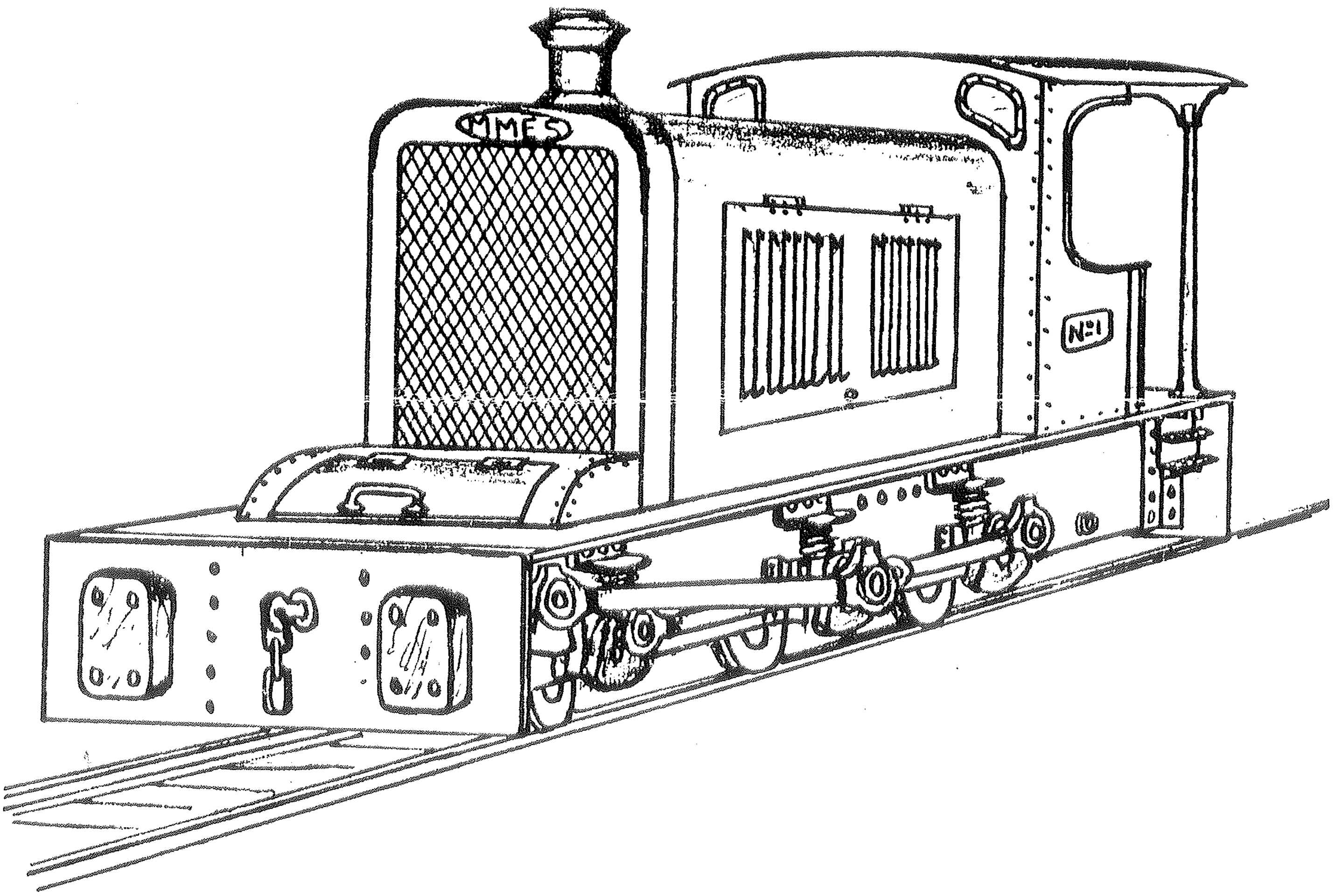
MAIDSTONE MODEL ENGINEERING SOCIETY



NEWSLETTER - Autumn 1985

S U E ' S   S P O T

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Well, here we are again nearing the end of yet another running season. Due to the wet weather there were several Sundays in mid Summer when we were unable to run for the public. Open Day in July was luckily fine and our thanks to all who helped to make it a success, particularly those in the kitchen. If anyone has not yet been reimbursed for catering expenses please do come and see me. Both our barbecues were rained off, but it did stay fine for our fish 'n' chip night and evening run. As usual it rained on us when we visited Sutton Club at the end of August! but fortunately cleared up later in the afternoon. To September, and I hear the Sheppey track opening went well, and the Southern Federation Rally at Tonbridge was certainly well attended.

Autumn Programme

Friday, October 4th:	Video Extravaganza at 7.30 p.m.
Sunday, October 20th:	Last public running day
Friday, November 1st:	Talk and slide show on the Kent & East Sussex Railway at 7.30 p.m.
Friday, December 6th:	Film/Video evening with Trevor Spooner at 7.30 p.m.
Thursday, December 26th:	Boxing Day run

Please don't miss the Mote Park Video blockbuster on Friday, October 4th. I can well understand why films take years to make, it has taken several days filming and many evenings putting together this entertainment. I'm sure you will recognise many people taking part (albeit unwittingly in most cases!) and you might be included!

Sunday, October 20th is the last public running day - deep gloom, this always heralds the onset of Winter.

Doug Lindsay is coming to give us another of his popular talks and slide-shows on the Tenterden line on November 1st. His last evening with us was very well received and I know that you will all look forward to hearing some more about the Kent and East Sussex Railway.

A new face for the December club night - Trevor Spooner is to give a talk/film/video. The subject matter has not yet been confirmed, but might include material on Robin Leigh-Pemberton's old track, 7 1/4" gauge railways, the Romney Hythe & Dymchurch line .... do come along and find out.

So Christmas will soon be with us again and the annual Boxing Day run. Booze and trains will be especially welcome, all donations to the Press Officer ....

Miscellaneous

There is still some remaining guardrail to be painted, so if you haven't done your bit (or even if you have and will do more!) please pledge your name on the chart in the Clubhouse. Summer holidays and the inconsistent weather have obviously slowed down completion, but those parts already done have improved the looks of the track no end.

Once public running has finished there will still be souls around on Sundays for a chat, possible work to be done if you feel like it, so do drop in as usual.

Finally, to the picture on the front cover provided by Graham Kimber. What is it? you may be asking yourselves. All will be revealed in the Christmas Newsletter, (and the closing date for articles is Sunday, December 8th - a bumper issue would be nice, so do pick up your pen - all articles welcome).

Look forward to hearing from you.

Take care of yourselves and see you anon.

Sue x

SUPERHEATERS

by

Jim Ewins

It was around the turn of the century that locomotive superheaters came into use in full size practice. As with all innovations snags appeared mainly with lubrication and valve wear. It was soon realised that slide valves would not stand up to the superheat temperatures and the higher pressures which were becoming common, and that piston valves must be adopted. These in turn presented difficulties until the multi-ring arrangement was adopted. It was the failure of Churchward on the G.W. to take advantage of high superheat that his pre-eminence in the field of loco design lost ground. Greater efficiency is obtained in full size by the use of superheat because in order to produce steam you first have to boil water, and having boiled the water and used valuable heat to do so you want to get as much extra heat into the steam as possible, for it is this extra heat only which is available to be transformed into useful energy at the driving wheels.

In the model context there is an even more pressing need for superheat since efficiency per se is not of paramount importance because we do not have to bother over much about the cost of the coal we use. The need for us is to offset the large and disproportionate cooling which occurs as the steam passes through the cylinders of our small engines. This cooling is disproportionate due to what is often called the square-cube law which can be described as follows. If one calls the ratio of the lengths of model and prototype the "scale" so that for 1" to the foot this would be 1/12, then all the areas of the model will be reduced in the ratio 1/12 X 1/12 = 1/144 those on the prototype. Similarly all the volumes will be 1/12 X 1/12 X 1/12 = 1/1728 those on the prototype. In relation to the cylinder therefore this means that the volume of steam enclosed is surrounded by a cylinder wall area 12 times greater in proportion than in the prototype and it is through this area that heat can escape. But this is not all, for that heat travels out onto the frames, running boards etc which serve as effective radiators of disproportionate area also. Indeed this cooling is so vigorous that even with the high superheat obtainable from a radiant superheater lubrication problems do not arise with slide valves and with pistons using soft packing. My 0-6-2T has both and has covered nearly 3000 miles (measured and not guessed at) without needing attention.

In conventional model practice practically nothing can be done to prevent this escape of heat and although this does not matter too much from the point of view of economy there are other and more compelling reasons to offset its effects. Wet steam does not flow freely through ports and passages and it also has the property of transferring heat readily to surfaces it comes into contact with. If the steam can be kept dry or superheated, pressure drops through ports and passages will be dramatically reduced and heat losses minimised. Keeping the steam dry during its time in the cylinder can only be achieved by starting with it at a high temperature. In addition to this the amount of water used to produce a given volume of steam decreases with the final temperature so that with high superheat less water has to be boiled up and less coal therefore used. The effect of this is to enable the engine to steam for longer periods before the fire becomes clogged with ash and clinker.

Wet steaming is normally evidenced by the appearance of white clouds near to the chimney but one can be deceived here in cases where the fire has been driven so hard (by a small blast nozzle) that the volume of flue gas mixing with the exhaust steam is sufficient to keep the steam from condensing even when it has left the chimney by a considerable distance.

I know cases where superheaters have been removed completely leaving the flue tubes empty. This results in very vigorous steaming because of the reduced resistance to flue gas flow but the penalty as indicated earlier is a short life and a merry one for the fire. Engines treated thus usually seem to perform well enough albeit sluggishly but they are soon back in the steaming bay with clinkered up grates.

There are two types of superheater, the flue tube type and the radiant. In full size the flue tube type is always used because sufficient superheat can be obtained with it owing to the high velocities both of the flue gas passing over the elements and of the steam flowing inside. In models, where owing to the scale, velocities are much less, the elements must be passed right through into the firebox to pick up radiant heat direct from the fire. Radiation is independent of flow conditions and depends primarily upon the temperature difference between the body giving off the heat (the fire) and the one receiving it (the superheater element). For those with an appreciation of mathematics it is salutary to observe that heat transfer by radiation is proportional to the fourth powers of the temperatures concerned i.e. heat transfer $\propto (T_1^4 - T_2^4)$ where in this case T_1 will be the temperature of the fire and T_2 that of the superheater element. This fundamental effect escapes the notice and passes the understanding of most of our prolific designers who persist in specifying large grate area in relation to the rest of the engine resulting in a large lazy fire. A radiant superheater is not much good over a black fire!

The design of superheaters does not lend itself well to analysis since conditions vary over such a wide range depending on the loading of the engine. One could write a thesis on this topic and still not arrive at the best result. There are however one or two fundamental considerations such as that mentioned above which one should bear in mind. For instance, the amount of heat picked up by a radiant element depends on its external surface area. This would seem to suggest having a large number of elements. However if one does this the total cross sectional area inside the elements will be large and the steam velocity through them small which is a condition conducive to poor heat transfer from the interior of the element to the steam passing through it. What is wanted, therefore, is a tube with a large external surface and small cross sectional area. I obtained such a result on my 9F by flattening the elements to an oval section. The fundamental effect governing the internal heat transfer to the steam flowing in a superheater element has become known as the "Reynold's Analogy". In the present context this states that the heat transferred to the steam from the internal wall of the superheater element will be directly related to the friction experienced by that steam in passing through the element. In order to overcome this friction there will be a pressure fall along the element resulting in some of the available boiler pressure being taken up by the process of superheating.

The manufacture of superheater elements presents some constructional difficuties associated with the need to provide a path for the steam up to the fire and back again to the smokebox. Ideally this would be achieved by bending a tube sharply back on itself without flattening, a quite impossible task for the amateur. Alternatives to this are the spear-head and the block return bend. This latter type if used as a flue-tube heater is better described as a "blocked" return bend for it very quickly becomes this in use and the heater rendered worse than useless because the pressure drop through it remains whilst there is no flue gas and therefore no heat to transfer. Another type sometimes advocated has a concentric configuration in which a small diameter tube is contained within a larger one, the steam flowing down the central tube and back between the two tubes or vice versa. This arrangement is inferior (very much so in most designs) because resistance along the central tube can take no part in the net heat transfer.

The production of superheater elements of satisfactory durability calls for some care particularly in the selection of materials. The preferred material for the tube which is readily available is stainless steel of the "Austenitic" type as exemplified by the British standard E.N. 58. specification. This material can be readily identified by checking that it is not attracted by a magnet. The main difficulty in making the elements is that of joining the separate parts in a way that will stand up to the high working temperatures. Welding is of course best but is not likely to be available to the home worker particularly as the argon-arc or similar technique must be employed on the thin material. Since I retired I no longer have this facility available but I have found that a good substitute is to braze with No 3 Sifbronze. This is a high melting point material containing 15% nickel which can be run with oxy-acetelene, oxy-propane or twin carbon torch. I have heard of cases where lower melting point alloys have been used but my experience is that, while they do not actually melt in service they quite rapidly deteriorate causing early breakdown. E.N. 58 is an alloy containing around 18% chromium and 8% nickel. The nickel is essential in preventing corrosion from within the element. At any joint made with a dissimilar material (i.e. not welded) there will be a line where alloying takes place with the parent metal. The composition of any alloy so formed must in this case be one which resists corrosion by containing a high nickel content. It is to this end that brazing must be carried out with alloys rich in nickel which renders the No 3 Sifbronze so suitable. At points where the temperature is not so high such as those near the smokebox Easy-flo No 3 which contains about 3% nickel and runs at 650°C is very useful.

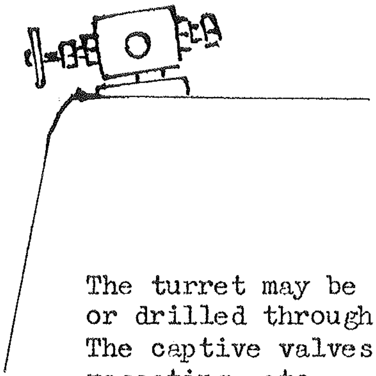
A difficulty which arises when using stainless steel for superheaters is that of bending the ends of the elements in the smokebox so as to join up with the wet and dry headers. A way out of this difficulty is to provide "tails" of a softer material. Copper is unsuitable for this duty because it flakes at the high temperatures achieved with a radiant heater. (If copper is used and it doesn't flake then you aren't getting much superheat!) I have used brass for this purpose of 70/30 composition very successfully, being prompted to do so by observing the way paraffin blowlamp coils stand up to running red hot for many years of use. The joint between the tail and the stainless tube is most conveniently situated within the flue tube near to the smokebox. The usual joint depicted in published designs is of the "muff" type using a larger diameter tube threaded over the two tubes to be joined. This is a poor way of doing things because it creates an obstruction against which ash and soot builds up. A better way is to turn male and female tapers on the tubes. When soldering this joint with Easy-flo No 3 one must guard against an effect known as "liquation". This occurs in brazing alloys due to their various constituents having different melting points. As these materials are heated up the lower melting constituent becomes liquid and flows into the joint leaving behind the rest of the alloy which is of higher melting point. Unless the joint width is small i.e. the alloy does not have to penetrate far, the final joint will have a graded composition with the low melting constituents furthest into the joint. In the present instance when conventional techniques are used the part of the joint inside the tube will be deficient in nickel and therefore liable to corrosion in the moist environment there. My solution to this problem is to "tin" the male component of the taper joint just mentioned with a thick coating of the Easy-flo No 3 thus ensuring that the composition is uniform right through the joint.

Earlier I said that not much can be done about the escape of heat in a conventional model loco. In my "Riddle" however I set out to show that by situating the engine in the smokebox and thus preventing the escape of heat and attendant condensation the engine would have the lively characteristics of a highly superheated engine in spite of deliberately using short travel piston valves of small diameter with no lead nor exhaust clearance,- all the desiderata so avidly espoused by our "draughtsman designers" and Great Western addicts who fail to understand that model locomotive design is a different "ballgame" from that of full size. These people do not understand the <u>physics</u> involved.

A SIMPLE BOILER TOP TURRET WITH EASY REMOVABLE VALVES AND SEATINGS.

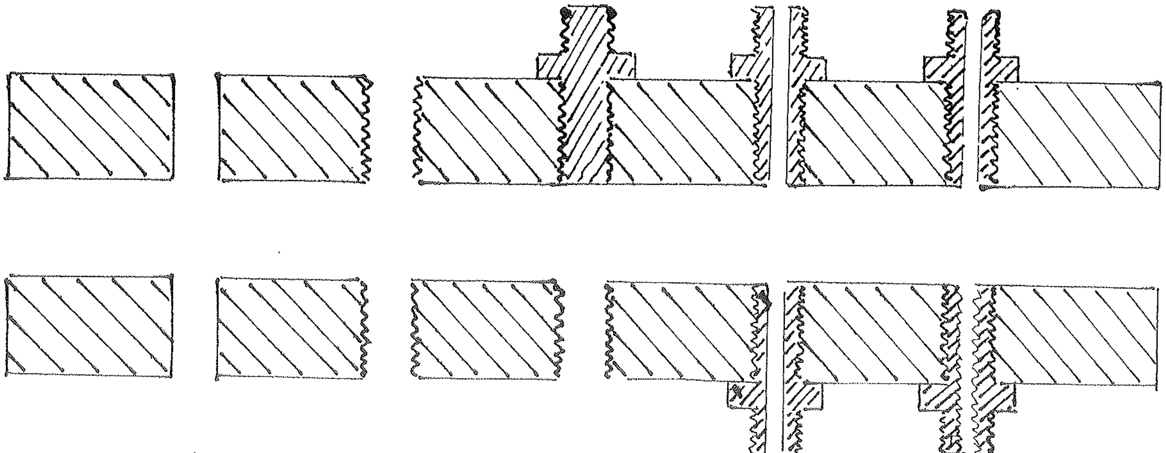
Made from a piece of rectangular gunmetal bar.(Drilled to suit the top boiler bush).

1. Drill.
2. Tap.
3. Plug with hexagon screwed bush.
4. Screw in second hexagon bush and usethis as a drill guide then follow with reamer.
5. Tap second bush.
6. Fit valve spindle.
7. Fit gland nuts and wheel. (Plug off ends)

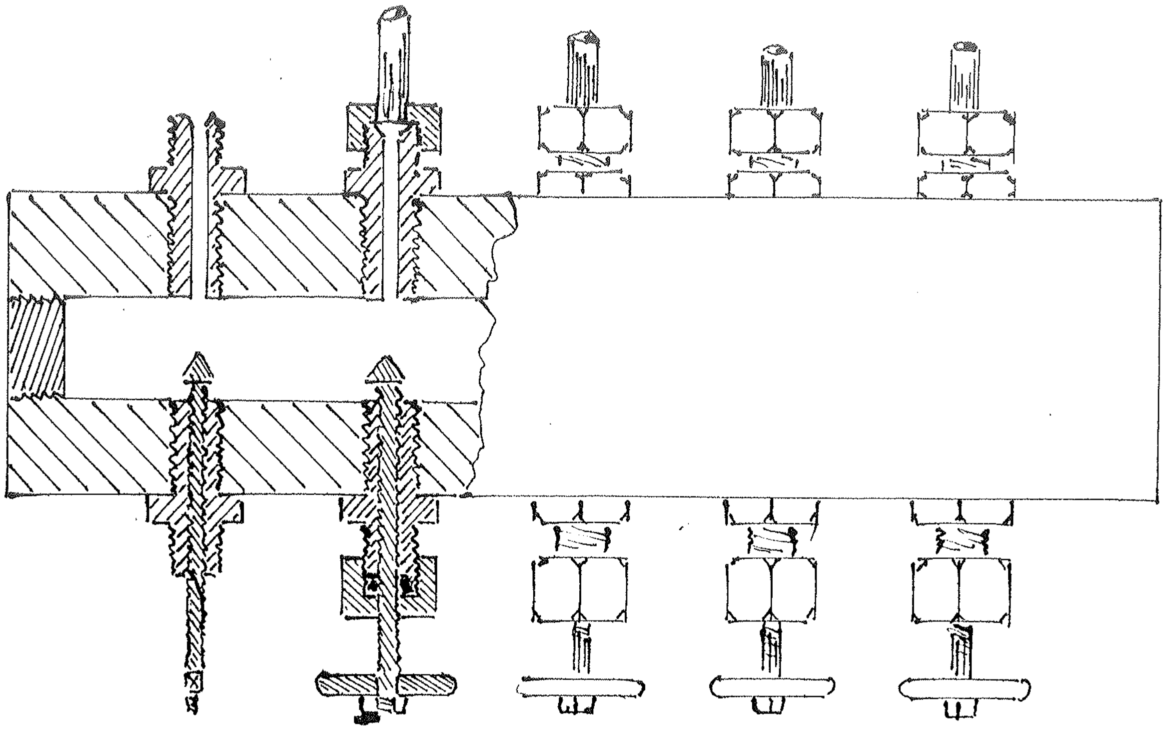


NOTES. A 3/32" reamed hole may be used for a 1/8" X 40 T.P.I. valve spindle.
The pressure gauge could be taken off one of the eends.
A whistle valve can be made by using one of the fittings, (Modify to slide the valve spindle off the seatings by the usual lever).

The turret may be fitted to boiler top by either a screwed bush or drilled through and bolted direct to boiler bush.
The captive valves can be removed from the block for repairs, such as reseating. etc.
A.H.W.P. (Jack)'85.



1. 2. 3. 4. 5.



6. 7.

MODEL LOCOMOTIVE WHEEL QUARTERING

by P.I. Clark

Martin Evans writes in his "Manual of Model Steam Locomotive Construction" -

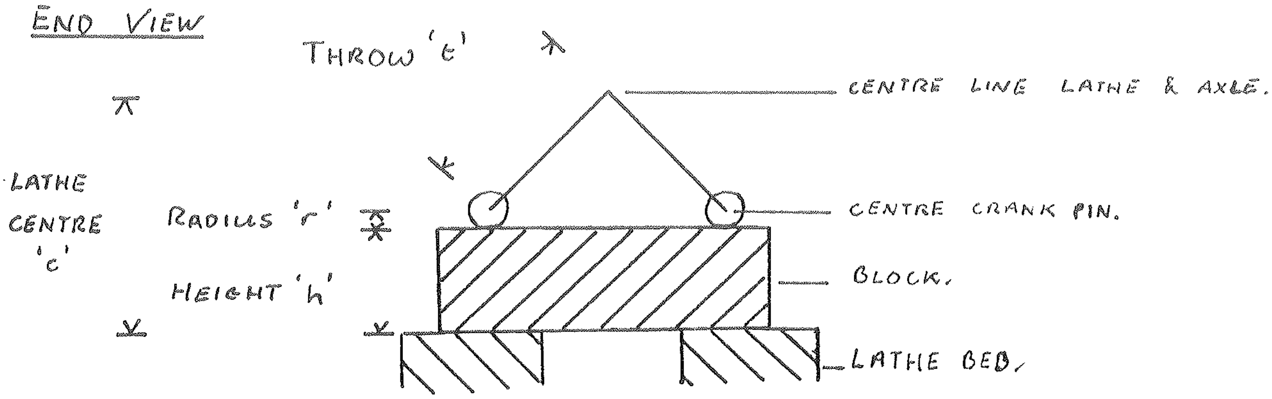
> "Driving wheels must be quartered before pressing home. That is to say the wheels on one side of the locomotive must be set at exactly 90° to those on the other side (for a 2 cylinder engine, or 120° for a 3 cylinder)".

Two methods are then described, the first involving a jig of two plates separated by four rigid stretchers. The wheels and axle are supported between them and quartered by pegs pushed through accurately placed holes in the plate. The other method involves pegs being temporarily fitted to the axle and crank holes. When set up on a flat surface a square aligns one crank vertically whilst a rule and D.T.I. are used to check the other is horizontal. When this is the case the wheels are correctly quartered.

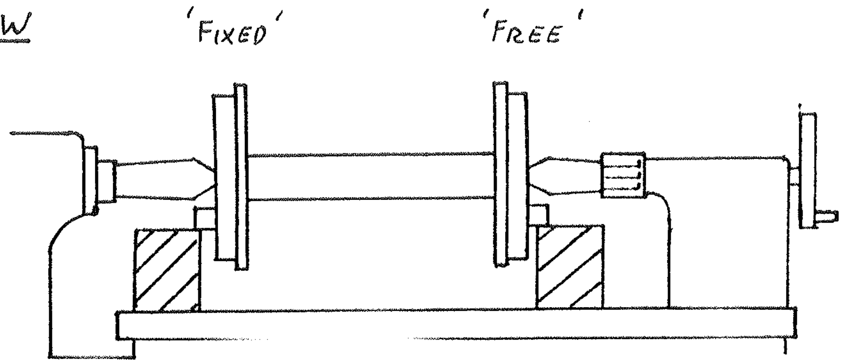
Butch, an 0-6-0 T, was quartered by the first method but this involved a jib of 10 parts. The other method again involved more parts and equipment so that for Sweet Pea and Dholpur a simple alternative was used, as below, which members may find useful.

The wheels are made in a jig so that the crank throw is absolutely constant between different wheels. The crank pins are then inserted into the finished wheels and loctited. One wheel is then loctited and pinned to each axle. The only "jigs" involved in quartering are two blocks which rest on the lathe bed and these are made next. The set up is best shown in a schematic diagram (for a 2 cylinder locomotive).

END VIEW



SIDE VIEW



The only critical dimension of the blocks is "h", machined by milling or on the lathe faceplate "h" is given by -

$$h = c - (t \cos 45° + r)$$

The values for c, t and r will of course vary for the locomotive and lathe concerned. In the set up shown the free wheel is being loctited and allowed to set in situ. As long as the cranks are in contact with the blocks they will be at 90°. A weight can be placed on each pin so that they don't move before the loctite has set. Then the wheel is pinned to the axle (pin parallel to the axle centre line).

If the components have been accurately made good quartering results will be obtained. Even if h is in error the wheels will still turn as each axle is out by an equal amount from 90°.

This method can be applied to a 3 cylinder locomotive as well. Here the cranks must be 120° apart so that h becomes -

$$h = c - (t \cos 60° + r)$$

One block would have to be narrow enough to fit between the inside crank webbs. This would be the initial reference and the wheels fixed to the axle in relation to it.

Does this method satisfy Inspector Meticulous? Sweet Pea and Dholpur's coupling rod centre's were marked out by centre drilling on the milling machine. When fitted to the cranks all turned without adjustment, Dholpur being an eight coupled locomotive. 'Nuff said.

(with apologies to LBSC)

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TALKING ABOUT TUGS AGAIN

On a recent South East News on T.V. there was a report on the Chatham Historic Dockyard which showed a brief glimpse of the paddle tug "John H. Amos" of Middlesborough. This is an exceptionally interesting vessel named after a local councillor and one that would be very well worth a visit by any model engineer when the restoration work is eventually completed.

The "John H. Amos" is the last steam paddle tug built in Britain and was built for the Tees River Commissioners by Bow McLachlan & Co. of Paisley in 1931 and the last vessel built by the Company - in fact the firm went bankrupt during her construction and she was completed after the liquidators decided to finish her. She is a little beamier than the average paddle tug, being 110.0' x 22.6' x 10.7' and of 202 gross tons. Like the screw tugs of the period she has pitch pine wooden decking over the living quarters only, to reduce the noise of people tramping about over the deck, and close stowing anchors in hawse pipes.

Her machinery is quite exceptional for a non Naval paddle tug as she has two sets of compound diagonal engines of 127 nominal horse-power with disengaging gear connected to her 7 float feathering paddle wheels. These take up quite a lot of space below, resulting in the mast being stepped in a socket on deck. The usual engines fitted to civilian paddle tugs were of the side lever type with either single or two cylinders working at very low pressure and perhaps best described as being a form of inverted beam engine with the beams or side levers placed at the bottom. The engines of most of the paddle tugs were supplied by two boilers and the 'John H. Amos' is no exception with her two boilers having their uptakes taken to the single stack.

After her withdrawal from service she was to be preserved by Stockton-on-Tees Council who carried out all the necessary work on the hull but the work had to be abandoned when the Council changed and the money dried up in the squeeze. She was then due to be sold for scrap until bought by a Teynham businessman Martin Stevens, who brought her to a mooring in Milton Creek. Unfortunately she suffered badly from the current senseless plague of vandalism, but of even more importance was the fact that the water and mud there contains something like nine times the safe limit of sulphur which would have eventually ruined her sound hull.

She was towed away from Milton for a short time at Faversham Creek where her overall beam of some 43' 0" over the paddle boxes caused problems resulting in her being towed away again to Queenborough and then to her present berth at Chatham.

It may be asked why paddle tugs should have been built as late as the 1930's and why so many incredibly old vessels should have been kept at work for so long until comparitively recently. The reason was that they were so hardy for stern work where steerability and the capability of taking the way off a ship were of prime importance a towing hook being usually provided forward, in addition to the one behind the funnel. It will be appreciated that a screw tug can exert considerably more power towing ahead then when going astern, when the propeller is thrusting against the body of the hull which naturally absorbs much of the effort. That was the great advantage of the paddle tug and remained so until the advent of the modern "tractor" tugs which were introduced to this Country in 1958.

These modern highly manoeuvrable tugs have their propulsion unit mounted about one-third of the vessel's length off from the bow and with the towing hook mounted quite near to the stern - a very valuable advantage in that it makes it impossible for the vessel to be "girted" - that is pulled over sideways by the tow attached to the usual midships - mounted hook. The actual propulsion unit itself consists of a single Voith-Schneider propeller mounted below the bottom of the hull on a vertical axis and protected by a baseplate and framing underneath. This propeller is mounted on a rotating plate some 12 to 14 feet in diameter flush with the bottom of the hull. Fitted to this plate are six vertical blades of adjustable pitch which can be further variable as to the point at which maximum thrust is directed so that the speed and direction of the tug is achieved by the one unit.

The "John H. Amos" was not the last paddle tug built as the Navy had some diesel-electric paddle tugs known as the Director Class built to act as especially manoeuvrable tugs to handle the great ungainly and windborn aircraft carriers.

Don Paterson