Black Five

The fabulous Stanier Class 5MT 4-6-0 in 5 in. gauge

by: DON YOUNG

Part 1 — Introduction

Eleven years ago when I took the decision to describe two locomotives simultaneously in LLAS, I reckoned if I could manage this for the first 10 years then I would be doing well on my own and hopefully by then I would be able to summon some assistance. Whilst the dream remains to groom another contributor on construction series in the Magazine, looking at the designs already prepared or in the planning stage, already there is sufficient for the next 10 years, in fact which engine to describe next has proved to be my hardest decision to date.

An obvious candidate was ETNA, the LNWR "Precursor" 4-4-0 in 5 in. gauge that I completed on the drawing board about a year ago. She was designed at the express wish of Norman Lowe as his next engine after E. S. COX and already is proving sufficiently popular to warrant a series. Then last winter whilst I was kicking my heels waiting for Works drawings that failed to materialise, came a question from Peter Greenwood as to whether a Great Central "Director" 4-4-0 featured in my future plans. At that point in time she didn't, but a week later I had completed the GA on my drawing board and in barely a month the design was complete. As the "Director" will probably be my last GCR design, then fittingly she is called ROBINSON in honour of that great CME, my sixth offering of his work being almost certainly the zenith of his achievement. Because I could take great chunks of ROBINSON from my earlier JERSEY LILY and POM-POM drawings, only four new sheets were required to complete the set, which was appealing both for the ease with which I could arrive at a new design, and equally so for description in LLAS. JACK and JILL are a pair of 5 in. gauge 0-6-0's from the Hunslet stable that I have had up my sleeve for some considerable time now, in fact the GA was produced as far back as 1976. These are bound to be a popular pair in time with their outside cylinders and Walschaerts valve gear, and being industrial engines they are inherently straightforward, JACK sporting a saddle tank whilst JILL has a pair of side tanks as being that much simpler. Then again there is MOLLY who came on the scene largely by accident. When I told John Hill of my decision to produce a 3½ in. gauge "Alice" Class 0-4-0ST which I haved called HUNSLETTE to differentiate from her 5 in. gauge sister, John recommended the longer wheelbase version, supporting his case with photocopies of an article. It so happened that this article finished half way down the final page, the rest being filled by a photograph of a Swiss narrow-gauge 0-4-0 called MOLLY. The only information I had was she had been built in 1944 by SLM in Winterthur, so a search was made of LLA'S Record Cards to discover my readers in that town, and by the greatest of good fortune I contacted Markus Kunz. Not only did Markus send me Works drawings, but followed up with photographs of the preserved MOLLY, all of which inspired me to produce a 5 in. gauge design, one which Markus is now building. With her combination of E. S. COX cylinders and modified LUCKY 7 boiler, MOLLY will likely be the ultimate in 5 in. gauge 0-4-0's!

Readers will thus realise that I was almost spoilt for choice, but at the back of my mind for more than eight years now was that BLACK FIVE was passed over in favour of E. S. COX the Horwich 'Crab' and that such omission could only be temporary. I had hoped to run the BLACK FIVE series immediately following that for DONCASTER, but at that time my good friend Tony Allcock was telling "Model Engineer" readers about his 5 in. gauge Stanier "Jubilee" Class 4-6-0 GALATEA which indicated a further postponement. Now, 15 years since she took shape on my drawing board, I can at last raise steam and get BLACK FIVE out of the Shed and onto the main line. At least the design is well proven, in fact John Edwards down in Cardiff who built the prototype told me a couple of years ago that his engine was practically worn out!, though knowing his fine workmanship I very much doubt if this is so. Having had the opportunity to drive AYRSHIRE YEOMANRY at the very first DYD Rally at Bristol and to witness two very spirited IMLEC runs with the Welsh lads in their distinctive green overalls being whisked around the track, the sight of this engine is always thrilling, even though I kept telling John that his 'lead' figure was not to drawing!

With 40 designs under my belt, it is impossible to have special favourites, although I am fortunate that an example of my very first published design, the full size Adams 02 Class 0-4-4T No. 24 CALBOURNE, is preserved on the Isle of Wight at Havenstreet, indeed I saw her this very afternoon before typing these notes, thus she always reminds me of my starting point and where this had led. However, I have a feeling that most who attended the DYD Rally at Kinver in 1989 will agree that the star performer that day was Malcolm Ferrier's BLACK FIVE, she certainly helped make my day, and I am now able to commend a BLACK FIVE to my readers.

Before 1954, I had very little contact with the BLACK FIVE's, apart from the statement from Uncle Frank Young that they were "good injuns". During National Service, I made a practice as before and since of always riding 'first compartment' whenever possible, for tradition was that enginemen congregated in this compartment, often talking shop. So it was that I overheard my first tale of a BLACK FIVE, in fact it was the sole Stephenson link gear variant, No. 4767. The driver related his refusal to take an engine off Shed as being a casualty and that he was offered No. 4767. He complained bitterly to the Shedmaster as to the very small coal on the tender, but was persuaded to take her, being told she was the best engine in the Shed, something he quickly discovered. Later on in National Service, I travelled from Ipswich up to Invergordon, with a five hour stopover at Edinburgh Waverley. I was surprised that the engine at the head of our train onwards to Perth was a BLACK FIVE, one in the most excellent condition, for I had thought that the road to Perth was ex LNER territory. However, I chatted with the crew and only missed a footplate trip because of my best Navy uniform, which of course was too conspicuous, so simply had to thrill to her performance from the first compartment, Forth Bridge and all!

With the imminent closure of the shipyard at Cowes on the Isle of Wight, I became rather unsettled and attended interviews at both Derby and Melton Mowbray. I went to Derby behind a "Britannia" which was OK, but came home behind a diesel which was not! The trip to Melton Mowbray out of St. Pancras was a bit of a disaster, losing about 30 minutes on the journey, but coming home was a revelation. Our train was double-headed by a grimy BLACK FIVE piloting an equally decrepid "Jubilee", thus I feared the worst. That pairing though was electric and after Bedford they really got into their stride. Approaching Hendon I estimated their speed as close to the magic ton, with possibility of a ten minute early arrival in St. Pancras. Then there was the most massive brake application, raising a storm of brake shoe and ballast dust, just overshooting a signal in the process, but from that day on I knew what a BLACK FIVE was capable of!!

My last sight of a Stanier BLACK FIVE in BR service was at Brockenhurst in the very last days of steam on the Southern, where I was waiting for my connection back to Lymington and the Island. This BLACK FIVE was in the most appalling condition and could not start its train onwards to Bournemouth. In the end, the level crossing gates had to be closed behind the train, it set right back, and then finally got going with the most uneven beat I have ever heard from a two-cylinder engine. For 10 minutes its struggles could be plainly heard up the bank to Hinton Admiral, a sad finale for a proud BLACK FIVE.

Sir William Stanier as he later became, was a dyed in the wool Great Western man and would have been content to end his railway career at Swindon as second-in-command to Collett. He had to be persuaded to assume the CME's chair on the LMS with a clear mandate to gel the various factions in the Locomotive Department into a unified body and to produce modern motive power in quantity. His departure from and later relations with Swindon were entirely amicable, thus he had the widest access to GWR locomotive drawings, etc. It was likely that the original intention was to build Swindon products at Crewe and Derby, among them the hugely successful "Hall" Class 4-6-0's, but Stanier had the greatest attribute of any engineer in that he was willing to listen and learn, thus he was able to make real design progress beyond what was then current Swindon practice, the BLACK FIVES being a fine example of his leadership skill. For although it is the name of the CME that graces a locomotive class, it is a design team that actually carries out the work, which if the CME is sufficiently brilliant is then tempered by running experience; Stanier carried this through almost to perfection. It is said that the original boilers did not steam freely and yet apart from increased superheating, the first engines built run throughout their long careers with vertical throatplates as against the sloping ones fitted to later engines which my BLACK FIVE emulates. It will always be my contention that when reports of poor steaming reached Derby, an enterprising draughtsman dusted off the boiler drawing for the Horwich 'Crab' and fitted that firebox to a taper barrel ahead of any official request to investigate; such things did happen in Drawing Offices as I well know from personal experience. I found the similarity out purely by accident by laying the E. S. COX boiler over that for the BLACK FIVE, when they formed almost an exact match. Whoever the originator of the modified boiler was, he ensured that the BLACK FIVES would become legend as a steam producer, the 'steam user' part of the engine in the shape of cylinders, rods and motion being right from the start. That the Stanier engines had their own distinctive identity which was in no way psuedo Swindon is perhaps his greatest achievement, the embodiment of good locomotive practice.

Translating a masterpiece in full size into miniature is a, relatively, easy process as all one is looking for is preserving that which was right, therefore for BLACK FIVE I could pay more attention to details than is my norm, for I usually have to select a specific engine at a specific time in its life. The original intention was to follow this line with BLACK FIVE and indeed I visited Carnforth in 1976 with this in mind, only to very rapidly come unstuck! At that time, three examples were shedded there, but when I looked at the details, it was to discover a bewildering array of number stamps, almost as if Crewe in their determination to prove interchangeability between engines had stripped 10 of them down, threw all the parts in one big heap, and then picked them up at random!!

Norman Lowe had half-decided to build a BLACK FIVE and supplied me with a mass of Works drawings, sometimes with at least three variants of a single part! Later on, Dennis Monk of tracklaying fame explained to me how such variations arose and why not all of them were in evidence on the more than 800 examples built, that number being the clue. Running more than 800 engines of the same class daily provides the sort of experience that aircraft manufacturer Boeing as example would appreciate, only BLACK FIVES do not fall out of the sky! Over 30 years, detail improvements became apparent and a draughtsman would commit same to paper. Such modification would then be placed before a Committee who would decide on its merits, whether the modification would need to be retrospective, or fitted only when the existing part wore out. This provided me with the perfect platform, as starting from scratch, I could decide where alternatives existed, which would serve best on my 5 in. gauge version of BLACK FIVE, both for ease of manufacture and extended service life, therefore I was acting as a Committee of one! I made but one near fatal error in numbering my BLACK FIVE as 45000, being blissfully unaware at the time that this pioneer engine had been selected for preservation and indeed can be seen running on the Severn Valley Railway. For among other things, this very first engine has a boiler with vertical throatplate, whereas I have adopted the MK3 boiler with forward top feed, a boiler that will not fit No. 45000! Whether what I have drawn represents any specific BLACK FIVE at one period in her career I cannot positively say, but with more than 800 engines to choose from there must be a distinct possibility; perhaps someone more knowledgeable on the subject can tell me?

Let us now look at some of the ingredients and technical particulars of the 5 in. gauge BLACK FIVE with a view to turning LLAS readers into DYD builders!

It is universally agreed that the origin of BLACK FIVE was the successful Churchward "Saint" Class 4-6-0's, themselves largely copied from American practice, and of course Collett arrived at the equivalent "Hall" Class by fitting six feet diameter coupled wheels to a "Saint". E. S. Cox has written that there was no justification for building the single BLACK FIVE with Stephenson link gear as she then became an LMS "Hall", but on this point I disagree with the great man, as I rate the LMS version of the Stephenson gear superior to the Churchward variant, having positive lead throughout, indeed this agrees absolutely with my own thoughts on valve gears, such that mine is a perfect scale representation; uniquely so. Fred Kennedy was the first BLACK FIVE builder to steam the Stephenson link version, albeit using a test boiler, but he was so impressed with the end result that I received a batch of colour prints of the event by personal courier within hours of the event; what a thrill! Most though will build BLACK FIVE with the traditional Walschaerts valve gear and here I have 'advanced' the valve gear events by three degrees at the same time making increased provision for 'lead' in the same way that I did on my LNER K1/1 'Mogul'. Thus it was good to prove the gear on Malcolm Ferrier's magnificent example at Kinver in 1989, when the engine ran faultlessly in mid gear, the boiler pressure with a light load settling at 60 psig. This is in exact agreement with both my K1/1 and RAIL MOTOR No. 1 and with increasing load the boiler pressure for equilibrium will also increase, thanks to Ell draughting, undoubtably the most significant feature I have been able to incorporate in miniature over the last 30 years. For even when one gets into trouble, as I did at Kinver for at 60 psig, Malcolm's home-made injectors failed to pick up, then Ell draughting makes a miraculous transformation to blower efficiency such that one can see the pressure gauge needle moving upwards!

The mainframes are 38³¹⁄₃₂ in. long from 4⅝ in. x 3mm section, though in later engines this was increased by ⅜ in. between the driving and rear coupled axles, as some engines were fitted with roller bearings. The coupled wheels are 6⅞ in. diameter with the very distinctive vee rims.

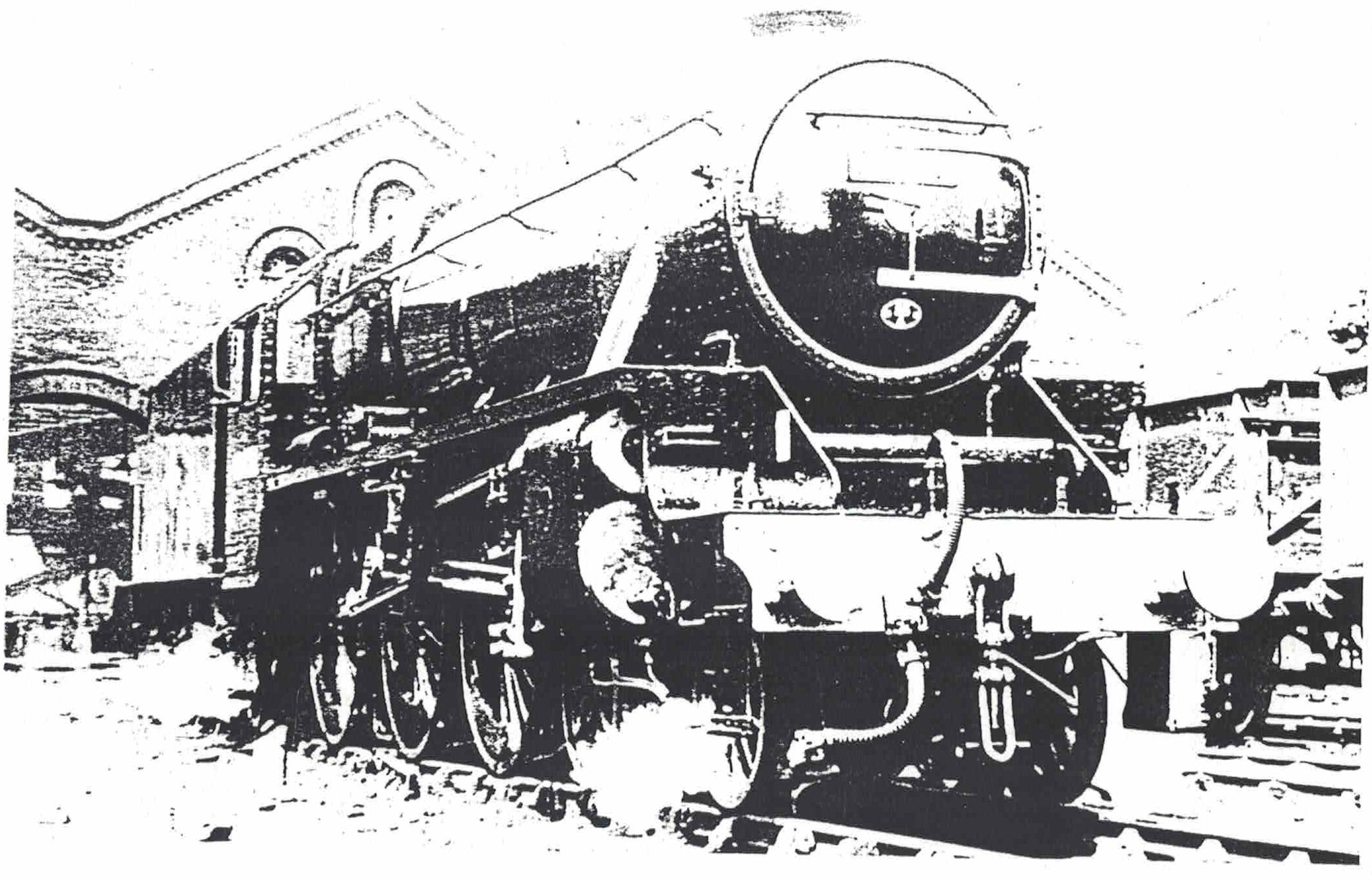
The cylinders deserve special mention, especially in comparison with Swindon practice, and show somewhat similar thinking to Ivatt and his famous 'Atlantics', another of the most successful designs of all time. Churchward standarised quite early on an 18½ in. bore and 30 in. stroke for his, outside, two-cylinder engines, this combined with a very moderate superheat. Once Stanier had increased the area of superheater on the BLACK FIVE's, then their cylinders at 18½ in. bore and 28 in. stroke appear tiny in proportion to the Horwich 'Crab' with its 21 in. bore and boilers virtually identical, almost ludicrous against the last batch of Sirling 'Singles' with their 19 in. bore and 28 in. stroke cylinders. It is important though in the most successful designs that the boiler be master of the cylinders, which was undoubtably so for the BLACK FIVE's.

Now for a little bit of controversy, for it is my humble opinion that Great Western men and I will include my good friend Bob Gale in this, have extremely short memories. When I wrote in glowing terms of the Robinson ROD 2-8-0's, Bob was very scathing of them, yet Robinson was very much a Great Western man, having been Works Manager at Swindon before moving on to the Great Central. I would state categorically that the Stephenson link gear on his POM-POM's was at least the equal of anything that Churchward produced, and Robinson's lovely lines followed on in the Dean tradition. Then as I was settling down to pen these notes, it was to read the latest diatribe by Bob against the Stanier BLACK FIVE's, which he compared very unfavourably with his beloved "Halls". I can well imagine the circumstances which led Bob to the conclusion that the BLACK FIVE's were "steam buckets", being enveloped in a cloud of said stuff. It was traditional for each depot to try and retain its best engines, always despatching the "black sheep" if at all possible when the request came to send engines to another depot, and of course Bod down in Newport, Gwent was at an outpost of the LMS and BR, thus he would sample more than his fair share of duds.

I will complete my introduction by telling a story of the other side of the coin, one I was told 'secondhand'. A great pal during my time at The Plant was Tom Greaves, indeed his photographs have been of inestimable value to my work in LLAS and in MY FIRST 50 YEARS WITH STEAM. When I knew Tom at The Plant, we were both Gresley 'Pacific' supporters, then we lost touch with each other after National Service. I next heard about Tom from Brian Hollingsworth, when he told me how he came to buy BLACK FIVE No. 5428 that is now immortablised as ERIC TREACY from BR. The person with whom Brian negotiated was none other than Tom Greaves, and Brian rapidly came to the conclusion that although nominally he could buy any of a number of BLACK FIVE's, Tom would ensure that it was No. 5428 he actually purchased. From Brian I was able to discover that Tom was now very much an ardent Stanier BLACK FIVE fan, and respecting his judgement, I dedicated my BLACK FIVE to Tommy, not knowing then that we would ever correspond or indeed meet again.

Let me end with a plea. Although I have a smattering of BLACK FIVE photographs, this series as with all those before will be so much the better for a little help from my friends.

The search through my own photograph collection being unproductive as far as BLACK FIVE is concerned, Tom Greaves has come to my rescue, yet again, No. 45428 being one of the Stanier engines in his care during BR days. Tom strongly makes the point that there is but one livery for a '5', being polished black with buffed steel buffers, motion, cylinder covers, bridle straps and dart. Straw numbers are to be discouraged and it is a criminal offence to use aluminium paint and all other tarting up save for red buffer beams; you have been told!!



Black Five

The fabulous Stanier Class 5MT 4-6-0 in 5 in. gauge

by: DON YOUNG

Part 2 — Making a start on the Tender

Several builders are so addicted to the 5's that they are tackling my 5 in. gauge BLACK FIVE up to 40 years after they first got to know the engine from LBSC's ever-popular 3½ in. gauge DORIS, and of course such invites comparison. I think we are all agreed that the late maestro concentrated on the essentials, maybe working parts is a better description, leaving the trimmings for builders to add to individual taste. In many ways our separate careers have been similar, for we both entered railway service with the intention of making it a job for life, only for life to intervene and then seeking solace by designing in miniature. The real difference is that my railway service was in the workshop and running shed, working on the actual piece parts that together built into a steam locomotive, whilst LBSC made his living on the footplate, thus his main interest was in performance rather than the shape of the parts to achieve same, though he was an outstandingly gifted engineer, one with the ability to inspire others. With 40 years hindsight, perhaps I was at a disadvantage right from the start, for those years spent building and repairing steam locomotives more or less demanded that I try to reproduce them as accurately as I could in miniature, though on occasion introducing what I thought were necessary improvements, which as instance is why I am so enthusiastic on the Joy valve gear. There are times though when I would have liked to have slipped into the LBSC mould, and Sheet No. 2 for BLACK FIVE is a perfect example of this, only to be taken severely to task for trying to cut corners!

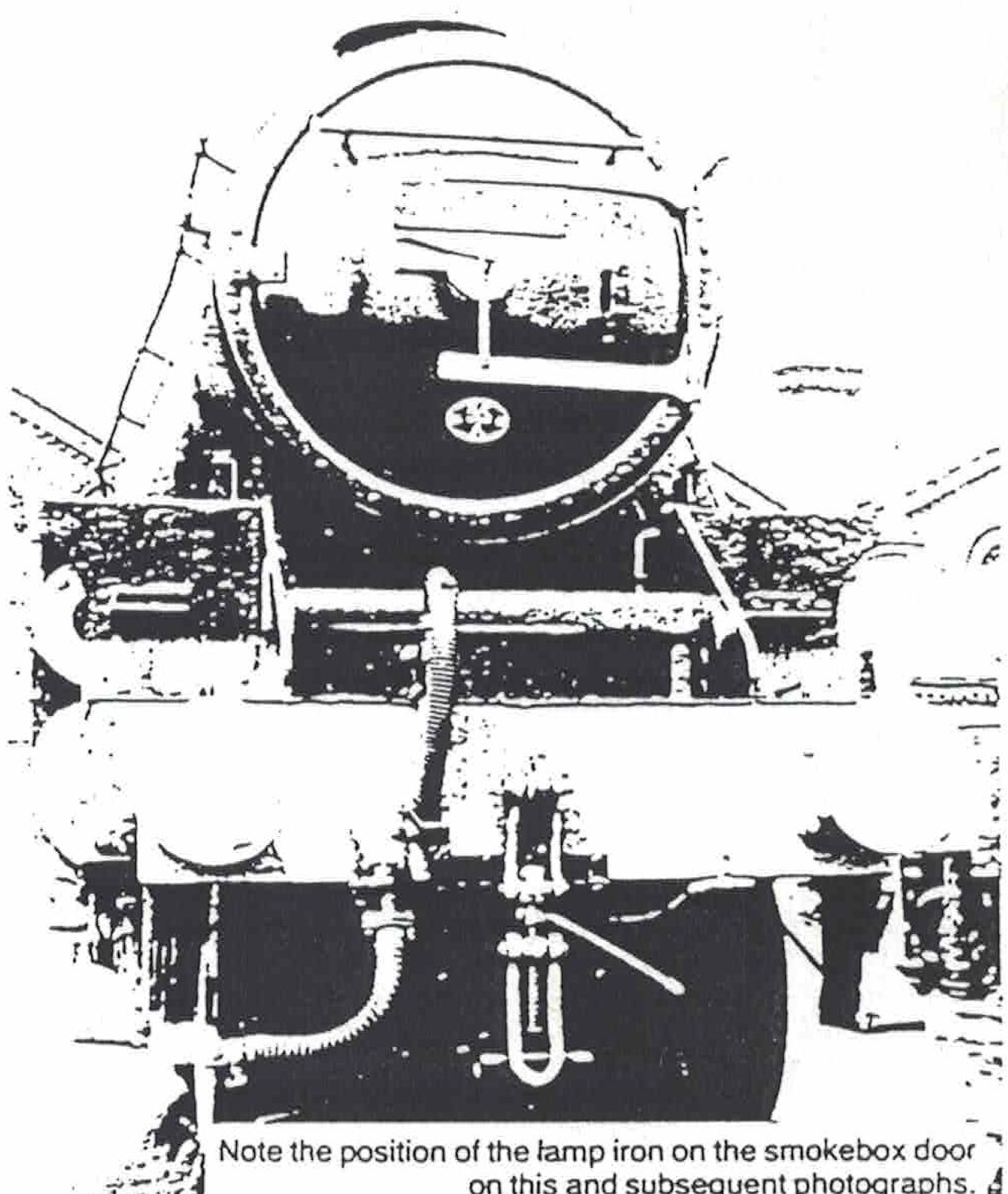
My line of thinking on tender bodies at that time was coloured by actual happenings and what was then accepted as the norm. This was a period when more and more tracks were being built for ground level running, with the driver using the tender as his perch, which therefore required some strengthening for the purpose, and the individual was best able to work this out for himself from his own body weight. Also, once a tender was coaled, then nobody but the builder knew the internal shape of the coal space, thus he could take some liberties with same, hence my dotted lines as indication of full size, plus note to lift dimensions direct from the drawing. In practice this did not work out for me, for as soon as builders reached the tender body, so I was asked to provide more details, with result that Sheet No. 13 had to be added to the drawing set, a sheet that has just been traced ready for this series, the pencil original having suffered greatly by its popularity these past 10 years! I guess this puts me in a 'no win' situation, for I am accused of making engines difficult to build by including all the details, but if I try to leave any out, then I am providing insufficient information to allow an accurate miniature steam locomotive to result. All this means there is very little I can describe in this second session, unlike for No. 78000 where I resisted the temptation of providing the additional tender body detail on a further sheet in favour of its pure description; let us begin to cut metal.

Wheels and Axles

I have a passion for turning cast iron, which is the reason why there is already a mountain of cast iron swarf in the Myford 254V plus tray! All the patterns for BLACK FIVE were made for me by Norman Lowe, who did such things for the full size 5's when employed at Horwich and shares my love of realism, thus you will enjoy looking at these wheels as much as machining them!

Grip a wheel by its tread in the 3 jaw and check that it is running nice and true before facing across the back and turning down the flange to 4 13/16 in. diameter, lightly radiussing the corner with a file. In my hurry, I have forgotten the cardinal rule about assessing machining allowances as the first step, something that is of paramount importance with wheels, as if the spokes are displaced axially by wrong machining, then the end result will not please you! Centre, drill through to 39/64 in. diameter and ream at ⅝ in. diameter; repeat this operation or four further wheels.

Grip the final wheel by its flange, and as this will most likely have been fettled, then use the 4 jaw and set to run true. The first operation is to turn as much as the tread as you are able down to around 4 9/16 in. diameter, which means packing the wheel off the chuck jaws so the latter do not interfere. Lightly face the front of the wheel and its boss, then centre, drill and ream as before. If a 1½ in. length of ⅝ in. diameter silver steel bar is not a tight fit in the reamed holes, or if you do not have this material by you, then chuck a length of ¾ in. diameter mild steel bar and turn to the required fit. Chuck the final wheel by its tread in the 3 jaw and turn the back and flange to size, insert the dowel you have made and bring up a second wheel, bolting firmly together through the spokes. Turn this second wheel down to size, save for a few thous on the tread diameter, then reverse in the chuck and complete the final wheel identically, going on to complete all wheels to this stage. With the last wheel in place, only its not the final wheel this time!, take a finishing cut at the tread to approximately 4½ in. diameter


Note the position of the lamp iron on the smokebox door on this and subsequent photographs.

and bring all wheels to this tread size, completing with that 1/16 in. chamfer to 30 deg.

The axles are 8 in. finished lengths from 20mm or 7/8 in. diameter steel bar, so face them off and centre each end. Mount between centres and carefully tighten the 4 jaw chuck onto the bar, so as not to distort same. Now comes the decision as to whether your wheels are to be a press fit, or secured with Loctite or Permabond. If the latter, then turn down to .623 in. diameter to drawing over the full 1 21/32 in. length, otherwise reduce to this diameter only over a 1 1/32 in. length and turn the remainder down to a press fit. Now set the top slide over 1½ deg. and with a round nosed tool, turn down to the centre of the axle, the 5/8 in. diameter being nominal: reverse and repeat.

Axlebox and Cover

I now have a 'standard' cast gunmetal stick for tender axleboxes, the first operation being to saw two 4 in. lengths from same. Grip each piece in the machine vice on the vertical slide in turn to reduce the section to 1¼ in. x 1⅛ in., chucking in the 4 jaw to clean up the ends. We now have to mill the 11/16 in. wide slot to ⅛ in. depth along the full length of the bars, so take a 5/8 in. end mill, mill down to the required depth and then widen to 11/16 in. to leave those ¼ in. and 3/16 in. dimensions as shown. Take note of the readings at which the final cuts were taken, swing the bar around and repeat on the opposite face, then on the other piece of bar: saw into individual axleboxes and face off to 1 3/16 in. length. If you fit the centre to the headstock, then this will locate each axlebox positively, and locking the carriage will ensure they are faced off to identical length.

Mark the centre on one axlebox, the inner face, chuck in the 4 jaw to run true, then centre and drill right through to 16mm diameter. Turn on the 1/16 in. raised face to 1 in. diameter, release two chuck jaws only, fit another axlebox and tighten the same jaws, then carry on and complete all six axleboxes to this stage.

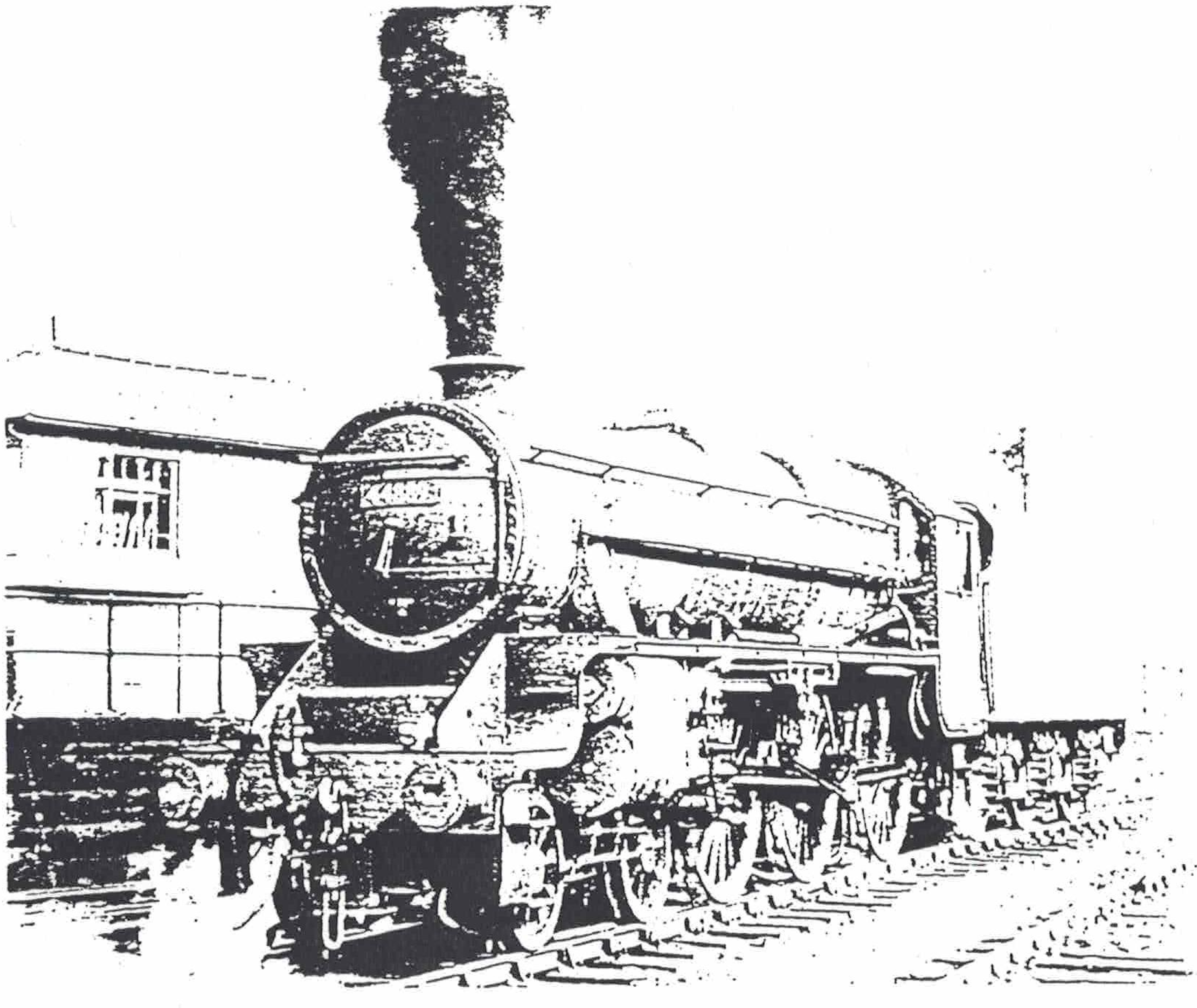
Covers next, so mark them off onto 3/32 in. steel or brass sheet, drill the No. 44 holes, then saw out and file to line. The ribs add that touch of class, they being fashioned from odd ends of 1.6mm brass, held in place with some homemade clamps and silver soldered to complete. Offer up to the axleboxes, spot through and tap the 8BA holes, securing with hexagon head screws, and we can finish the axleboxes.

The outer shape of the boxes have to match that of the covers, with ⅛ in. lugs as shown, so carefully mill around the cover, then complete with the 3/32 in. radius at the bottom. Sadly we have no frames or horns in which to try our wheelsets in this session, though we can make a few more parts in anticipation.

Buffers and Couplings

For the buffer stocks, chuck a length of 1 in. square steel bar truly in the 4 jaw, face, centre and bring the tailstock into play. Turn on the outer profile with a round nosed tool, radiussing the outer end lip with a file, then part off at a full 1 5/16 in. overall and repeat another three times. Rechuck in the 3 jaw by the 13/16 in. diameter portion, face off to length and scribe on the bolting circle at 15/64 in. diameter with a knife edged tool. Centre, drill to 39/64 in. diameter, and as we have a 5/8 in. reamer by us from the tender wheels, run this through the bore to complete same.

The buffer socket starts from the same 1 in. square bar, so chuck in the 4 jaw, centre and drill No. 30 to about 5/8 in. depth, following up at ¼ in. diameter and 'D' bitting to ⅜ in. depth. Face and turn down to provide a 5/16 in. diameter spigot over a 7/64 in. length, then part off at a full ½ in. overall, reversing to face off to length. Chuck a length of ½ in. steel rod in the 3 jaw and face off to leave about 13/32 in. projecting from the chuck jaws: centre, drill No. 40 to ¼ in. depth and tap 5BA. Fit an embryo buffer socket over the mandrel and secure with a 5BA bolt, then turn on the remaining profile, to leave a 5/64 in. thick flange and a spigot



A very grubby 44889 sets back onto her train with the fireman preparing for a major effort.

to be a tight fit in the buffer stock. Drill the latter No. 44 in four positions for the 8BA fixing bolts, offer up to the sockets and drill through, then bolt together. Transfer to the machine vice on the vertical slide to reduce the flange to the required 15/16 in. square then file on a radius at the corners to complete.

The wee step on the buffer stock adds a finishing touch, and although not all Works drawings and the many hundreds of photographs I have studied show such steps fitted to the engine buffers, personal preference would be to fit same. Cut pieces 11/16 in. x 7/16 in. from 1.2mm steel or brass sheet, flange the ends to bring them to 7/16 in. square, sit them on top of the stock and silver solder in place.

The LMS buffer head of the period is extremely distinctive and worth spending time over to get the profile correct. Chuck a length of 1 3/8 in. diameter steel bar in the 3 jaw, centre and bring the tailstock into play. With a round nose tool, one that will produce the 5/64 in. corner radius, turn down to 5/8 in. diameter, a nice sliding fit in the stock, over a 1 3/32 in. length. Set the tool over 10 deg., or rather it is the top slide we have to set over, to produce the 1/32 in. chamfer to drawing. Replace the centre with the tailstock chuck, to first drill No. 40 to 13/16 in. depth, following up at 7/16 in. diameter and 'D' bitting to 5/8 in. depth; tap the remains of the no. 40 hole at 5BA.

Part off to leave a full 9/64 in. thick head, reverse in the chuck and carefully profile the head, in fact a template would be helpful here to get them all the same.

Ordinary die-holders in my experience are so well made that I have never indulged in the luxury of a tailstock die-holder, allowing mine to rest against the Myford drill pad to ensure the threads are square along the bar; making the four spindles that way takes a matter of a few minutes. Screw the spindles into the buffer heads, but before we can complete assembly we require the most important item for any buffer; its spring.

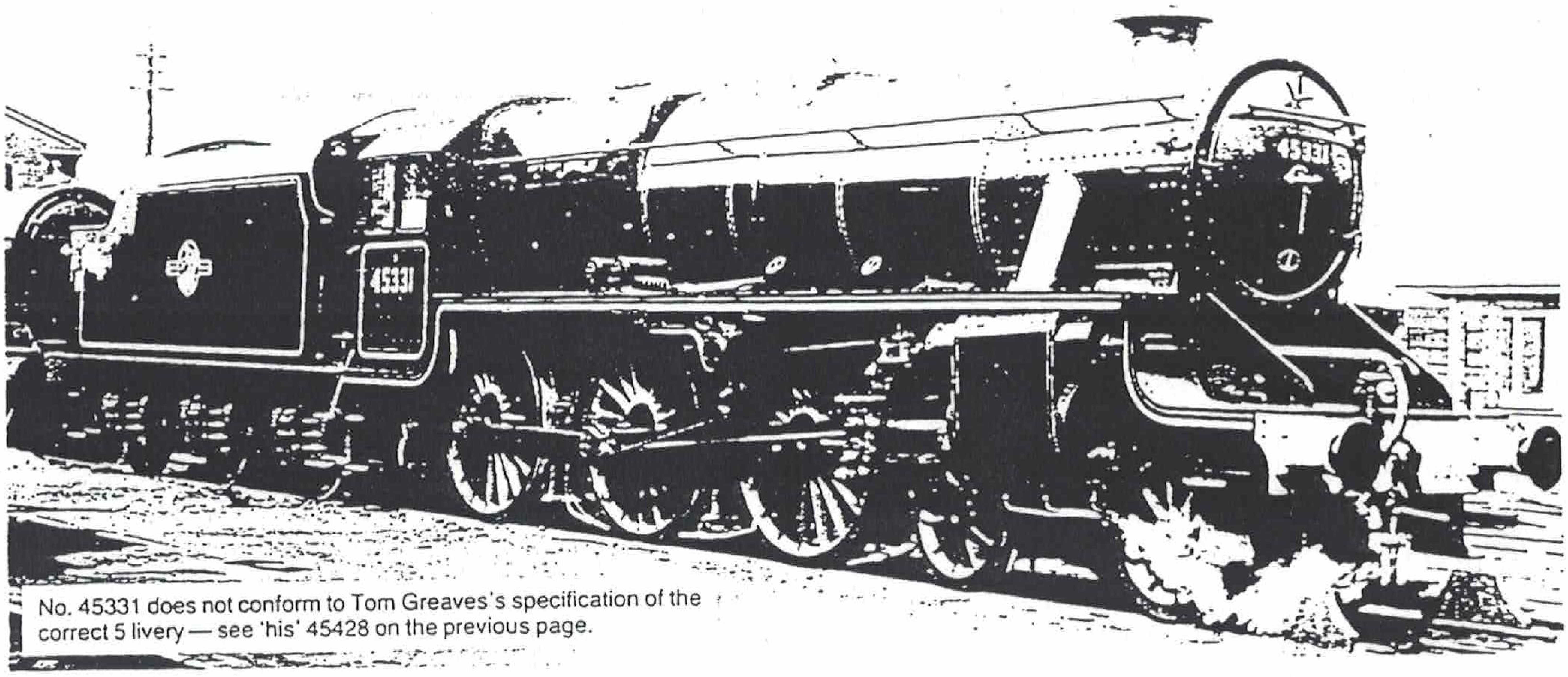
Your BLACK FIVE will walk away with a pay-load of over a ton and although I shall be specifying vacuum brakes for the train, sadly the adoption of a Hughes vacuum train brake is far from universal after a quarter of a century since its introduction. Therefore, there will be times when emergency action will have to be taken, like that which I experienced with Les Pritchard's ROYAL SCOT at Guildford a couple of years back, though they have since taken the remedial action of providing a braked, guard's, trolley on all public passenger hauling. Anyhow, the traditional method of increasing engine braking is to bring back to full reverse gear and apply steam, when of course the heavy train will buffer hard up against the tender. This is potentially hazardous, as the tender is far and away the lightest vehicle in the whole train, but it helps a lot if the tender buffers do not go 'solid', but retain some springing, thus it is vital that the buffer springs be sufficiently robust. The suggestion is that you first fit one buffer with a spring to my specification on the drawing and check it out, when it should prove impossible to fully depress the buffer by hand pressure alone, changing to a stronger spring if necessary and then completing the four to be identical.

I mentioned a pay-load in excess of a ton, and although the 'pulling power' required for same is much less than the 'stopping power', only a properly forged hook of 1/4 in. thickness, with correct grain flow, would be suitable for such a pay-load; couplings fashioned from steel bar are simply not good enough. So if you intend to exhibit your BLACK FIVE, then make up two couplings as at the front, but for goodness sake remember to replace the rear one with that specified before attempting any passenger hauling, especially as the system with steam braking on the engine will only stop the train if there is a break-away! For this reason, I will let builders fashion the front coupling to their heart's content, whilst I concentrate on the, non-authentic, rear one.

Chuck a length of 7/16 in. square steel bar, it wants to be good quality, truly in the 4 jaw and turn down to 1/4 in. diameter in about 1/2 in. increments over a 2 1/8 in. length, screwing the end 3/8 in. at 32T. Transfer to the machine vice on the vertical slide to mill the 5/16 in. square over the next 3/8 in. length, then saw off to leave 11/16 in. length of the original bar. Centre pop and cross drill this No. 10 in the position shown, saw down to start forming the fork end, then back to the machine vice to complete the 3/16 in. slot with a 5/32 in. end mill. Radius the end over a mandrel with an end mill and the reduction of width to 3/8 in. is very much optional; it just looks better to my eyes.

Again the spring is important, as for instance we do not want the 5/16 in. square portion to pull completely out of the rear tender buffer beam at maximum effort, so check this out. Fit an ordinary 1/4 in. steel flat washer at the inner end, then a 5/16 in. thick nut and locknut to avoid future embarrassment!

We have achieved very little in these first two sessions, but from now on we shall be making real progress each time, indeed I am being spurred on by first sight of the traced Sheet No. 13 yesterday; now I have no excuses!!



No. 45331 does not conform to Tom Greaves's specification of the correct 5 livery — see 'his' 45428 on the previous page.

Black Five

The fabulous Stanier Class 5MT 4-6-0 in 5 in. gauge

by: DON YOUNG

Part 3 — The Tender Chassis

One of my newer recruits to the BLACK FIVE fold whose name for the moment escapes me, telephoned the other day to say how pleased he was with the Drawing set. He showed them to a friend who fired the 5's in BR days, who commented that the full size tenders did not have the double frame feature as I had detailed, though later the pair of them were able to verify that what I have drawn is correct from inspecting a preserved example. Now of all the engines I have drawn thus far, Norman Lowe was able to provide me with more Works drawings than for anything before or since, indeed my problem was sorting out which went where, as for instance there were even full details for a roller bearing tender. Had I known beforehand of the inspection of the full size tender, then maybe the pair could have solved a 15 year old mystery for me.

As I have said, every detail was taken from Works drawings, from which I expected everything to fit neatly together, yet such did not prove to be the case. For when the first tender was assembled, came the baffling news that the front pair of wheels fouled the front box stretcher, hence my note to cut the latter to place to clear said wheels. I don't know how it happened, but since the note was appended the problem seems to have been resolved, though I don't like mysteries!

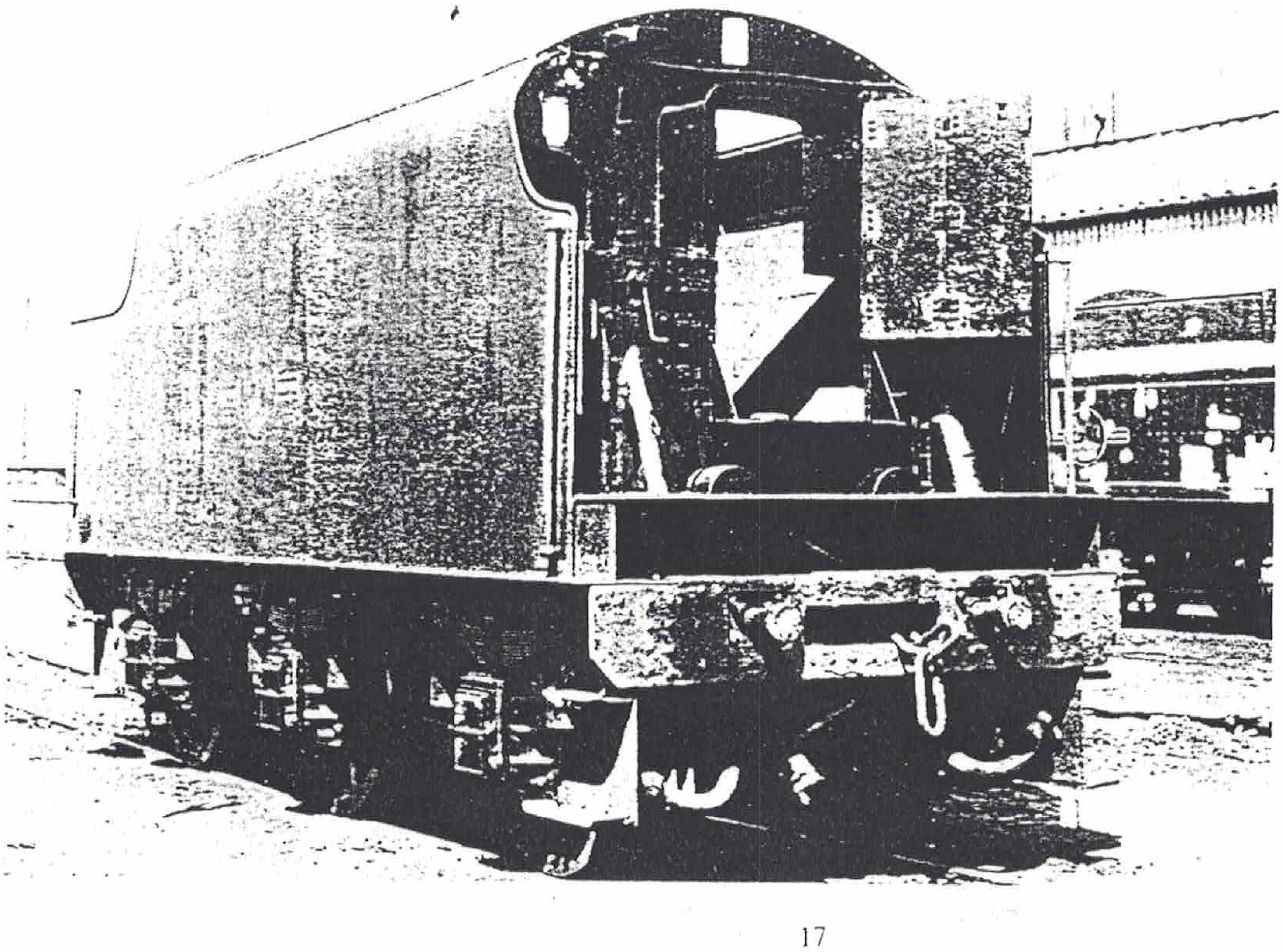
Outer Frames

The nearest available section appears to be 3½ in. x ⅛ in. or 3mm, sheared from plate, so file one edge flat on each piece as the top datum, then square off as a pair to 24³⁄₁₆ in. overall. Apply marking off fluid to one piece and carefully mark out to the drawing detail, then clamp together and drill about six ³⁄₃₂ in. holes, using aluminium or copper snap head rivets and hammering well down to hold them as a pair. It is best to drill all the holes to their specified size first, before attempting the profiling, though I must qualify this statement in the light of my own and other builders experience. On my K1/1 tender, I drilled the frames first for the tender horns, only to find that some of said holes rather clashed with the webs on the horns. So it will be as well to check this out ahead of drilling the frames, indeed you can drill the horns first if you like, and this comment applies equally to the engine.

Unless you have the luxury of a milling machine, profiling the frames is very much a saw and file operation, though I always find this extrememly enjoyable. If you are able to drill ¾ in. diameter holes at the ends of the cut-outs, then sawing these out will be so much simpler, when you can file to line. The Stanier tender had a radius in the top corners of the horn cut-outs to reduce the incidence of frame cracking, so drill a row of ⅛ in. holes along this top edge, then saw down inside each line and break out the redundant portion. It is possible to grip the frames in the machine vice, on the vertical slide, to mill to the required 1¼ in. dimension, but I prefer to file to a short length of 1¼ in. square bar as my gauge, after which arrive at the ⅝ in. dimension for the horn gap stays and here you can make use of your micrometer. Separate the frames and remove all burrs and sharp edges, this to prevent a visit to your first aid box.

Inner Frames

Sadly 1⅜ in. x ⅛ in. or 3mm steel flat is not available, so we shall have to mill down from 1½ in. wide flat, the same applying to the beams, thus you will generate quite a pile of swarf! Cut the ⅛ in. wide slot at the rear end to ¹⁵⁄₁₆ in. depth and both dimensions can be fairly generous, as the bolts will provide the alignment we are seeking. Mark off and drill the holes not specified as mating with those in the outer frames, and this is as far as we can go for the moment.



Today it is Norman Lowe's turn to step into the frame to show us some of his photos of BLACK FIVE's. We start with a 4,000 gallon Stanier tender pictured at Horwich in 1957.

Horn Gap Stay

BLACK FIVE was the second design I tackled immediately after leaving industry, where I was told that everything would be metricated in a few short years: how wrong the pundits were! For even in 1991, it is more likely that $\frac{1}{4}$ in. square steel bar will be more readily available for the horn gap stays than the 6mm square I have specified; it matters not one iota. The best way to tackle these stays is to mill each slot in turn to suit the frames, when the fit must be a tight one, after which you can saw off the ends and fashion to drawing before offering up to the frames again to drill the No. 44 holes, these for 8BA hexagon headed bolts.

Front Box Stretcher

This will be the first of many fabrications that go into building BLACK FIVE, so I will describe the process in some detail to avoid needless repetition later on. Again we shall require lots of $1\frac{3}{8}$ in. x $\frac{1}{8}$ in. steel flat, the cold rolled stuff with a dull finish being the ideal. Start by squaring off two lengths to $5\frac{29}{32}$ in. overall as the main cross members, then square off two $2\frac{1}{8}$ in. and two $1\frac{7}{8}$ in. lengths to begin building up the front part of the box. To hold the various pieces together for brazing, we are going to use 8BA round head brass screws as temporary fixing, as there is a little latitude when tapping 8BA into the ends of the $\frac{1}{8}$ in. thick member pieces without breaking out of the side of the material. We can now start adding the diaphragm plates, the horizontal pieces that stiffen up the whole assembly, and if these are cut to a tight fit then no other form of fixing will be necessary ahead of brazing. For the centre pieces, we have to add bosses to help support the drawbar pin, so chuck a length of $\frac{3}{4}$ in. diameter steel bar in the 3 jaw, face, centre and drill No. 11 to 1 in. depth, parting off four $\frac{1}{8}$ in. slices. Drill the plates No. 11 to suit and assemble with a long 2BA screw, and I should have mentioned the $1\frac{1}{2}$ in. x $\frac{1}{2}$ in. cut-out in the front member for the drawbar, which gives access to feed in the bosses and washers to space same correctly.

The rear cross member is a $3\frac{29}{32}$ in. length from the $1\frac{3}{8}$ in. x $\frac{1}{8}$ in. steel flat, when you can complete building up this part ready for brazing, not forgetting as I have done the 1 in. x $\frac{1}{2}$ in. cut-out in the cross member!

Brazing up steel fabrications is easy, providing one takes a few simple precautions, and I have used everything from brass rod to Easyflo No. 2 as spelter, the latter to be recommended. Mix the correct flux to a fairly runny paste and apply liberally to all the joints, making absolutely sure there are no 'misses'. Lay on the brazing hearth, get your propane torch going with a fierce flame and heat the job up as fast as possible, feeding in spelter the moment it begins to run freely. Done quickly and before the steel has opportunity to oxidise, there is not the slightest problem, but fail and you could spend hours getting back to a bright surface! It is permissible to dunk the fabrication into acid pickle for a few minutes, to help free any excess flux, after which wash off thoroughly and then gently warm to completely dry the surfaces. Run over the joints with a wire brush, then spray the whole fabrication with zinc from an aerosol can.

Only a minimum of machining is required, the first step being to file away the now redundant 8BA screw heads and remove the 2BA bolt, opening out for the drawbar pin to $\frac{5}{16}$ in. diameter. Deal with the No. 20 hole immediately to the rear, the slot for the brake lever will have to wait until later, when we are ready to machine the side flanks.

Grip in the machine vice on the vertical slide with one of the side bolting flanges facing the 3 jaw chuck. We have to remove $\frac{1}{64}$ in. of metal using a large diameter end mill, after which advance the carriage by exactly 1 in. and deal with the bolting flange for the inner frame. Turn the box stretcher through 180 deg. and the easiest way to do this on the 254V plus is to swing the vertical slide with everything still in place, to reduce the width over the front section to $6\frac{1}{8}$ in.; the rear to $4\frac{1}{8}$ in. Handling and machining the fabrication will have removed some of the zinc plate, so restore same when the risk of rust forming is removed until final painting, much later on!

Rear Box Stretcher

Again we start with the two main cross members, fixing the end bolting flanges to same by medium of those 8BA brass round head screws. This time though there is a distinct difference in that we cannot machine the faces for the inner frames, or indeed drill them after brazing up. Remember too that the $4\frac{23}{64}$ in. stated dimension is for 3mm thick inner frames, so if you are using $\frac{1}{8}$ in. thick material then amend said dimension to $4\frac{3}{8}$ in. Although I am going on to complete this fabrication, you may well assess that it will be prudent to delay completion until the frames are temporarily assembled, with the intermediate stays in place, so that you can check things out before the fabrication becomes a permanent one.

Except for the central, box, section, for the rest of the stretcher there is a single and central diaphragm plate, so cut the pieces to place, hold together with 8BA screws, and braze up. If the $\frac{5}{16}$ in. square and $\frac{1}{4}$ in. diameter holes have not already been dealt with, tackle these next, then mill the outer bolting flanges to $6\frac{1}{8}$ in. overall, keeping the inner bolting faces nice and central; complete for the moment with another coating of zinc.

Front and Rear Beams

After the box stretchers, the beams come as light relief, especially if we already have the required $1\frac{3}{8}$ in. x $\frac{1}{8}$ in. or 3mm section flat by us. Mark off and profile to drawing, then deal with the holes as specified, when they can be offered up to the respective box stretchers to drill and tap to drawing.

Rubbing Plate

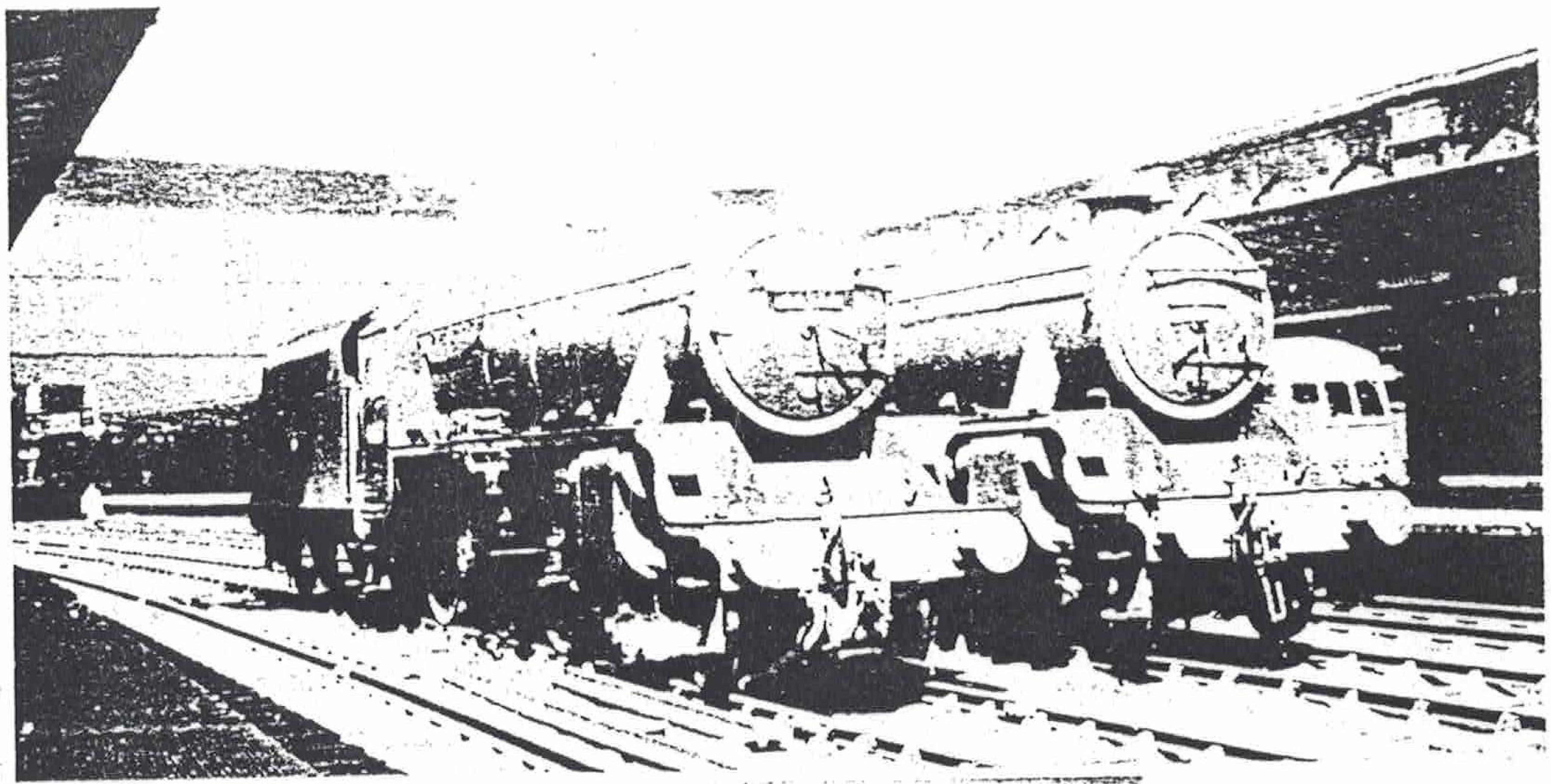
We need a pair of these for engine and tender and I would machine them from $1\frac{1}{2}$ in. x $\frac{3}{8}$ in. section BMS, for which we require two $2\frac{1}{8}$ in. squared lengths. Start by marking off and drilling the 14 No. 34 holes, then drill a row of $\frac{7}{16}$ in. holes to start forming the drawbar cut-out, milling away as much surplus material as possible and completing with files to suit the beams. You can also mill away at the ends to form the $\frac{1}{8}$ in. thick flanges, but I am afraid the rest is filing. Countersink the holes specified, offer up to the front beam, drill through, tapping the box stretcher 6BA and securing with a mixture of hexagon and countersunk headed screws.

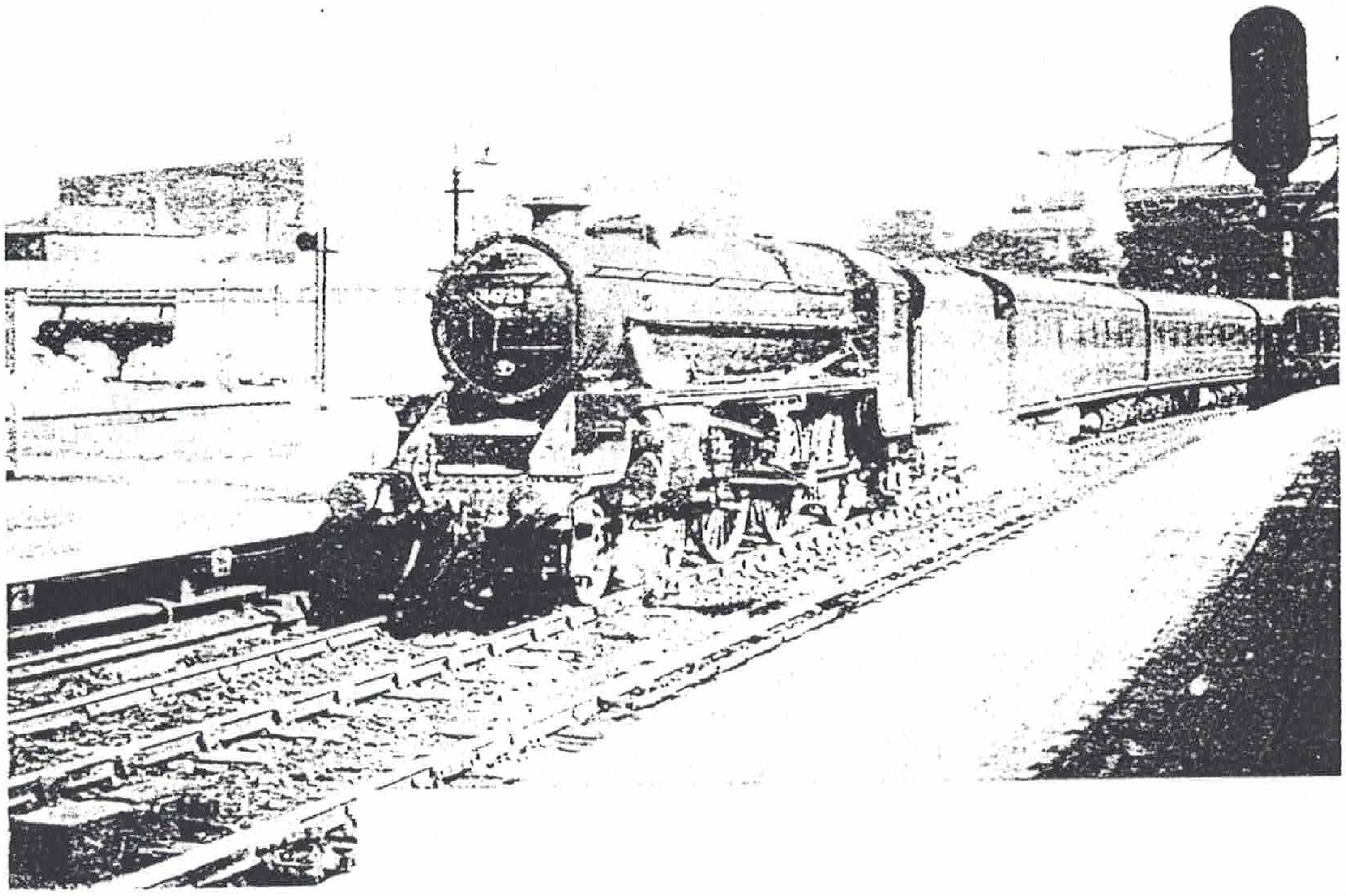
Frame Stay

Cut a piece 7 in. x $2\frac{1}{4}$ in. from 1.6mm steel sheet and mark on the bend lines a bare $\frac{1}{2}$ in. in from each end. Grip in the bench vice with one of the bending lines flush with the top of the jaws and tap over to a 90 deg. bend with a wooden mallet, checking with an engineers square. Repeat at the other end of the piece, when the measurement over flanges should not be greater than $6\frac{5}{32}$ in. The stiffeners are 6 in. lengths from $\frac{5}{16}$ in. x $\frac{1}{16}$ in. steel strip, spaced $1\frac{9}{16}$ in. apart and held in place with clamps for brazing; remove all excess flux with a wire brush. Grip in the machine vice on the vertical slide to first mill away the surplus metal back to the stiffeners, completing the little corner gussets with a file. Now grip by the stiffeners and use the side teeth of an end mill to deal with one of the bolting faces. Use either ordinary or vernier calipers to arrive at the $6\frac{1}{8}$ in. dimension as for the front and rear box stretchers, then deal with the second bolting face on the frame stay to match.

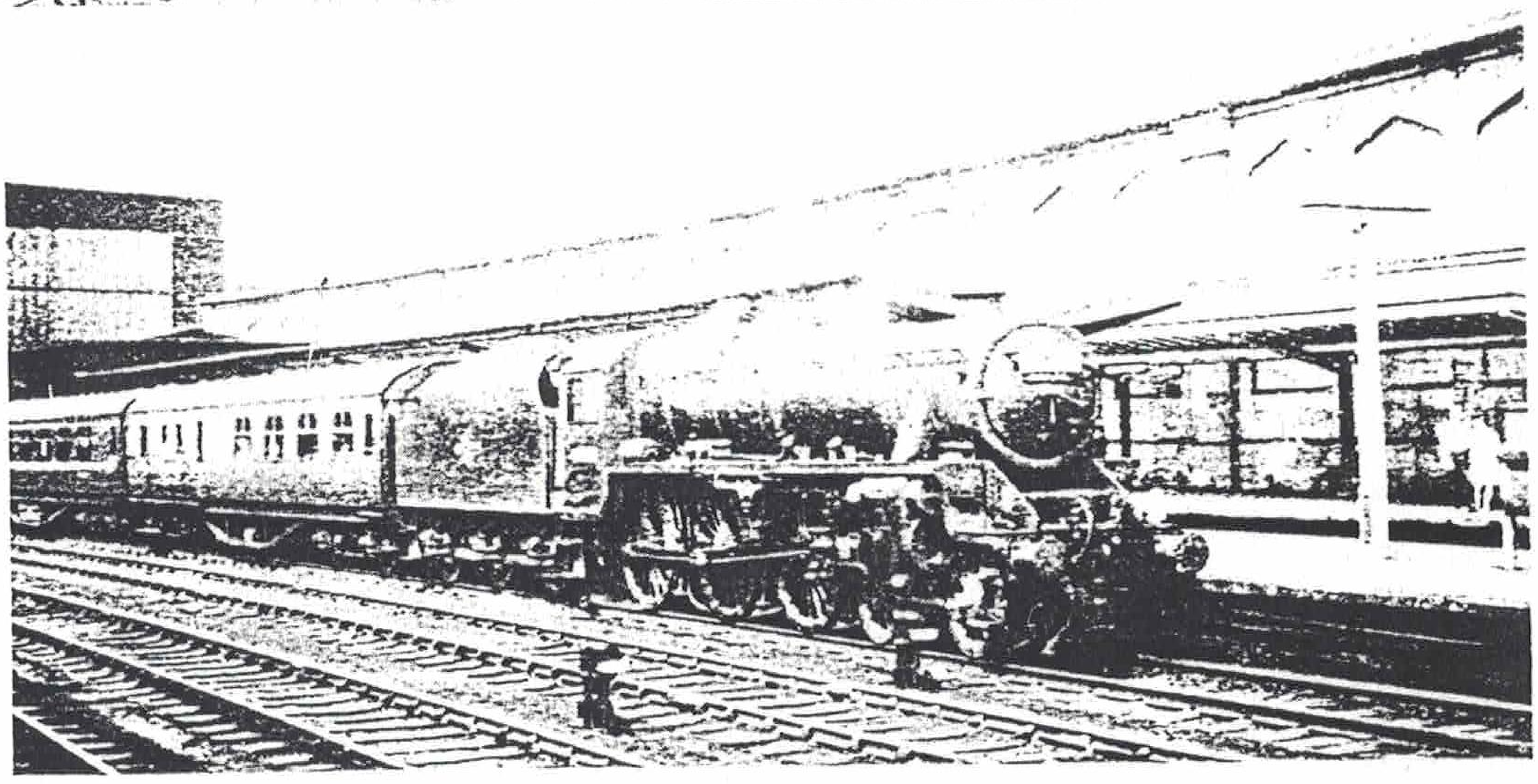
Jack Coulson told us in LLAS No. 7 how to make hole saws for cutting large holes in thin sheet metal, his purpose at the time being dome openings in boiler barrels. There are also

The pair of Class 5's on the middle roads at Carlisle are waiting to take over Glasgow-Blackpool excursions.





The 11.47 Manchester-Hellifield sets off from Victoria Station in August 1962.



Back to Carlisle, where this BLACK FIVE is deputising for a failed "Duchess", having just backed onto the train. The "Duchess" had suffered the misfortune of a shattered anti-vacuum valve, which resulted in a very late arrival at Carlisle, with both injectors on and very little steam! The train is the 11.45 Glasgow-Crewe.

proprietary hole cutters for domestic water tanks and the like, otherwise you will have to resort to drilling around each cut-out at No. 30, breaking out the redundant piece and filing to line, a time consuming exercise.

Inner Frame Stay

Again we have a pair of stays to make, and if you are able to fold up the main centre portion from a single piece of 1.6mm steel sheet, size 3 29/32 in. x 3 1/2 in., then this will make life so much easier in holding all the parts together for brazing. The webs are also from the 1.6mm sheet, the end bolting flanges from 1/8 in. steel flat. Leave the end flanges oversize at this stage, clamping firmly over same, when the centre webs should hold themselves in place for brazing. This time you can pickle and wire brush before adding the coating of zinc, then mark off and complete profiling the bolting flanges. Grip in the machine vice to mill said bolting flanges to 4 1/8 in. overall, using the same technique as for the frame stays, and likely you will have a 3/4 in. diameter end mill by you with which to deal with the three lightening holes, drilling 1/2 in. diameter pilot holes first; repair the damage to the zinc coating.

We can now have our first trial assembly of the parts made thus far, using either the lathe bed to check for flatness, or a well supported glass sheet, and checking with an engineers square as far as you are able. Do not drill a single fixing hole at this stage, but make up some home-made cramps to place. These are short lengths of, say, 3/8 in. x 1/8 in. steel flat bent to a 'U' shape, drilled and tapped 2BA for a clamping screw.

Intermediate Stay

We can now check the measurement for the intermediate stays, and if the inner frames are from 1/8 in. thick material then the dimension we are looking for is 7/8 in. As there are four stays to make, it is worth spending time making up a bending block, milling it down from 1 1/4 in. x 1 in. BMS bar, when with a bit of luck you can arrive at the correct overall dimension to avoid machining same. Cut out and braze in the stiffeners, then profile to drawing with saw and files, as milling may well lead to distortion.

Tender Horns

The acid test of frame alignment is that the wheels turn sweetly, and once the horns are made and fitted we shall be ready to prove same. The horns are cast in fours, which is a long unsupported length when held in the machine vice, in which case cut into pairs as the first step. As always, assess the machining allowance, grip in the machine vice and use small packing pieces between the webs, to mill the frame fixing face and tidy up the outer edge. Now turn through 90 deg., deal with the working face, and then use the side teeth of the end mill to arrive at the 5/8 in. dimension. Cut into individual horns, square each up to 1 5/8 in. overall, keeping the webs nice and central. If you omitted to drill the 3/32 in. rivet holes in the frames, mark off and drill the horns at this stage, then clamp a pair of horns to a tender axlebox. Offer the whole assembly up to a horn gap, again clamping firmly in place, when you can drill through for the rivets. Ease any tight spots so that the axleboxes are a free fit, get all of them up to this stage, then assemble the chassis again and check with the wheels and axles in place. Once proven, you can proceed merrily in substituting 6BA hexagon bolts for those home-made clamps, when you will arrive at a chassis that is already amazingly strong, as well as being authentic; we can start adding the details.

Support Angle and Outriggers

One of the problems of adhering to scale is in locating suitable materials. My immediate cause for concern arises over the specified 5/8 in. x 5/16 in. x 1/16 in. section for the support angle, for whilst something suitable must have been available in 1976 when originally detailed, in 1991 I cannot as yet locate a suitable source of same. I have a feeling that had I been asked for a supplier in 1976, then my answer would have been Whiston's whom I then used regularly, but latterly I have completely lost touch. Anyhow, from the current Reeves Catalogue, it looks as if 1/2 in. x 1/2 in. x 1/16 in. section brass angle will have to be utilised, the second face being reduced to 5/16 in. width, when adjustment will have to be made to both steps and outriggers to cater for the lost 1/8 in.

Whilst there are a number of No. 34 holes conveniently placed 1/4 in. below the top edge of the outer frames for attaching the support angle, thus making them doubly useful, it will be a good idea to provide some extra fixing over what would otherwise be quite long unsupported lengths, which could with advantage be 3/32 in. snap head iron rivets. Ahead of making such a permanent attachment, it will be as well to tackle both outriggers and steps, riveting them to place as the next step.

The first time I saw the use of outriggers for attachment of a tender body to its chassis was on a batch of LMS Class 4 'Moguls' building at Doncaster in 1950. At The Plant, the feature was not greatly appreciated, as they were roughly at eye level and a potential hazard, though we shall reap the full benefit in 5 in. gauge, as we don't have to pierce the tank space to bolt the body down to the chassis. As ten outriggers are required, it is worth spending time making up a template so that they all look the same, a template that can also be used as the drill jig, and of course do make allowance if the top face of your support angle is only 1/2 in. wide. Clamp the outriggers in place, drill through at No. 51 and countersink for copper rivets, hammering well down and filing the top face flush.

Steps

We must now break off to tackle the steps, especially if we decide to rivet same to the support angle, which I favour. Mark off on a 1.6mm steel sheet and cut out the backing pieces, filing to line.

In these days of Health and Safety at work, no doubt a lot of attention would be given to such a simple item as a cab step in a bid to reduce accidents. I have a permanent scar on my right knee from having slipped off one of them whilst carrying a heavy bag of tools and am sure I am not alone in this, the end restraint as detailed being rather insignificant. We do not have to climb them though, only provide an authentic representation, so mark each step off on a piece of 1.2mm steel or brass sheet, cut them out and fold to drawing. As we are in the process of riveting others items in place, we may as well use said method of fixing for the steps to their back plates, when three 1/16 in. countersunk copper rivets will suffice for each step, filing flush on completion.

Whilst on the subject of support angles, we need some extra pieces to fix to the rear buffer beam, for holding down the tank, or rather its soleplate. As the specified section is 7/16 in. x 1/4 in., this time we can get it out of the 1/2 in. brass angle without having to deviate from specification, plus No. 44 holes are already in existence in the beam, which indicates 8BA bolts as the method of fixing.

TENDER SPRINGING

Let us make a start with the spring material, taking note of the particulars given at the bottom of Sheet No. 3. The bottom leaf is a plain 1 3/16 in. length from the 7/16 in. x 1/32 in. spring steel flat; cut the top leaf 4 1/4 in. long initially. Mark off for the No. 27 hole for the spring bolts at 3 7/8 in. centres, centre pop heavily, then file away the 'pimple' produced until a wee hole appears, opening this out gradually to size.

Take a length of 7/16 in. x 1/32 in. Tufnol, obtainable from Reeves, coil inside one of those round tobacco tins that seem to get ever more scarce, pop into a domestic oven and 'bake' for a few minutes to produce a permanent set. Cut into the required lengths and drill the upper ones for the spring bolts, using the top leaf as your drill jig.

Spring Buckle and Socket

For the spring buckle, grip a length of ⅝ in. x ⅜ in. BMS in the machine vice on the vertical slide, mill the protruding end square, then cut a slot to 11/16 in. depth with said end mill, opening out to 7/16 in. width to be a good fit for the spring material. Saw and square off to 15/16 in. overall length, then make up and braze in a 5/32 in. thick top closing plate. Back to the machine vice to mill the overall width down to 9/16 in. as specified, then centre, drill and tap 4BA for the cup point socket head grub screw to hold all the leaves firmly in place.

The socket I recommend is made in two pieces, so start with the base from 1¼ in. x ⅛ in. bright steel flat, cutting the slots to be an easy fit between the horns and completing the profile to drawing. The top portion is from ¾ in. x ⅛ in. steel flat, first drilling a couple of ¼ in. holes and then opening out into a slot to accept the spring buckle. Now fashion the top plate around said slot, clamping firmly together and brazing. Lightly pickle, clean and then apply a coating of zinc to keep them pristine.

Spring Hanger

The spring hanger is one of those parts where a Doug Hewson lost wax casting would come in very handy indeed, though it is possible to fabricate them. Start with a length of ¾ in. x ¾ in. x ⅛ in. steel angle, or of course the metric equivalent, reducing the thickness to 2.5mm, then mark out all 12 of them, sawing and filing to line. Cut the wee webs from 1.6mm steel strip, pack them in place and braze, checking with a square that they have not distorted too badly, which means making them a good fit initially, but correcting any small error. Pickle, clean and zinc coat, then drill the No. 26 hole before offering up to the frames to drill and rivet in position.

Dummy Shock Absorber

Full size the shock absorbers are steel cups which are filled with rubber and fitted with a steel closing plate, which we can reproduce in 5 in. gauge by merely chucking a length of ⅝ in. diameter steel bar, facing off, centering and drilling No. 27 before parting off twelve 13/32 in. slices, deepening the hole as we proceed: that bit was easy!

Spring Gripper and Special Washer

The spring gripper would make another ideal lost wax casting, a Hewson speciality!, otherwise we shall have to start from ½ in. x 3/16 in. BMS flat, the bogie quartet from ⅜ in. wide material. Deal with them in pairs, first marking out and then drilling the No. 27 holes, then grip in the machine vice to mill to 11/64 in. overall thickness before removing another 3/64 in. to form the 'gripper' portion. You will have to file on the 5/16 in. radius, then reduce the width to 7/16 in. keeping the No. 27 hole nice and central, before sawing out and filing the profile to drawing to complete.

For the special washer, chuck a length of 5/16 in. steel rod in the 3 jaw, centre and drill No. 27 to about 1 in. depth. Grip in the machine vice to mill the 5/16 in. radius with an end mill, though it will be just as easy to file this on against your gripper as a gauge, after which part off to the 1/16 in. dimension shown and repeat, almost ad infinitum! The spring bolts are 4BA x 2 in. long and if you have to make these then use 5BA hexagon steel bar for the slightly smaller and neater head, using said material for the nuts and locknuts.

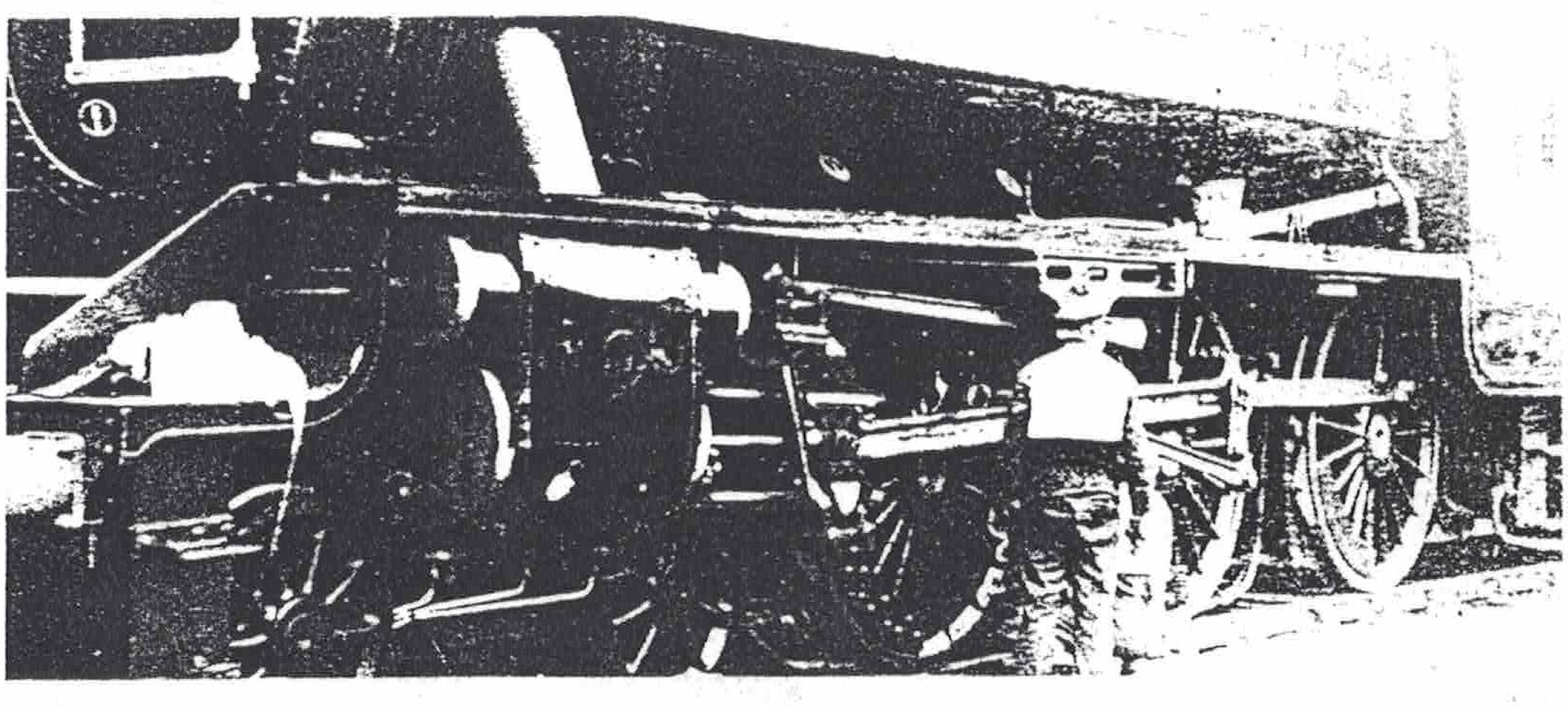
We now have a rolling chassis, the accent being on rolling, for the most important bit is being able to stop it, there being a moral to my tale as I will relate before we make those bits of brake gear that are detailed on Sheet No. 3.

I went along to Durrington at the weekend, 20 October, 1990, to judge the Worthing & District SME Exhibition, an event worth coming many miles to see, so please give me ample notice for 'Calendar of Events' two years hence! Anyhow, as light relief for the daunting task of judging, I was allowed loose with Don Marshall's RIVER ADUR on the Club track which is adjacent to The Barn in which the Exhibition was staged, my first load of passengers including the SEEBOARD Chairman, who was a fellow judge. Don Marshall almost insisted I wear his driver's hat to look the part, for which I shall evermore now label him "big head"!, the peak coming down below nose level!! The result was a near rear end collision with the other train on the track, said Chairman averting same with a timely tap on my shoulder, after which the cap was dispensed with!

To continue the story to its logical conclusion, having said that driving RIVER ADUR was boring, I almost paid the penalty. Don provided me only with a firing shovel and with the combination of very small coal in the bunker and me driving as slowly as possible once I had begun to get to grips with this most interesting track, pressure fell off alarmingly as the firebed fused. Don told me he used the shovel handle as his slice, which got some air through the fire, but for a moment I was in deep trouble with a load of fretting passengers wanting to be away and only 20 p.s.i.g. on the gauge. I asked for and got some large lumps of coal that would just go through the firehole, fed some on and was away without pause, RIVER ADUR barely whispering at that pressure. Those large lumps did the trick though, the exhaust bark came back, and as I completed a double lap so did the safety valves lift. No longer was RIVER ADUR boring, for she had got me out of trouble like the real thoroughbred she is! It was a day when Bert Perryman could look down from on high and be proud of what is being carried on in his memory.

Brake Hanger and Pin

Those brake hangers demand a simple building jig, the base of which can be a 3 in. length of ¾ in. x ⅜ in. BMS flat.



I guess this will be my sole photographic contribution to the BLACK FIVE series, and then only by cutting off the top of the picture am I able to show No. 5000 being prepared at Bold Colliery for ROCKET 150.

Black Five

The fabulous Stanier Class 5MT 4-6-0 in 5 in. gauge

by: DON YOUNG

Part 5 — Tender completion; part Bogie; Mainframes

The most difficult part of BLACK FIVE, at least from the design aspect, was undoubtably the bogie, thus as soon as I had broken the back of the tender, on Sheet No. 4 I had a look at said bogie and also cleared the piston valve cylinders out of the way. I am sorely tempted to repeat the exercise here in print, but to do so would delay completion of the tender, or rather the brake gear for same, plus at least by describing the items on Sheet No. 5 next, the mainframes are in logical sequence, thus only a few of the bogie parts have no immediate home. Let me hurry on and get the tender out of the way first.

Pull Rods, Links and Compensators

The brake beams and shoes are already attached to their hangers, so let us begin with a very simple item, the links. Cut eight $\frac{7}{8}$ in. lengths from $\frac{5}{16}$ in. x $\frac{1}{16}$ in. BMS flat and mark off for the pair of No. 30 holes at $\frac{1}{2}$ in. centres on one of them. Grip all the pieces in the machine vice, on the vertical slide, to centre and drill through at said specified No. 30. Use a 5BA bolt through one of the No. 30 holes to hold them all firmly together, slip the other end over a mandrel and radius with an end mill, holding with a 'Mole' wrench, then transfer the bolt and repeat at the other end; separate and remove the machining burrs.

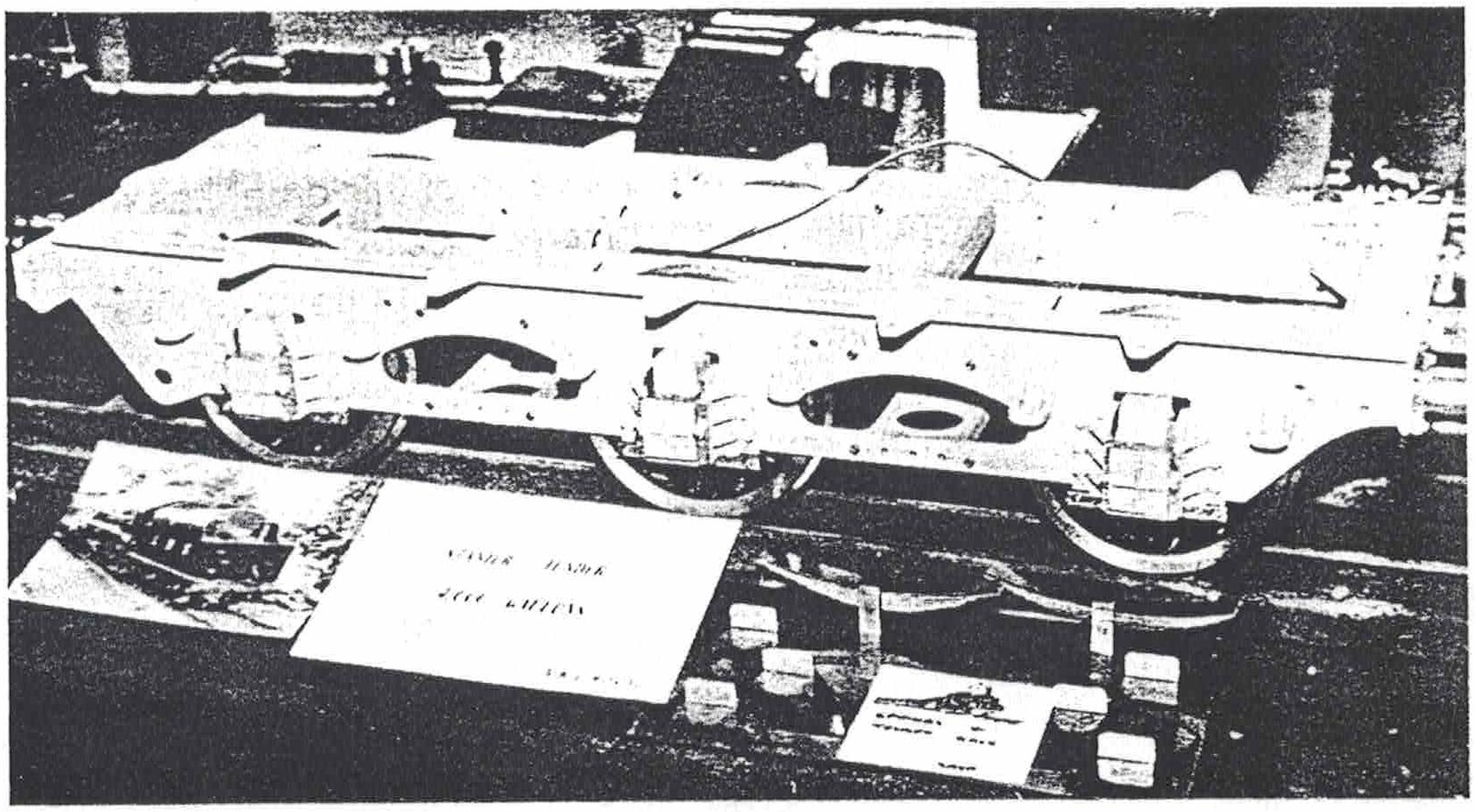
With care, we can make the compensators from $\frac{3}{4}$ in. x $\frac{1}{8}$ in. BMS flat. Mark one off, drill the three No. 30 holes, then saw from the parent bar and begin filing to line. Grip with a 'Mole' wrench and use the mandrel and end mill technique to deal with the corner radii, tidy up the profile then caseharden. Use first as a drill jig to deal with the remaining trio, then bolt each in turn to the master and file down to same as your filing gauge; that was easy! We know how to make brake gear pins, so assemble links and compensators to the first and second beams, as shown.

We will deal with the pull rods working from the front of the tender towards the back, thus our first requirement is two $2\frac{9}{16}$ in. lengths from $\frac{5}{16}$ in. x $\frac{5}{32}$ in. BMS bar, a section that will have to be arrived at by milling from the nearest commercial size. Chuck truly in the 4 jaw to turn down over a $\frac{15}{16}$ in. length to $\frac{5}{32}$ in. diameter, blending the end as shown and screwing 32T over a $\frac{3}{4}$ in. length. Mark off and drill the pair of No. 22 holes, radius the end over a mandrel with an end mill, then complete the profile with files.

The intermediate pull rods start as $2\frac{3}{16}$ in. lengths from $\frac{5}{16}$ in. square steel bar. Chuck truly in the 4 jaw, face and turn down to $\frac{5}{32}$ in. diameter over a $1\frac{9}{16}$ in. length with a round nosed tool to blend into what will be the forked end, screwing 32T again over a $\frac{3}{4}$ in. length. Cross drill No. 30 for the brake gear pin, then move on $\frac{3}{8}$ in. and in the other face, again drill No. 30 for the end of the fork. Saw down and open out to an $\frac{1}{8}$ in. slot with a key cutting file, then radius the end over a mandrel with an end mill before both completing the profile and reducing the thickness to $\frac{1}{4}$ in. over the fork.

That takes care of the pull rods up to the leading brake beam; now to take them on to the second beam. There are many ways of making long pull rods and I have tried a few of them in my time, including bending up the fork ends from $\frac{5}{16}$ in. x $\frac{1}{16}$ in. steel strip, but this time my specification is first to braze 1 in. & $\frac{5}{8}$ in. lengths of $\frac{5}{16}$ in. square steel bar to a $6\frac{1}{2}$ in. length of $\frac{1}{8}$ in. steel rod. If you have any qualms about getting the rod nice and central to the ends, then chuck each of the latter in turn truly in the 4 jaw, centre and drill, say, No. 50 to $\frac{3}{32}$ in. depth, making the central rod $\frac{3}{16}$ in. longer to suit and turning each end to a press fit over a $\frac{3}{32}$ in. length. Cross drill for the brake gear pins, then again No. 30 to start forming the slots, completing in exactly the same manner as for the intermediate pull rods and again pinning in place.

Nobody in the past 15 years has told me about the rear pull rods, and yet they never existed!, and what is worse, I specified too many links and compensators!! I only discovered my mistake when I came to describe construction, so at last the drawing has been corrected, with due apology to those who have gone before me. Apart from changing the centre distance from $7\frac{21}{32}$ in. to $8\frac{15}{32}$ in., construction is identical to the pair of pull rods just described, though it would be wise to check this centre distance to place now that all the rest of the brake gear has been assembled.



Steve Russell is attempting to build his BLACK FIVE as the series is published, though I predict he is in for a tough time come 1992! The tender chassis seen here on display at the Scunthorpe ME Exhibition is noteworthy for its fine workmanship; well done Steve.

Mark off and drill the two end holes at No. 23, pressing in ¾ in. lengths of 5/32 in. steel rod, then deal with the brake shoe pin hole at No. 31, pressing in a ¾ in. length of ⅛ in. steel rod.

For the top bosses, chuck a length of ⅜ in. steel rod in the 3 jaw, turn down the outside over a ⅜ in. length to 11/32 in. diameter, then centre and drill No. 11 before parting off a ¼ in. slice; repeat. The bottom bosses are from 5/16 in. steel rod, drilled centrally at No. 22 and again the slices are ¼ in. thick.

For the centre portion of the hanger, start with a length of ½ in. x 3/16 in. BMS flat and first reduce the thickness to ⅛ in. except in way of the brake shoe, drilling this No. 30. Offer up to the jig, scalloping the ends to suit the bosses, then mark off and complete the profile before brazing together. Brake gear parts are not painted full size but to avoid rusting I brush the parts over with black undercoating, which to my eyes at least looks like 'raw' steel.

For the hanger pins, chuck a length of 3/16 in. steel rod in the 3 jaw, file a wee taper on the outer end and part off at 1 11/32 in. overall. For the pin head, chuck a length of 5/16 in. steel rod in the 3 jaw, face, centre and drill No. 13 to ¼ in. depth, parting off at a full 3/32 in. Press onto the plain end of the pin, braze for additional security, then chuck in the 3 jaw and clean up the head. Fit the pins to the frames, to drill through at No. 57 for the 3/64 in. split pin to retain same.

Brake Beam

Although in 1976 I specified that the beam be fabricated, 15 years on I reckon that I would now turn them up from 7/16 in. steel rod, thus such will now be my description. Cut three lengths and square them off to 5⅛ in. overall, then chuck each in turn in the 3 jaw and turn down the centre 2⅛ in. length to 9/32 in. diameter. Now concentrate on each end in turn, dealing with the 3/32 in. diameter over a 1/16 in. length, then ⅛ in. turned down to .142 in. diameter and screwed 4BA, followed by ¼ in. to an easy fit in the brake hanger. That leaves the ⅛ in. thick collar to 5/16 in. diameter, blending into the parent bar.

Remove to the machine vice and use an end mill to deal with each of the lands for the pull rods in turn, though you will have to complete these with a file, afterwards reducing their width to 13/32 in. and completing with the No. 30 holes. You can now erect the beams and their hangers, making up the spacers as per my note to centralise same, although it will be prudent to give them a wee bit of end float, so that the brake shoes can follow the wheels.

Brake Shoe

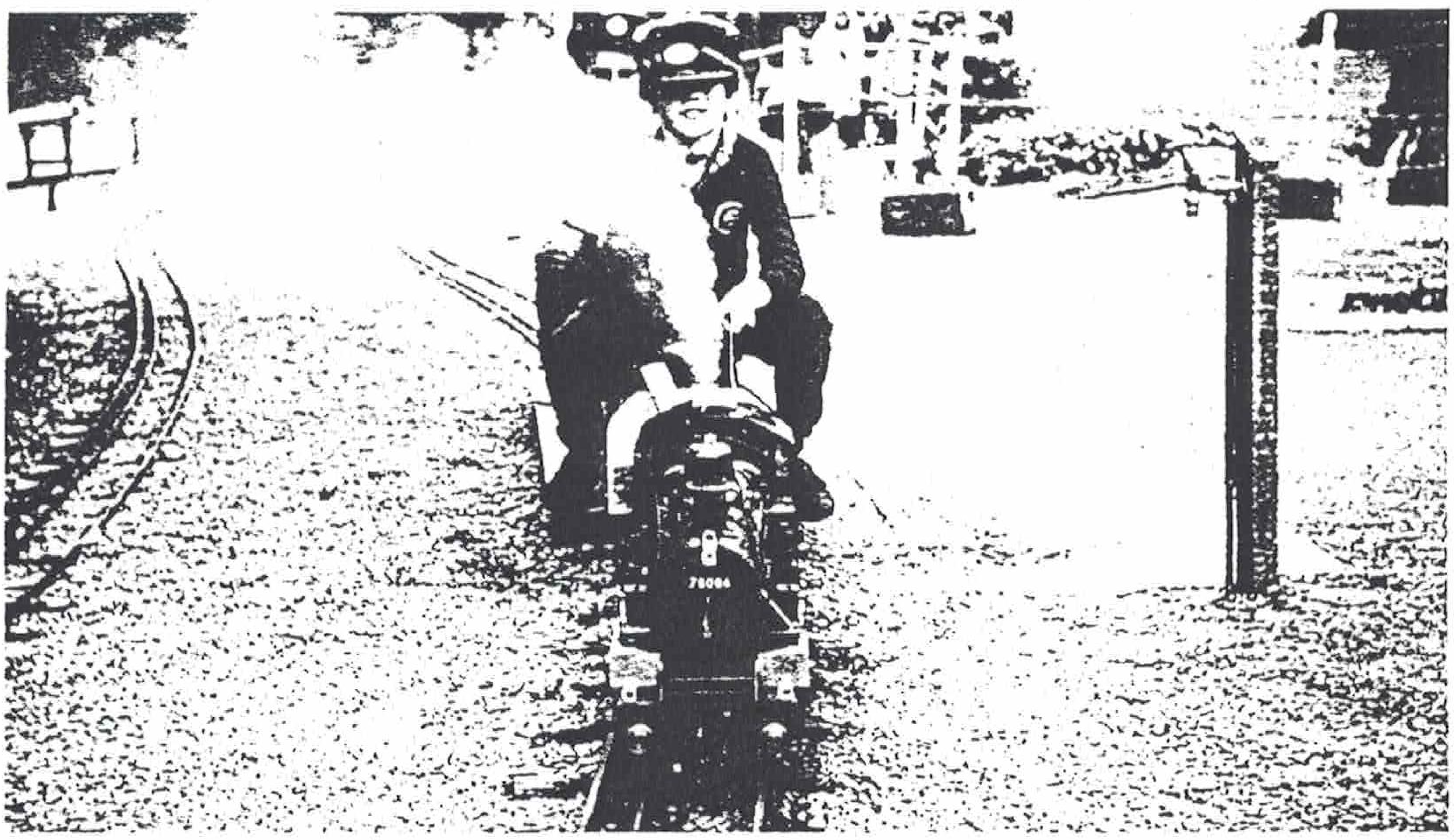
Stocking a range of cast brake shoe rings I have found over the years to be totally uneconomic, so when Jay's sent me a plain ring for the intricate shoe I designed for my 7¼ in. gauge passenger bogie, initially I was most unhappy. Then looking at the rings again, I could begin to see they had many applications, among them the brake shoes for the BLACK FIVE tender, thus they were accepted with alacrity! There is a lot of metal to be removed, but somehow builders don't seem to worry about this, so first turn the ring to 5⅞ in. o.d., 4½ in. bore to suit the wheels and including a wee radius to suit said wheel profile, and ⅜ in. thick. Mark them off, drill the No. 30 pin hole and cut into individual shoes. Now grip in the machine vice and with a 5/32 in. end mill, start forming the slot to accept the brake hanger. Keep trying in place, for in conclusion the shoes must be able to follow the wheel as it rises and falls, but movement must be restricted so that the shoes do not 'trip' and dig into the wheel tread, thus they must be fitted carefully. Possibly the brake shoe pin appears on another sheet, but in any case the item can just as easily be made using the description for the hanger pin.

Guard Iron

I expect many of you have experienced the same problem as I in that a guard iron will hit something and all of the bolts bar one will shear, so the guard iron is left swinging about; such irks me! Although I have never experienced same, it must have happened on occasion full size, which is likely Stanier's reason for the step to fit hard against the rear buffer beam, making the assembly so much stronger. When added to this in miniature is my use of 6BA securing bolts, as against the 8BA ones I used as instance on my RAIL MOTOR No. 1, I think these will stay in place!

With careful marking out, and the loss of a few thous on the bolting face, the guard irons can be cut from 1 in. x ⅛ in. BMS flat. File to line, mark off and drill the three No. 34 fixing holes to suit the frames, then produce the 5/16 in. set, doing this as a pair to be identical rather than exact to dimension, then erect and we have made as much progress as we are able in this session.

The remaining tender brake gear appears on Sheet No. 5, which puts me in a bit of a quandary, as major parts of the engine are dealt with on Sheet No. 4. Anyhow, to give me a bit more time to consider what to do about this, next time I think we shall concentrate on the tender body which appears on its own on Sheet No. 13, though from now on there will be plenty of challenges in all directions!



The ghost of the valve gear clanger I dropped on No. 78000 still just occasionally raises its ugly head, not quite laid to rest by my series in LLAS. This picture above all has the answer, for builder Roger Sully reports but one problem, this being that his son Robert is so thrilled with the Class 2 that it is hard to prise him off the driving trolley!

Black Five

The fabulous Stanier Class 5MT 4-6-0 in 5 in. gauge

by: DON YOUNG

Part 4 — Tender Body

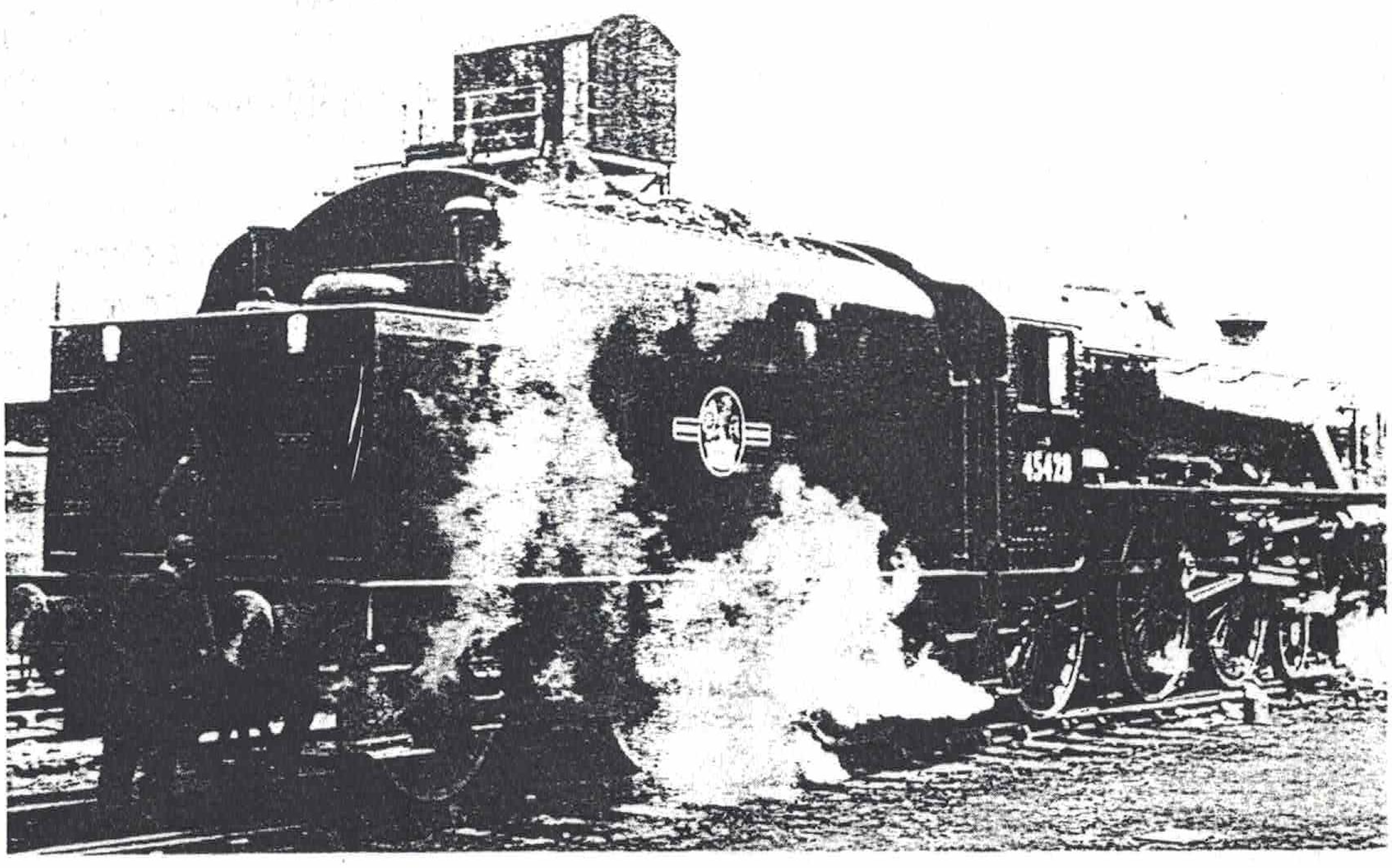
In a quite recent issue of "Model Engineer" that worthy Editor, Ted Jolliffe, was telling his readers how in trying to complete a model of some vintage, he was struck by the paucity of detail on the drawings. This took me back to the first 15 years I spent on the drawing board on model engineering projects, up to and including FISHBOURNE, all of which were in the LBSC era. Now apart from his regular contributions to M.E., our late maestro was also responsible for such books as his famous SHOPS, SHED AND ROAD and THE LIVE STEAM BOOK, both of which builders made constant reference to as their "bibles". Thus there was no need to detail such things as mechanical lubricators or boiler fittings, they were universally accepted standards, in fact to commit such details to paper might well have infringed either Percival Marshall or LBSC Copyright, which was quite out of the question. Those were the days when one built an LBSC locomotive to his "words and music", the end result being quite basic and to which it was permissible to add "blobs and gadgets", but any fundamental changes in design were greatly frowned upon. Drawings were sacroscant, the builder had to struggle to find his own way round any errors that there were, indeed this was the mentality within the Drawing Office in which I worked in industry for a few short months at the outset of my career on the drawing board.

This sort of thing lingered on into the 1970's, as I was to discover when I spent a day with the late Harry Clarkson in York. I went along to see Harry as I thought his 5 in. gauge Gresley A3 Class 'Pacific' design was capable of improvement, this as a result of driving Alan Fay's BLENHEIM on the Southampton track, being disappointed with her performance. Harry was working on a 3½ in. gauge "King Arthur", so I took along my 2½ in. gauge ELAINE drawings and was pleased to grant permission for my drawings to be used in scaling up for the Clarkson design. Harry looked at Sheet No. 1, the General Arrangement, and commented enthusiastically that I had adopted his principle in putting no dimensions on the drawing, saying if a dimension does not appear, then it cannot be wrong! I rather threw Harry when I opened up the other seven sheets, all fully dimensioned!!

By 1980 the roles were reversed, it was the builder who was demanding full details for the locomotive he was building, hence the addition of Sheet No. 13 to the drawing set for BLACK FIVE. For several years following that addition, sales of LMS 4,000 gallon tender drawings exceeded those for BLACK FIVE herself by a considerable margin, many of them taking up duty behind a "Royal Scot", until the advent of Tony Allcock and his 5XP GALATEA, since when I guess Norman Spink fulfills this role. In many ways, it is good that the market controls what the designer now produces on the drawing board, though thankfully as yet you do not tell me which engine to draw, your choice of prototype still being as wide as ever it was!! Now we had better start cutting metal before space runs out.

Talking of metal, it must be around 25 years ago now that the price of brass began to influence builders for such things as tender bodies and steel was widely considered. For the relatively simple shape as it appears on Sheet No. 2, then steel does have its attraction, but once one adds all the detail on Sheet No. 13 reproduced on the centre pages of this issue, such complexity means that brass alone is suitable, all the sheet being 1.6mm thick. The soleplate is a massive 24⅞ in. x 9½ in. and wants to be perfectly flat, so that we can use it as a building board for the rest of the body, so take your time in levelling the sheet as a first step if it is warped in any way.

Next job is to mark off, drill around and break out the six cut-outs for the splashers and the larger one for the tender well, though the latter is remarkably modest after what was the norm on the LNER. For the splasher sides, scribe two



I guess it can be said without fear of contradiction that 45428 is Tom Greaves' favourite BLACK FIVE. Fortunately for us, Tom took pictures of her from all angles, this one being particularly useful in showing some of the tender body detail, including the overhead cable warning flashes.

5 in. diameter circles on a piece of 1.6mm brass, saw out roughly to line, then drill, say, a ½ in. hole through the centre. Chuck a ½ in. nut, any thread, and bolt the discs to same to skim them down to line. Scribe into segments, saw one off slightly oversize, sit the soleplate on top of the tender chassis and try the segment to place to check that the splasher will be clear of the tender wheels, adjusting if found necessary. Cut all the segments to pattern, then use ⅞ in. x 1/16 in. brass strip for the top of the splashers, bending or rolling to suit the side pieces, then clamp the three pieces together and silver solder the joints. Offer up to the soleplate, getting each a tight fit ready to be sweated together later on.

The shell plate for the tender well wants to be 7½ in. x 2½ in. from the 1.6mm brass, bent to drawing with the ends then trimmed to place. I have shown the back plate from 1.6mm thick material, the front plate 3mm thick, whereas for larger wells I usually make these plates as a pair. The fit wants to be a really tight one, to hold the shell plate in place in the soleplate, and again the joints want to be silver soldered to form a neat sub-assembly. Mark off, drill and tap the two holes for 5/16 in. male unions and I had better say something about that 100 mesh filter gauze at this stage, if only as it proved a bone of contention with one BLACK FIVE owner who purchased his engine complete.

Just like the full size engines, our BLACK FIVE is going to rely for boiler feed on a pair of injectors. Provided that the water reaching the injectors from the tender is free of both air and foreign bodies, which means air-tight flexible connections between engine and tender, plus efficient filtration of the feed water, then the injectors we supply will be perfectly reliable in service. Now the design of the Stanier tender is such that the filter is remote from the traditional removable section of tank top in way of the filler, so how does one clean the filter. The best way is to ensure a clean supply of water at all times, but accidents do happen in the best regulated circles, which is why the filter is specified. The accepted method of cleaning industrial filters of this simple type is by back-flushing, and if those pair of 5/16 x 32T tapped holes for the male unions are thought inadequate for the purpose, then provide a larger tapped hole in a central position and fit a hexagon plug, so that you can then stand the tender on its buffers and flush any debris out through the filler tube, the filter being a permanent fixture, so use bronze gauze.

We are ready to start building on the foundation of the soleplate and I recommend the front and rear coal bulkheads as the next step, as they give us the correct profile. Mark them out in the solid on sheets of 1.6mm brass, sawing and filing carefully to line. Later on we shall be piercing these bulkheads to provide circulation for the water in the tank, but for the moment we need them whole so that we can make the tender sides to suit. I suggest you cut the sides initially 24 in. x 8 in. from the 1.6mm thick brass sheet and start marking out from the rear end. That 2½ in. dimension above the rear of the tank in the filler area is a vertical one, so mark this off on the pair of bulkheads and measure round for the actual dimension "in the flat", scribing this latter onto the side sheets. Now you can saw away the surplus material at the top, filing to line, and scribe on the bend line a bare 6 9/16 in. up from the bottom. The way I deal with these long bends on brass platework, and it takes me back to the 'S' bend in the base of the bunker on FISHBOURNE, is to grip the side sheet together with a, say, 2 foot length of 1 in. diameter steel bar in the bench vice and pull round a little at a time. Do use soft clams to avoid disfiguring the brass, and anneal the sheet only as a very last resort, as it is much better to deal with same whilst it is springy, just pulling it round to the bulkheads as your gauge. When the correct fit is obtained, move to the vertical bend at the front of the side sheet, trimming to length and pulling round the bar as before. The rear sheet is a plain piece, 8 15/16 in. x 5 3/16 in. from the 1.6mm brass sheet, when you can start adding ¼ in. x ¼ in. x 1/16 in. brass angle to hold the pieces made thus far together.

First attach lengths of brass angle to the bottom of the side and back sheets, taking note of the positions of the various bulkheads and stiffeners and omitting the angle in way of same; this will take a deal of your time. Use 1/16 in. snap head copper rivets as the means of attachment, heads inside and hammering down into countersinks on the outside face, filing flush in conclusion. Avoid brass rivets like the plague, they are hard and hammering them into countersinks will distort the brass sheet, whereas copper rivets are kind and only require gentle hammering. Use further lengths of the ¼ in. brass angle to attach the sides to the rear sheet, taking note of the position of the tank top, this time riveting only to the rear sheet at this stage. Drill off for attachment to the side sheets, but instead of rivets use 10BA countersunk brass screws, nutted inside, so the assembly does not become a permanent one as yet. Later on you will have to decide where riveting is feasible and where not, and in the latter instances we shall change to 8BA countersunk brass screws, tapping the 1/16 in. holes in the fixing angles for said screws.

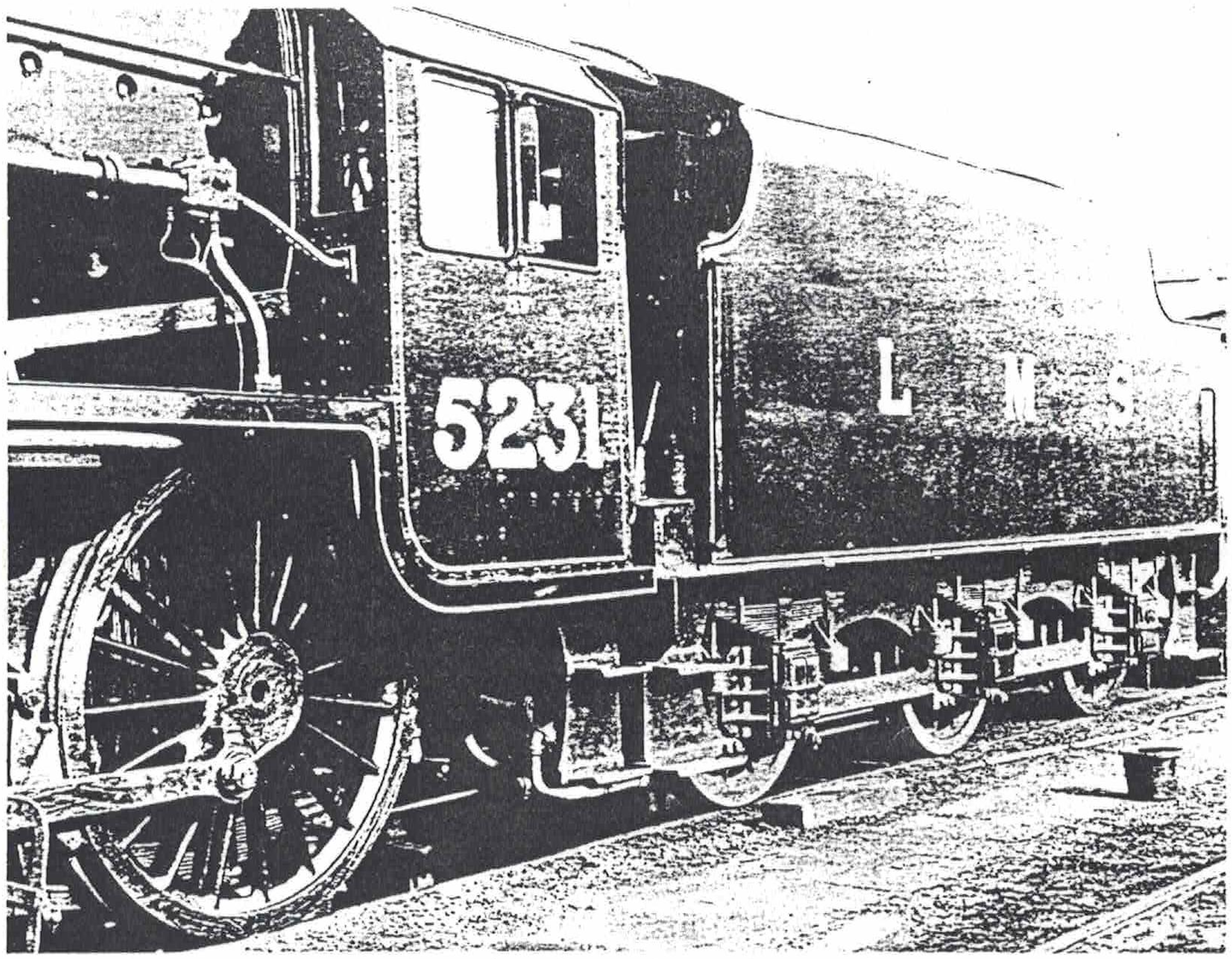
Sit the side and back sheets on the soleplate, mark off and drill for about twelve 8BA countersunk brass screws at this stage, just to hold the bits nicely together, and we shall add further screws on final assembly, so space the first few accordingly.

Adding the wing tanks will stiffen up the whole assembly, so let us tackle them next. Both wing tanks are supported on a trio of diaphragms, so cut six pieces 4 9/16 in. x 3 5/16 in. from the 1.6mm sheet, measure out 1⅛ in. for the tank top, then shape at 40 deg. as shown; secure to the side sheets and soleplate with ¼ in. brass angle. For the wing tanks themselves, cut two pieces 14 3/16 in. x 5¼ in. from the brass sheet and fold to fit the diaphragms; left like this those tanks will be almost hermetically sealed, so cut slots as shown in the view from the front with the bulkhead removed to assist circulation. Use only short lengths of the ¼ in. brass angle to secure the wing tanks to their diaphragms, riveting to the latter and then screwing the wing tanks in place.

Now for the tank top within the coal space, which ideally should be a single piece, so first make a cardboard template, trimming to place, then transfer to the 1.6mm sheet and cut out, folding as per the template and including the 11/16 in. projection for the coalplate. Now is the time to cut away those front and rear coal bulkheads, so that it is clear what will form the water space. Continuing with the tank top behind the rear coal bulkhead, we require a piece roughly 8 15/16 in. x 6 7/16 in., which can be removable, though such is not imperative unless a tender hand pump is fitted. Fit lengths of ¼ in. brass angle to the rear and side sheets, plus rear coal bulkhead, to support the tank top, which will be held in place with a few 8BA brass countersunk screws. Before doing so though, we have to attend to the filler and water scoop dome, starting with the latter.

Sadly, 2¾ in. o.d. x 16 s.w.g. copper tube is no longer widely available, and it is a most useful size for all sorts of odd things, the alternative being to roll it up from 1¼ in. x 1/16 in. brass strip. The top you will have to machine from a gunmetal casting, so chuck by the periphery in the 3 jaw, clean up the chucking spigot and grip again by the latter. Turn down to 2¾ in. diameter, then further reduce to 2⅝ in. diameter over the end 1/16 in. to be a tight fit in the rolled tube. You can now hollow out the casting and turn on the outer profile as you wish, finally parting off the chucking spigot, then silver solder the complete assembly, cutting a hole in the tank top to accept same.

The filler tube is a ¾ in. finished length from 1⅝ in. o.d. x 16 s.w.g. copper tube, which is widely available, so no



This is the sort of picture that schoolboy dreams are made of, at least they were in my younger days, gazing up at the footplate in awe. Given time, we can supply an authentic vacuum ejector as part of a brake kit.

top of the casting back to the four ribs, then move on and deal with the vertical face to arrive at the 13⁄32 in. dimension. Now mill along the bottom edge to arrive at the 1 7⁄32 in. dimension, though you will have to complete the profile later on to match the bogie frames. Next, mark out for the 1 in. x 25⁄32 in. cut-out for the bogie buffer, drilling away as much metal as you are able before changing to a small diameter end mill to machine to line, the corners being completed by filing to the buffer as your gauge. We now have to machine the vertical, frame fixing, flange to 5⁄32 in. thickness, so use a short length of 1 in. x ½ in. BMS bar against the base of the machine vice and the just machined face to set the bracket up nice and square, then mill to thickness, which gives us a nice tongue to grip for the rest of the machining. Deal with the top surface first, only that within the pair of inner ribs requiring attention as this forms the rubbing area for the socket, then mark off and drill the pair of No. 34 holes as specified. That leaves just the boss on the underside to accept the spring buckle spigot, so set this up in the machine vice, first deal with the whole surface with a 5⁄32 in. end mill to arrive at the 1 15⁄32 in. dimension from the bottom of the flange, and the ¼ in. thickness, then centre, drill 5⁄16 in. diameter to ⅛ in. point depth and 'D' bit.

Spring Buckle and Ball

Two unrelated piece parts, but in getting them out of the way it will just leave the equaliser beam assembly for now.

For the spring buckle, chuck a length of ½ in. x ⅜ in. BMS bar truly in the 4 jaw, face and turn down to 5⁄16 in. diameter, an easy fit in the bogie bracket, over an ⅛ in. length. Centre, drill No. 40 to about ⅜ in. depth and tap 5BA for a ¼ in. long cup point socket grub screw. Mark off for the 11⁄16 in. x ⅜ in. cut-out for the spring leaves, drill a couple of 5⁄16 in. diameter holes to start forming same, then open out with a small diameter end mill, though completion will have to be with files to the spring leaf material as your gauge. Do this with the embryo buckle still attached to the parent bar, then part off to complete.

For the ball, chuck a length of gunmetal cast bar in the 4 jaw, face and turn down to 1¼ in. diameter over a ⅝ in. length. Further reduce to ⅜ in. diameter over about a 3⁄16 in. length, just sufficient that the spigot can be gripped in the 3 jaw chuck, then part off to arrive at the 11⁄32 in. dimension. Rechuck by the spigot, reduce the flange to ⅛ in. thickness as shown, then start forming the 5⁄16 in. spherical radius, and this really requires a form tool to complete. Scribe on the 15⁄16 in. diameter bolting circle with a knife edged tool, then rechuck carefully by the flange to reduce the spigot to the 3mm dimension before marking off and drilling the five No. 34 holes. Back to the machine vice and vertical slide to mill the flange down to the ⅜ in. dimension, then complete the ⅜ in. radii with a file.

Equaliser Beam, Ends and Spring Pivot

It was a great relief to confirm that Reeves still stock 1½ in. x 3⁄32 in. steel flat in their current Catalogue, even though a sheared section, as the thickness is crucial both for ease of forming the sides of the beam and for clearances. This does, however, rather rule out the later profile because of the extra width of material this involves. As four 'joggles' are required in each side member, and accuracy is essential, it is worth spending time making up a press tool, which should be the full 1½ in. width, when you can press them out using the bench vice. Mark out each beam, but then drill them as pairs and stamp them before going on to saw out the profile and file to line.

For the beam ends, chuck a length of ⅝ in. x ¼ in. BMS bar truly in the 4 jaw, face and turn down to 5⁄16 in. diameter over a 3⁄16 in. length, turning a spherical radius as shown at the outer extremity; part off at 9⁄16 in. overall. Offer up to a pair of side members, check with an engineers square and through the No. 30 holes that you have achieved the correct alignment, then drill through from each side for the 1⁄16 in. snap head iron rivets, only delay fitting them until the spring pivots have been made and are in place.

Let us fabricate the spring pivots to vary the description, so start with a length of ⅜ in. x ¼ in. BMS bar and square off four 13⁄32 in. lengths. In the centre of the 13⁄32 in. face and 5⁄64 in. up from the bottom, cross drill No. 31 and press in centrally a 19/32 in. length of 1/8 in. steel rod, adding a touch of silver solder to prevent the pin from coming adrift in service. Chuck by each spigot in turn to remove any excess spelter, then take to the machine vice on the vertical slide to first mill the 1/4 in. wide slot to 3/32 in. depth and then complete with the No. 27 hole; that is as far as we can go with the bogie this session.

Coupled Axle

These are the classic example of how far we have come along the road to metrication, as supposedly imperial sizes were to be phased out by 1980, yet finding metric bar in our suppliers catalogue belies such statement. The thing that has changed in the interim is that Loctite No. 35 is no longer available to us, the alternatives from that manufacturer somewhat inferior, but at least we can employ Permabond A118 with confidence.

Start by squaring off three lengths of 7/8 in. diameter bright steel bar to 5 15/16 in. overall, centering each end and then mounting between centres. Tighten the 4 jaw chuck onto the bar as the means of driving it, then turn down over as long a length as you are able to 13/16 in. diameter. Next concentrate on the outer end, reducing to 3/4 in. diameter over a 5/8 in. length to suit the coupled wheels. Turn the next 1 5/32 in. length down to .787 in. diameter, which is 20mm, then deal with the centre section with a round nose tool down to 11/16 in. diameter, the length I make as 2 3/8 in. Reverse the bar and deal with the other end wheel seat and journal, then fit the 3 jaw chuck and grip the embryo axle by its central section to begin drilling through at either 6.5mm or 1/4 in. diameter, going about half way through, then reversing to complete. This really is taking authenticity to its ultimate, unless you want fresh air to pass through the centre of your axles!, in fact the provision of same on the 'Britannias' was their undoing in that as Alan Rimmer, described, wheels moved on axles and the remedy was to plug the holes.

MAINFRAMES

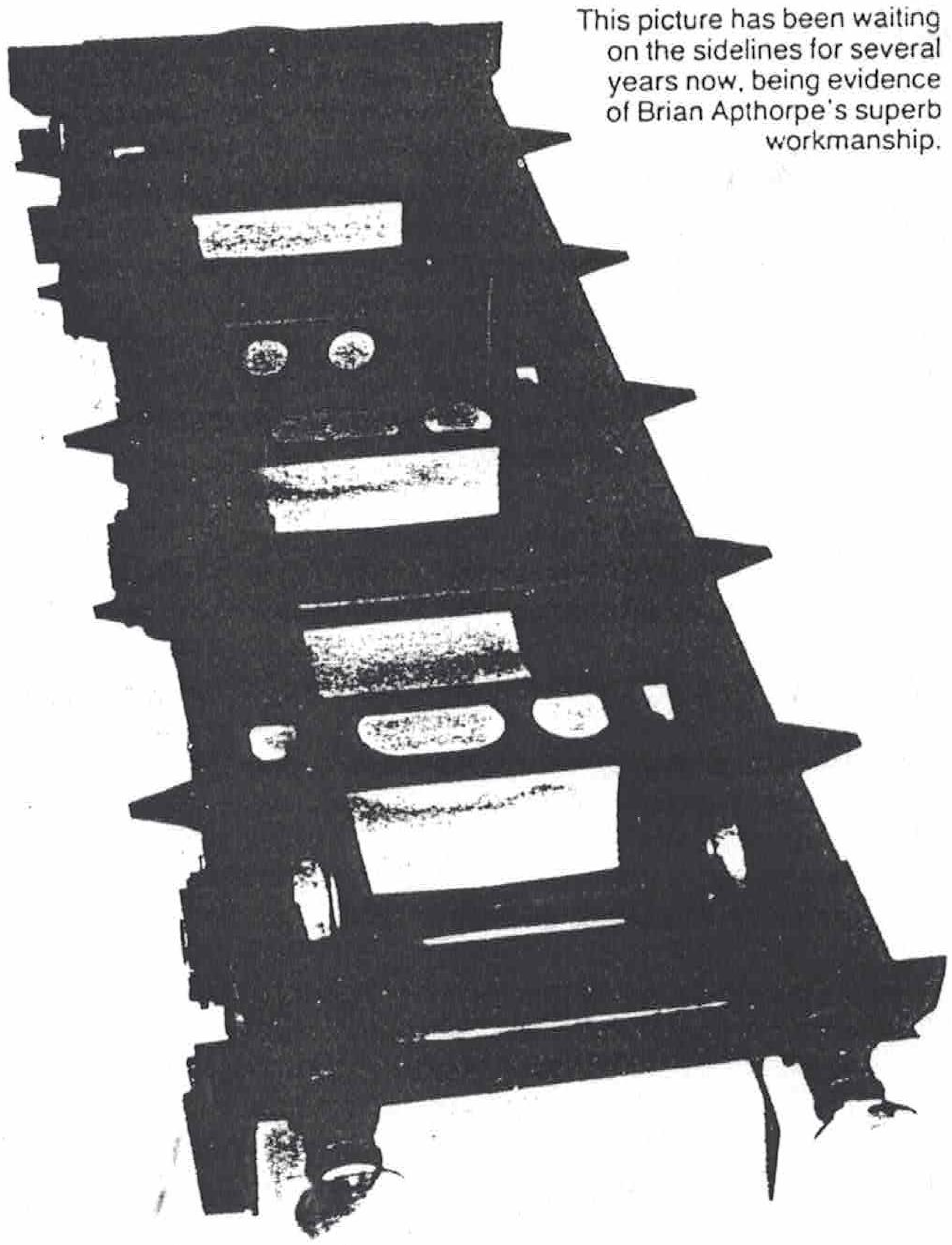
This is where the story really begins for many BLACK FIVE builders, who have been waiting patiently to make a start for a whole year! I would, however, recommend that the tender be dealt with first, as coming at the end of a big project such as BLACK FIVE, it is something of an anti-climax. The material section is available from Reeves, albeit sheered from plate, the first job being to tidy up a datum edge, which can be the top or bottom one as you prefer. Square off the front edge as the second datum, then first establish the main centre distances on one piece, after annointing with marking out fluid, and here you will come across an either/or dimension between the driving and trailing axles. It was put there for completeness, the extra 3/8 in. having fooled me at first on many of the Works drawings, though unless the engine which you choose to follow is very definitely to the latter dimension, I would recommend you ignore same and work to 8½ in. centres, as none of the other parts which are affected have been highlighted; things like side running boards and reach rod, though not the boiler.

Once you have established the main centre dimensions and cross checked them as far as you are able, carry on and complete the profile, noting that the RH and LH frames differ in way of the reverser, then move on to the cut-outs and finally all the holes as specified, and there are plenty of these latter!

Let us take a quick look at the frame plan to familiarise ourselves with what fits between the frames before we start removing metal. Starting at the front end, the front beam is well supported, what with its end gussets and massive horizontal stay between the frames. The horizontal stay comes right back to the smokebox saddle, another massive stiffener, one that is aided from below by the bogie bolster, and with another horizontal stay going back to that for the motion plate, this is a real strongpoint. Sadly this is followed by an area of great weakness, the Achilles heel of the BLACK FIVES, the next and vertical stay being that for the weighshaft. Yes, I know there is external staying back through the motion plates, girder and expansion link bracket to the weighshaft bracket, but this is inherently weak as there is no cross bracing. It all comes back together again at the driving axle, with both horizontal and vertical stays, after which there is another great gap back to the cross ties at the trailing axle, followed by the really massive drag box to round things off nicely.

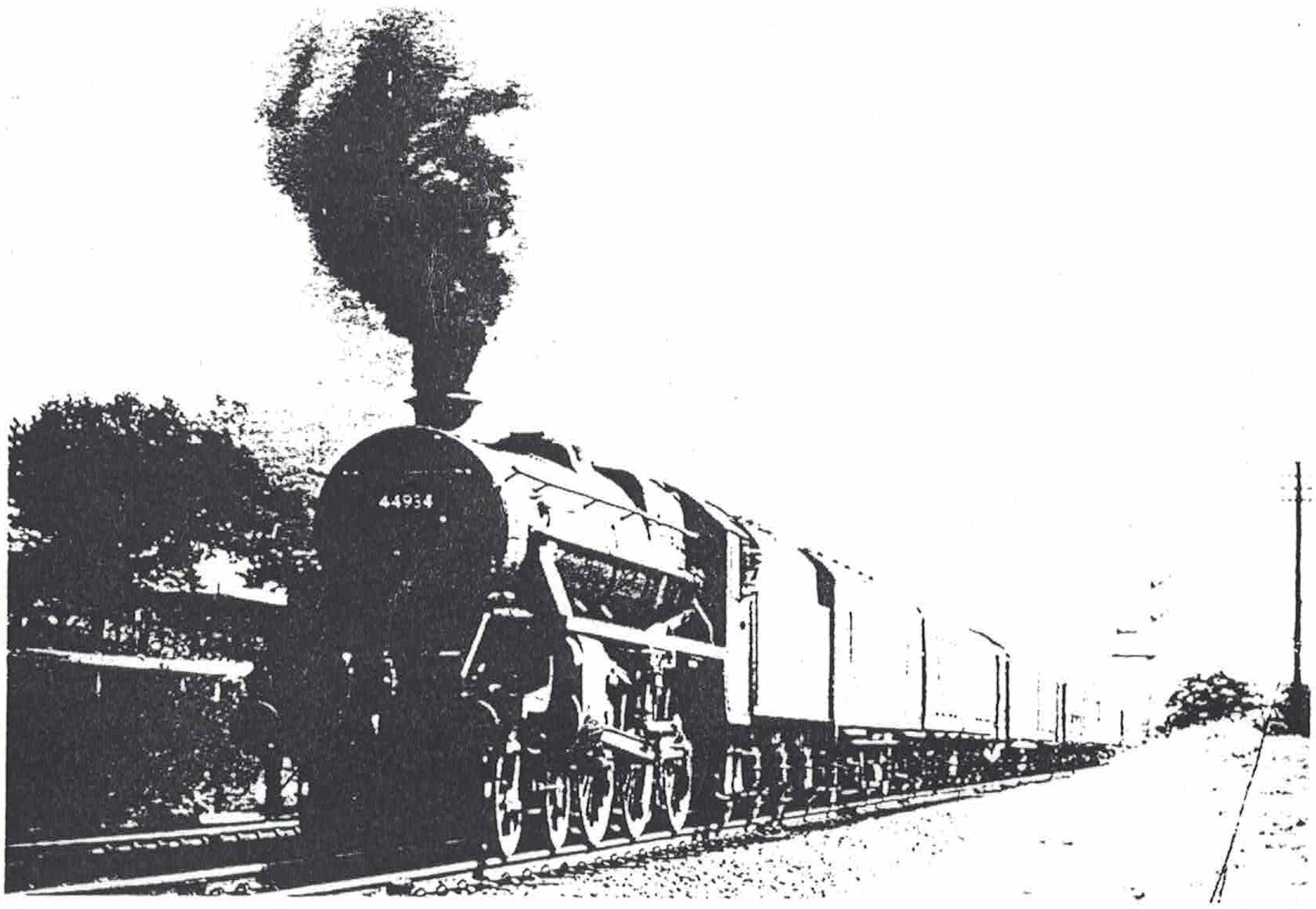
As for all my engines, builders may decide to drill the main horns first rather than the frames, in which case omit these holes at this stage, plus those which are shown tapped from mating piece parts; otherwise drill all holes as specified. Actually, I am jumping the gun, for first clamp the pair of frames together, drill about six holes along the full length and secure temporarily with copper or aluminium rivets, when you can go ahead and drill. Deal with the cut-outs next, and after assessing the milling potential of the Myford 254V plus, I am forced to the conclusion that an engine such as BLACK FIVE deserves a decent milling machine, and what better than a Myford!, to deal swiftly with both cut-outs and then the actual frame profile, not forgetting the differences in way of the reverser. With a milling machine, not only can you deal with each frame opening for the horns to the required accuracy, but also mill those 3/16 in. x 1/8 in. recesses to accept the hornstay projections, ones which will add massive strength if correctly fitted.

Separate the frames and remove all the burrs and sharp edges, then the last parts you can make this session are the doubler flanges at the front cranage points, being 1/8 in. slices from 7/8 in. diameter steel bar. Offer up to the frames, drill through the 1/16 in. rivet holes, but do not attach them as yet. Next time we will move on to complete the bogie and more importantly the cylinders, as we need the cylinder flanges to complete drilling the mainframes.



This picture has been waiting on the sidelines for several years now, being evidence of Brian Apthorpe's superb workmanship.

This picture epitomises the mixed traffic capability of the BLACK FIVES, apparently working hard with this heavy parcels train, yet with the reverser set surprisingly close to mid gear. This shot of No. 44934 was taken at Whitley Crossing by Norman Lowe on 7th July, 1959.



problem here; radius at the top as shown. We can now supply a gunmetal casting from which to machine the filler lid, so clean up the chucking spigot and then grip by the latter to arrive at the fancy shape. If your BLACK FIVE is going to be purely a "work horse", then leave the casting with a spigot to fit inside the filler tube, a good fit in same, and as this will preclude air entry if the vents are omitted, drill a No. 30 hole down through the centre of same before parting off the chucking spigot.

The filler fixed hinge is fashioned from 3/8 in. square brass bar, so first mark off and drill the 1/16 in. hole for the hinge pin, then mill the 5/16 in. slot, before completing with files. The mating hinge for the lid is from 5/16 in. square brass bar; again drill the 1/16 in. hole for the hinge pin as a first step and I am afraid the rest is saw and file to place, securing to the lid with a couple of 1/16 in. copper rivets. Now you can locate the fixed hinge to the filler tube, hold it in place with a rivet, then silver solder the joint. Cut a hole for the filler tube in the tank top, then sweat in the water scoop dome and filler tube. We now need a handle for the lid, bent up from 16 s.w.g. stainless steel wire and secured with 10BA brass nuts, a short length of chain and the 1/8 in. x 1/16 in. anchor strip. Although the rear handrail detail is shown hereabouts, don't drill the specified holes in the side sheets as yet, for shortly we shall be swilling soft solder around the inside of the tank space and the last thing we need is holes for said soft solder to pour out of!

Pukka air vents next and these add a touch of class to any tender, even though they will likely get in the way when you are driving. First requirement are two squared 2 11/16 in. lengths of 9/16 in. o.d. x 20 s.w.g. copper tube, the tank top being drilled to accept same. Next chuck a length of 1 in. diameter brass or gunmetal bar, face and turn down to 5/8 in. diameter over a 9/32 in. length. Centre and drill 9/16 in. diameter to 7/16 in. depth and part off to leave a 1/16 in. flange; repeat. The top fitting is best made in two parts, so chuck a length of 5/8 in. diameter brass bar, centre and drill 9/16 in. diameter to 5/8 in. depth. Remove to the bench vice, leave 1/8 in. of tube, then cut the two vents over the next 3/16 in. length to leave 3/8 in. of tube at each side as shown, then back to the 3 jaw to part off a full 1/2 in. length; repeat. The vent caps are from the 1 in. diameter bar, so chuck in the 3 jaw, turn down to 31/32 in. diameter over a 3/8 in. length, then fashion to drawing and a wee template will be of assistance here. Part off to the 9/32 in. dimension, assemble all the pieces and silver solder them together.

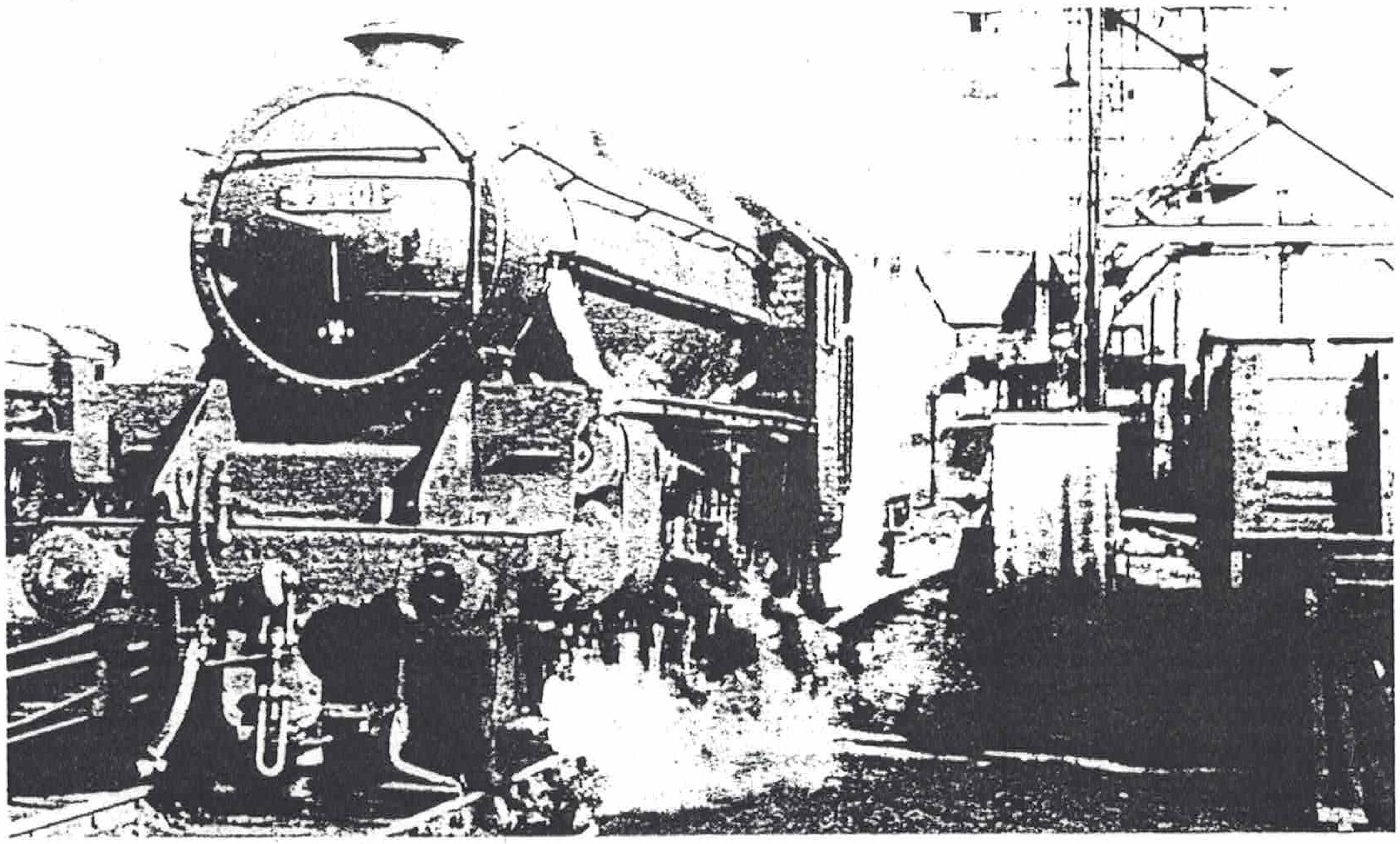
As we move forward again, we can add some of the finishing touches, starting with the half round beading for the top edge of the two coal bulkheads, only this cannot be attached as yet. Inside the coal space, there are lengths of 3/16 in. brass tee bar in the positions shown on the side sheets, coming up from the tank top to within 3/16 in. of the top edge of said side sheets. Then on the R.H. side and running the full length of the coal space, is a horseshoe shaped enclosure for the fire irons, with a cut-out in the front coal bulkhead to suit. Perhaps you can imagine a fireman in trouble on a long run, pitch black, with wind howling and rain sheeting down, having to get the slice or clinker shovel out of that tunnel, swing same way out of gauge to get the business end into the firebox, and then attack the fire in a bid to get rid of some clinker. Lineside hazards such as signal posts and bridges, yet sometimes a fire needed the most urgent attention in a bid to get the train in on time; it was a hard and sometimes dangerous life on the footplate.

From now on, all our energy is going to be devoted in getting the front end of the tender body sorted out, starting with the front bulkhead. The cut-out for the coal opening you can either mark off from the dimensions given on the view below, or better make it to place, then you will be sure! Cut the 'T' opening for the hand brake gear, then space the bulkhead 1 9/16 in. ahead of the front coal bulkhead and we can fill in the gap. First there are two horizontal tank top plates ahead of the coal bulkhead, size roughly 3 1/4 in. x 1 1/2 in. On the R.H. side there are two vertical plates so that we can keep the space in which the handbrake gear is fitted dry, only the inner vertical member being fitted on the R.H. side. Sitting on the horizontal plates are a pair of lockers, one each side of the coal opening, the top plate extending from the locker tops right across the opening. Then there is a 1/4 in. wide facing as a stiffener around the top portion of the coal opening, which almost completes the structure of the tender body. The coalplate though has two triangular side supports, which again are cut to place, and if you make these a tight fit in the lower coal opening, no other fixing will be required ahead of sweating them permanently in place.

A fancy shaped stool supports the fall plate on the engine and goes right across the full width of the tender body, so cut this initially $8\frac{15}{16}$ in. x $2\frac{1}{2}$ in. from the 1.6mm brass sheet. Trim to fit between the side sheets as they curve inwards, completing the profile at the front edge, then cut the two supports as shown and secure with short lengths of $\frac{1}{4}$ in. brass angle and we are ready to sweat up the body.
Blank off those tapped holes in the well, apply a coat of hard soap to the bronze gauze so that it does not become clogged up with soft solder, then pour in some Bakers fluid. Heat the whole of the tender body very gently until the soft solder begins to melt, swilling it around to make sure all the joints are sealed and applying more spelter to the external joints. Wash thoroughly with hot, soapy water, give the whole tender body a good scrub, then rinse out properly and dry with a gentle application of heat. Now comes the acid test of filling the tender with cold water and checking for leaks. Reheat and seal any major leaks with soft solder, but ignore any minor ones, for once we have added all the trimmings then my final instruction is going to be to pour in some white gloss paint and swill this around, as this will not only seal any minor weeps, but also ensure that if any foreign bodies get into the water space, they will be seen.
If you look back at Sheet No. 2 in LLAS No. 45, you will see that half round beading extends all around the top of the tender side and back sheets, coming right down to the soleplate at the front end. Many builders tell me they try to fit this beading in one long length, which is a mistake, the best way being to tackle the job about 1 ft. at a time. Bend a length of beading to follow the profile, then "tin" the flat face of the beading. Using an electric soldering iron, press the beading against the tender body, moving along fairly quickly as soon as the solder melts and thus applying only a minimum of heat. The problem is in keeping the beading in place whilst the solder sets; too much heat and this can seem to take hours, whereas done correctly it only takes a matter of seconds and your progress will be rapid. Mix up a little Isopon P38 to fill in any unsightly gaps between the sections of beading, rubbing files and emery cloth over same once it has cured, and your tender body should be looking good!

Coal and Locker Doors

Only the coal and locker doors to complete another large slice of BLACK FIVE, and for a change I shall have given you weeks of work for only a few pages of description, though I shall be earning my keep from now on!
Building FISHBOURNE, I spent literally weeks making up miniature hinges for such things as cab doors and lockers, never being satisfied with the end result. Then a visit to a local DIY store produced lengths of brass hinge from which I could cut and shape the miniature ones I was looking for, and if I remember correctly then the description of same was "piano hinge". This reduces the locker doors to plain pieces of brass sheet, sweating the hinges first to same and then to the coal opening surround. Of course, a staple and hasp is required on Gold Medal winning engines, but for the work horses that most BLACK FIVE's will become, a wee blob of soft solder to stop them swinging in the wind is all that is required.
Make each of the coal doors to drawing, sweating that $\frac{5}{16}$ in. x $\frac{1}{16}$ in. strip to the L.H. one, offer up to the coal opening and locate the hinges, sweating them to the doors. Bend up the coal door handles from $\frac{1}{8}$ in. x 1.2mm steel strip, locate on the L.H. door and drill right through at No. 57 for $\frac{3}{64}$ in. snap head iron rivets, hammering down into countersinks on the back face of the door. Back to the coal opening, to locate further lengths of the $\frac{1}{8}$ in. x 1.2mm steel strip as the means of locking the coal door handles, and I should have said a moment ago that spacers are required on the L.H. door so that the handles clear the joint strip, these being $\frac{3}{64}$ in. lengths of $\frac{1}{8}$ in. steel rod drilled centrally at No. 56. Once the doors work correctly, you can go ahead and sweat the hinges to the surround.
According to Tom Greaves painting specification, the tender body will be painted black with not a vestige of lining, though proudly pronouncing LMS on each side. This though is not a licence to use a tar brush, indeed a plain black finish calls for a great deal of skill to look right in conclusion. Start by spraying the whole body with zinc from an aerosol can, getting a nice even end result, which I rate as good as any etching primer. Move on to three or four coats of black undercoat, rubbing down well between each coat, until the surfaces look nice and flat without any ripples. Now you can apply the gloss coats, three should be sufficient, rubbing down the first two and immediately the final coat is applied, vacate the workshop until dry, dust being the worst enemy. Many of you I know now spray paint your engines, but such never happened full size, and I still rate a brush finish to be superior. Full size, gloss paint was never applied to a steam locomotive, at least such was my experience, it was two coats of clear vanish that transformed an engine from semi-matt to glistening monster!



Freshly coaled and watered, 45001 is ready for another turn of duty. Note that she still carries her original boiler, with top feed at the dome and a vertical throatplate, though by now she has gained ATC gear as indicated by the shield behind the front coupling.

Brake Shaft and Arms

Let us deal with the four arms that attach to the brake shaft ahead of the shaft itself, starting from the centre and working outwards, which means the return spring arm is first in line for treatment. Mark off on a length of ⅝ in. x ⅜ in. BMS bar, then grip in the machine vice on the vertical slide to drill the 13/32 in. diameter hole. Move on 1⁵⁄₁₆ in. on the cross slide, then drill the second hole No. 22. Turn the bar over to cross drill No. 22 to start forming the fork end, completing this with saw and key cutting file. Next change from the machine vice to an angle plate on the vertical slide and clamp the embryo return spring arm to same, using the side teeth of an end mill to reduce the thickness beyond the fork end to 5/32 in., still attached to the parent bar, then thin the fork end to 11/32 in. as per drawing. Radius one end of the arm over a mandrel with an end mill, then saw from the parent bar and deal with the second end likewise, tidying up the profile with a file to complete. With care, the pair of brake arms can also be machined from the same ⅝ in. x ⅜ in. section bar, the two holes are the same, but this time at 9/16 in. centres, and the fork end similarly produced though not quite so deep. If the fork is made 1/64 in. off centre, then you will only have to remove metal from one face of the arm to complete to thickness, when the rest follows as for the return spring arm. That leaves the hand brake arm, from ½ in. x ⅛ in. BMS flat, so drill the holes as specified, radius one end before cutting from the parent bar to deal with the other end, then complete the profile with a flat file.

The brake shaft is plain turning, only instead of turning the 13/32 in. and 11/32 in. diameter portions to nominal size, use the arms as your gauge and get them a tight fit so that they will remain firmly in position for brazing up. Both axial locations and orientation are shown on the brake gear arrangement, so lay on the brazing hearth, mix the flux to a stiff paste and apply around all of the joints, heat rapidly and feed in spelter. Allow to cool, then wash off, clean away any excess flux, dry and coat with oil to prevent rust forming.

Brake Shaft Trunnion and Spring Rod

The brake shaft trunnions are turned from ¾ in. diameter bar and having once experienced seizure of a brakeshaft in its trunnions, through being too exhuberant when filling the tender, I would use brass here. Face the bar, then turn down to ⅜ in. diameter over a 5/16 in. length before centering, drilling ¼ in. diameter to 5/16 in. point depth and completing with a 'D' bit. Part off to leave a full ⅛ in. thick flange, then reverse in the chuck to clean up to thickness and with a knife edge tool, scribe the bolting circle at 9/16 in. diameter. Mark off and drill the four No. 44 holes, offer up to the frames, to spot through, drill No. 50 and tap 8BA for hexagon head bolts.

For the spring rod boss, chuck a length of 5/16 in. steel rod in the 3 jaw, face, centre and drill No. 22 to ¼ in. depth before parting off a 5/32 in. slice, checking it is a free fit in the return spring arm. Next chuck a length of 5/32 in. steel rod in the 3 jaw, face and screw 32T over a ¼ in. length, then part off at 1¾ in. overall. Scallop this plain end to suit the boss and braze together, then assemble with a brake gear pin. The return spring has to be of sufficient strength to give positive release of the brakes, so this is best done to place once the assembly is complete, when you can vary the spring if necessary. Remember though that all brake gear joints should be a 'rattling' fit, so that the brake shoes are free to follow the wheels.

Adjuster

To complete the actual brake gear, we need a pair of adjusters to join the pull rods ahead of the leading tender axle. I have specified these from 9/32 in. A/F hexagon steel bar, but likely this specification will have to be varied to suit available material. Chuck in the 3 jaw, face and lightly chamfer the end, before centering and drilling through at No. 30, or rather to 1 in. depth. Tap only to about ½ in. depth at this stage, then part off at a full ⅞ in. overall, reverse, face to length and again lightly chamfer; now you can complete tapping the hole as it is no longer a blind one.

HAND BRAKE

Centre piece of the hand brake is the very simple univeral joint, one which Norman Gawler first showed me when we were working together at J. Samuel White's back in the 1960's and which I have used in miniature on more than one occasion, though if memory serves me right, this was its first application. I believe then it was the subject of a Dutch patent, so do hope I am not infringing any rights, though of course the original intention was for industrial use.

Bearings

The fixed bearing being the more complex, let us get this out of the way first. Arrive at the required 13/16 in. x 5/16 in. section by milling from the nearest commercial size of BMS bar, then mark off and drill the No. 30 hole right through. If possible, radius this end over a mandrel with an end mill, though this is not absolutely necessary as the part will be well hidden. You will likely do all this in the machine vice on the vertical slide, which is the perfect way of setting the mandrel at the correct height, in which case now grip the bar in said machine vice and carefully mill out the ⅝ in. portion. Saw from the parent bar, mill the sawn face to true it up, then centre and drill through at No. 23 for the brake spindle. Next chuck a length of ⅜ in. steel rod in the 3 jaw, face the end and radius as shown, then centre, drill No. 23 and ream 5/32 in. diameter to 5/16 in. depth before parting off a 3/16 in. slice. All we need now is a 15/32 in. squared length from ⅝ in. x 3/32 in. BMS flat, marked off and drilled No. 44 for the 8BA fixing bolts and scalloped to suit the end boss. Clamp the three pieces together, braze up, then run the 5/32 in. reamer through.

The second bearing is from 1 in. x 5/16 in. BMS bar, so first cross drill No. 30, radius this end, then mill out the 13/16 in. portion to suit the fixed bearing. Saw from the parent bar, not forgetting the boss, then chuck in the 4 jaw, with a 2BA bolt and nut opened out so as not to distort the two legs, to turn on the boss and face across. Centre and drill No. 22 to complete and later on you will assemble the pair of bearings with a couple of ⅛ in. soft iron snap head rivets, just peening the shanks to prevent them from coming adrift.

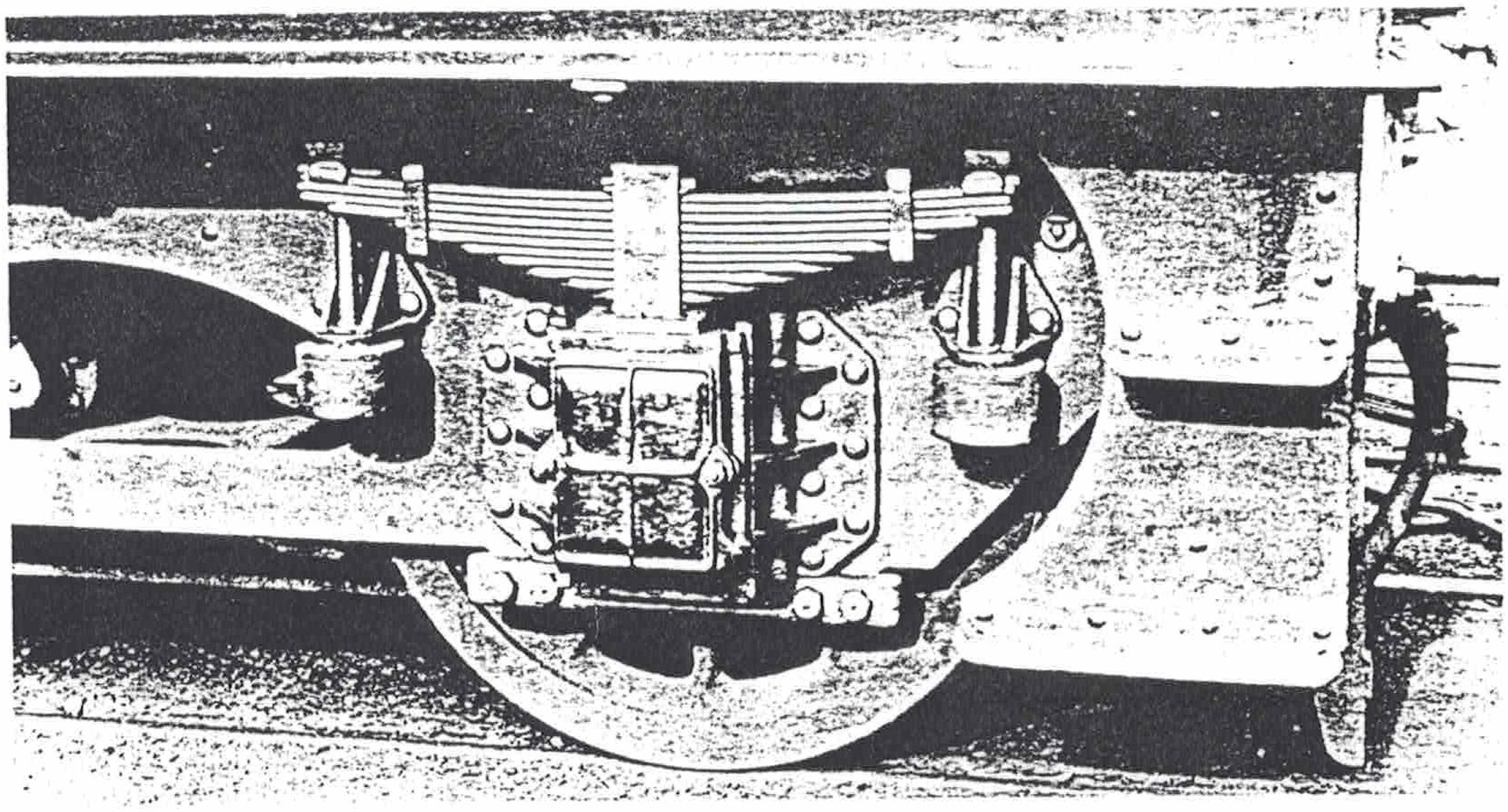
Brake Spindle, Handle and Screw

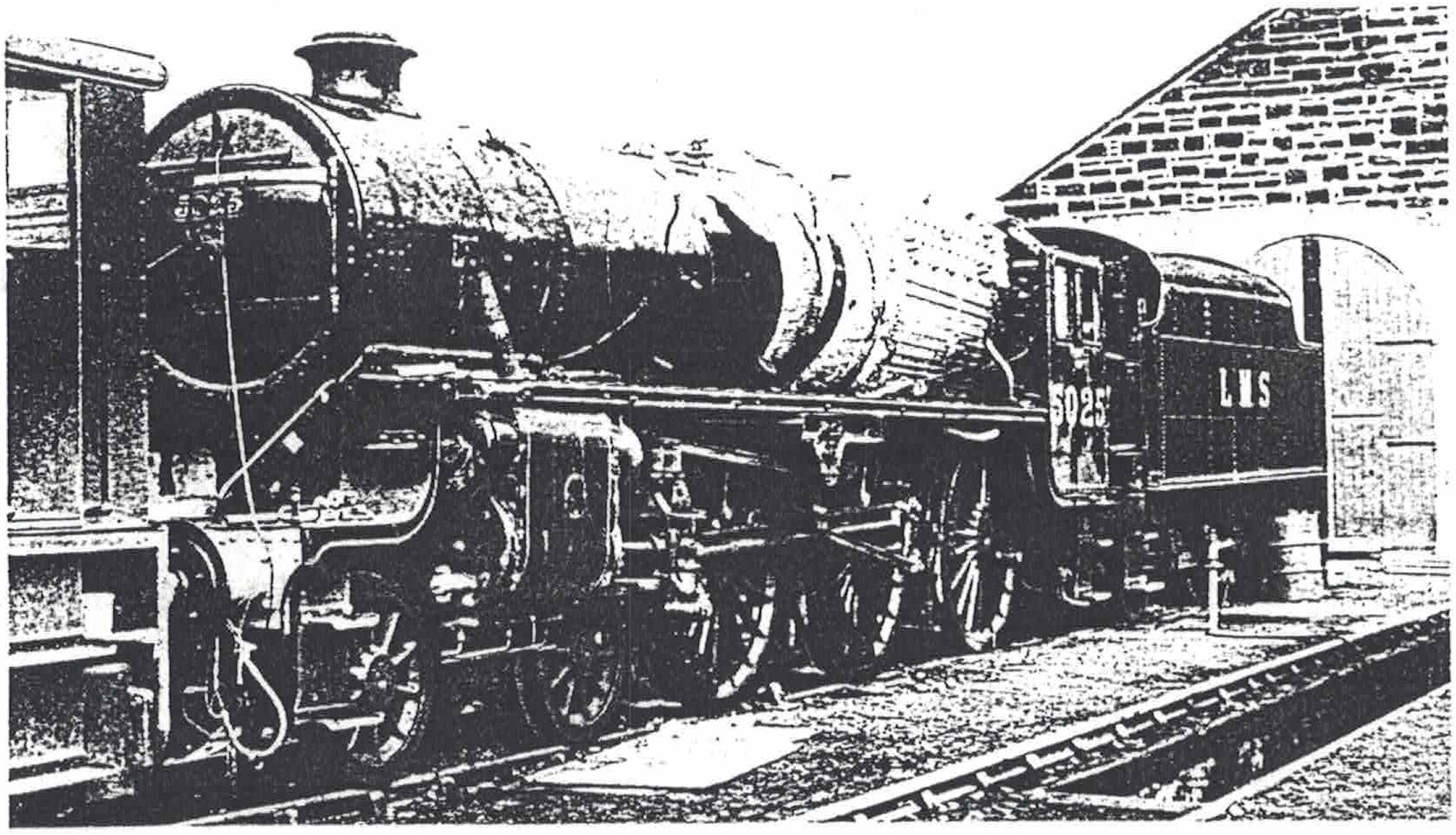
Before we deal with the actual universal joint, we had better clear the parts surrounding same, starting with the brake spindle. Chuck a length of 5/32 in. silver or mild steel rod in the 3 jaw, face and turn down to .086 in. diameter over a 3/32 in. length, screwing 8BA. File or mill an ⅛ in. square on the next 5/32 in. of rod, then part off at 11/16 in. overall. For the handle, chuck a length of ¼ in. steel rod in the 3 jaw and lightly radius over an 11/64 in. length, though leave a little plain length beyond this. Centre and drill No. 31 to about 5/16 in. depth, but don't part off from the parent bar as yet.

Next cross drill No. 31 for the 3mm wire handle, bending this to place, although you can make the handle in two parts, when you can drill into the centre boss at the 15 deg. as specified; in either case braze together. Back to the 3 jaw to face the boss flush with the handle on the outside, and an end mill is the best way to tackle this, then part off and again keep the tool clear of the actual handles. To complete, use a Swiss file to deal with the ⅛ in. square in the boss to suit the brake spindle.

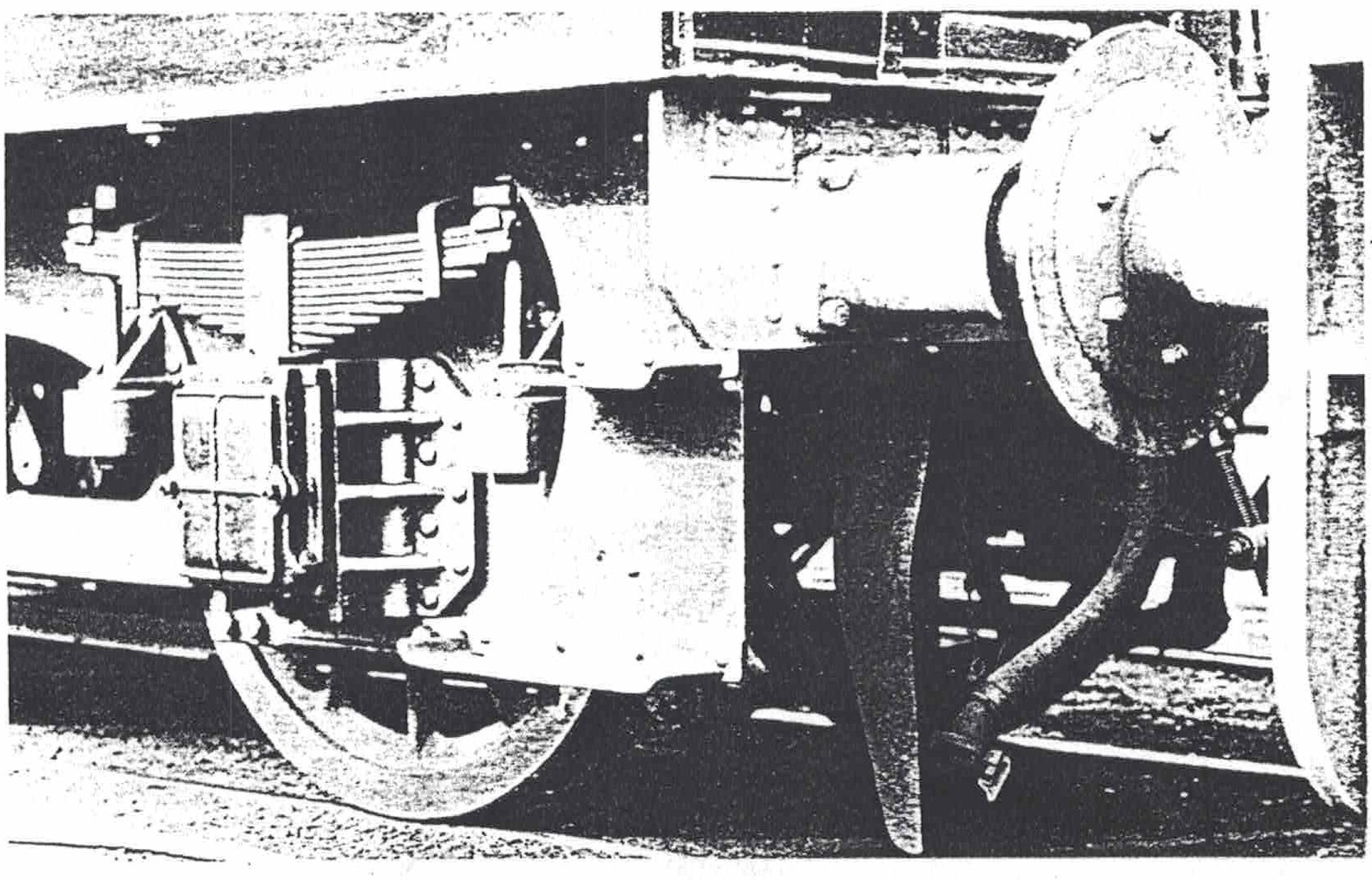
The brake screw is a 5½ in. squared length from 5/32 in. steel rod, screwed for 1⅜ in. at one end, though it needs a wee collar to complete. For the latter, take a length of 5/16 in. steel rod and first cross drill No. 60 for the 1mm spring dowel pin which we shall be using to secure same to the

All the photographs on this page are from Tom Goulding, this one being particularly useful to builders who are following along behind Steve Russell.





5025 receiving attention on the Nene Valley Railway; note that the rear coupling rod has been removed.



I am sure I shall find as the BLACK FIVE series progresses that steps are as variable on these engines as on the Horwich 'Crab' previously serialised in LLAS.

brake screw. Chuck in the 3 jaw, lightly face, then centre and drill No. 22 to about ¼ in. depth, parting off to leave the No. 60 hole nice and central in the collar.

Disc and Joint Pins

For the discs, chuck a length of ⅝ in. diameter steel bar in the 3 jaw, face and scribe the joint pin circle at 7/16 in. diameter, then part off an ⅛ in. slice; repeat. Mark off and drill the six No. 43 holes, and these do need to be fairly accurately spaced for the coupling to work sweetly, after which braze a disc to both brake spindle and screw. The joint pins are ⅜ in. lengths from 3/32 in. silver steel rod, with one end well radiussed, and as they will be heavily loaded at times, harden them right out before pressing into the discs, when you can complete this part of the assembly and erect to the tender body.

Brake Nut and Cover

The brake nut is from ¼ in. square steel bar, so chuck truly in the 4 jaw, face, centre and drill No. 30 to 1¼ in. depth before tapping 5/32 x 32T. At the other end, you can drill a plain ⅛ in. hole, the slot being a legacy from the steam brake cylinder which was fitted full size, though as we are representing the latter in part by the return spring rod, an ⅛ in. slot would look that much more authentic. So I suggest drilling a row of No. 31 holes and opening out into a slot with an ⅛ in. end mill, when you will have to saw down and complete the second slot to fit over the hand brake arm with a key cutting file.

The brake screw projects beyond the front bulkhead on the tender, thus requires a wee cover that is akin to the spats we shall be fitting later around the steam pipes from the smokebox down to the cylinders. It does, however, have a rather fancy flange for fixing to the bulkhead, which can be lifted directly from the view on Sheet No. 1, being secured in place with 8BA or 10BA hexagon screws.

BOGIE PARTS

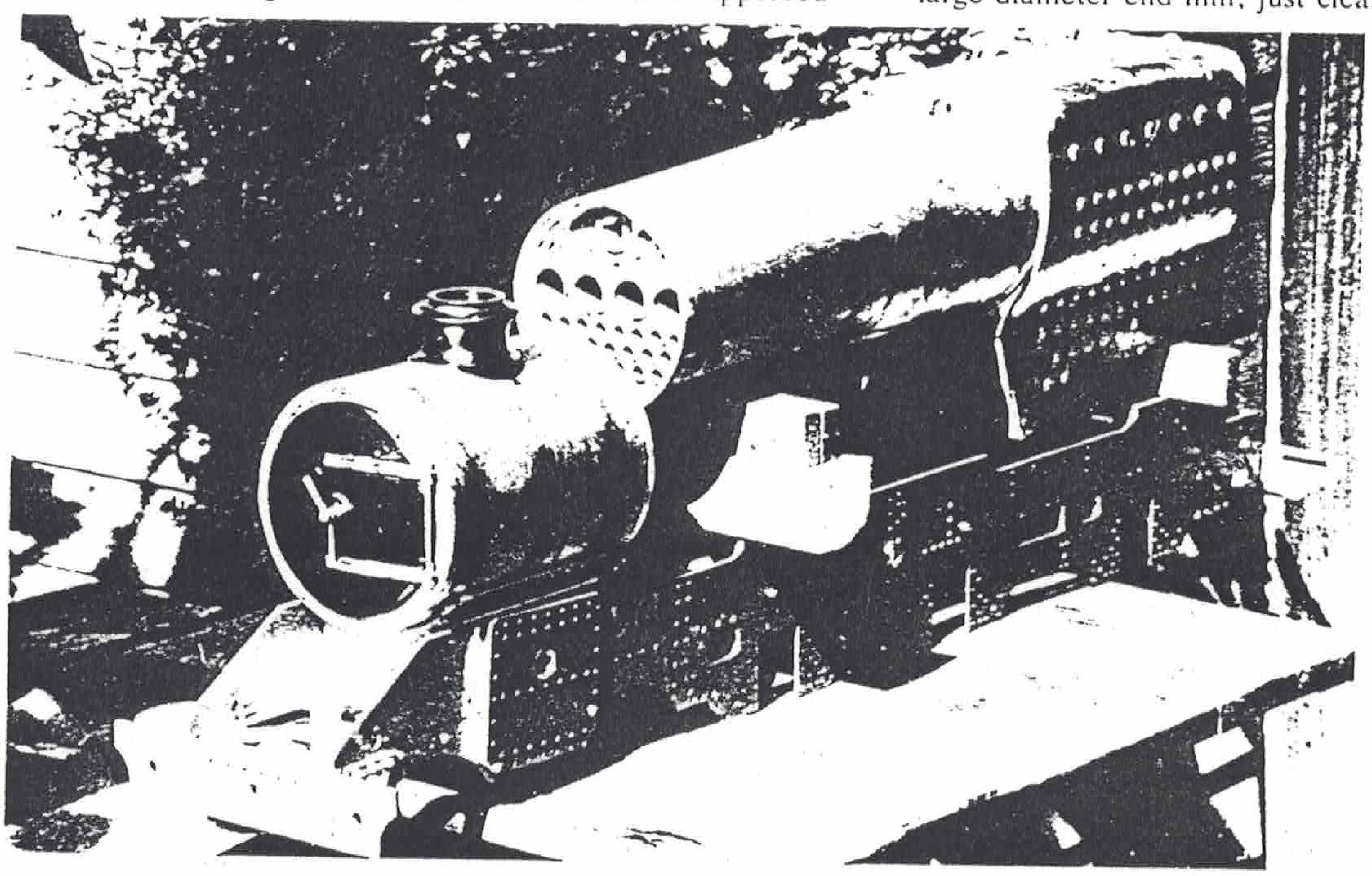
Although completely out of sequence, we may as well deal with the bogie parts detailed on this sheet, which will give us a head start for the next session.

Reading some of the accounts which have been published on the conclusions of the Investigating Committee on the Indian 'Pacific' disasters of which Stanier was a leading member, one might conclude that he did not properly understand the role of the bogie on a steam locomotive, whereas the design for BLACK FIVE which appeared several years earlier proves this not to be so. The problem with the Indian 'Pacifics' was largely one of harmonic motion, the engine acting like a large pendulum in the horizontal plane, a pendulum that was set in motion by the action and reaction of the cylinders. Such posed no real problem passing around curves, but on long straight sections of track there was no dampening effect and the oscillations built up until derailment occurred. The engineering solution to any such problem is to change the natural frequency of the machine to design out the critical speed from the normal operating range, and this was achieved by stiffening of the side control springing. Obviously this had a beneficial side effect in reducing the flange loading on the leading coupled wheels as they entered curves, the bogie accepting a larger proportion of the total, but it was to keep the engines on the straight and narrow that was the main reason for the alteration, the 'Royal Scots' being similarly modified. Harmonic motion of a simple pendulum is easy to establish, the principle has been known for centuries, but even in this computer age it would be a different task for a steam locomotive, especially when one has to take into account such things as water movement within the boiler, being slopped around by the oscillations. Anyhow, this preamble is to introduce the massive cast steel bogie centre as employed on the BLACK FIVE's, only I have broken it down into four constituent parts for ease of machining, two of them being the bogie brackets which are first in line for treatment.

Bogie Brackets

Almost laughingly, I have given as alternative that the brackets can be steel fabricications and yet I would be hard pressed to describe same!, whereas I was able to have recourse to the patternmaking skill of Norman Lowe back in 1976, which has considerably eased our task. The brackets carry out a multitude of functions, like they support the bogie buffer, the cut-out in the vertical face being for same to pass through. They also provide fulcrum for the equaliser spring, and above same is the bearing area for the socket which mates with the ball which is detailed hereabouts, thus calls for careful machining, the first step being the assess the allowances provided.

Grip by the horizontal portion in the machine vice on the vertical slide and as there are tapered sections involved, add pieces of packing to get back to the flat surfaces. With a large diameter end mill, just clean up the inner edge at the



George Freeman took delivery of this BLACK FIVE boiler from Reg Chambers at Guildford just minutes before I visited his stand, thus at last I am able to drool over Reg's workmanship. George is finding my BLACK FIVE a stiff challenge after LBSC's DORIS which he made some 40 years ago now, thus is waiting for my notes before making further progress; you can make a start on the bogie now George!