then drill out the 0.5mm hole in case it is blocked with solder. Note that the outer brake block has a leg which, when folded over, is soldered to the hanger to strengthen it. Next fold over these double thickness brake blocks to form the four-layer set, again using a short length of 0.5mm wire

to assist, checking that the brake block detail is on the outside when the unit is bent up to form a wide channel. After soldering into a four-layer set, re-drill out 0.5mm. Do **NOT** form up into a channel at this stage as it is much easier to add the brake hangers (the right way round - see figure 26). Clean up the brake blocks to remove the cusp lines so that they appear as one solid piece of metal.

Fold up the brake hangers (bent lines on the inside of bend) to the form shown on Figures 14 and 24 to 26, soldering each bend as you proceed (I use 179 solder cream placed with a cocktail stick and a hot iron). Insert these through the slots on the base of the brake fret where they will be at the bottom, **making sure** that they are the right way round as figures 21, 25 and 26. Lie the assembly on its back and solder the hangers from the underside, with a little solder cream placed either side of the triangular stops to each hanger.

Now form up as figure 26 and solder the bend on one side only protecting the base of the brake hangers from heat to avoid unsoldering them, turn the assembly over and trim off the underside and file flush.

Now deal with the brake yokes. For P4 there is nothing to do to them. If EM then file away the P4 stop adjacent to the EM stop opposite as the sketch indicates.

The "B" and "C" marked brake frets (the inner ones) use the long yoke. The "A" and "D" marked brake frets (the outer ones) use the short yokes. All of these yokes must have the end twisted 90°. They are attached to the upper and middle holes of the "S" shaped lever using a short length of 0.3mm wire. It is worth considering soldering these wires into both holes before forming the module up. Solder a third 0.3mm wire in the lower hole, which is for the brake rod.

Insert the outer yokes through the brake hangers, locating one end into the hole in the brake block on the side that the bend was soldered. Bend the other brake block end out to allow the opposite end of the yoke to be inserted, tighten up the bend and then solder the unsoldered bend. Do not at this stage trim off the ends of the yoke nor solder or glue them. The brake blocks may need adjustment to line them up with the tyres and that will be difficult if you have attached the ends of the yoke.

All brake frets should have the two tabs turned up at right angles. These are for the 0.35mm wire keeps that hold the pair of completed modules in place whilst wheeling. The wheels **MUST** be in place before the outer yokes are fitted.

Fold down the "a/A" and "d/D" body tabs and drop the outer yoke modules over them. Insert a pair of wheels at each end.

Fold down the "b/B" and "c/C" body tabs and drop the inner yoke modules over them, whilst attaching the twisted end of the long yokes to the upper 0.3mm wire spigots on the "S" shaped lever. Secure these modules with 0.35mm wire keeps.

Now put the main brake rod in place, picking up the lower 0.3mm wire spigots at each end and bending the end of the 0.3mm wires over to secure it. With the wheels in place, line up the brake shoes. It might not be smart to solder the ends of the yokes for fear of unsoldering the brake shoes but to glue with Araldite.

Sand pipe building jig WN4560SP – figure 27

Fold up the tabs with the bend lines on the inside as usual. Solder at the bend line to form a fillet to strengthen tab.

Take five lengths of 0.5mm brass or nickel silver wire 50mm long and half way along each, bend around a 15mm (heating pipe) bar until the leg is bent at 67° (113° internal) to the other. The actual inside radius is 14.2mm.

Place one of these wires between the tabs and set at the bottom. This wire is a spacer to allow the others to be cut with a piercing saw or marked where to bend.

Load the four remaining wires on top of each other.

Mark each of the wires at the bottom end adjacent to the words "bend". Without moving the wires, cut off all four wires at the top end **parallel** to the end of the jig, where the jig is marked "cut". This is to get the cut ends parallel to the rail head when fitted.

Run a fine file across all four ends to clean up the cut, using the fifth wire and a spacer to keep the piercing saw clear of the jig.

Carefully mark all four sand pipes where it says "bend" on the jig, on the straight part of the pipe, beneath the curved part of the pipe.

Remove all four sand pipes and bend two of them away from you at right angles to the 12mm bend at the lower bend mark, and the other two towards you. Cut off the horizontal tails to about 3mm long. You should now have four identical sand pipes, two of each hand.

They are positioned with the tail inserted in the hole at the base of the clasp brake module on "A" and "D" ends only. Best to use either 145° for this to avoid unsoldering the modules and causing the yokes to fall out, or Araldite in place.

Trusses, queen posts and struts

The truss on the vacuum side **MUST** be put in place **BEFORE** the vacuum cylinder is fitted on all clasp-braked wagons and on the S8 Bloater.

The longer vehicles have trusses that are inboard of the Vees. The various photographs will confirm this. It will be necessary therefore to put a slight set in the queen posts and vertical struts just behind the main body side to offset them away from the line of the Vees. The truss rods and the ends of flat trusses (except the S8 Bloater) will also need to have a slight set before soldering in place. The queen posts and struts go between the marking on the inside the main body sides whereas the truss rods, and the flat trusses of the Mink G and Fruit D, are located on the marks on the inside of the main body sides close to the W-irons.

The etches that have a rod truss and queen posts have a drawing showing the shape of the 0.5mm truss wire, and the position of the queen posts and struts. If this drawing is partially masked off with tracing paper/masking tape, the trusses could be assembled and soldering on this drawing. Don't forget the sets that are necessary to clear the Vees when assembled on the underframes. The S8 Bloater truss does not require sets, as spacers are built-in to offset the truss by 0.3mm from the Vee.

Specific notes for the Mink G and Fruit D trusses

Figure 31 shows the construction of these trusses as regards the laying up of the two layers. The queen posts need a slight set to get the truss 0.3mm away from the Vee, as do the ends of the truss.

These two trusses have been drawn so that the side of the trusses facing you on the etch are actually the **inside** faces that will face towards the centre of the underframe when assembled. Do not remove this wider truss from the etch at this stage. The narrower truss overlay facing you also goes on the inside and aligns with the top edge. Lay the narrower truss on top of the wider truss, align and then solder together.

Remove the assembly from the etch and clean up the truss, in particular the double thickness (top) edge to make it look as if one solid part. When fitted to the underframe with the wider truss on the outside, the half-etched lower edge will be on the lower outside and it should look like a truss made from angled steel.

The queen posts need a slight set at the top to get the truss 0.3mm away from the Vee, as do the ends.

Specific notes for the S8 truss

Figure 31 shows the construction of this truss as regards the laying up of the truss of two layers.

The truss has been drawn so that the side of the trusses facing you on the etch are actually the **inside** faces that will face towards the centre of the underframe when assembled. Do not remove this bigger truss from the etch at this stage. The narrower truss overlay facing you also goes on the inside.

Lay the narrower truss on top of the wider truss, align using the 0.35m holes and wire and then solder together.

Remove the assembly from the etch and clean up the truss, in particular the double thickness (top) edge to make it look as if one solid part. When fitted to the underframe with the wider truss on the outside, the half-etched lower edge will be on the lower outside and it should look like a truss made from angled steel.

The 0.35mm end holes align with the holes in the sides of the underframe. The centre of the truss, that is the verticals, will locate in the slots in the main body. The tabs on the outer part of the assembled truss fold over on top of the wider outer face to form spacers, which set the truss 0.3mm behind the Vee.

Etched solebars

These are made of two main parts, the backing part and the rivet detail overlay. The solebar is 2mm shorter than the overall length of wagon length of the wagon type. If the kit is undersize then the solebar and the detail overlays must be shortened equally at either end to suit.

Note the handing of the solebars and particularly the slots that take the door springs and pin handle guides (if fitted) which must be at the top. These have their "tails" passed through, bent over and are soldered flush from the back. You may need to add 0.3mm spacing pieces close to the 0.5mm fixing wire to locate the solebar properly.

Before removing the solebar channel for the etch, mark where the numberplate is to be fixed, if it is not located by the 0.5mm fixing wire. For instance on the S8 Bloater the numberplate is outside these holes in free space.

Note that the different rivet sets for the vacuum cylinders are on one side only, whether the cylinder is offset or central. This overlay could be RSU touch soldered but I prefer to use Araldite.

Using etched solebars makes it much easier to fit pin/ratchet handle guides and door springs. The tails of these simply pass through the slots in the rivet detail overlay and the channel, are bent over and soldered at the back of the channel. Check that the rivet overlay is correctly positioned before it is fixed/glued in place. It is handed on vacuum fitted vehicles.

Assembly of solebar

Bend up, preferably using a "Hold & Fold" supplied by Eileen's Emporium. These are available 2", 4", 5½", 8" and 14" long. I use the 8" as I need to bend Mink D solebars.

The dimension across the solebar should be 3.1mm. If it is greater than this, close down carefully in a smooth jawed vice. Do not over close otherwise the rivet detail fret will not slide into place.

Use a loop of 0.3mm brass wire placed on the inside of the channel with tails projecting out for the lower side. Feed up the folded axlebox bumper on to the tails and solder. Cut off and clean up the top flush with the inside and trim the tails on the lower side to look like bolt heads.

Insert the rivet fret and solder/Araldite in place. Fix the door springs and handle guides if fitted through the slots in the detail fret and channel, solder and trim off flush at the back.

Note that the keep wire passes through the top of one of the rectangular numberplates and that locates the plate correctly.

The solebars are attached using a 0.5mm brass wire run through the solebar overlay (and its numberplate), the solebar and the side frame of the underframe and out the other side picking up the other solebar. This locates the two solebars correctly for fixing. The wires can be left in place or removed to choice. Fix the chosen numberplate.

The underside of the solebars must be level with the underside of the underframe. This is the underframes datum.

Be careful with the wagons that have 10" solebars as the wagon underframe is designed 3 mm deep overall (9"). Thus on these wagons, like the Open C, the solebar projects above the wagon underframe and a 1mm plasticard spacer needs to be inserted between the underframe and the body.

Note if you are not using a "Hold & Fold"

Folding the solebar edges at right angles is not easy because the thin edge has to be gripped then folded. I made up special folding bars from two lengths of ¾ x 1" aluminium flat 3mm thick obtained from B&Q. One edge on each was chamfered 5°. They were drilled 5.0mm as a pair and flat headed M5 bolts fitted to one side, using Araldite to glue the head of the bolts in place. M5 wing nuts and washers were then used to clamp the two together. I drilled out at about 50mm centres for the longer solebars.

Once the second edge has been folded at right angles, the solebar channel was placed in a smooth jawed vice and closed up, to set the overall width of channel to around 3.1mm, BEFORE fitting the overlay. Whether you solder or glue the overlay is your choice.

Assembling the S8 Bloater and P19 Python

Whilst these two vehicles are assembled in accordance with the appropriate instructions above, the S8 has standard brakes and the Python clasp brakes. There are additional parts that need to be dealt with.

Both vehicles have etched solebars on the etch and these should be used rather than the solebars on the Parkside kits.

Assemble the solebars as above and fit the axlebox bumpers. Note that these two solebars have outriggers and are fitted as the bodies are much wider than the standard underframe. These trap the rivet detail overlay. They have a half etch tail, which should make handling easier. These tails could be bent back and soldered to the back of the solebar channel. There is a little slop between the outriggers and their slots so use 0.5mm wires through the fixing holes to align the rivet detail overlay with the channel before soldering the outriggers in place.

Both vehicles have steps. The lower step uses wire hangers (0.45mm N/S is suggested) and these are attached after the step has been folded up, using the notch in the frame as a guide to its correct length. The wire goes to the top of the notch in the frame. Fold up and solder as shown on figure 30 and in the sequence shown.

However before you solder these wires in place or fit the upper step, you must reduce the height of the upstand of the step to 0.8mm or less. It is drawn at 1.2mm so it can be bent. In the case of the upper step it should just touch the outrigger as the large sketch on figure 30 shows.

Once the lower step upstand has been reduced to match that on the upper step, then solder in the 0.45mm N/S wire using masking tape to hold the upper end touching the top of the notched slot. Once soldered in place, obviously at right angles to the step, then cut way the frame and clean up that cut. These steps are handed, one for the left side wheel, one for the right and one without a large slot for the middle step. The solebars have a half-etched slot running upward from the lower edge and the wires of the step should be fully located in these to set the step at the right height.

The upper step is centralised between the wires and is seated on the underside of the channel and the channel's back. Take care not to unsolder the axlebox bumper when fitting the upper step.

The 0.45mm N/S wires in theory should just be 0.3mm proud at the back of the solebar. The solebar is spaced 0.3mm off from the sides of the underframe so if that gap is larger then file down a little of the N/S wire. There are 0.3mm spacers on the etch and these can also be used where the 0.5mm fixing wires run though from one side to the other, to maintain that gap and keep the solebars properly located.

Notes. The outer lower steps are handed as they go over the axlebox off centre. The smaller slot in the upper step is to allow it to be placed over the axlebox bumper.

Attach the numberplate; hopefully you marked where it fits on the S8. There is no numberplate on the P19 Python.

Complete the solebar as a sub-assembly before attaching it to the underframe.

Assembling the O13 China clay wagon

The O13 is included on the DC2 WN.4410 etch. The only difference between the standard DC2 and the O13 is that the O13 has brakes both sides, uses both Vees and the ratchet is on the "off side" of the wagon as the etch marking shows. It is only Hayward adjusted so do not use the single arm brake rod that goes with a DC2. The other change is the ratchet, the O13 uses the DC3 type of ratchet (special) and that is included on the etch. Standard brakes levers and spares are supplied but two slightly longer levers have been added in case they are preferred. With only one photograph to work from it is difficult to judge the brake lever length.

Painting

From now on paint as you go, but do not get any paint on the inside rubbing face of the W-iron or on the rubbing faces of the bearing plates. It has been suggested that the whole underframe could be chemi-blackened and then later painted where necessary to avoid concealing the fine detail, the chemi-black acting as a primer. I have never been successful chemi-blackening and I always end up with large blotches where the brass shows through.

Adding axle boxes/solebars

Whether you use new cast axle boxes and springs or using those from the plastic kit, you will probably need to remove material from the back of the axlebox to ensure that the pinpoint bearing can move up and down over a small

range of about +/- 0.6mm. I use a Dremel and a dentist's burr to open up the hole and to deepen the hole. A tricky job because one has to remove a fair amount of material to be sure that the bearing does not catch. You can also remove some of the head of the pin point bearings and give this a smooth top. If you need to remove the plastic W-irons with a scalpel leaving just the axleboxes and springs attached to the solebar, then do that now.

When you are satisfied, fix the solebar/axle box/springs to the sides of the underframe and to the fixed side W-iron with quick setting Araldite or your favourite brew, but on no account get any glue on the rubbing/sliding surfaces of the W-iron or the bearing plate.

The adjustable side only needs for the solebar/axlebox/springs to be glued to the W-irons themselves. Do not put any glue on the side of the main body between these W-irons or the outer sides. When the glue has set this will leave the adjustable side as a moveable separate assembly.

It was mentioned earlier that the design was drawn using Exactoscale pinpoint bearings and accurate pin point axles 26mm long and these should be assembled so that the adjustable W-irons are almost flush with the sides. With other pinpoints and axles the inside bearings on the fixed side may have had to be shimmed.

The underside of the solebars must be level with the underside of the underframe. This is the underframes datum.

If you are fitting solebars with their axleboxes straight from the kit, then you will probably need to remove a considerable amount of material from the inside bottom of the body so that the body fits over the solebar, as the dimension over the solebars may now be greater than that intended by the kit manufacturer.

You will certainly have to thin the solebars down to a considerable degree, including the W-irons and axleboxes. I carry this function out using a Black & Decker belt sander with a belt of 120 grit turned upside down and held in a Black & Decker Workmate. With care you can remove a lot of material fast but do watch your fingers. The remaining thinning is done with files.

Re-wheeling

Before re-wheeling give everything a thorough wash to remove any flux residue, then dry carefully.

Now with the brake frets and most of the Dean Churchward brake rods in place, the wagon can be re-wheeled.

Fitting final details that needs to be fitted after re-wheeling

Dean Churchward

Fit the swan neck brake handles to the cross shafts and solder/Araldite in place.

Pin/ratchet handle guides

With a solebar in place, bend the horizontal leg a further 90° downwards to fit the guide into the slot on the main body or the W-iron and then solder/Araldite to fix in this location. If you are using the etched solebars, there are slots in the top of the solebars from the tail of the handle guide to pass through and be folded over and soldered on the backside. Note that the bottom of the pin/ratchet handle guide is attached at the bottom of the W-iron, just behind the keep plate, using the long tag on the etched part.

Fit the brake levers and solder/Araldite in place.

Door springs

The door springs if fitted, should be as figure 4, and bent to the profile on the etch. The position of these varies with wagon type. The wagon drawings give the spacings when door springs are fitted, or you can calculate the spacing yourself if you have a side view photograph of the wagon. With a scale, measure the distance between the door springs and then between the wheel centres. The actual distance of the wheel centres is known so that the distance between the door springs can be calculated by simple proportionality.

The horizontal leg is then fixed to the back of the main body at the calculated centres either by soldering or with Araldite. If you are using the etched solebars then the solebars have slots to take the tail of the door spring, which can be folded over and soldered, on the back side of the solebar.

Tie bars

Before fitting tie bars the wagon needs to be re-assembled and wheeled. Flat tie bars for vacuum fitted stock are provided on the etch. They replace the keep plate on the W iron, which hopefully you removed earlier. They should be riveted in the usual way and soldered in place at the end of the construction.

Alternatively 0.45mm nickel silver wire may be used, soldered behind the keep plates of the W-iron. Once soldered to the removable side, they can only be dismantled as a pair, but the pair will be very weak for handling.

Final cleaning

Any further soldering after the wagon was re-wheeled needs to be washed with hot water. Fortunately these are external parts so they could be washed without getting the steel wheel tyres wet. If there is a risk of that then perhaps using Araldite is the better solution, say for the door springs and the pin/ratchet lever guides. The tie bars are far enough away to not give rise to trouble.

Couplings and buffers

Standard couplings and buffers are fitted as usual after the body has been fitted. The holes for the buffers are at 22.83mm apart, the standard 5' 8½" dimension. There is sufficient clearance for MKT sprung buffers and Exactoscale sprung coupling hooks so that a body can be lifted from the underframe and re-fitted at will. The standard buffer height centre from the railhead is 3' 5½" (13.8mm).

Changes to brake frets tabs to assist fine scale 00 modellers in using these etches

The standard braked wagons can be used with 26mm axled EM wheels set to 00 gauge but the existing P4/EM brake fret tabs cannot be used and these need to be removed during early assembly.

The two 00 gauge strips shown on page 10's depiction of a typical etch are folded up according to the "bend line on the inside of the bend rule" and take the place of the brake tabs now removed. They are located by 0.3mm wire passed through them and the main body and soldering in place. The brake frets locate on them as before and are held by the 0.7mm brake shaft in the usual way.

Clasp braked versions **cannot** be used in 00. The design changes necessary are just too complicated even to consider. The S8 Bloater does not carry the 00 strips to enable it to be fitted up for 00. There was just was no room on the etch for these strips.

Development and Appreciation

This development has taken over 5 years. There were always FIVE main features: compensation or springing, to be able to have and build quickly accurate highly detailed brake gear dimensioned as close as possible to the prototype, to cover the range of plastic kits available in the recent past and the present, the inherent dislike of having to assemble an underframe from a variety of parts with the inherent inaccuracies introduced by making a set of W-irons to cover a range of wheelbases and then not knowing which part to use and where it is to fit, and finally the desire to have removable W-irons so that no metal was sprung apart to insert the wheels. It is never possible to set up the wheels without sideways slop for free running, if metal has to be sprung apart.

The desire for a complete underframe for each type became essential as one noted the differences like the different height of the end cross shaft between DC1 and DC2, the different spacing of this end cross shaft from the headstock, the different spacing of the DC2 vacuum cylinder and DC3, the differing ratchets, the changes in the end cross shaft bracket detailing, the differing Vee heights, the differences between the Dean Churchward and Morton wagons, and then the variations within each type.

The first design had torsion bar springing at both ends and this was concealed by the main body being upside down. The upside down construction seriously complicated the addition of the Veeps and brake frets so the design was quickly abandoned.

The next design reverted to a simple transverse torsion bar that I have used on bogies. This was always very sensitive and has much to commend it. One whole side, while being removable for wheeling, rotated about the torsion bar on the centre line. This was the first design that led to the present method of forming up the brake frets and they have remained the same ever since. The defect of the design is the significant movement at the ends of the solebar, which interfered with the fitting of the body.

The third design reverted to the three point stool principle with one end fixed and the other a rocking assembly of two W-irons. Both ends had adjustable W-irons to allow for wheels to be inserted without bending metal. The defect of this design comes when one has pin or ratchet lever guides. Those guides have to move with the rocking W-iron at that end, whereas the brake lever is fixed on the centre brake shaft and resists the rocking movement. The fixed end was not a problem. This design indicated the desirability of having one end fixed using the three legged stool principle and that was retained on all future developments.

The fourth design had torsion bar springing at one end and, like the previous design, had the adjustable W-irons fixed by a vertical 10BA bolt. The first production wagon underframes were of this type. The springing is very sensitive but not easy to set up. This design covered 11 different types and 33 variants. Once those wagons were out to a limited market, thoughts turned to eliminating the vertical 10BA bolt.

The development of these production underframes with the horizontal 10BA bolt on the underside of the wagon meant that a different method of springing had to be used, as the adjustable W-iron was now put in place vertically whereas in the fourth design it had been assembled sideways.

Many trials were carried out using guitar string springs in the conventional layout, parallel to the length of the wagon. They all failed because the fulcrum length was too short due to the adjustable W-iron. Uniquely the spring was turned through 90°, transverse across the wagon and that produced promising results but the sensitivity of the old torsion bar was not there.

Eventually the design evolved into the present form where the guitar string spring is held by a fulcrum plate that can be adjusted in height and where the fulcrum plate can be changed over quickly to change the spring rate. The bearing plate carrying the pin point bearing now just floats. The result is a very sensitive springing system that can be adjusted to take account of the actual weight that it is practicable to carry on the wagon and of course the buffer height can be adjusted to suit that weight.

By having a sensitive springing system at one end and a fixed axle at the other, the result is a very stable wagon that runs freely. Many modellers over-emphasise the degree of springing needed. Time and again one sees modellers testing the springing over a millimetre or more. Even badly built track is not that bad. The springing needs to move just fractions of a millimetre but it does need to be sensitive without the wagon having to carry grandma.

The number of underframes is now 27 covering over 60 variants. Practically all of Great Western open wagons and vans are covered and it is only the more obscure brake gear like the Morton link gear and the early Fruit and Micas that are not covered.

This development has been followed by a number of modellers. David Rothwell of Jersey has been particular helpful over very many years and has built up many wagons and contributed in all sorts of ways to the design process. David, I am most grateful for all of your help. Graham Pearson has made several contributions in earlier days and encouraged me to dispense with the vertical 10BA bolt. Greg Coady tested out the first construction of the latest design and John Pletta in the US encouraged me to look at solebars as an alternative to the ones in the plastic kit. To those and others who I haven't mentioned but who made useful comments, my very grateful thanks. I have been encouraged by the interest shown even though I know that the demand for these underframes will never set the world on fire. Maybe I have taken the fun out of scratch building Great Western wagons, I have heard that said. I have been encouraged by my wife Gill who has put up with the massive expense over many years and who has worked on the instruction sheets several times over, and over again. Without her help none of this would have been possible.

Final comments

The sales and marketing of the 8 more popular types are in the hands of the Scalefour Society. These have the numbers on BOLD on the schedule and on any price lists. It is intended to add the WN.4530 DC3 Mica and solebars shortly and perhaps one of the Mink D's. The WN.4480 Mink C will still be available but the supplies of the Kirk kit, which is no longer produced, must by now be drying up. Coopercraft were planning to do one but that has fallen by the wayside. Maybe Cambrian or Parkside will oblige. I will look at the possibility of etching one but don't hold your breath.

The whole range of 27 will be handled by myself, using a website as a shop window.

Please contact me, Brian Morgan at 9 Chy Pons, St.Austell, Cornwall, PL24 5DH tel (01726) 76461 or email at briamor@btinternet.com

Bibliography

GWR Goods Wagons by A.G.Atkins, W.Beard and R.Tourret published by Tourret Publishing, 5 Byron Close, Abingdon, Oxfordshire OX14 5PA, was £40.

GWR Wagons before 1848 Volume 1 published in 2005 by Cheona Publications, The Railway Study Centre, Tal Eithen Isaf, Llanllyfni, Caernarfon, Gwynedd LL54 6RT. Tele (01286) 882332, was £9.95 but now out of print.

GWR Wagons before 1948 Volume 2 published in 2010 by Cheona Publications.

Great Western Wagons Plans book by J.H.Russell, published by OPC in 1976. Out of print but available from time to time in second-hand bookshops and stalls.

A Pictorial Record of Great Western Wagons by J.H.Russell, published by OPC in 1971. Out of print but available from time to time in second-hand bookshops and stalls.

Three articles by John Lewis in the Great Western Journal.

Modern Minks in volume 2, number 9 (page 393) to 14 (page 579).

Open wagons in volume 5, number 34 page 98, number 35 (page 140) to 40 (page 444) with number 41 (page 37) and 42 (page 115).

GW covered wagons in volume 8, number 62 (page 355) to 70 (page 353)

There is also a series of articles by Martin Goodall on GW Cattle wagons (vol 25) and GW vans (vol 27 to 43) in the Model Railway Journal.

Articles and photographs in Great Western Study Group's journal Pannier. Pannier 32 – Mink C clasp braked, Minks B, C and D by John Lewis. The missing captions are in Pannier 30, back page.

Tourett says that is no evidence that Mink C V7's were ever clasp-braked and yet the diagrams that I have show them. The V7's were built 1906/7 and as the DC3 drawing is dated November 1906, it is very unlikely they were ever clasp-braked.

Two photographs of clasped braked Mink B to V3 have turned up courtesy of John Lewis showing 79112 in 1947 and 79065 in 1949. The Great Western Study Group have just published these in their journal Pannier No.32 but the captions were missed off and Pannier 33 will make a correction in that regard. These were very early numbers built 1904/5.

There is also an informative letter in MRJ volume 42 by S.C.Bromhall, which makes particular reference to the clasp brakes on V4 vans, Mink B V3 and Mink D's to V9.

However I cannot agree with Stephen Bromhall that the V4's had the Y2 type of clasp brake or had a fixed vacuum cylinder. The V4's were built between 1904 and 1906 as one lot, lot 476. The Swindon drawing that I have for clasp-braked 10T open and covered wagons (vans) is dated March 1905 and is for both 9' and 12' underframes with the vacuum cylinder on trunions. It is clear that this drawing was issued and used for V4 and V3. Stephen says that all V4's were clasp-braked and yet the V4 diagram is for DC1. Tourret says that almost immediately the V4's were built with DC2 clasp brakes (as my Swindon drawing) so some of the early V4's may have been DC1.

Particular photographic references

Single Lever Cheona Vol 2. Off side. plate 20 page 14, plate 22 page 15 and plate 24 page 16.
1930 modification Tourret fig 356 page 369 and plate 616/617 page 459

DC1 Off side plate. Tourret plate 505 page 377

Morton Cheona Vol 2. Off side. plate 37 page 22
Tourret plate 377 page 289
Cheona Vol2. Near side plate 36 page 22
Tourret plate 512 page 386

Mink D V9	Cheona Vol 2. plate 28 page 18 Tourret plate 537 page 402
Mink D V11	Tourret plate 538 page 402
Mink G V22	Tourret fig 382 and plates 540 and 541 page 404 Cheona Vol2. plate 47 page 28

Drawings

Various drawings from the Railprint collection at the National Railway Museum. York, Tourret and from the OPC GW Wagons Plan Book by J.H.Russell.

Proprietary wagons kits plus some RTR and matching underframes

Note. WN4620 solebar carries two solebars and is used in conjunction with WN4630 which carries 52 numbers across a range of DC3 underframes.

CooperCraft					U/F Etch	Solebar		
1001	O4	Open A 5pl	9'	DC1	16' o/a	WN4400	WN4600	
1002	N13	10T Loco coal	9'	DC1	16' o/a	WN4400	WN4600	
1003	V5	Mink A	9'	DC1	16' o/a plain ends at first	WN4400	WN4600	
1004	O5	Open A 4pl	9'	DC1	16' o/a	WN4400	WN4600	
1005	O5	Open A 4pl	9'	DC3 & Morton	16' o/a post 1925	WN4420/50	WN4620/50	
1006	O2	Open 7pl	9'	DC1	16' o/a	WN4400	WN4600	
1007	V4	Mink A 8' 0"	9'	DC1	16' o/a	WN4400	WN4600	
1008	V4	Mink A 7' 6"	9'	DC1	16' 0 o/a	WN4400	WN4600	
		Clasp braked Mink A				WN4435	WN4635	
1008	can be used with double bonnet ends to make up V18 Morton					WN4450	WN4650	
1009	Match truck					none		
1010	W1/5	Cattle	11'	Lever/DC2/3	18' 6" o/a	WN4470	WN4670	
				Clasp brakes DC3		WN4472	WN4670	
		Made up W8 from 1010 + 1007		DC3		WN4475	WN4675	
1011	Q1	Provender	11'	DC1 with offset Vee		none		
1017	Alternative vents for 1003/7/8							
1018	Alternative bonnets for 1003/7/8							
1019	3p Open				TBA			
1020	V5 Mink A				TBA			
1023	V5	Mink A	9'		DC3	16' o/a	WN4420	WN4620
1027	V5	Mink A 8' high	9'		DC3	16' o/a	WN4420	WN4620
1028	V5	Mink A 7' 6" high	9'		Morton	16' o/a	WN4450	WN4620

New proposed

V12	some vac. Shutters	9'	DC3	16' o/a	WN4420 or WN4430	WN4620
V14	vac Twin bonnets	9'	DC3	16' o/a	WN4420 or WN4430	
V16	Twin bonnets	9'	DC3	16' o/a	WN4420	WN4620
V18	some vac. Twin bonnets	9'	Morton	16' o/a	WN4450	WN4650
V2/3/7/8	Mink C	12'	DC3	21' o/a	WN4480	WN4680

(the planned Mink C has now been put back for quite some time)

Note: V4 and V5 converted to DC3 later and twin bonnets fitted after 1923.

David Geen.

H6	9' container	9'	Morton	17' 6" o/a	WN4455	WN4655	
H7	10' container	10'	Morton	17' 6" o/a	WN4460	WN4655	
N6	Loco coal	9'	Lever	16' o/a	WN4440	WN4640	
O8/16	Open C	15'		DC3	25' o/a	WN4520	WN4620

David Geen (continued)**U/F Etch Solebar**

O32/33 5pl Open	10'	Morton	17'6" o/a	WN4460	WN4660
X5 MICA	10'	DC3	16' o/a	WN4530	WN4730
Y3 Fruit	12' 6"	DC3	25' 5" o/a		none
DD5 Gas	9'		18' 6" o/a		none

Cambrian

P18/20 Ballast	9'	Morton	16' 6" o/a	WN4450	WN4650
N30 Loco coal	9'	Morton	16' 6" o/a	WN4450	WN4650
M4/5 Shunter's	7'	M4 DC3 M5 Morton			none
O30 OPEN metal	10'	Morton	17' 6" o/a	WN4460	WN4660

Parkside

PC74 Y11 Fruit D	18'	Morton	28' 6" o/a	WN4510	none
PC79 N13 Horse box					none
PC37 P19 Python				WN4590	included
PC38 V11 Mink D	18'	DC3	28' 6" o/a	WN4494	WN4694
	also	20'	DC2/3	WN4490	WN4694
		18'	DC2/3	WN4497	WN4697
PC44 S8 Bloater	18'	DC3	28' 6" o/a	WN4580	included
PC48 V22Mink G	19' 6"	DC3	30' o/a	WN4500	none
PC64 W7 Beetle 1927	16'				none
PC67 W7 Beetle 1909	16'	DC3	26' o/a		none
PC74 Y14Fruit D	18'	Morton		WN4510	none
PC81 O11/15 Open	9'	DC3	16' o/a	WN4420	WN4620
PC82 O13 China clay	9'	DC2	16' o/a	WN4410	WN4610
PC84 V12 to V16	9'	DC3		WN4420 or maybe	WN4430 WN4620
	V18 using V16 above	9'	Morton	WN4450	WN4650
PC85 X5/7MICA B	9'	DC3		WN4530	WN4730
	X8 MICA B 10'	9'	Morton	WN4540	WN4730
PC86 Z2 Gunpowder van	9'	DC3		WN4420	WN4620
	Z3 Gunpowder van	9'	Morton	WN4450	WN4650

Ratio

5063 Iron Mink	9'	Lever	16'	WN4440	WN4640
5064 O29 Open 5pl	9'	Morton	17' 6" o/a	WN4455	WN4655
5065 V23/24/26 & 34 Vans	10'	Morton	17' 6" o/a	WN4460	WN4660
G34 MOGO	10'	Morton	17' 6" o/a	WN4460	WN4660
AA13 20T TOAD				WN4560	none

Blacksmith

Multi 21T Loco coal all 12' Morton 21' 6"o/a which covers,

N23		spec.Morton			
N24		Morton			
N27	plain ends	DC3		WN4550	none
N28		Morton			
N29		DC3			
N33		DC3			
N34		spec. Morton			

Ian Kirk Now discontinued. Colin Ashby took over the tools but the Mink C was not run by him.

8802 V9 Mink D			underframe useless, body not checked.		
8803 N23 Mineral	9'	DC3	16' o/a	WN4420	WN4620
8805 V2/3 Mink C	12'	DC2/3	21' o/a	WN4480 or	WN4482 WN4680

Ian Kirk (continued)

						U/F Etch	Solebar
8808	10T open wagon						
8810	O18 5pl Open	9' DC3	16' o/a			WN4420	WN4620
8820	P17/23 Ballast	12' DC3	21' 6"o/a	maybe use		WN4480	WN4680

RTR Mainline

Y8	Fruit	10' Morton	17' 6" o/a	needs new headstock		WN4460	WN4660
V2312T	Van	10' Morton	17' 6" o/a	needs new headstock		WN4460	WN4660

RTR Airfix

N34 Loco coal 12' Spec. Morton 21' 6" o/a

Not covered but use to make up N27 plain ended, needs new headstock. WN4550 WN4650

RTR Dapol

W8 (Airfix kit)	CO39 Cattle					WN4475	WN4675
V34	Van Gunpowder						
	Fruit D						
N34	Loco coal	7 pl OPEN	and 4 pl OPEN				

Page for your own construction notes

Figure 8

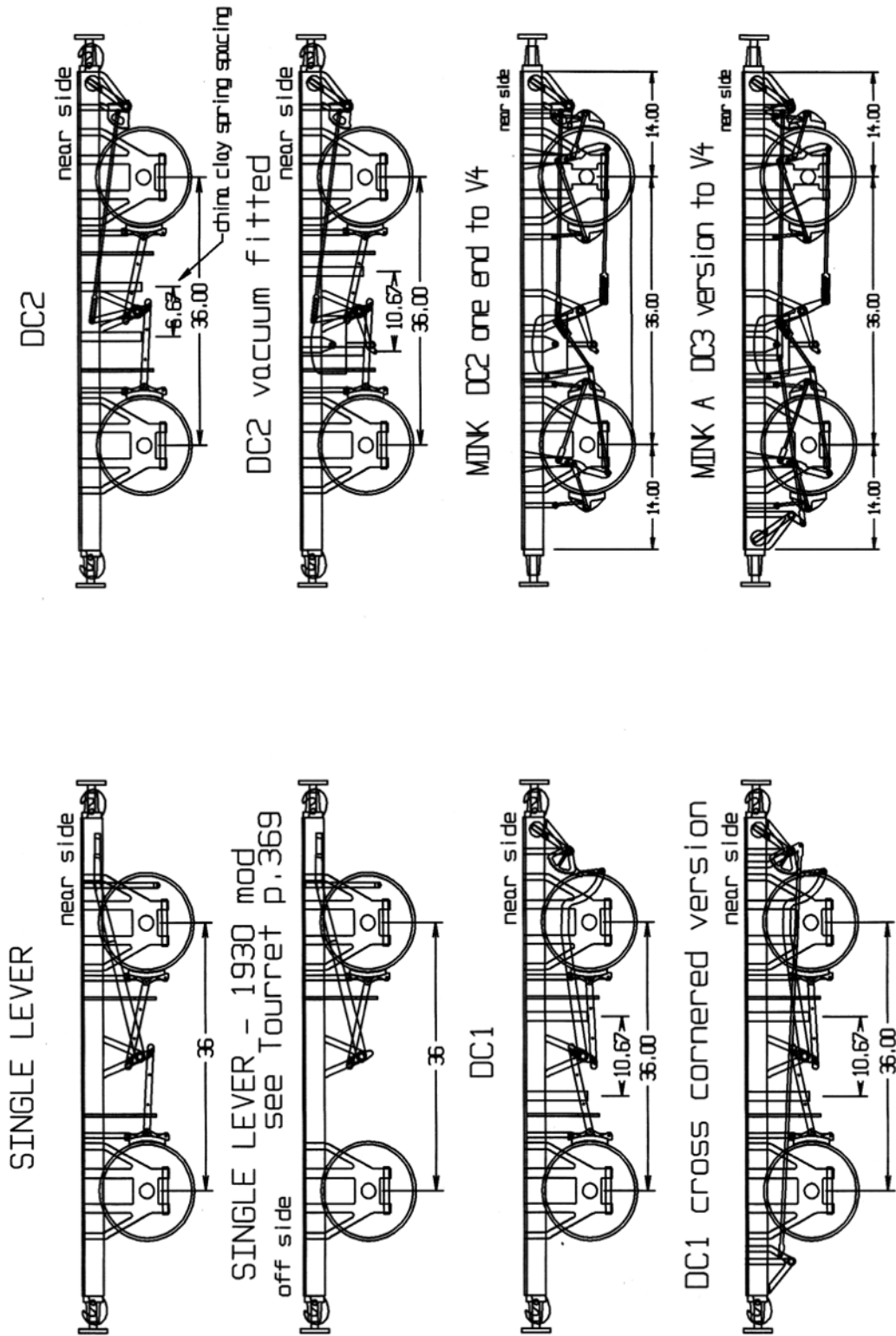


Figure 9

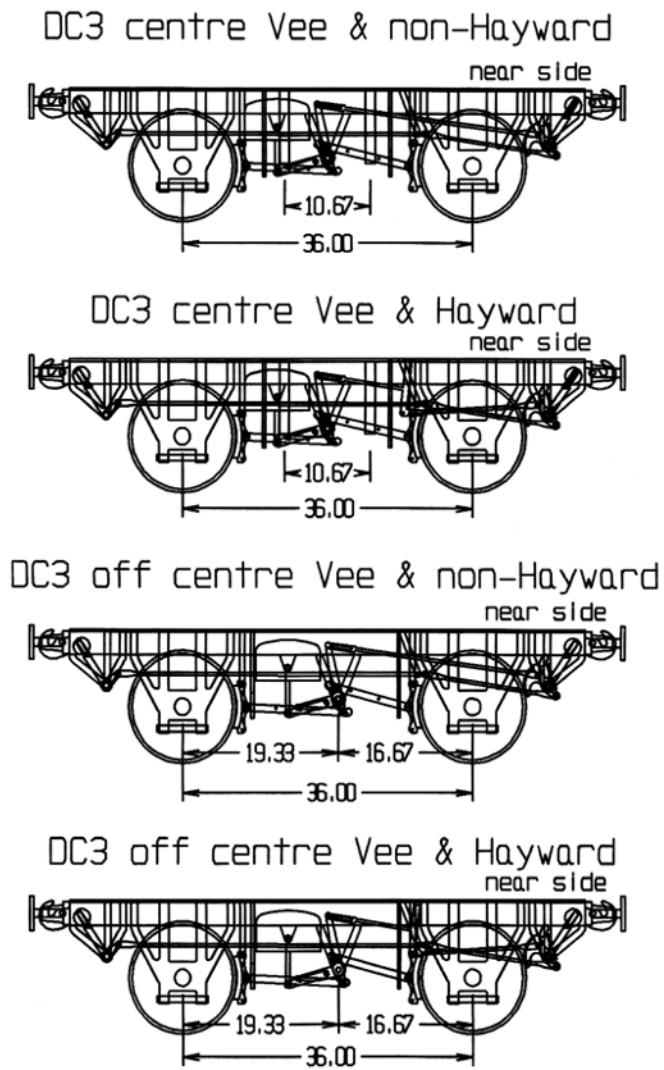
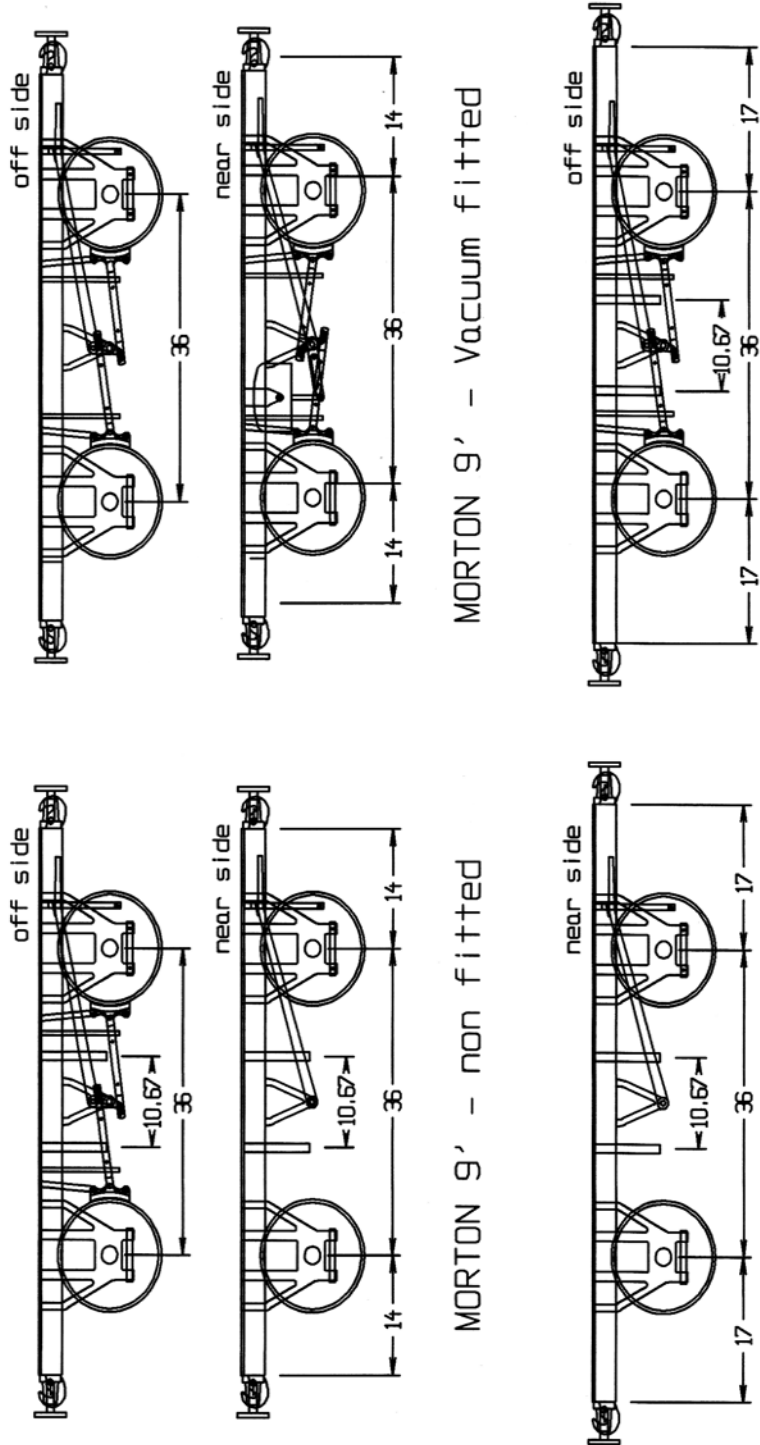


Figure 10



MORTON 9' - Vacuum fitted

MORTON 9' - non fitted

MORTON 9' - non fitted 17' 6" overall

Figure 11

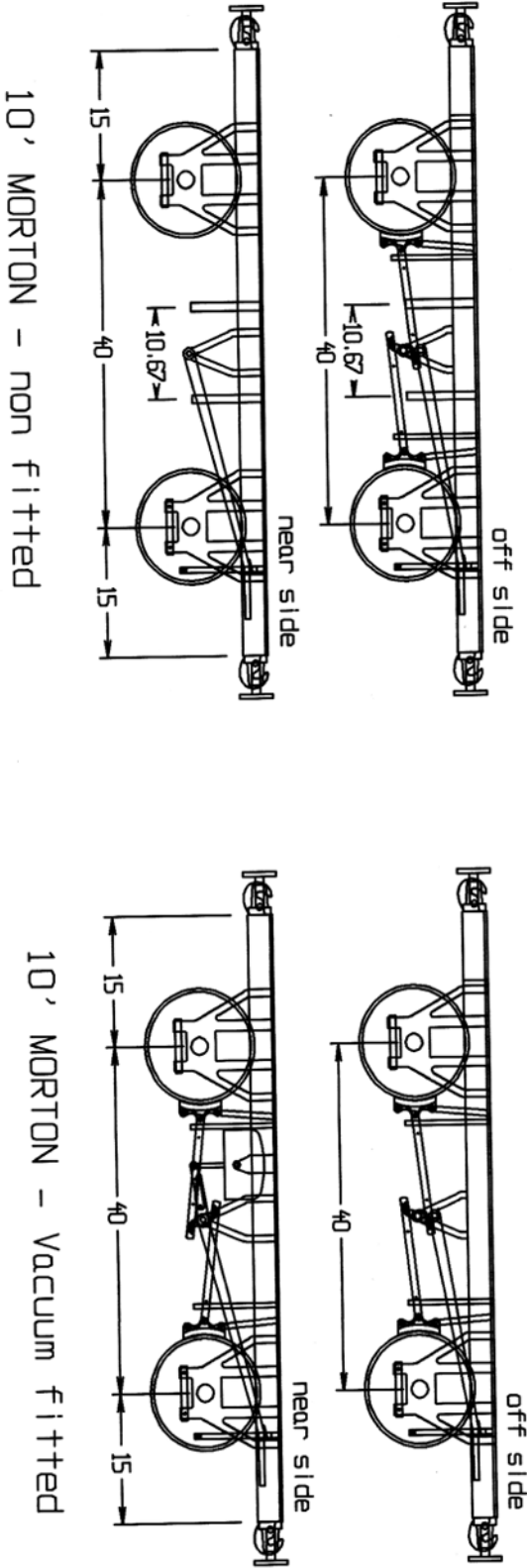
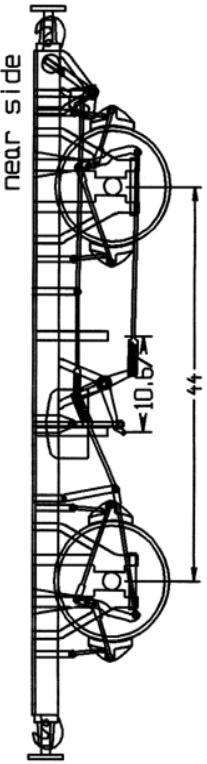
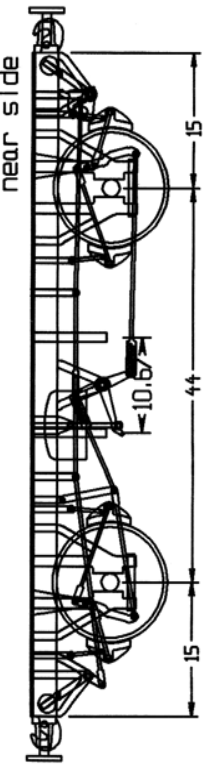


Figure 12

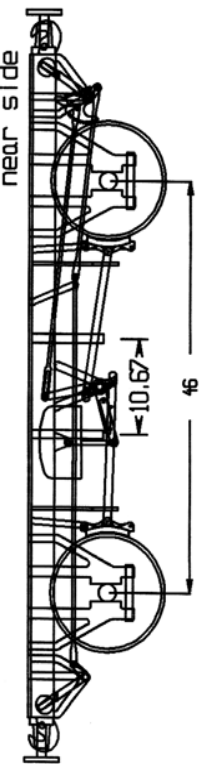
W1/W5 CATTLE - CLASP BRAKE VERSION -DC2



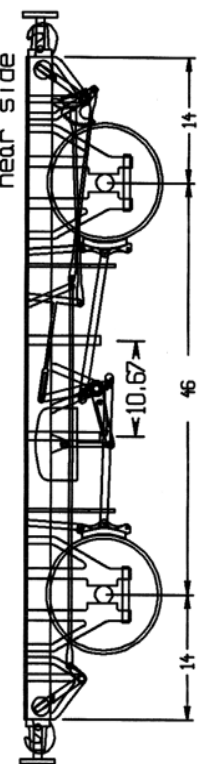
W1/W5 CATTLE - CLASP BRAKE VERSION - DC3



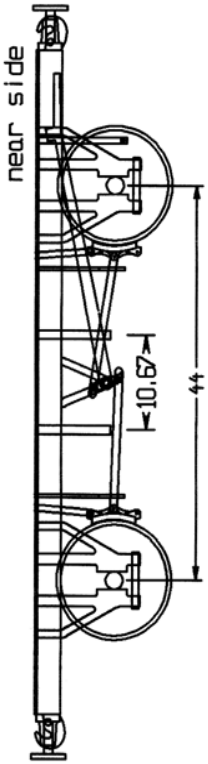
W8 CATTLE non-Hayward



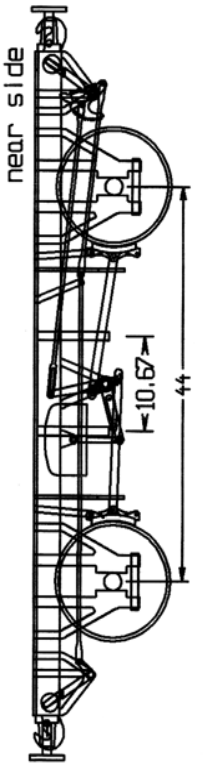
W8 CATTLE - Hayward



W8 CATTLE LEVER



W1/W5 CATTLE non-Hayward



W1/W5 CATTLE - Hayward

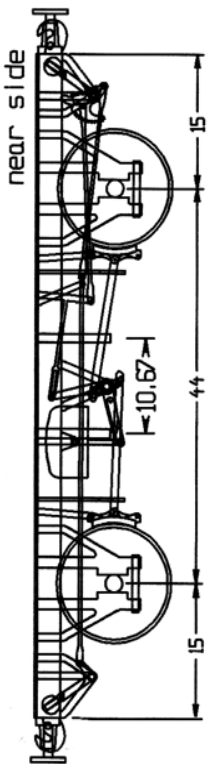
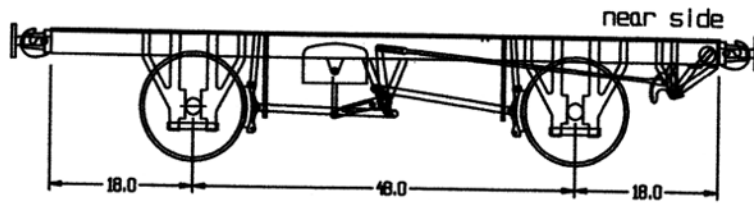
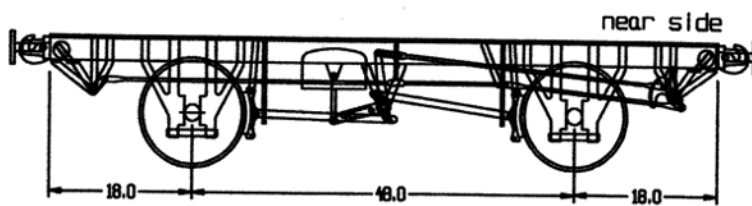


Figure 13

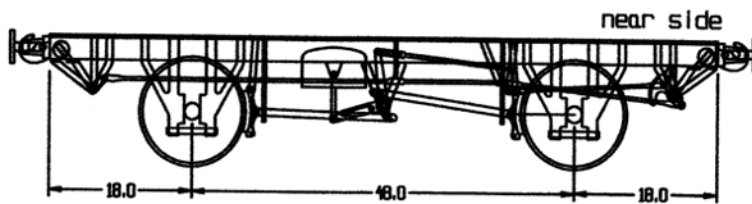
MINK B/C DC2 - non Hayward



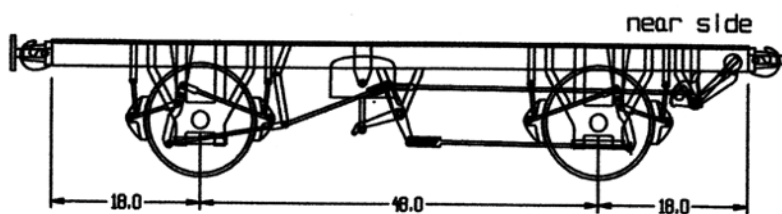
MINK B/C DC3 - non Hayward



MINK B/C DC3 - Hayward



MINK B/C DC2 clasp brakes



MINK B/C DC3 clasp brakes

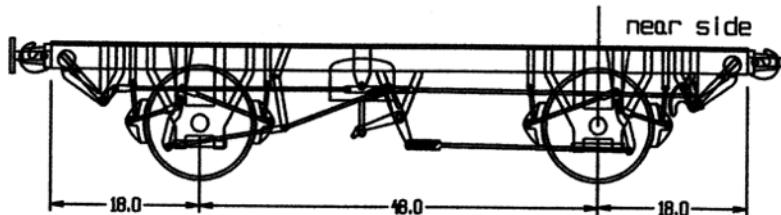


Figure 14

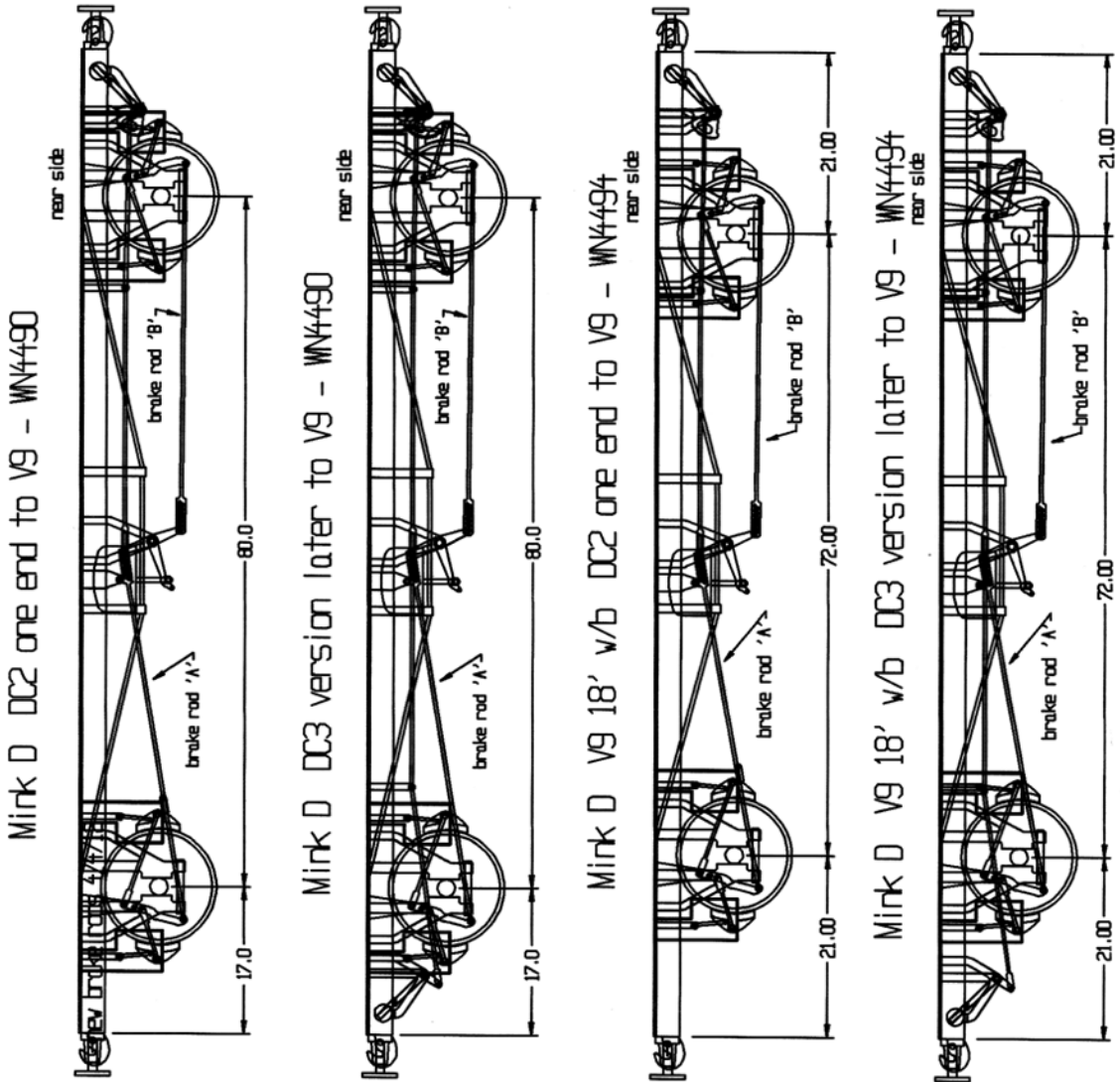


Figure 15

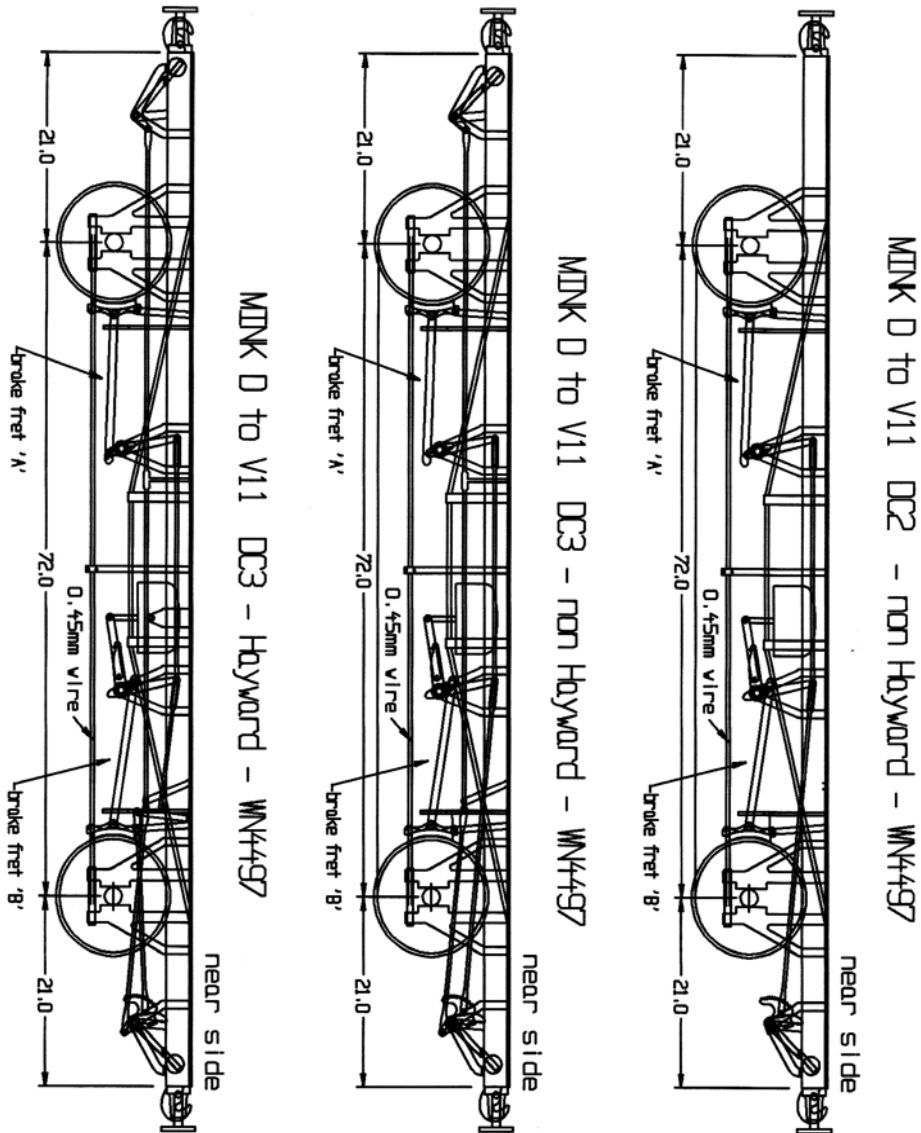


Figure 16

MONK G to V22 DC3 - Hayward

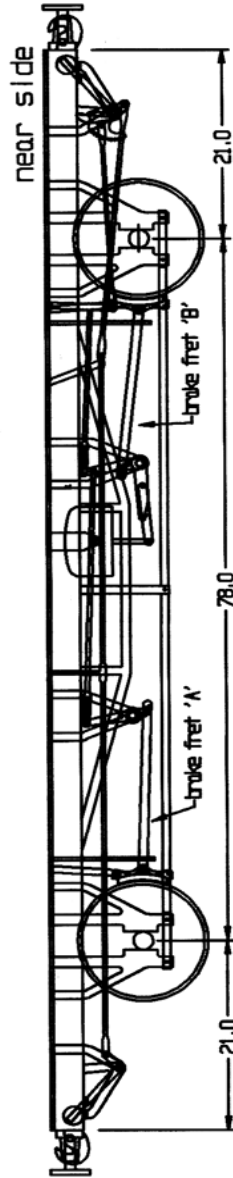


Figure 17

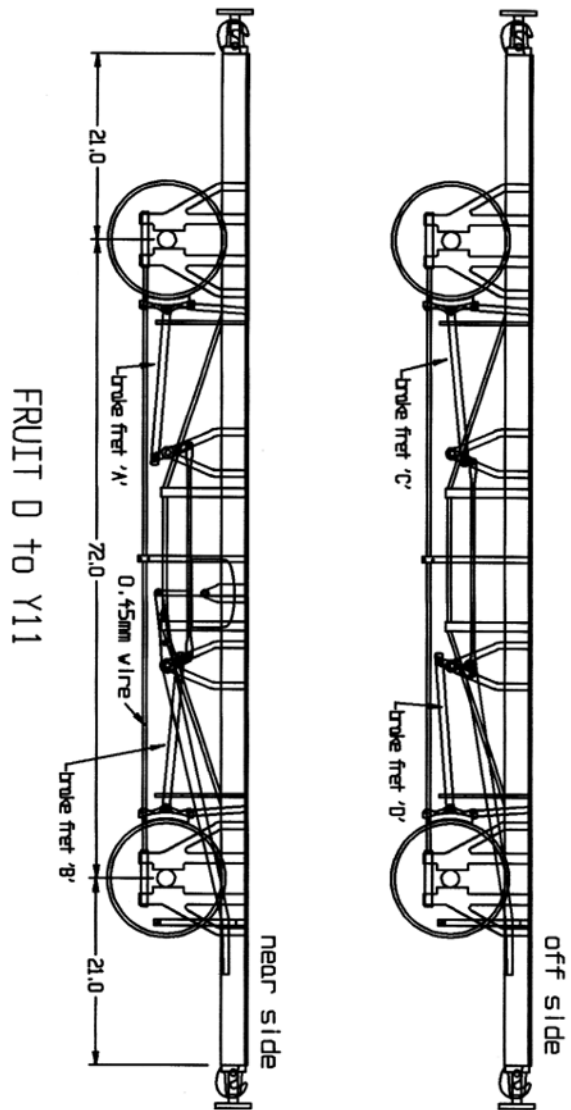


Figure 18

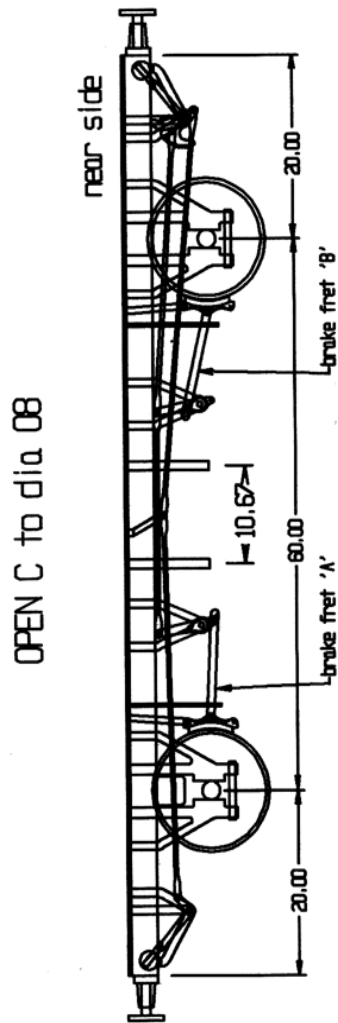


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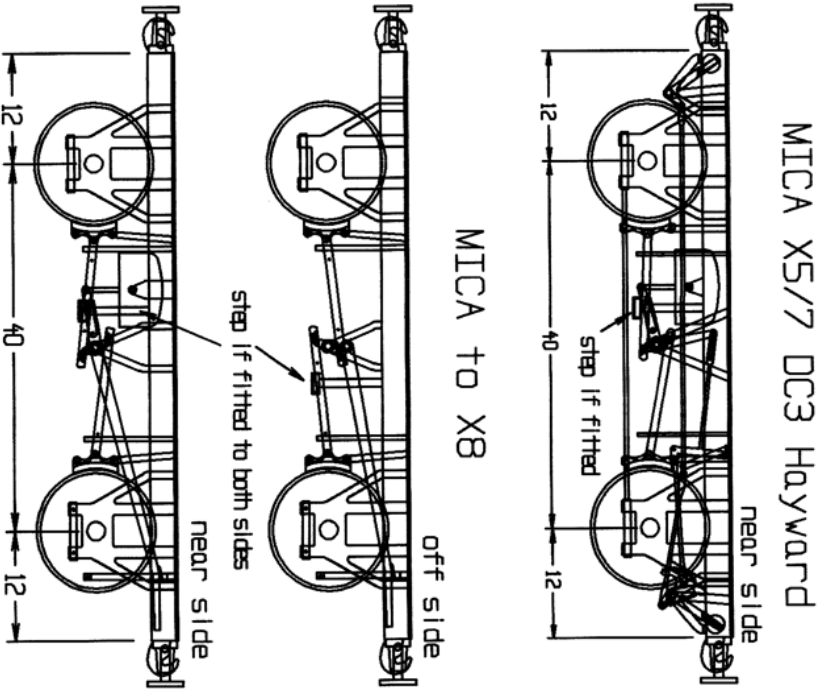


Figure 20

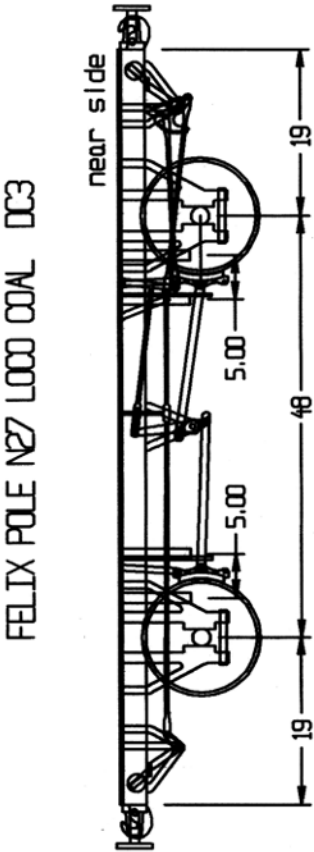
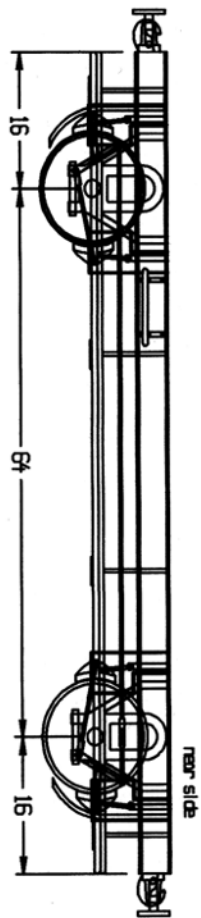


Figure 21



TOAD Brake Van to diagram AA13 20T

Figure 22

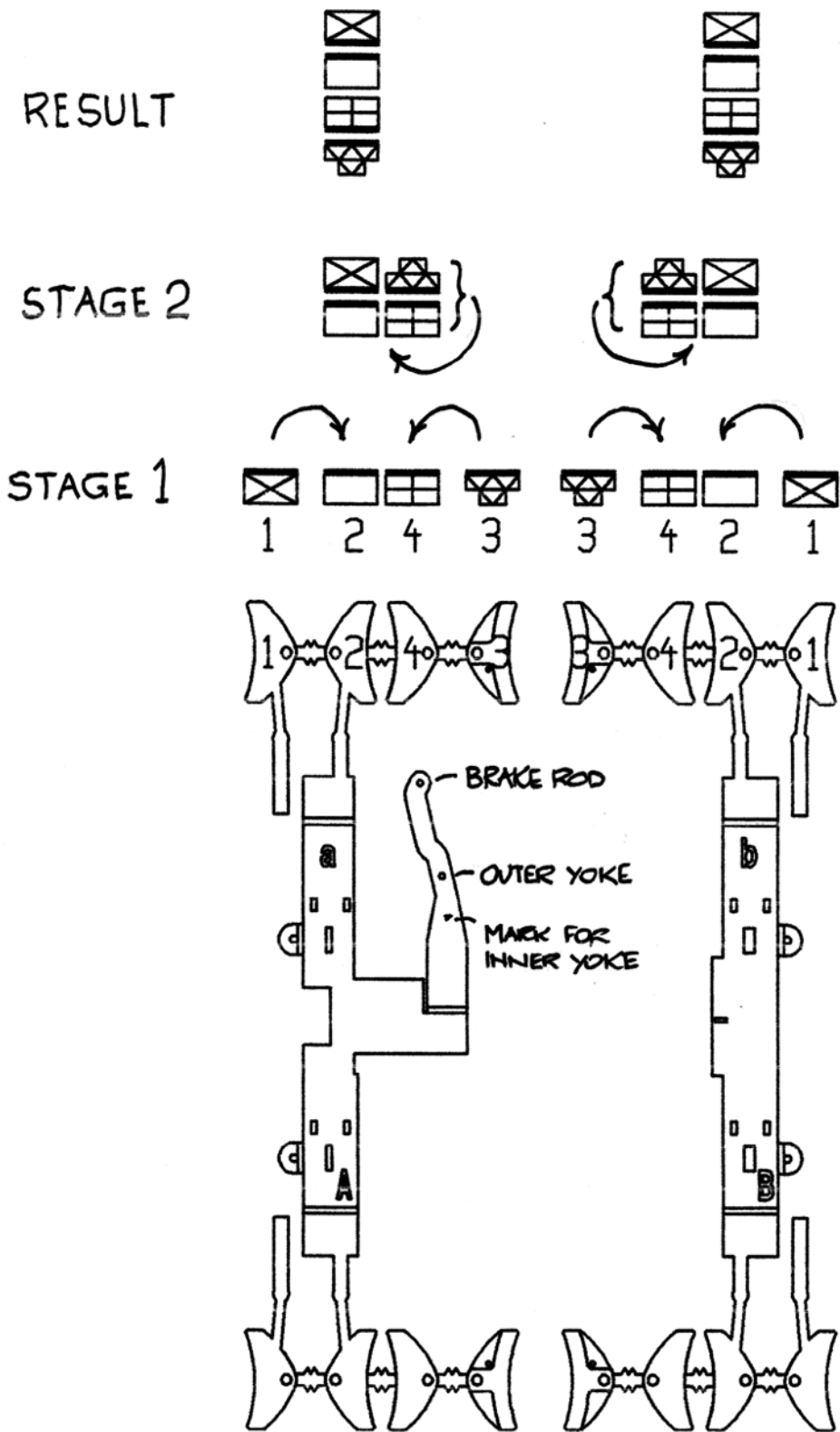
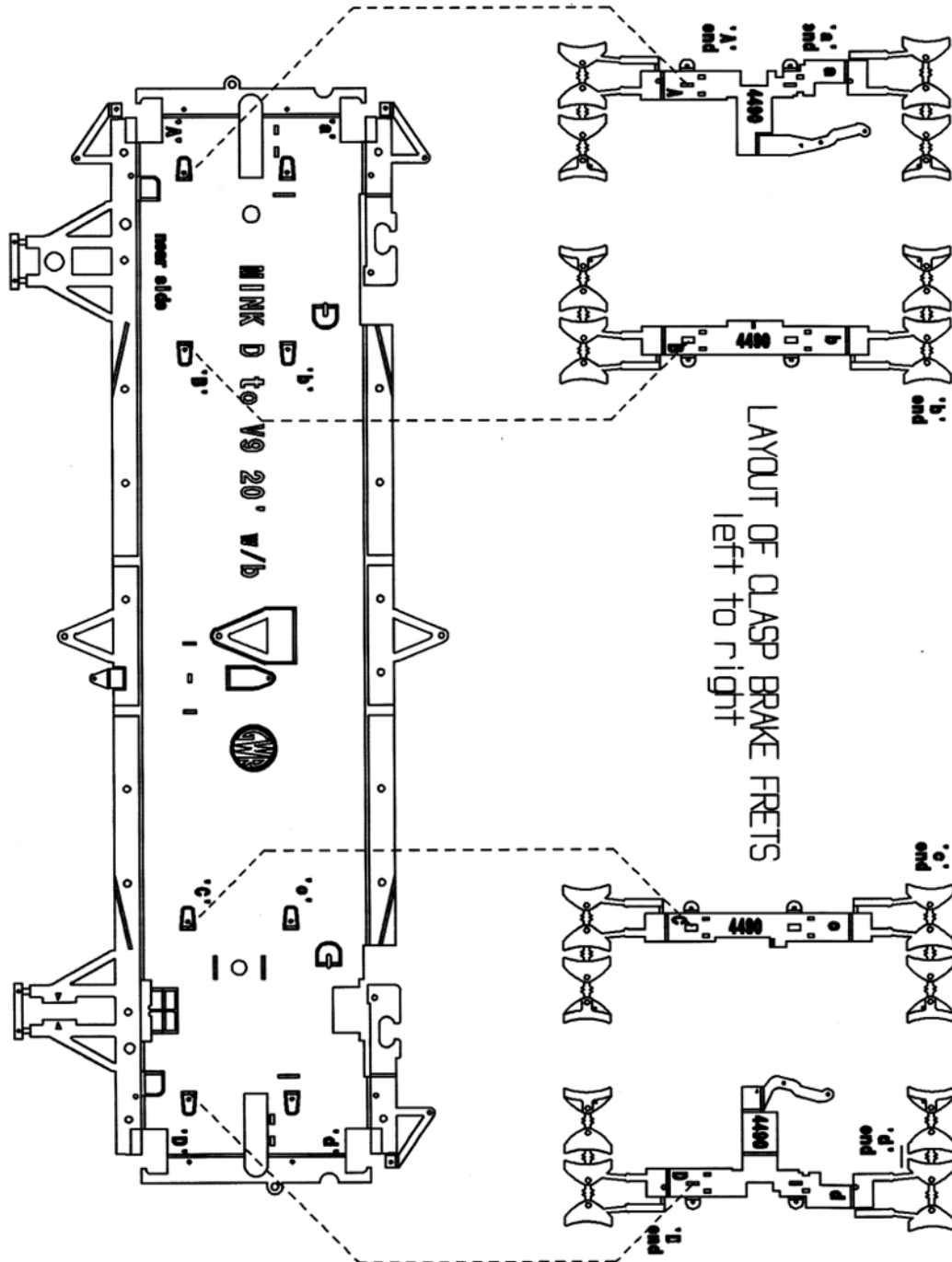


Figure 23



V4 V9 & W5 BRAKES

Figure 24

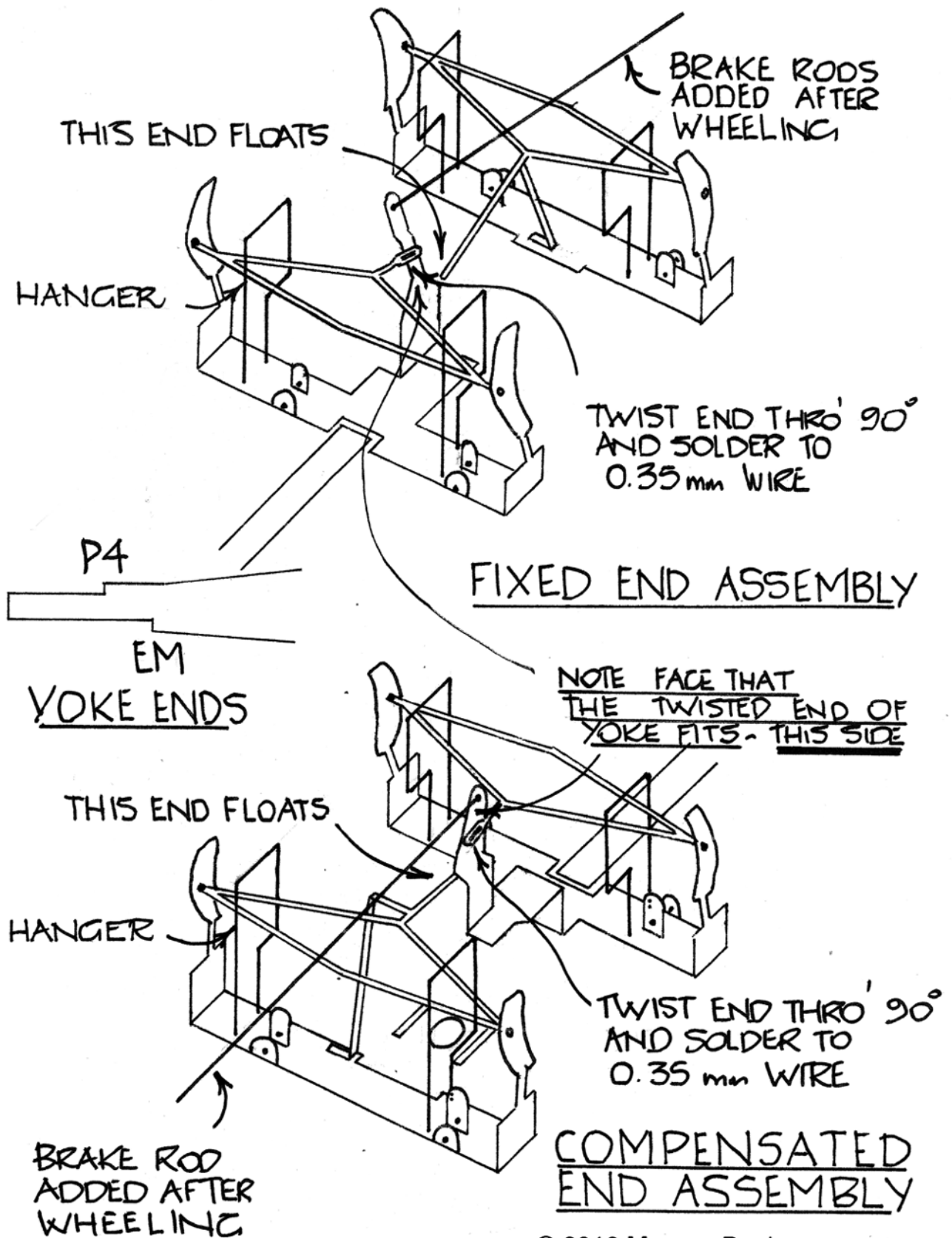
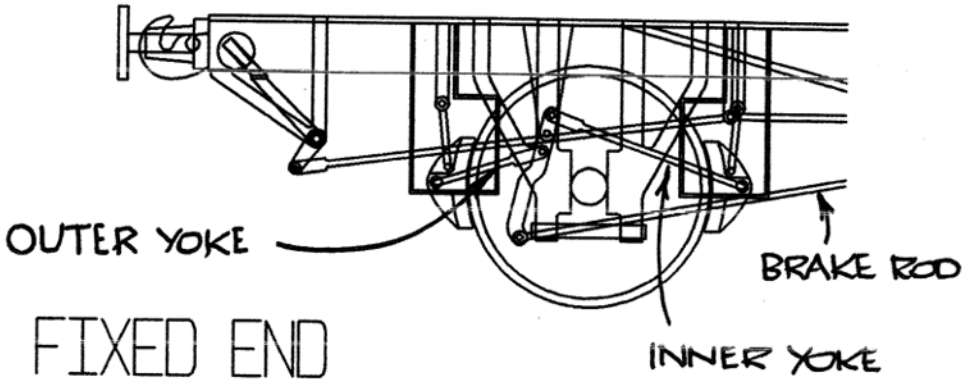
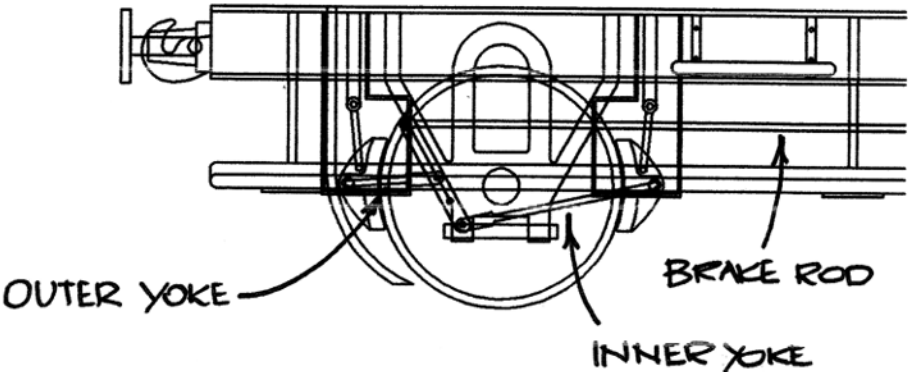


Figure 25



Clasp Brakes for MINK D, V4 and W5

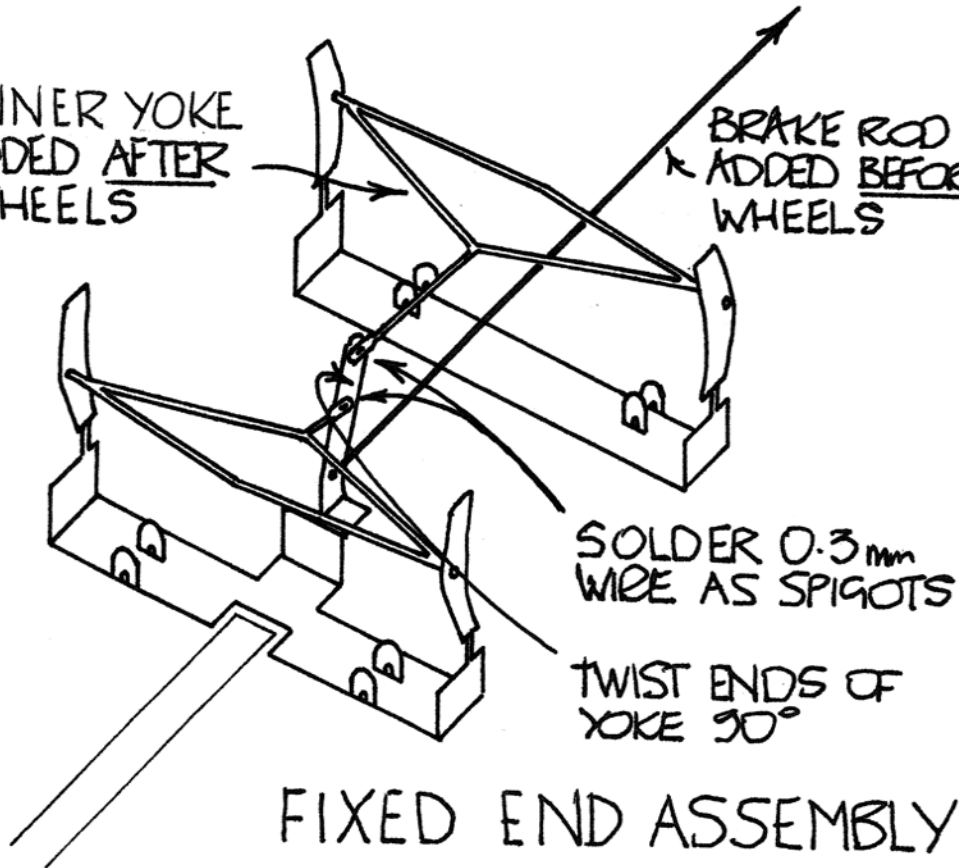


Clasp Brakes for TOAD Brake Vans

Figure 26

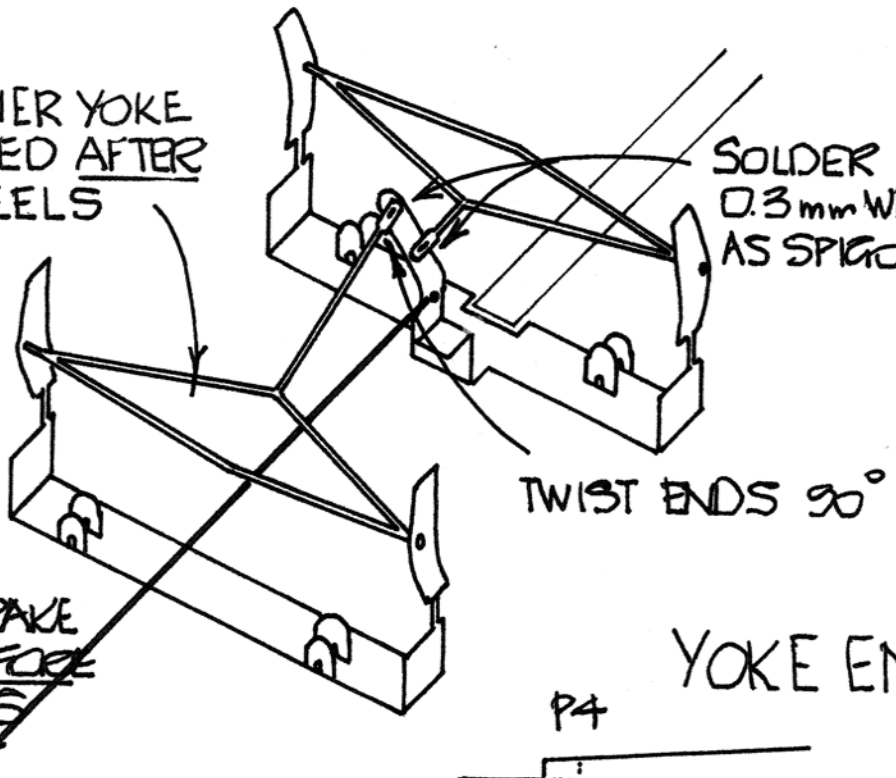
INNER YOKE
ADDED AFTER
WHEELS

BRAKE ROD
ADDED BEFORE
WHEELS



INNER YOKE
ADDED AFTER
WHEELS

SOLDER
0.3mm WIRE
AS SPIGOTS



YOKE ENDS

P4

EM

© 2012 Morgan Design

Figure 27

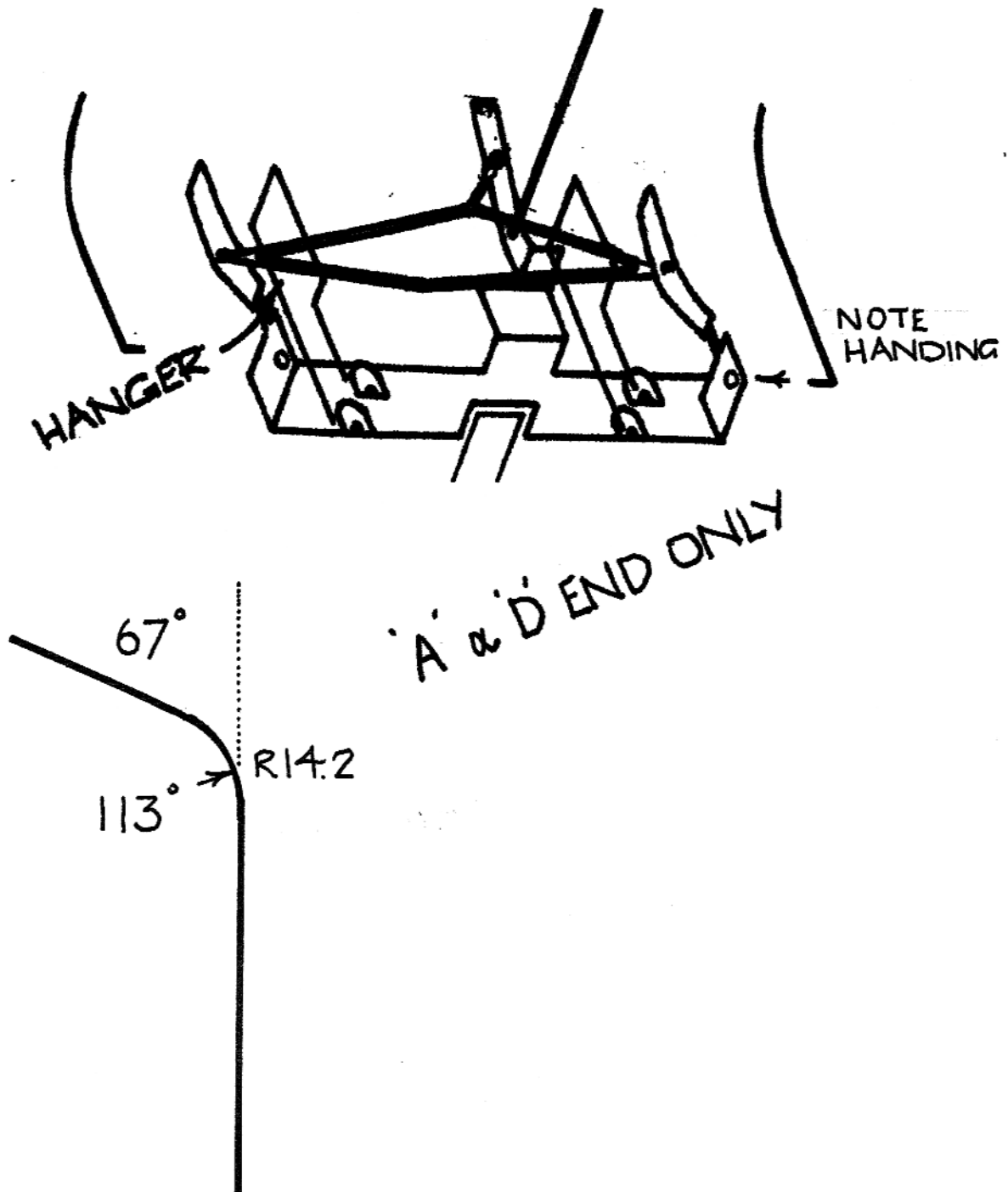


Figure 28

IF DC2 CUT AWAY BRACKET & INTERMEDIATE BRACKETS
IF DC3 CUT AWAY ONLY

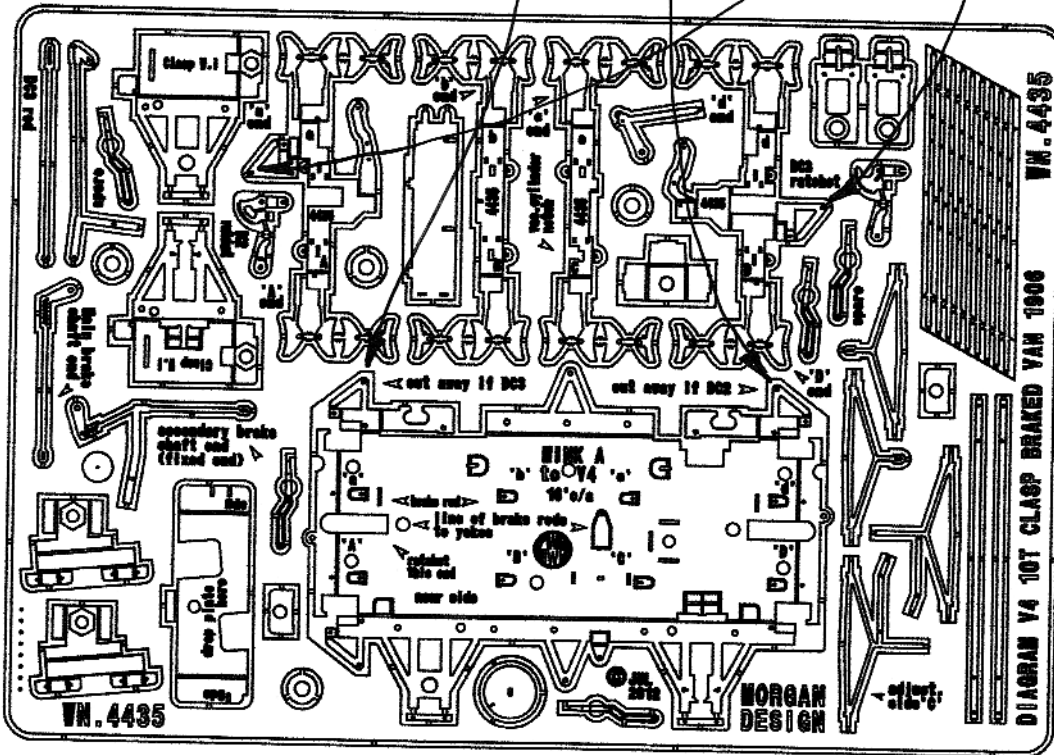


Figure 29

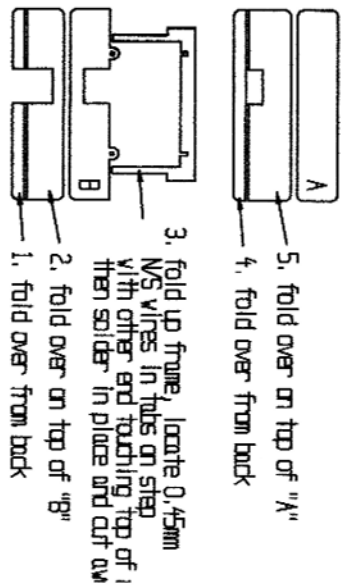
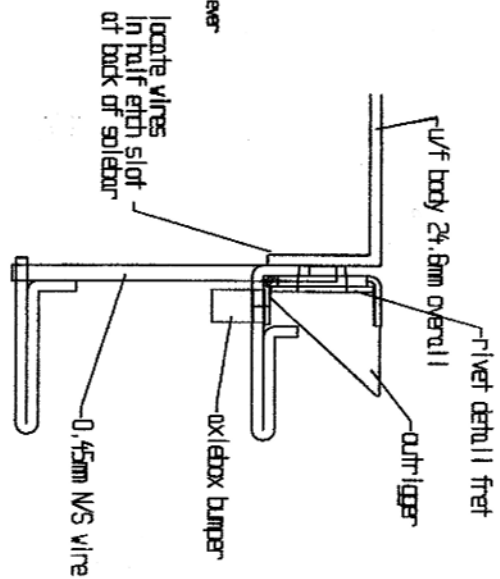
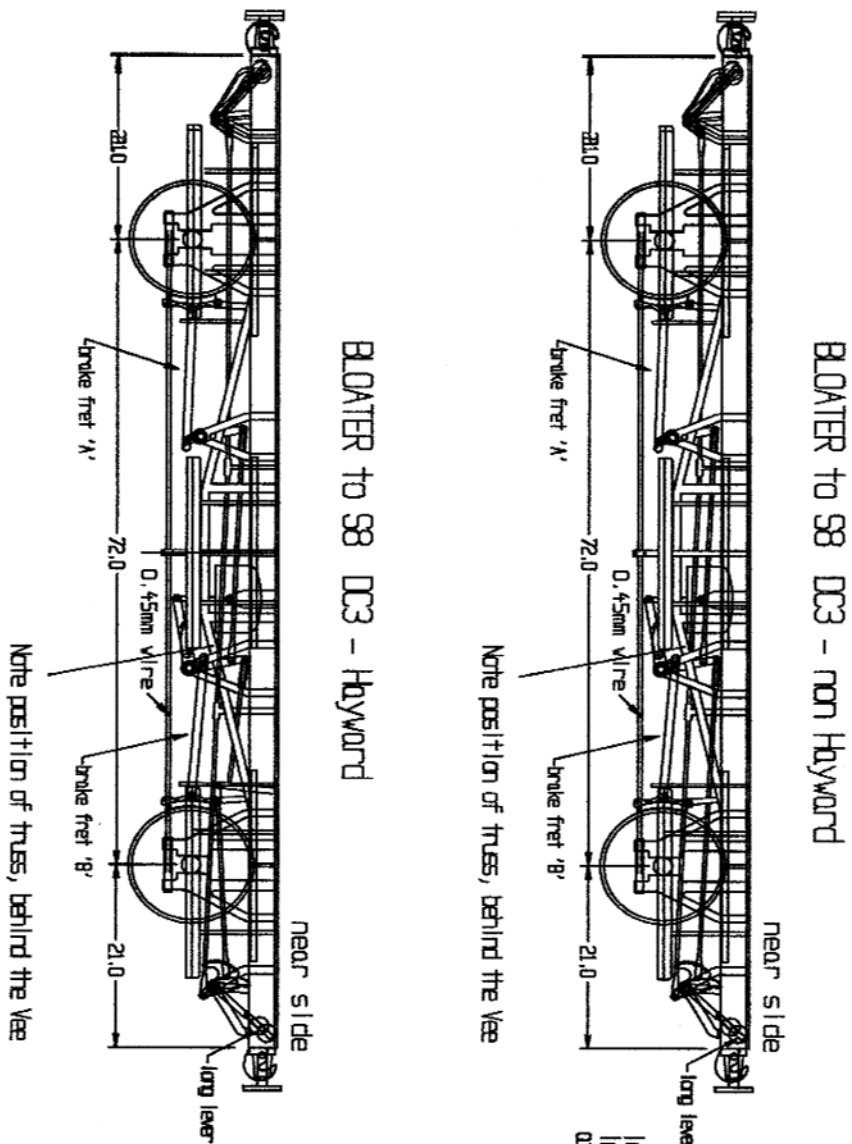
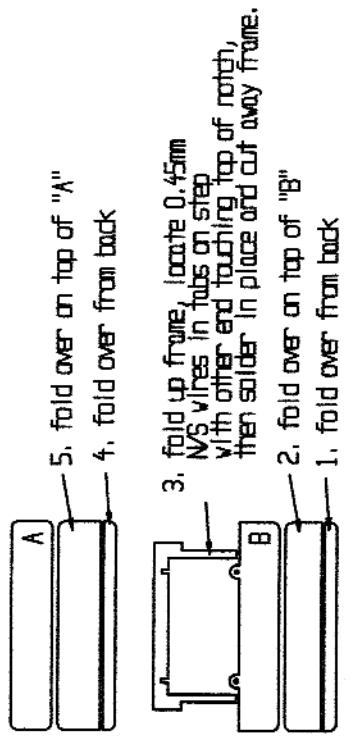
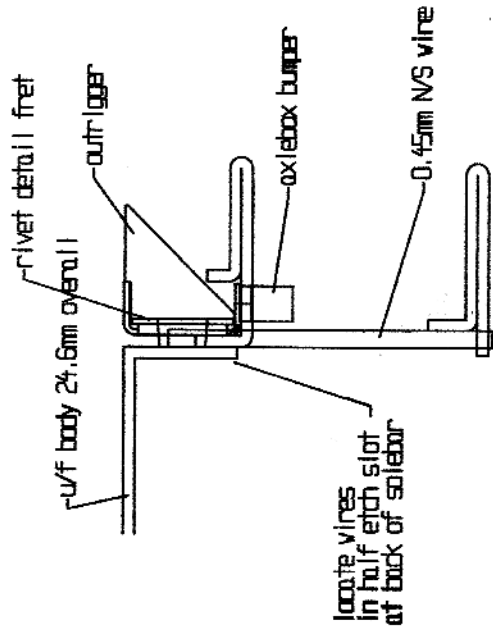


Figure 30



PYTHON P19

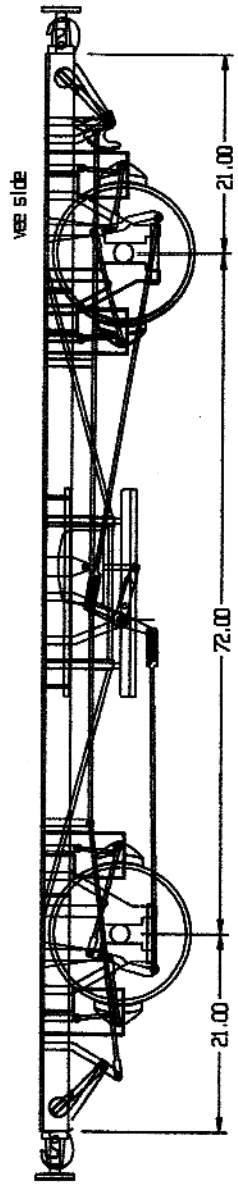


Figure 31

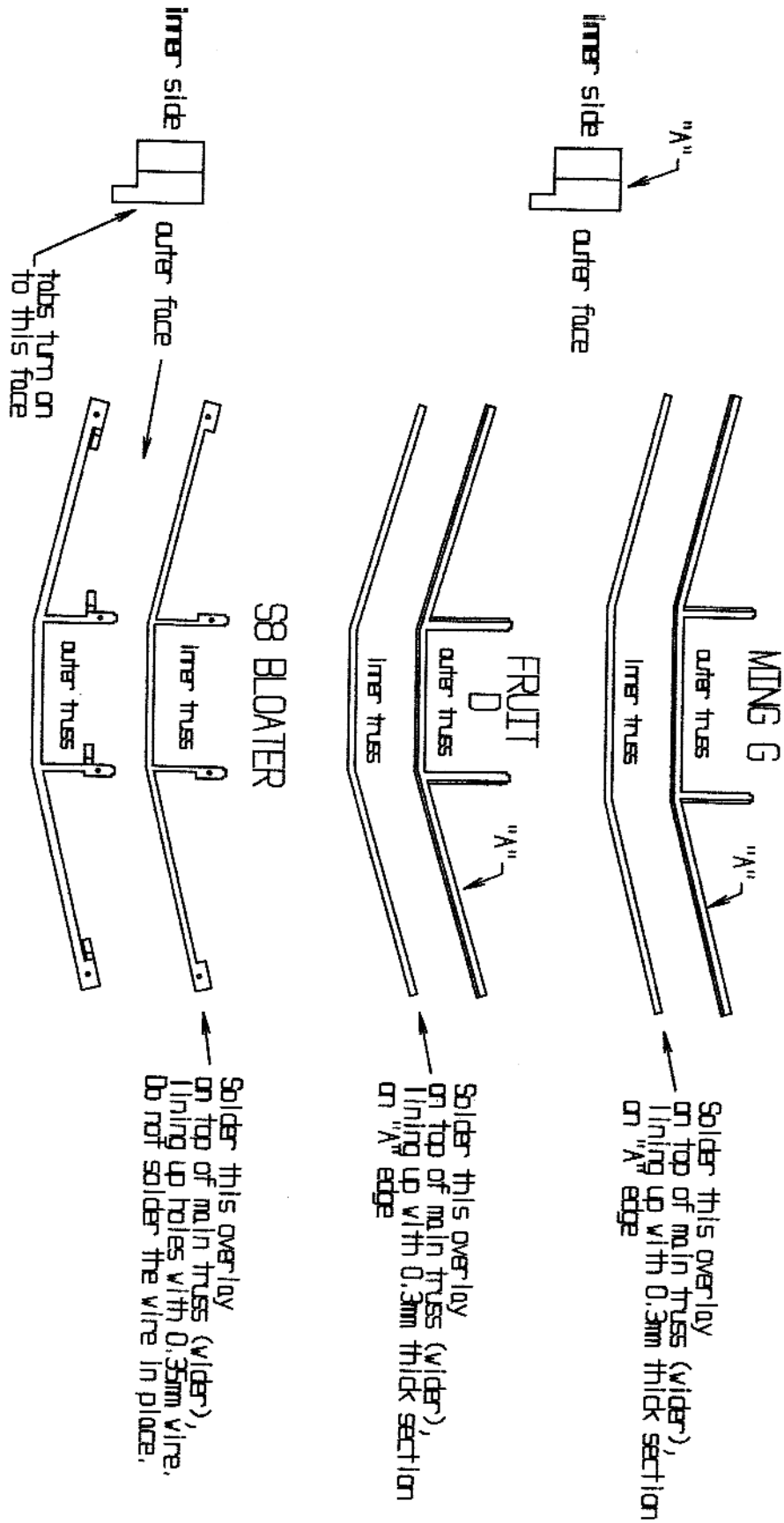
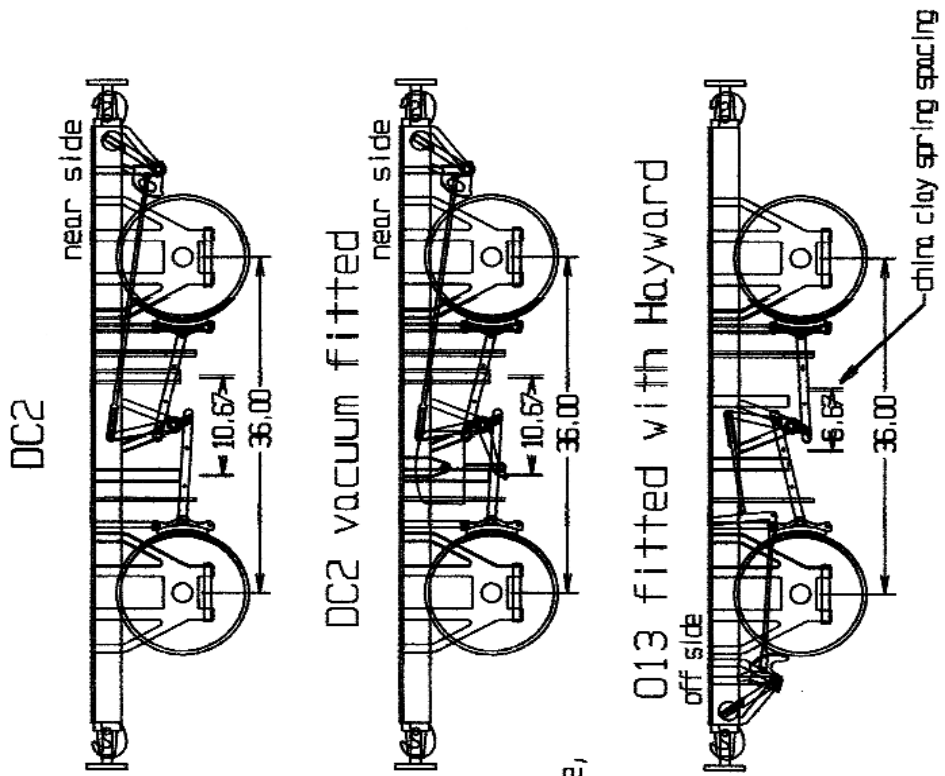


Figure 32



Standard DC2

Note

The standard DC2 had the ratchet on the near side close to the end bracket.
 However on the 013 the ratchet was on the opposite side, the off side, close to the end bracket

013 China Clay