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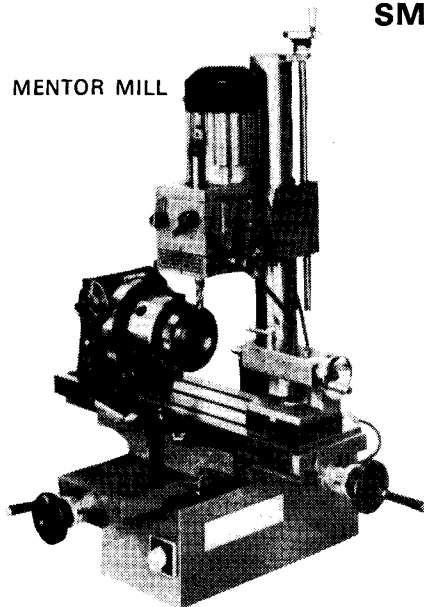
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Volume 145
17 August 1979

Number 3615

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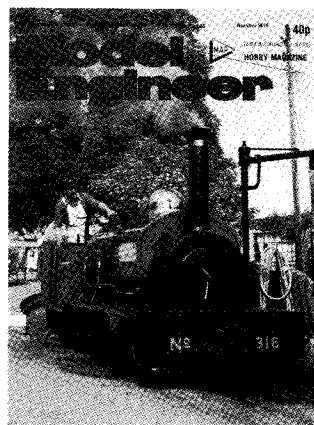
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COVER PICTURE

The narrow gauge loco number 316 "Gwynedd", 1 ft. 11 in. gauge at Bressingham. Photo by A. W. Beal.

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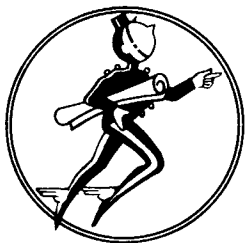
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AUGUST 1979



Model Engineer PLANS

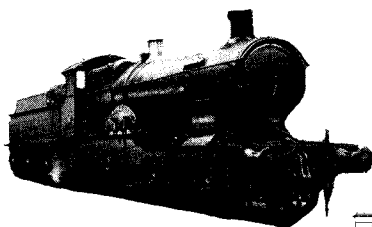
Precision engineering drawings for model



L.O.954 "COLUMBIA"

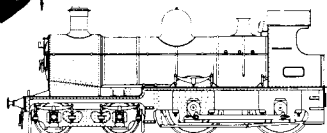
3 1/2 in. gauge 4-8-4 locomotive based on an American Baldwin prototype — by Martin Evans

- Sheet 1** General arrangement, frames, pilot and drag beam, trailing truck and trailing truck axlebox. **Price £1.80**
Sheet 2 Driving and coupled wheels, springs and spring pins, coupling rod, engine details. **Price £1.80**
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Sheet 5 Boiler details. **Price £1.80**



L.O.953 "BULLDOG AND DUKEDOG"

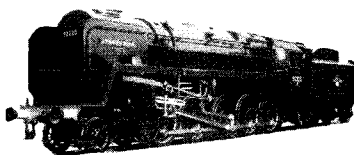
G.W.R. 4-4-0 type locomotive for 5 in. gauge — by Keith Wilson



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Sheet 2 General arrangement Dukedog. **Price £1.50**
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 (Further Sheets to follow).

L.O.99 "EVENING STAR"

3 1/2 in. gauge
British Railways
2-10-0 locomotive



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Sheet 2 Details of pony truck, coupling rods, boiler feed pump and eccentric. **Price £1.50**
Sheet 3 Full details of the boiler. **Price £1.50**
Sheet 4 Piston valve cylinders and details, alternative slide valve cylinders, crossheads, slide bars, connecting rods, guide-bar brackets. **Price £1.50**
Sheet 5 Buffer beam, drag, beam, side elevation and plan of valve gear, left- and right-hand expansion link brackets, radius rods, eccentric rods, valve crossheads, union links, combination levers, expansion links, lifting and reversing arms. **Price £1.50**
Sheet 6 Valve gear for slide valve engine, double blastpipes, smokebox, steam brake and details, mechanical lubricator, alternative single blastpipe. **Price £1.50**
Sheet 7 Details including end elevation of locomotive, details of cab and running boards, running board brackets, smokebox details, poppet valve regulator body, grate and ashpan, saddle, superheater, snifting valve. **Price £1.50**
Sheet 8 Tender, fire door, blower valve and boiler clack valve details. **Price £1.50**
Sheet 9 Tender frames, injector and brake details. **Price £1.50**
Sheet 10 Reversing wheel and reach rod, cab layout, manifold, regulator handle and rodding, water gauge, safety valve, brake valve, whistle valve and injector steam valve. **Price £1.50**
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L.O.949 "HOLMSIDE"

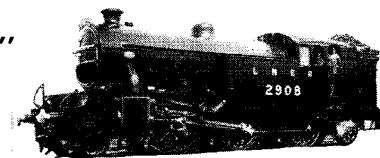
a 1 1/2 in. scale
saddle tank
locomotive for
both 7 1/4 in. and
7 1/2 in. gauges
by Martin Evans



- Sheet 1** General arrangement, frames, buffer beams, frame stretchers. **Price £1.50**
Sheet 2 Axleboxes, horns, wheels and axles, crankpins, cylinders. **Price £1.50**
Sheet 3 Details of motion plates, crossheads, coupling rods, slide bars, layout of valve gear, eccentric rods and straps, valve rods. **Price £1.50**
Sheet 4 Additional details of the boiler for the 7 1/2 in. gauge "Holmside", details of the smokebox, steam and exhaust pipes, final detail of the valve gear, and the grate. **Price £1.50**
Sheet 5 Details of the boiler. **Price £1.50**
Sheet 6 Details of ashpan, snifting valve, brake arrangement, construction of reach rod and lever reverse. **Price £1.50**
Sheet 7 Stroudley type and slide valve type regulators, smokebox door, crossbar and dart. General arrangement of steam and hand brakes, cylinder drain cock gear. **Price £1.50**
Sheet 8 Steam and hand brakes, buffers, safety valves, spectacle plate, saddle tank details. **Price £1.50**
Sheet 9 Arrangement of mechanical lubricator, water gauge and glass protector, tank water gauge protector, saddle tank water gauge, details of driver's brake valve. **Price £1.50**
Sheet 10 Manifold, blower valve, side view of cab fittings, injector water cock, cab and bunker side, cab backplate, cab roof, check valve. **Price £1.50**
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L.O.952 "ENTERPRISE"

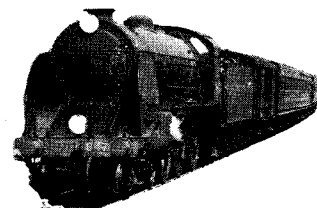
an L.N.E.R.
Class VI 2-6-2T type
locomotive for 5 in.
gauge
by Martin Evans



- Sheet 1** General arrangement, main frames, front buffer beam. **Price £1.80**
Sheet 2 Frame stretchers, main hornblocks, main axleboxes, pony truck assembly, main buffer brakes and buffers. **Price £1.80**
Sheet 3 Driving wheels, trailing wheel, crank axle, quartering jig for crank axle, coupled axle, trailing axle, crank pins, trailing spring, trailing axle box. **Price £1.80**
Sheet 4 Details of inside cylinder, coupling rods, alternative trailing suspension, valve spindle guides. **Price £1.80**

L.O.950 "GREENE KING"

an S.R. 4-6-0 locomotive
Class S.15 for 3 1/2 in.
gauge — by Martin Evans.



- Sheet 1** General arrangement, main frames, buffer and drag beams, stretchers, horns and axleboxes. **Price £1.50**
Sheet 2 Wheels, coupling rods, axles, bogie details, horns and axleboxes. **Price £1.50**
Sheet 3 Details of cylinders, connecting rods, crosshead, slide bars, gudgeon pins, eccentric rods, expansion links, die blocks, return cranks and reversing arms. **Price £1.50**
Sheet 4 General arrangement of valve gear, plan of valve gear, combination levers, anchor link, link frame, radius rod, lifting arms, weighshaft and bearings. **Price £1.50**
Sheet 5 Details of the boiler, grate and ashpan, regulator and cab spectacle plate. **Price £1.50**
Sheet 6 Lubricator, cylinder drain cocks, lubricator ratchet gear, reverser details. **Price £1.50**
Sheet 7 Brake gear; mechanical lubricator; tender details — axle, axlebox, horn, wheels, frame stretcher, springs and buffers. **Price £1.50**
Sheet 8 Cab layout, running board details, chimney, dome, safety valve, pipe layout, injector steam valve, lagging and cleading, boiler bands, whistle, blow down and check valves. **Price £1.50**
Sheet 9 Brake shaft bracket, shaft and lever, brake standard and nut, brake hinges and pins, tender brake beams, injector water valves, Maunsell type bogie tender, Urie tender, six wheel tender. **Price £1.50**
Sheet 10 General arrangement of tender, tender frames. General arrangement of Urie bogie tender, brake details, tender bogie wheel, brake block, axle boxes. **Price £1.50**
 Complete set L.O.950. **Price £13.25**

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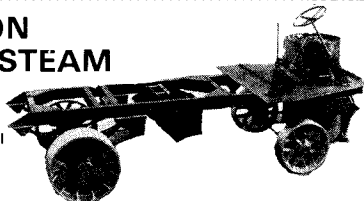
M.34 PISTON DROP VALVE

MILL ENGINE A working replica of a typical mill engine — by Alan Haworth

- Sheet 1** General arrangement, high pressure cylinder and valves and further valve details. **Price £1.80**
- Sheet 2** Piston valve HP layshaft and eccentric exhaust valve details. Steam valve HP cylinder LP cylinder block. **Price £1.80**
- Sheet 3** Air-condensate, extraction pump, pump crosshead, jet condenser, condensate sump, engine crank and fly-shaft, crosshead guide, tailslide, HP mitre bevel gears. **Price £1.80**
- Sheet 4** Sectional sub-assembly of Governor stand, etc. Counter-weight and details, detail of mitre gears for Governor drive, Governor column, Governor stand, sub-assembly of damping cylinder and piston, sub-assembly of safety trip latch, sub-assembly of spool yoke and bushings, etc. **Price £1.80**
- Sheet 5** Valve details, pump details, feed water tank, bearing housing, sub-assembly of crankshaft bearing, bearing wedge block, crankpin bearing. **Price £1.80**
- Sheet 6** Engine foundations, flywheel, governor and conn, rod details. **Price £1.80**
- Sheet 7** Main and extension bedplate — extension bed for tail-slides, details of hand barring gear, schematic arrangement of Governor linkage. **Price £1.80**
- Sheet 8** Engine gauge panel, engine cylinder and valve lubricator; exhaust eccentric and crankpin lubricators; high pressure and low pressure valve operating and trip gear arrangements; plant arrangements of engines and boilers; engine warming through arrangements; steam valve settings. **Price £1.80**
- Sheet 9** Further details of valve settings; exhaust eccentric and rocker rods; exhaust valve coupling rods. **Price £1.80**
- Complete set M.34. **Price £13.25**

M.35 CLAYTON UNDERTYPE STEAM WAGON

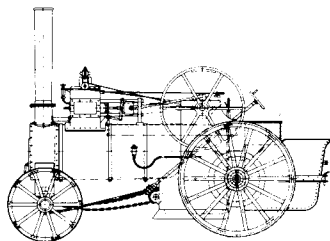
2 in. scale model of a typical 1920's steam road wagon
by Robin Dyer



- Sheet 1** General arrangement. **Price £1.80**
- Sheet 2** Steering assembly, front axle, front wheels and hubs. **Price £1.80**
- Sheet 3** Chassis, springs, rear axle box, front axle details. **Price £1.80**
- Sheet 4** Rear axle assembly, rear wheel, Differential centre, Differential sprocket rear axle, axle collar offside/nearside. Hub cap. **Price £1.80**
- Sheet 5** Cab floor and cab reverser, steering wheel, track rod, front/rear spring cap, Drag link pin and collar. **Price £1.80**
- Sheet 6** Boiler details. **Price £1.80**
- Sheet 7** General arrangement of engine, engine details, bearers. **Price £1.80** (Further Sheets to Follow.)
- Sheet 8** Engine details. **Price £1.80**

T.E.17 COUNTRYMAN'S STEAM

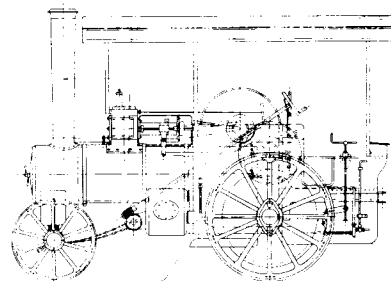
a 2 in. scale Durham and North Yorkshire single cylinder agricultural traction engine.



- Sheet 1** General arrangement, hornplates, boiler details and smokebox. **Price £1.80**
- Sheet 2** Crankshaft, hind axle and second motion shafts, tee rings for road wheels. **Price £1.80**
- Sheet 3** Cylinder and valve chest details, top steam dome cover, connecting rod, weightshaft brackets, flywheel. **Price £1.80**
- (Further Sheets to follow)

T.E.16 RANSOMES, SIMS & JEFFERIES LIGHT STEAM TRACTOR

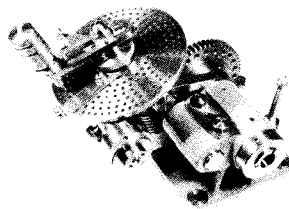
2 in. scale — by John Haining



- Sheet 1** General arrangement, details of boiler, smokebox and chimney. **Price £1.50**
- Sheet 2** Fore axle, perch pin, trunk guide, perch housing, details of cylinders. **Price £1.50**
- Sheet 3** Connecting rod, crankshaft, flywheel piston and rod, crankshaft bearings, expansion link, eccentric straps and rods, valve and valve spindle, rocking lever and shaft, regulator block and rod. Firebars and firehole door. **Price £1.50**
- Sheet 4** Details of hind axle, crankshaft gears and clutch. **Price £1.50**
- Sheet 5** Eccentric rod, hind axle, hub cap, winding drum, drive plates. **Price £1.50**
- Sheet 6** Steering gear — regulator details; reach rod. **Price £1.50**
- Sheet 7** Pipe fittings, ash pan and doors, plough body types. **Price £1.50**
- Sheet 8** Details of hose pipe hangers and lid, steering spindle sleeve, water gauge and manifold, safety valves, spring retainer cap. **Price £1.50**
- Sheet 9** Gear and clutch details. **Price £1.50**
- Sheet 10** Gear guard, layout of drain cocks, brake spindle lever, exhaust pipe, toolbox, plough body. **Price £1.50**
- Complete set T.E.16. **Price £13.25**

W.E.20 A VERSATILE DIVIDING HEAD

by George Thomas

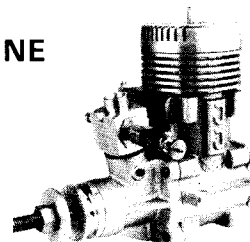


- Sheet 1** General arrangement drawings. **Price £1.50**
- Sheet 2** Further details of individual components for general arrangement. **Price £1.50**

P.E.31 JONES .605 10cc GLOW PLUG ENGINE

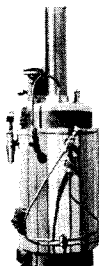
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by Colin Jones

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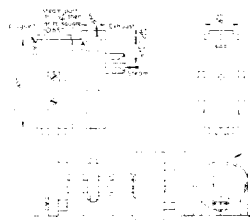


M.36 5 in. TEST BOILER
by Tubal Cain
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M.33 SMALL MARINE ENGINE
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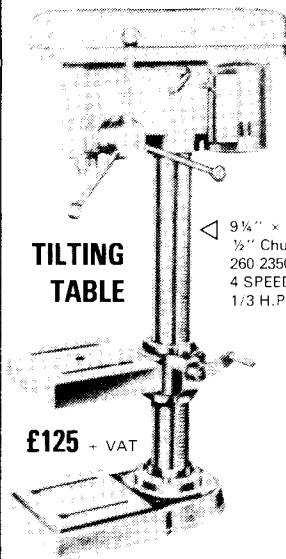
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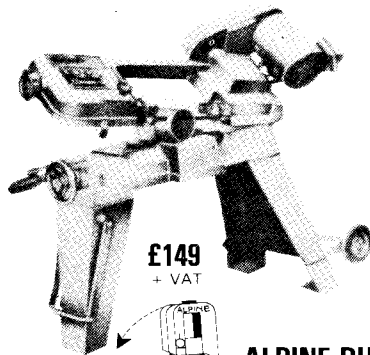
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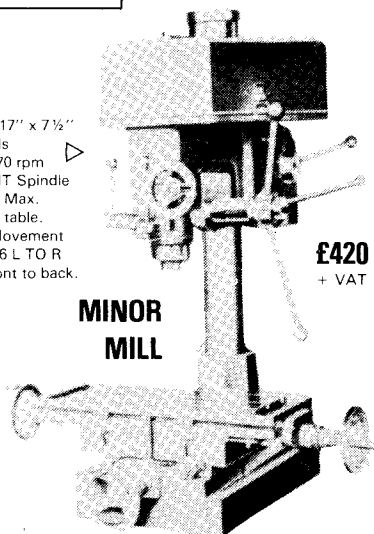
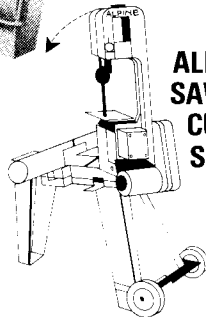


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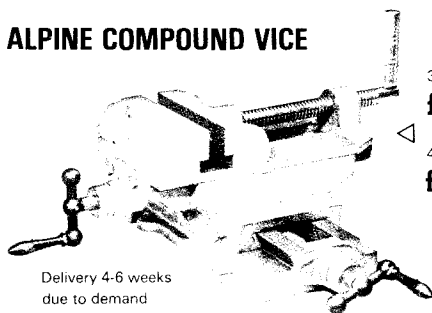


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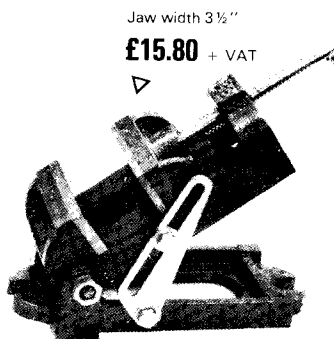
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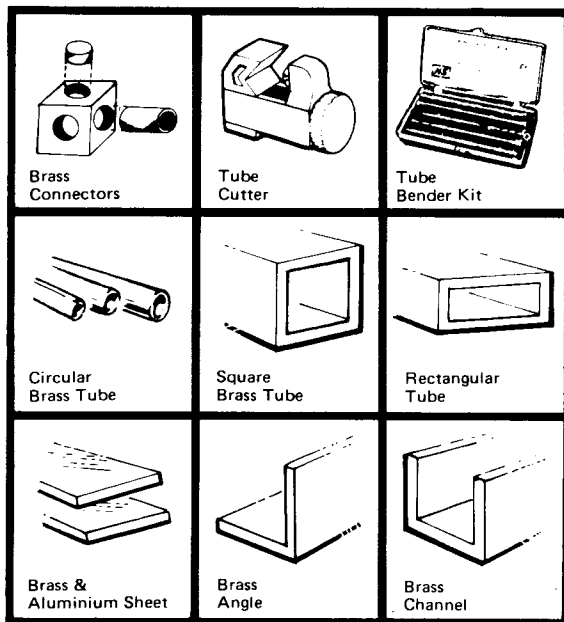
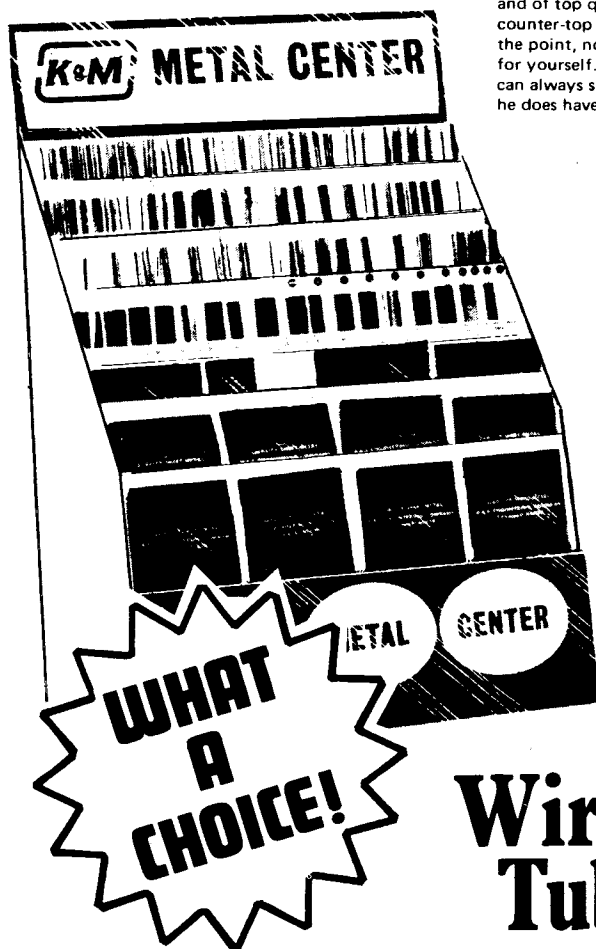
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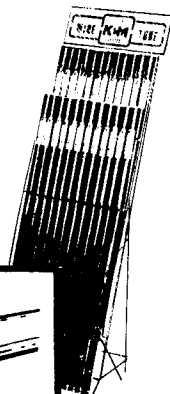
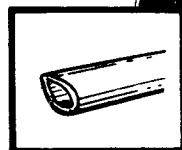
Send SAE for a FREE leaflet explaining the K & M Metal Centre and Wire & Tube Centre. Trade enquiries very welcome.

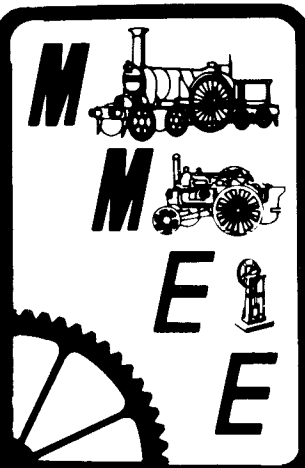
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2nd Midlands Model Engineering Exhibition

Granby Halls, Leicester.
26th October - 3rd November 1979

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 EXHIBITION MANAGER - MR. C.L. DEITH

Open 10.30 a.m. to 8.00 daily (7.00 p.m. final day) inc. Sunday

Admission - Adults £1.00 Children 50p

Special family ticket £2.00 (Two adults - 2 children)

THE EXHIBITION DEVOTED EXCLUSIVELY TO MODEL ENGINEERING

Locomotives -- Traction Engines -- Stationary & Marine Engines -- Machine Tools & Workshop Equipment --
 Clockmaking -- Woodworking -- Plus a major new section devoted to horse drawn vehicles (Farm Wagons,
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A COMPLETE 7 1/4" GAUGE MINIATURE RAILWAY SYSTEM
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Presented by the Exhibition Sponsors in Association with Milner Engineering, Chester Ltd., Track Length 250 ft.

Last year at the 1st MIDLANDS MODEL ENGINEERING EXHIBITION visitors saw what was probably one of the largest displays of Model Engineering exhibits ever seen at any Model Engineering Exhibition.

As a result of the very high standards set it is hoped that even more entries will be seen at this years exhibition. For competition entries there are some annually awarded cups and trophies and last year prizes valued at nearly £1,000 were awarded. All exhibitors also received attendance plaques in the form of a miniature works plate together with appearance certificates. Security at the exhibition is extremely good and intending exhibitors are assured of the safety of their models.

FROM THE VISITORS POINT OF VIEW

this years exhibition will see improved direct lighting over the models, smaller security barriers and more readable display cards. We are also increasing the already very extensive display area by a further 1,000 square feet to reduce overcrowding in certain classes.

DESPITE having the appearance of a Victorian Railway station the Granby Halls is ideal for an exhibition of this nature, permitting the actual working of many steam models. Particularly popular last year were the working model traction engines up to six inch scale steaming around the exhibition hall.

THE MODEL ENGINEERING TRADE will again be very well represented since nearly every one of last years exhibitors will again be present. Several new exhibitors will also be attending and the exhibition will therefore have a full and comprehensive selection of trade suppliers and visitors will be able to purchase anything from raw materials to machine tools.

COMPREHENSIVE TRADE REPRESENTATION is of course an important feature of any exhibition since it gives visitors the opportunity to both see new products and purchase most items they require. It is, however, important that stands should be limited to allow sufficient room for the main part of the exhibition - the exhibits. The Granby Halls has an area of 34,000 sq. ft., of this the trade stands occupy just over 4,000 sq. ft. whilst the exhibits occupy approximately 14,000 sq. ft. The remaining space allows us very wide gangways so visitors can enjoy the exhibition in comfort regardless of how many people are in the hall.

As last year in accordance with the aims of the organisers, trade participation will be limited to companies engaged in the Model Engineering trade.

MODEL ENGINEERING WORKSHOP

An open plan workshop will be presented staffed by experts demonstrating and answering visitors questions.

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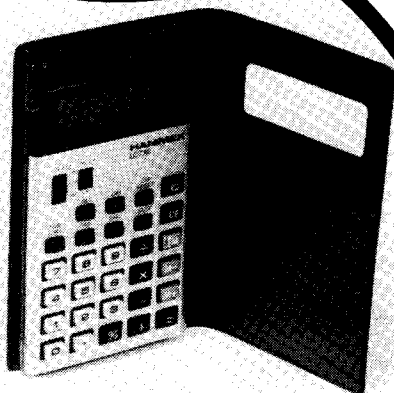


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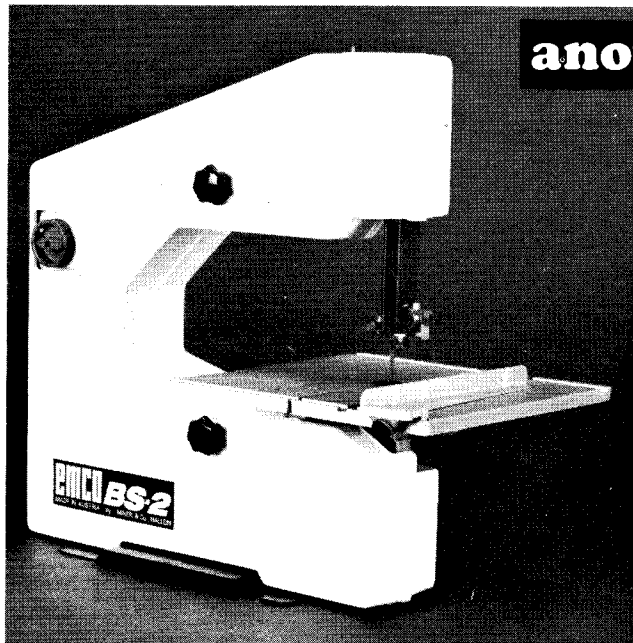
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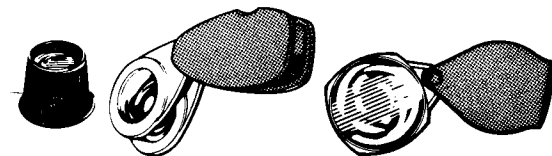
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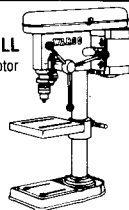
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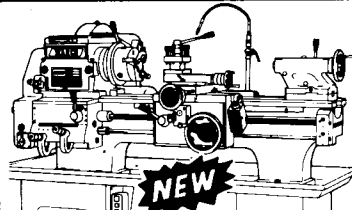
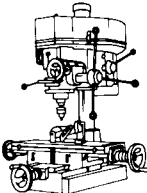


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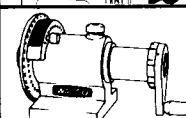
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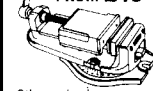
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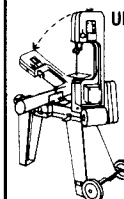


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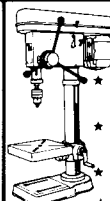
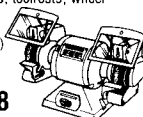
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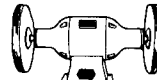
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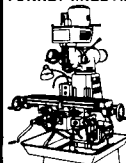
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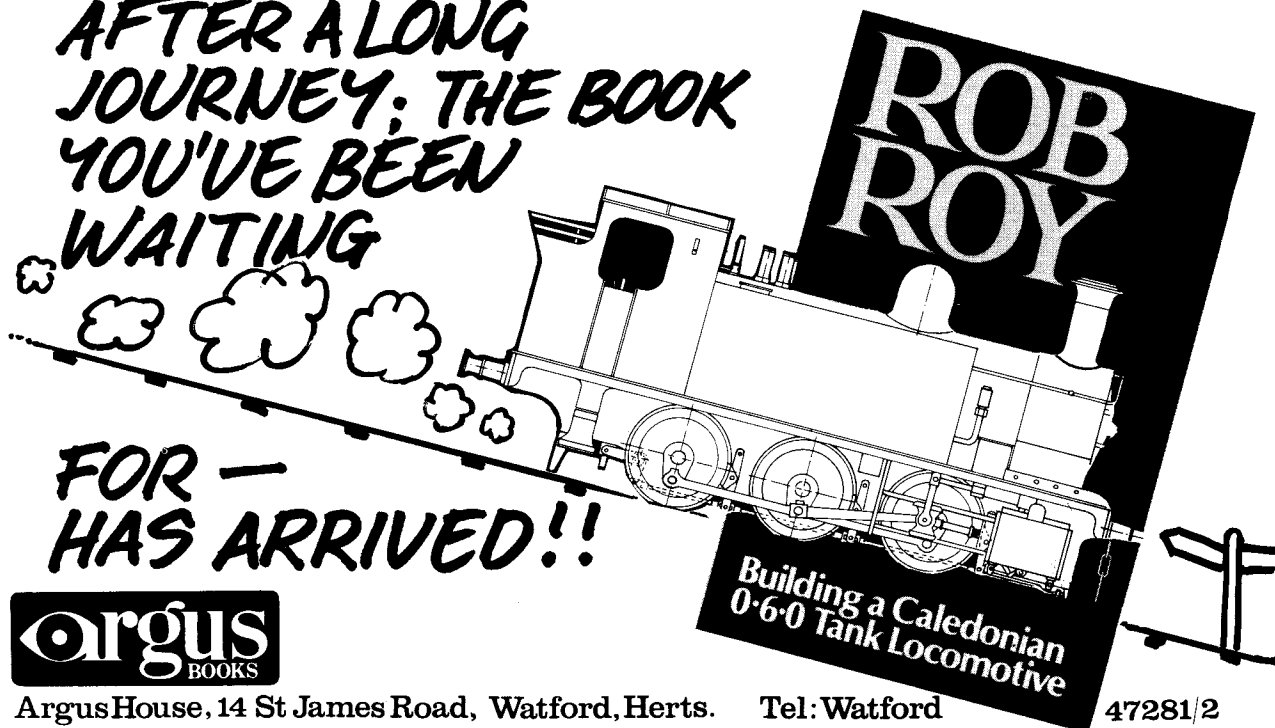
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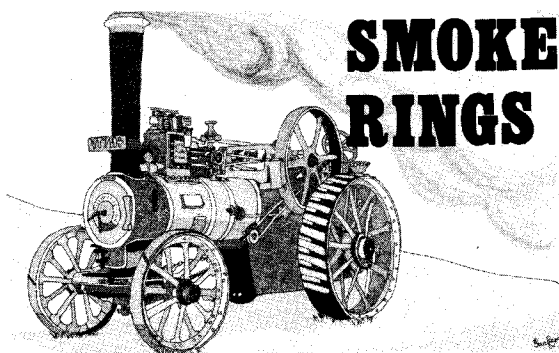
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A Commentary by the Editor

Model Engineer price increase

It has to happen — we trust you will understand that rising costs cannot continue to be absorbed by *Model Engineer*, and as a consequence we have to break the bad news to you that as from the next issue, 7 September, *Model Engineer* is going to cost 45p per issue. Subscription rates will be £15.75 for U.K. and Overseas Sterling, \$35 U.S.A. and Canada.

A Club Seminar

Elsewhere in this issue there is a report by Tom Mallett of a particular Club meeting which was of extra interest and which is reproduced in full. The Chingford M.E.C. arranged a day seminar of several lectures and I think other Clubs may find this sort of thing an attractive proposition for a special event, say once a year, for their enjoyment. As a participant at the Chingford seminar, I found that it was difficult to demonstrate effectively small items to a large audience and that, in spite of careful preparation beforehand, it would have been of great assistance had I known more about the available facilities, hall size, seating arrangements etc., in advance. This part of the experience I offer for the benefit of any other people brave (or foolhardy!) enough to stand out front and give forth.

Chingford deserve to be congratulated on their initiative in arranging the seminar and I believe they are considering another for next year.

Northern Militaire

Hinchliffe Models Limited and Model & Allied Publications Limited have come to an agreement by which Northern Militaire will from 1980 be owned and organised by Model & Allied Publications.

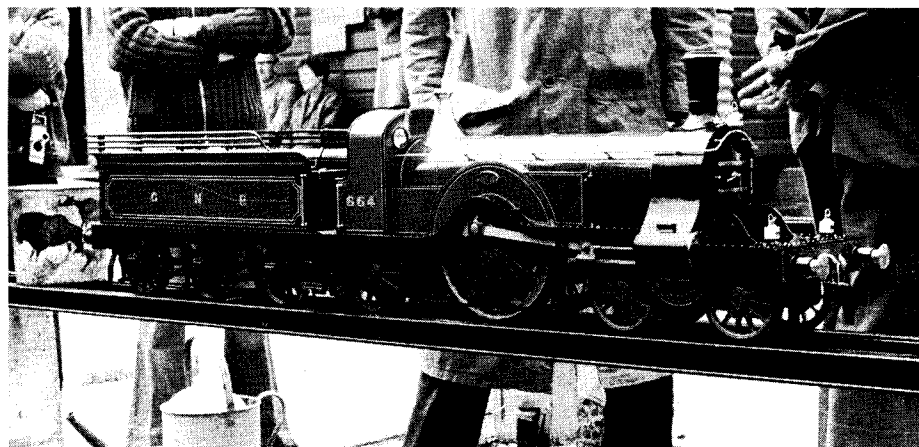
Recognising the need to widen the scope of the very successful Northern Militaire Exhibition to make it the premier modelling show in the north of England, Mr. Frank Hinchliffe and his fellow directors feel that the time has come to pass the exhibition into the hands of a company which has, not only, the widest and longest experience of exhibition organisation in the modelling field but also the necessary range of modelling magazines to give the exhibition the enlargement into other areas of modelling that the present organisers feel will be needed from 1980 onwards.

They also believe that the name of the exhibition should be changed to The Northern Modellers Fair, thus setting the tone for an exhibition which, while always having a vital and strong military and wargaming aspect, will embrace model boats, cars, aeroplanes, and model engineering as well.

Model & Allied Publications share these opinions and also believe that with the support of clubs and societies the best interests of modellers throughout the north may be met, building upon the established success of Northern Militaire.

The venue for 1980 is yet to be decided but the timing will continue to be in late October or early November.

STOLEN ! ! ! Between 16 April and 7 May, 12 lengths of dual-gauge portable track were stolen from **Polegate & Dist. M. E. C.**'s track site, Pevensey Bay Road, Eastbourne. Track is steel angle, steel bar, with tubular spacers. Any information to P.R.O. Mr. N. A. Cowtan, Nursey Cottage, Horsebridge, Hailsham. Tel. Hellingly 412 or to police.



The overall winner at IMLEC — David Moriss's 5 in. gauge Stirling Single.

ENTERPRISE

A three-cylinder L.N.E.R. 2-6-2 tank locomotive for 5 in. gauge

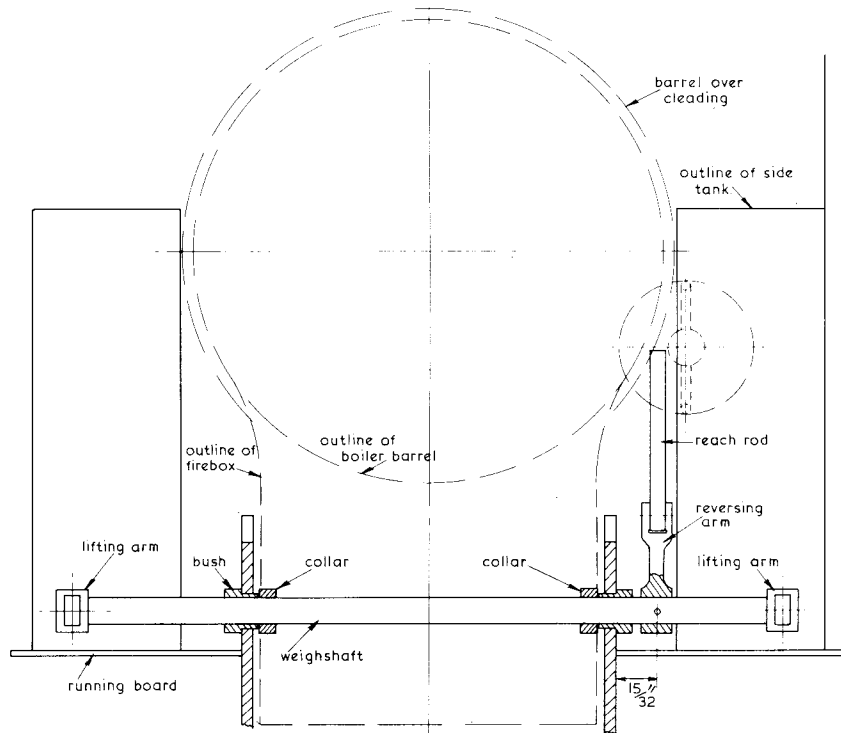
by Martin Evans

Part XI

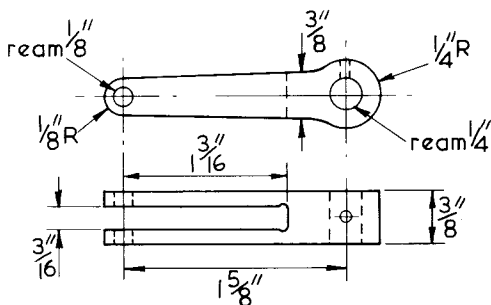
From page 827

THERE ARE A FEW more components of the valve gear to tackle before we can have a look at the boiler. Two lifting arms, one reversing arm and the weighshaft with its bushes could be made next. I prefer ground mild steel for weighshafts, as it is nice and true to diameter, yet easy to drill for the taper pins which I generally use to secure the lifting and reversing arms to it. The weighshaft is $\frac{5}{16}$ in. dia., turned down at each end to $\frac{1}{4}$ in. dia. for the lifting arms. The bushes, turned from cast or drawn gun-metal, are made a light-press fit in the $\frac{7}{16}$ in. holes in the frames.

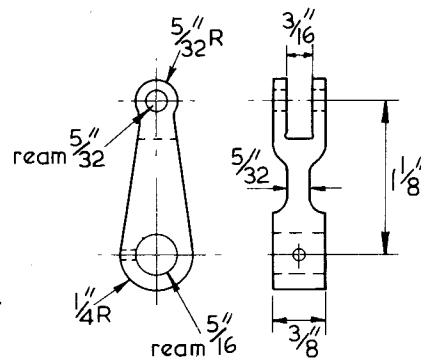
Both the lifting arms and the reversing arm are cut from $\frac{1}{2}$ in. \times $\frac{3}{8}$ in. b.m.s. As the former need a very deep $\frac{3}{16}$ in. slot in them, it is best to mark out and drill the holes in a piece of bar about twice as long as



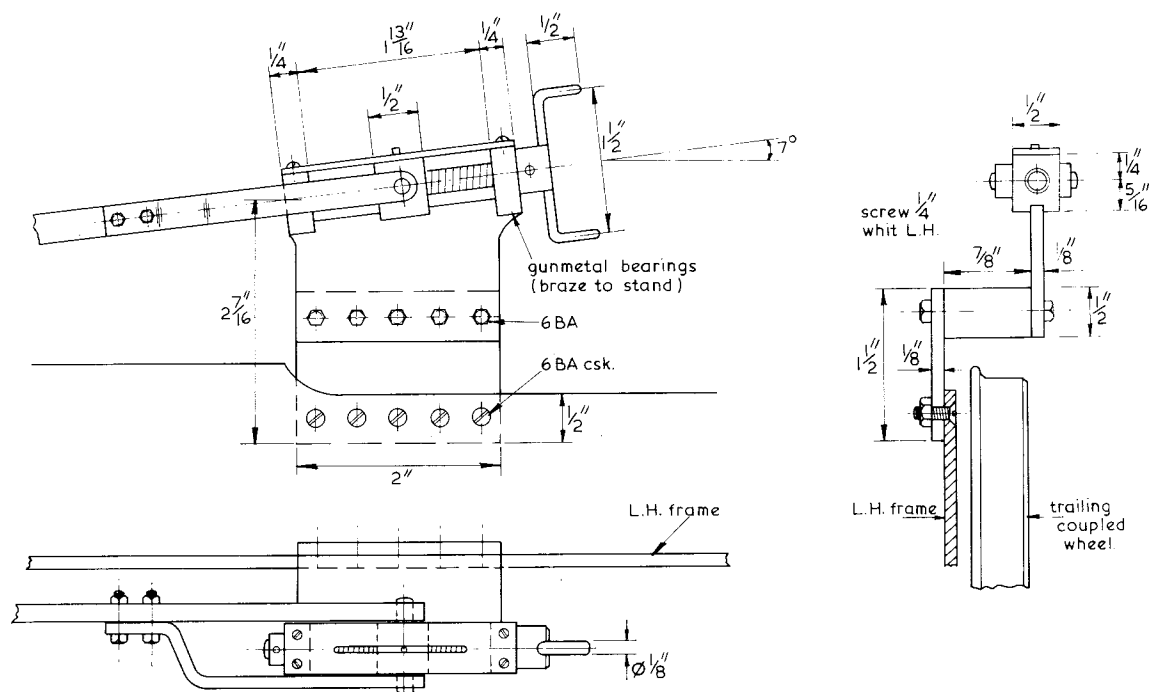
PART CROSS-SECTION AT WEIGHSHAFT



LIFTING ARM: 2 off b.m.s.



REVERSING ARM: 1 off b.m.s.



the finished component, then we have something to hold while milling the slot. Many builders will not have a face cutter of large enough diameter to cut to the full depth; in any case, to cut the slot in one pass would put rather a heavy strain on the job. However, many will have a large diameter slitting saw which can be used, making two cuts and breaking out the part left in the middle. (To make this easy, drill a hole first, at the end of the slot).

Both lifting arms and reversing arm must be a really nice fit on the weighshaft, otherwise they will quickly work loose in service.

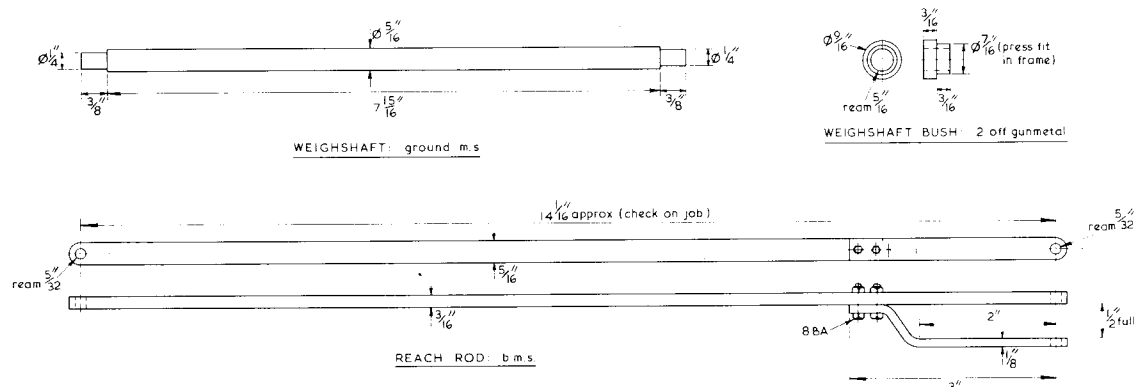
Cab reverser

Fortunately, the cab reverser is well to the rear of the firebox in this design, so we will not have the usual problem of clearance. My drawing shows that the reach rod lies nicely between the inside of the left-hand

side tank and the side of the firebox.

One small problem here is that we have to place the stand of the cab reverser just behind the trailing coupled wheel, so it has to be fitted first to a hefty piece of b.m.s. bar, which is itself bolted to a plate of 1/8 in. thickness, bolted on the inside of the frame. This piece of bar is 7/8 in. \times 1/2 in. section and 2 in. long, and it brings the centre of the reversing screw to a convenient distance out from the frames, yet not too close to the cab side.

The major part of the reach rod is made from 5/16 in. \times 3/16 in. mild steel, with an additional piece of 5/16 in. \times 1/8 in. attached on its outer side, so as to embrace the reversing nut. Incidentally, on the full-size 2-6-2 tanks, there was an intermediate weighshaft, situated just behind the driving wheel, and a vacuum operated clutch was fitted to it; the purpose of which



Some builders make up a temporary extendible eccentric rod, but this is not really necessary. The time-honoured method of measuring with dividers is I think sufficiently accurate for our purpose. Briefly, the method is as follows: the return crank should be tightened just sufficiently to prevent it shifting while we turn the wheels. Set it in retard of the main crankpin so as to describe a pitch circle of 1.26 in., or as near to that as you can get it. Now clamp the



When the dividers match, they will be set at the exact spacing for the eccentric rod, which can now be made and fitted. This operation should be carried out on both sides of the engine quite independently, just in case there is a slight difference. *To be continued*



VETERAN PUMPING ENGINES

by John L. Townsend

Part II

From page 854

The concluding part of this short series on the pumping engines of the Herefordshire Waterworks Museum Trust

THE HEREFORDSHIRE WATERWORKS Museum Trust, registered as a Charity, was formally set up in 1974 to lease the building from the Authority (the Board having been absorbed into the newly created Welsh National Water Development Authority) and to administer and operate a Museum as a voluntary organisation. The demand, after clearing out the engine house and a small workshop, was to get the engines working again because it was immediately obvious that these would become the focal point of the Museum and provide the greatest interest to visitors.

Attention was then turned to the triple-expansion engine and Lancashire boiler. Examination of the engine did not reveal any obvious defects. A few tallow cups were missing (probably now gracing somebody's mantelpiece) but otherwise all seemed complete and as the engine had apparently been working satisfactorily when last in operation it was decided just to re-pack the glands and conduct a careful trial under steam when this was available. However, as the engine had not turned for 25 years it was felt prudent to bar it over just to check all moving parts were free.

Teeth are cast into one of the flywheels and two ratchets are fed into these by a geared hand lever to

bar the engine round. This would not move the engine when turned and eventually it was only by slacking off all the crankshaft and big end bearings and by lashing scaffold poles to the flywheel spokes on which volunteers could pull (they did not need lashing!) that eventually the engine was persuaded to turn over and it was confirmed that all parts were free. Subsequently all steam packing was renewed, oilways cleaned, grease and tallow cleared out and replaced, and valves removed from the pump chests to prevent pumping taking place when the engine was working.

Turning to the boiler the situation was not so good. Fortunately the boiler was complete with all fittings and there were no obvious defects in the shell of furnace tubes. Inspection of the brick flues, however, revealed that some had collapsed or were about to, in others the brickwork was wet and badly corroded. The flue leading from the boiler to the chimney shaft had once contained an economiser and when this had been removed the patching up of the brickwork had been so badly done that this flue was collapsing. To make matters worse, work carried out by contractors in recent years to make the chimney safe had entailed removing the sandstone coping and throwing this down inside the shaft. Thus the bottom was now blocked with several tons of stone too large to drag out through the flue and in a position where breaking up was almost impossible.

It was decided to remove all but the side and bottom flues and to build new, taking the opportunity to improve the layout of the flue to the chimney. Apart from the old brickwork and chimney coping that had to be removed there were also several tons of sand at the base of the chimney, this was packed nearly five feet deep in a space too confined to use anything but a hand shovel. Removal of this revealed the remains of an older flue, presumably originating from the time of the low pressure boilers for the beam engines. The brickwork surrounding this was also in bad condition and remedial work had to be carried out to give adequate support to the chimney shaft itself. At the same time grant-aid enabled a new sandstone coping to be made for the chimney.

Old lagging was stripped from the boiler shell,

Below. A view of the Museum building with the new replacement pumping station in the foreground and the meadow leading up to the River Wye in the background. A 2 ft. gauge railway is to be laid across the meadow.



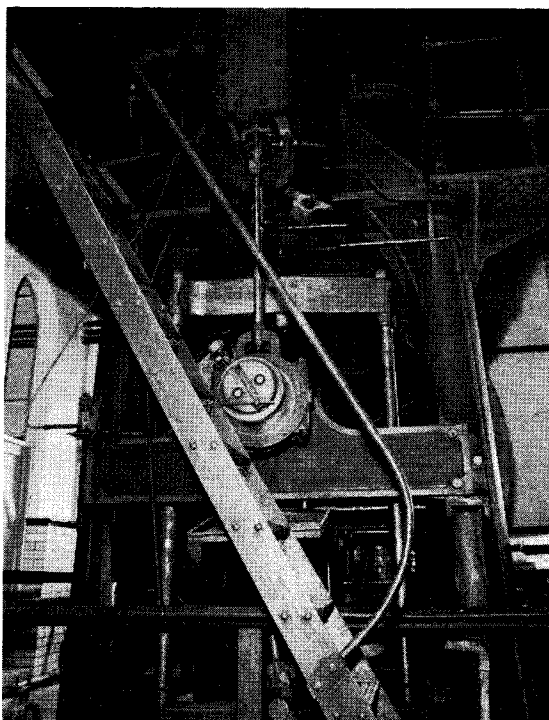
scale wire brushed and, where necessary, chipped off and bricks removed to reveal all the riveted seams. A thorough visual inspection of these and of the interior and exterior of the shell and furnace flues together with test drillings satisfied the Boiler Inspector as to the basic soundness of the boiler and all the mountings were then blanked off preparatory to conducting an hydraulic test. The boiler was then 81 years old and had been out of use for 25 years so it was with some trepidation on our part that the day of the test approached. We need not have worried however. The boiler held 200 p.s.i. for over an hour with no sign of any leakage and the Inspector passed it for a test under steam at 90 p.s.i.

All fittings, furnace fronts, firebars, etc., were replaced and in April 1975 steam was first raised again. In order to dry out the brickwork and to allow for steady expansion of all parts of the boiler the fires were lit three days previously and gradually built up with at least one member in attendance throughout the period, night and day, in case of any unforeseen problems. None arose however, and by the time the Inspector arrived the pressure was nearly at 90 p.s.i. He spent a long time setting the safety valves to his liking and testing that, however hard the fires were worked, the valves were capable of keeping the pressure below the 10 per cent above blow-off permitted.

Eventually we were relieved to hear him pronounce all was to his satisfaction and the moment had arrived when the engines could be tried under steam. The two-cylinder engine was tried first as this had already performed on a number of occasions under air and, as anticipated, it worked easily immediately with no problems. It was the triple-expansion engine that aroused the greatest excitement as nobody present had ever seen it in motion and a quarter of a century is a long time to lie dormant.

The engine was barred round so that the high-pressure end was just on the down stroke, all drains checked to be open, and the regulating valve slowly turned. Gradually the engine started to turn and, after a few coughs and wheezes, settled into the steady motion with which we are now familiar.

For this first test and several subsequent demonstrations in public the engine was working in its simplest form and since that time, various "refinements" have been brought back into use. A fractured pipe joint has been repaired allowing for the use of cylinder jackets and re-heater, the air pump has been fitted with new valves, a water supply laid on again to the condenser and a pump feeding condensate from the condenser back to the boiler re-commissioned. Each step has led to greater economy in steam and easier working of the engine. Early on it was suspected all was not as it should be with the drains from cylinders, jackets and receivers because of the large quantity of water being forced passed gland packing.



Above. The HP end of the Worth, Mackenzie triple-expansion engine. The main steam regulating valve is to the left of the valve chest.

Subsequently it was discovered that some of the galvanised drain pipes were corroded and blocked beneath the floor of the engine house and in view of the "spaghetti" nature of the pipes which had been put in crudely at different times it was decided to rip it all out and simplify and improve the system with rodding points.

Many readers will probably be familiar with beam engines and their operation as there are now nearly 20 working again in various parts of Britain. At the time of writing, however, I do not think there is another vertical triple-expansion engine that can be seen working by the general public although the Thames Water Authority continues to use its 1,000 h.p. engines at Kempton Park and a 1913 Hathorn Davey inverted vertical triple-expansion engine is being restored by volunteers at Twyford in Hampshire.

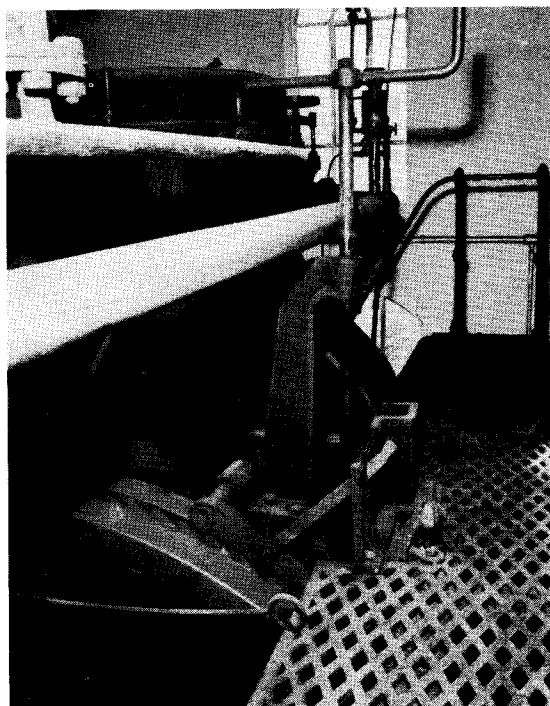
It may therefore be of interest to outline the technical details of the engine and its operation, assuming only a basic knowledge of engine construction. We can define the machine fully as a vertical, inverted, triple-expansion, condensing, direct-acting, pumping engine and so an explanation of each of these terms as they apply to the Worth, Mackenzie engine may simplify an overall understanding.

The three cylinders are set vertically at the highest part of the engine and act directly downwards. On opening a regulator valve steam at 90 p.s.i. (originally 160 p.s.i.) enters the 16½ in. dia. high pressure cylinder via a variable cut-off gear and slide valve. Surrounding the cylinder is a jacket containing steam at full boiler pressure which originally drained back to the boiler but in latter years was drained to waste. Around the jacket is a further annular space—the receiver—into which exhaust steam from the h.p. cylinder is discharged. The receiver not only assists in maintaining the cylinder at the highest possible temperature but also acts as a reservoir to store steam until the moment it is required for entry into the next cylinder.

The centre, or intermediate, cylinder of 21¼ in. dia. is of similar construction to the h.p. except that it has fixed cut-off gear. The greater piston dia. is to permit the lower steam pressure (perhaps about 55 p.s.i.) to carry out approximately the same quantity of work. Exhaust is passed into a receiver and then through a re-heater before entering the valve chest of the low pressure cylinder. The re-heater is a horizontal cylinder through which the steam passes surrounding nine 1 in. dia. brass tubes containing steam at full boiler temperature. The temperature and pressure of the exhaust steam are thus raised, although by the time it enters the 36 in. dia. low pressure cylinder it may be down to 20 p.s.i.

The L.P. cylinder has no steam jacket or surrounding receiver and used steam passes from this into an exhaust pipe leading down to a vertical jet-condenser at the base of the engine. Fixed across the cylindrical condenser is a bronze pipe with 150 ¼ in. dia. holes along its upper surface through which jets of cold water spray upwards and meet the exhaust steam condensing it and creating a vacuum within the condenser and exhaust pipe. This means that instead of the engine exhausting against an atmospheric pressure of approximately 15 p.s.i. it does so into a more or less perfect vacuum thus saving unnecessary waste of energy. The condensed water, cooling water (from a mains supply) and air which accumulates in the condenser are removed by a vertical air pump worked from the L.P. crosshead and much of the water runs to waste. A proportion of this however, may be returned to the boiler by a feed pump also worked from this crosshead.

Each of the piston rods acts downwards onto a cross-piece from which a connecting rod passes either side of the crankshaft down to a combined cross-head/pump ram casting running between slideways mounted on the columns of the engine. Each of the three single-acting ram pumps could lift 64 gallons per stroke, a total of 1 million gallons per 12-hour working day. From the crosshead a short connecting rod returns upwards to the crankshaft which is supported in four main bearings. Besides carrying the eccentrics to operate the three sets of valve gear the

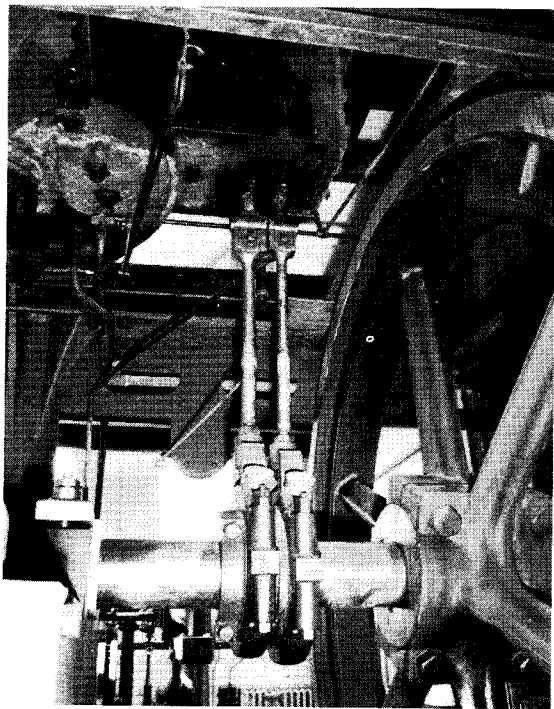


Above. The hand barring gear of the triple-expansion engine, turning the handle feeds pawls into teeth cast into one of the two flywheels. These can be disengaged when the engine is operating.

crankshaft also turns the two flywheels, each of 98 in. dia. and 55 cwt. in weight.

The three ram pumps lifted water from a sump, just outside the engine house and connected to the intake on the river, to the raw water storage reservoir, a total lift of about 135 ft. when the river was at summer level. As has already been mentioned the opportunity was taken when installing this engine to supersede the Evans engine pumping to the engine tank. This was done by connecting two double-acting bucket pumps to the intermediate crosshead. By use of the appropriate valves, water returning down from a reservoir could be pumped back up again to the tower approximately 175 ft. above the pumps. By this means the lift which these pumps were called upon to make was effectively only the height from the reservoir to the tank of about 85 ft. with an additional small loss through pipe friction.

Starting the engine commences at least 36 hours beforehand when the boiler is lit. 30 minutes before working time a boiler stop valve is opened to admit steam to the cylinder jacket feed pipe and in turn the two jackets are supplied. This helps to raise the cylinders to working temperature to reduce condensation when the engine is started although the jackets themselves have to be purged of air at the top through bleed valves and drained of water at the bottom.



Above. Looking upwards to the IP cylinder and valve chest with the fixed cut-off valve gear drive from eccentrics on the crankshaft.

It is known that originally the jackets, being higher than the boiler, drained back into it reducing heat and water loss. However, there is no trace now of exactly how this was carried out and the jackets have to be drained at intervals to waste. It has been found in fact that the losses through draining are so great as to make the use of the jackets undesirable except for this warming up process.

A check is made that all the cylinder, receiver and valve chest drain cocks are open and that the water trap on the main steam pipe is functioning. If necessary the engine is usually barred over to get the L.P. piston off dead centre, although there are simpling valves from the steam jacket pipe into the L.P. and I.P. valve chests to allow full pressure steam to be admitted direct to these for starting purposes.

The engineman has already checked all the oil and tallow cups and grease caps as well as the mechanical lubricator and, after checking everybody is clear, the main regulating valve may be slowly opened. After a few irregular strokes the engine soon settles down to a steady rhythm and once smooth running is maintained all the drain cocks may be closed and cylinder jackets shut off.

Now the trickiest part of the operation commences, for the engine has to be put onto condensing. Close to the regulating valve is an injection valve admitting

cooling water to the condenser. As this is slowly opened, cold water is sprayed into the exhaust steam condensing it and forming a vacuum. At once the engine speeds up, drawing in more water, forming a more perfect vacuum and speeding even more. The engineman needs his wits about him to reduce steam to offset the effect of the vacuum and prevent the engine running away for, as we often tell knowledgeable visitors, the only governor on the engine is the man in the boiler suit!

Over-speeding (the engine is suppose to be maintained at 28 r.p.m.) can take place unexpectedly even after a long period of steady running, perhaps through a fluctuation in cooling water supply or slight increase in boiler pressure. Under pumping conditions such fluctuations would probably have had little effect, but with the engine off-load and running very freely smart action is occasionally required and consideration is being given to re-introduce pumping in a closed circuit system to overcome this problem.

Operating the boiler, too, has not been without minor problems. Coal being such an expensive fuel it was decided to try scrap timber which, with transport, is only about 20 per cent of the cost. This is delivered in bales of about 2 tons and has consisted very largely of diseased elm, short ends from pallet manufacture, etc., and usually has to be cut in half by hand or chain saw before stacking outside the boiler house. A normal day's operation with both engines working will use between 2 and 3 tons.

During some events all has been well with adequate steam generated to keep the engines in operation and feed the boiler but there has been no reserve of heat and with poor climatic conditions, a load of green timber or for reasons which we have been unable to explain sometimes, there has been extreme difficulty in raising and maintaining the required pressure. Preparation of the timber is "labour-intensive" and firing an almost continuous process with overnight banking only achieved with difficulty. During 1978 two types of coal fuel were tried with varying degrees of success, not much more expensive than wood, they considerably eased operating difficulties.

Water feed for the boiler is from three sources. Condensate from the triple engine condenser can be fed through as previously noted, there is a Penberthy injector feeding from the mains and a Worthington-Simpson vertical feed pump supplied by a header tank. Originally there had been a donkey pump (probably by Worth, Mackenzie) but this had been removed many years ago and latterly reliance was placed largely on the injector. This did not seem a very satisfactory arrangement, especially with a reduced boiler pressure, and we were fortunate in being given the feed pump by Worthington-Simpson & Co. Ltd. after this had been removed from their own boiler installation after 50 years duty at Newark.

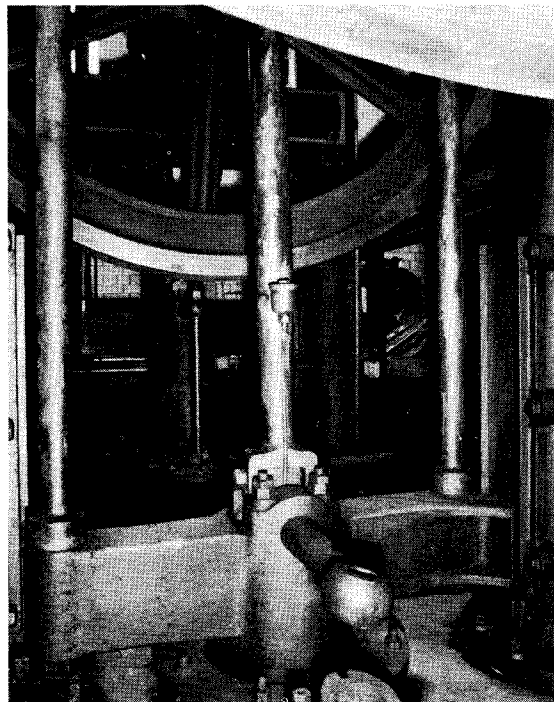
The two cylinder engine is a far less complex

machine. The main steam pipe branches into two 14 in. dia. by 12 in. stroke cylinders each exhausting into a combined vertical jet condenser with air pump operated by a rocking lever off one of the crossheads. Each side of the engine is otherwise identical and follows a similar return connecting-rod design to the triple engine. When installed, the engine took over the duty formerly carried out by the H.P. pumps of the triple engine (i.e. pumping to the tower tank) and the pump rods of the latter were disconnected.

The aim of the Waterworks Museum is threefold—to preserve as far as possible in original condition all the Victorian waterworks, to cover the development of water supply and distribution in Herefordshire and to show the historical and technical development of water supply and distribution in general. Whilst there are other Museums preserving and operating steam pumping engines and some having displays of related equipment we think Broomy Hill is unique in setting out to preserve a whole waterworks as well as its other wider aims.

What is planned therefore for incorporation into the Museum is the construction (already commenced) of a 2 ft. gauge railway from the pumping station to the intake on the River Wye (to demonstrate the type of railway equipment used in waterworks and on storage and distribution construction sites), the opening to the public of the original raw water

Below. A view at floor level of the IP (foreground) and PL pumps and connecting rods for the 1895 Worth, Mackenzie triple-expansion engine. At one time, a HP pump was fitted to the arm projecting in the foreground from the LP crosshead.



reservoir, two filter beds and surrounding gardens, and the re-opening of the water tower which has a viewing gallery on top overlooking the whole of the City and various rooms which may be used for display purposes. Various exhibits, more appropriate to external display such as wind pump, waterwheel operated pump, etc., will be set on the hillside above the pumping station.

Already available for working exhibition in the lower pumping station are a 32 h.p. National gas engine of 1912 driving an 1888 horizontal twin pump by Joseph Evans, a Campbell gas engine, a 12 in. x 24 in. single-cylinder horizontal Tangye steam engine believed to be of the 1890s, a two-cylinder vertical Allen 60 h.p. diesel engine of 1930 with its borehole type pump, an 1890s Hayward & Tyler hot-air engine and borehole pump, a Gilkes & Gordon water turbine driving a Warner triple-throw horizontal pump of 1896, a Fielding 15 h.p. oil engine, numerous petrol and diesel stationary engines, small pump units, hand pumps, gauges, meters, etc.

Further sections of the Pumping Station are now becoming available for the use of the Museum, the first phase of which at present occupies only about a third of the building and detailed development plans are being drawn up for the remainder. For the present the Museum is only open on the first Sunday each month (April-September) and on Saturdays and Sundays in July and August with steam weekends, for 1979, on 18/19 and 25-27 August and 29/30 September, but it hopes this will gradually be extended. Special days are available for school parties as part of a limited educational service that has been started and on the first day of each steaming period the working is extended until 10.00 p.m. with the engine house lit only by gas lights after dusk which provides a memorable atmosphere.

The Trustees are of course always very grateful to learn of old items relating to water supply becoming available for disposal and, whilst available space precludes consideration of much more large machinery, there is a very noticeable shortage of smaller items such as photographs, catalogues, gauges and meters, pipe and valve samples, etc., and we should be very pleased to hear of the availability of any of these from readers. We are especially anxious to obtain photographs of men at work plumbing, repairing mains, constructing dams, etc.

As the accompanying photographs will, I hope, bear out both of the pumping engines are relatively simple machine and, I hope that in due course it will be possible to make available suitable drawings from which scale models could be constructed. In the meantime we would like to ascertain if any older vertical triple-expansion pumping engine or any other products of Worth, Mackenzie & Co. Ltd. survive in Britain. Indeed any other information about this firm and its products would be greatly welcomed.

THE MARSHALL PORTABLE STEAM ENGINE

by Ron Kibbey

Part XXVI

From page 915

THE MAIN GOVERNOR spindle is made in two parts for ease of manufacture. The slotted head is turned to the profile shown, before milling the sides and slotting. I recall that, when I produced mine, I secured it to the finished spindle by Loctite in order to get a longer and more robust chucking purchase on it for the milling and slotting operations. The spindle itself was made from stainless steel close limit bright bar as supplied for piston rods and the like, the reduced diameters being machined with the tail stock centre giving the necessary support. A good finish is also required on the 1/8 in. and the 3/16 in. dia.

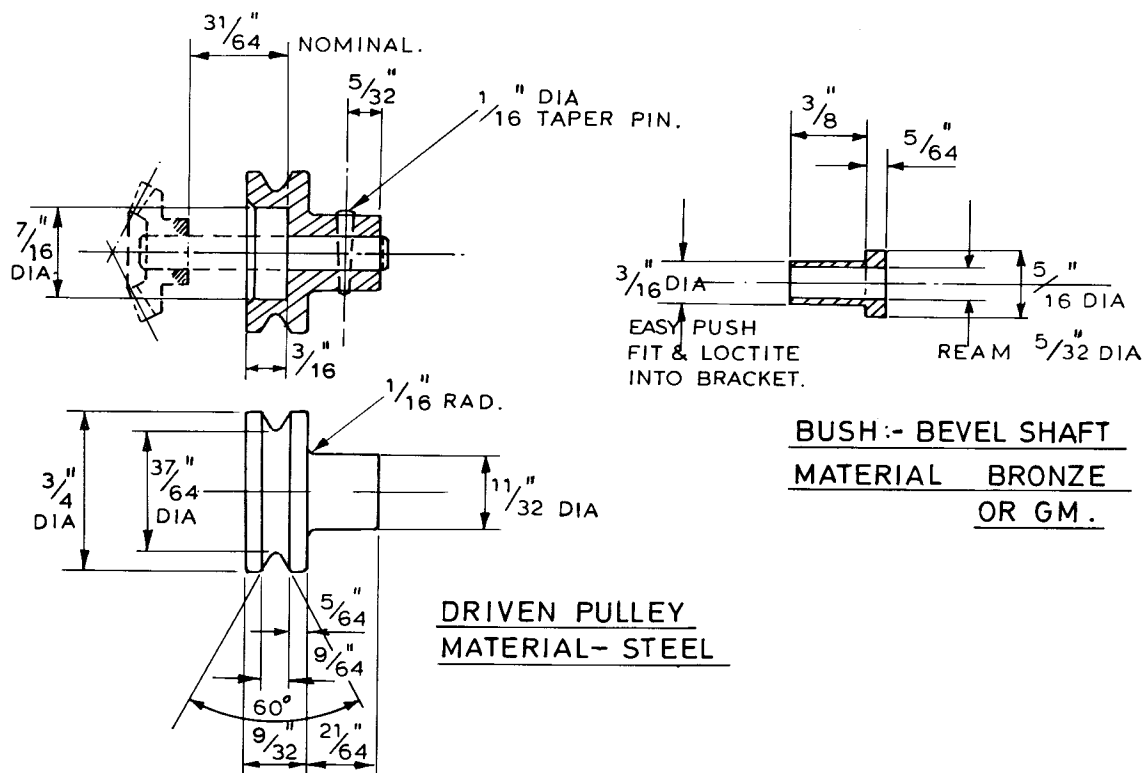
The upper and lower bearing bushes specify an easy push fit in the bracket bores to secure by Loctite. Those who prefer it will, of course, use press fits here instead, but this always introduces the chance of

distortion when fitting.

The governor arms are slotted at the cross-over point, the only difficulty they present is due to their small proportions. For the pivot pins I used short lengths of 1/16 in. dia. stainless steel rod, very lightly riveted over on both sides. The governor links again are troublesome only because of their size.

I had no bronze ball valves available at the time, otherwise I should have used these for the weights, mine were produced from brass bar using a form tool already to hand. I have checked that 7/16 in. dia. balls are obtainable in bronze. The pivot pins for the links were made from 3/64 in. dia. steel rivets, again lightly riveted over on both sides.

At the time I was building, there were no available gears and I adapted some gears from the scrapbox for



the purpose. However, Reeves have now arranged for the manufacture of gears specially for the Marshall to my design of governor and these are available to finished size ready for fitting. The necessary installation dimensions are specified on the detail drawings included in this article.

It will be seen from the arrangement drawing, that a thin bronze adjusting washer has been provided at the back thrust face of the bevel pinion, in order that the teeth of gear and pinion may be accurately mated with a small degree of backlash. I would suggest that the final thickness of this washer is determined by a trial assembly, and without the upper bush Loctited in position.

Having finalised the washer thickness, the spindle bush and gear can be re-assembled together with the washer (but not in the bracket) for cross drilling and reaming for the 1/16 in. dia. taper pin. Mark the rotational relationship of the gear and spindle and the large end of the taper before dismantling for final assembly in the bracket. Unless marking has been done, it is very difficult with these small pins to get things the correct way round when re-assembling.

It is also necessary to ensure that the lower surface of the bush protrudes a few thou from the cast bracket surface, as shown on the arrangement drawing. To achieve this, it may be necessary to dress the casting back a little.

The operating sleeve requires a good smooth finish in the 1/4 in. dia. bore which should have the sharp corners removed at both ends, and slide freely on the spindle but with minimum clearance.

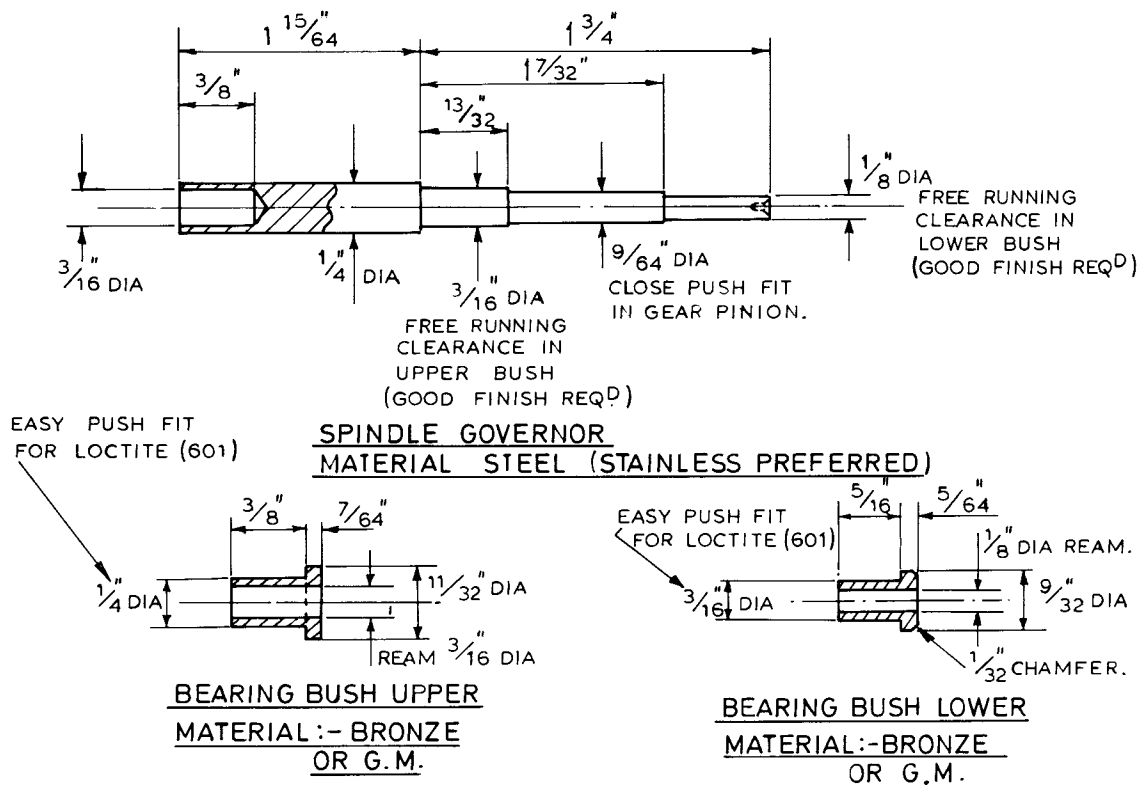
The governor pulley is a straightforward lathe job. The bronze bevel wheel should first be Loctited to the driving spindle in the position shown on the bevel wheel detail. The overall length of the driving shaft can be determined on the job, and assembled in the bracket with the pulley in position for the drilling and reaming of the taper pin hole.

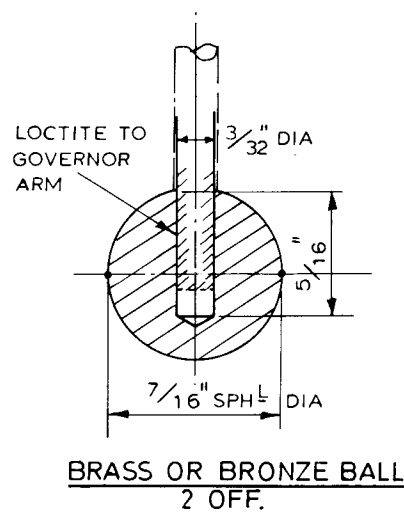
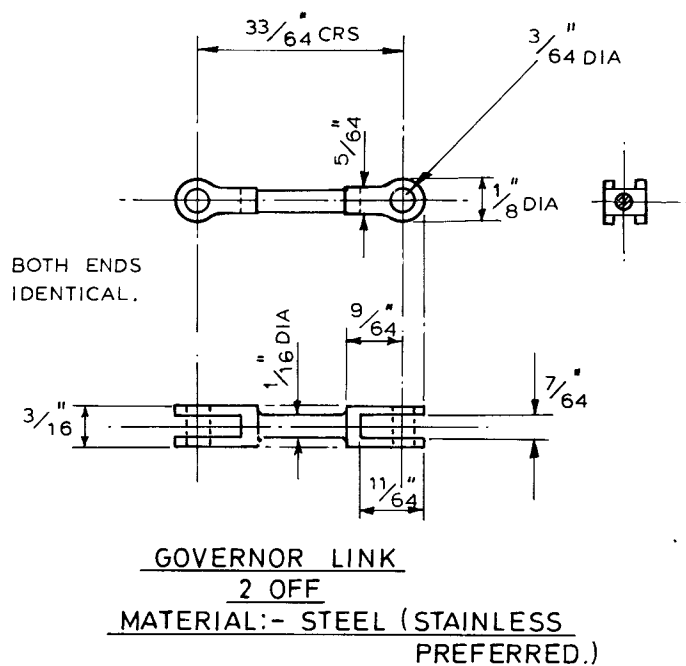
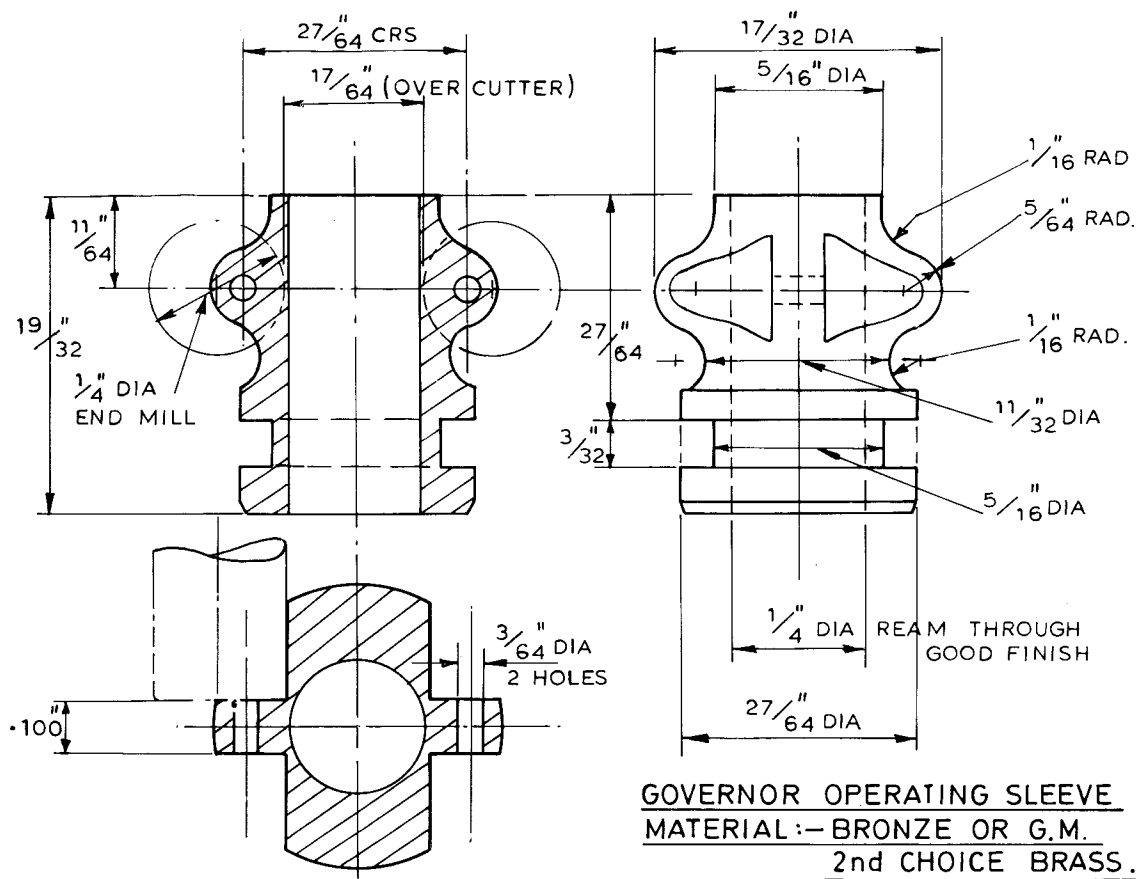
For the driving belt, I obtained a large hard Viton rubber "O" ring of 1/8 in. dia. section, which worked very effectively.

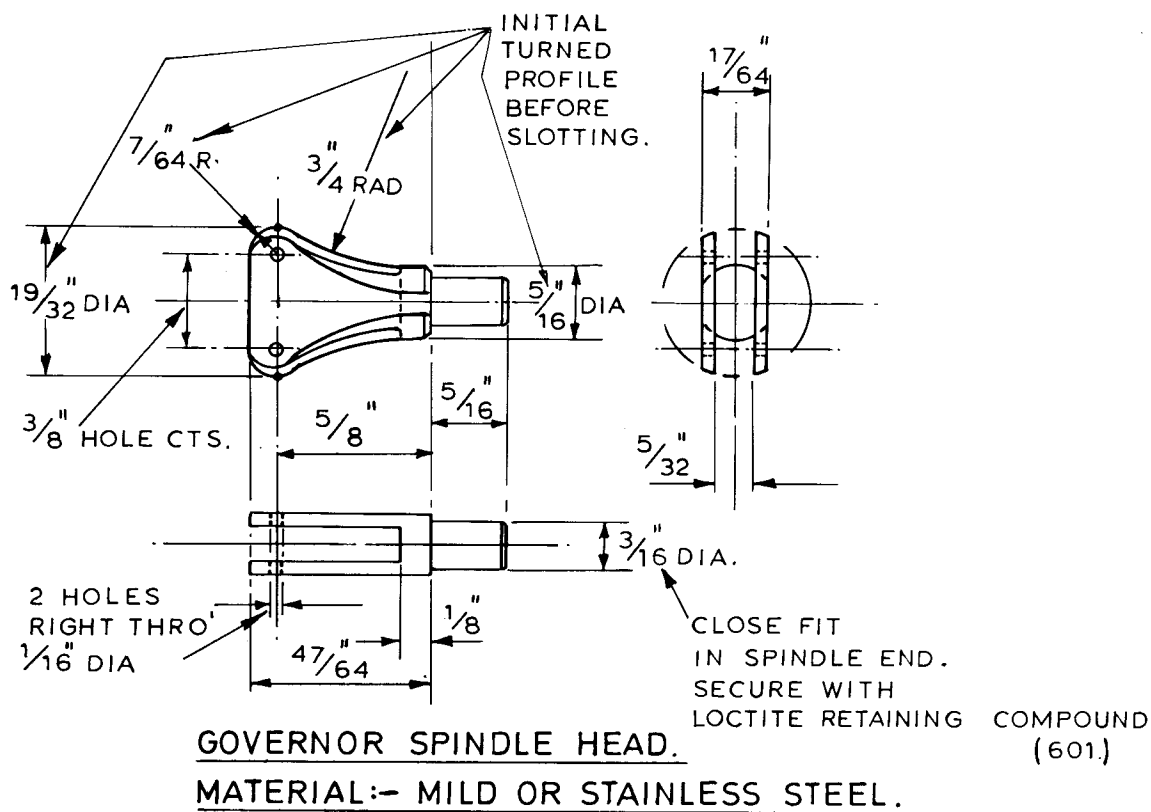
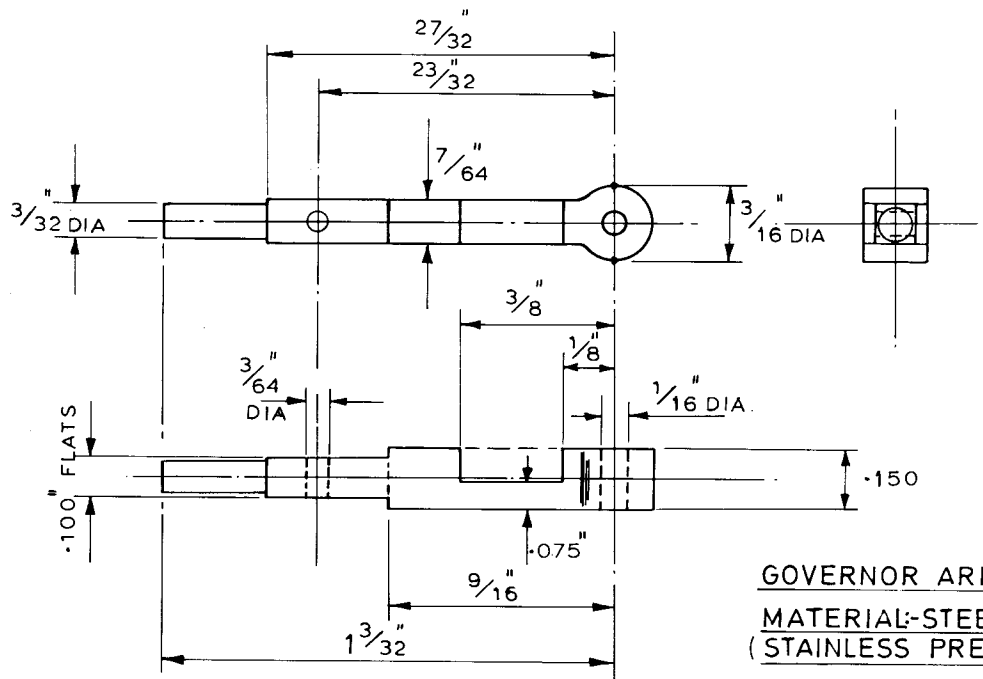
With the governor details now completed, this brings me to the end of the Marshall series.

I started the completion of Bill Hughes' series with some trepidation, and not a lot of enthusiasm for the drawing and writing involved. This, I suppose, was principally because, having spent my whole working life on the design and draughting side of engineering, I retired early in order to concentrate on the more satisfying work of actually making and building rather than producing plans for others to have all the fun.

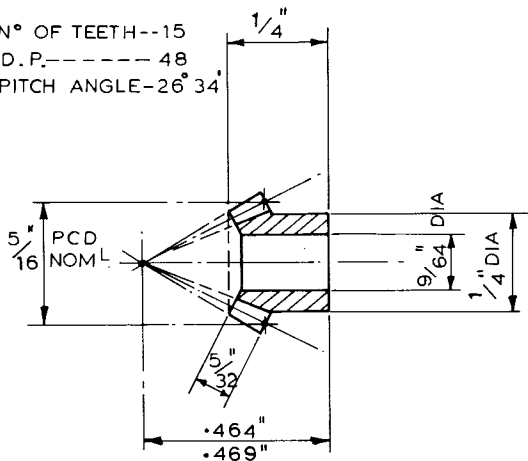
I naturally hope that in the future we shall see many Marshalls, both at Wembley and at the local M.E. Society Exhibitions and that builders will not have too much difficulty in following my articles.





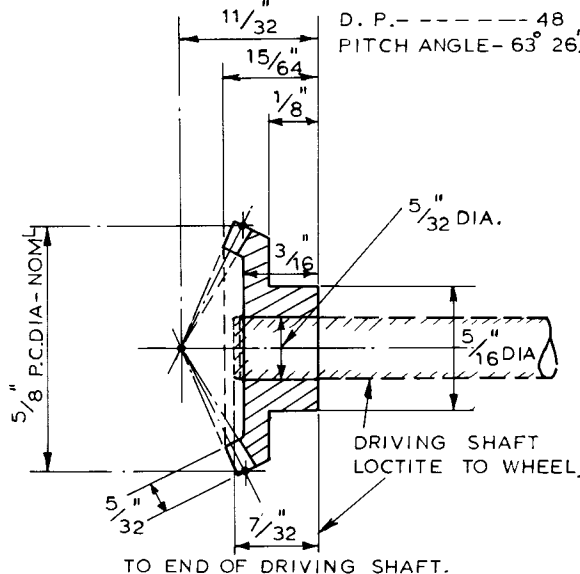


N° OF TEETH--15
D. P.-----48
PITCH ANGLE-26° 34'



BEVEL PINION.
MATERIAL:- STEEL

N° OF TEETH--- 30
D. P.----- 48
PITCH ANGLE- 63° 26'



BEVEL WHEEL.
MATERIAL:- PHOS BRONZE

CLUB

Dates should be sent at least five weeks before the event to ensure publication. Please state venue and time. While every care is taken, we cannot accept responsibility for errors.

DIARY

AUGUST

- 1 Rochdale S.M.E.E. General Meeting, Springfield Park.
- 17 East Sussex M.E. Bits & Pieces Evening. Library Extension, Robertson Terrace, Hastings at 7.30 p.m.
- 17 Stockport & District S.M.E. Evening meeting at the track.
- 17 Romford M.E.C. Track & Bar-B-Q Night.
- 18/19 Colwyn M.R.C. Annual Exhibition. Saturday 11 a.m. - 7 p.m. Sunday 11 a.m. - 5 p.m. Admission: Adults 35p, Children 20p, at the Pavilion, Eirias Park, Colwyn Bay.
- 18 St. Albans & District M.E.S. Woodhall Farm Community Assoc.
- 19 Furness M.R.C. Park Railway 2 p.m. - 5 p.m.
- 19 Guildford M.E.S. Public open Afternoon.
- 19 Cannock Chase M.E.S. Visit to Stafford M.E.S. at County Show Ground.
- 19 King's Lynn & District S.M.E. Public running on The Walks track. 2.00 - 5.00 p.m.
- 19 Hull S.M.E. Track Open Day. 1 p.m. - 6 p.m.
- 19 Northampton S.M.E. Public Running Day - Delapre Park, London Road, Northampton. 10 a.m. - 5 p.m.
- 19 Rugby S.M.E. Members Running.
- 19 Chelmsford S.M.E. Public running 2 - 5 p.m. Waterhouse Lane.
- 19 Worcester & District S.M.E. Public running day.
- 19 Ardeer Recreation Club - M.E. Section. Track meeting.
- 20 Willesden & W. London S.M.E. Brent Show. Kings Hall Community Centre, Harlesden Road, London NW10 at 8 p.m.
- 20 Wigan & District M.E.S. Sievert Demonstration presented by Mr. H. Ilett.
- 21 Milton Keynes Model Society. Meeting at Flying Field, Old Wolverton Road, 7.00 for 7.30 p.m. start.
- 22 Harrow & Wembley S.M.E. Track Meeting.
- 23 Hull S.M.E. Workshop Hints and Tips by J. Chilver. Trades & Labour Club (Room 3), Beverley Road, Hull, at 7.45 p.m.
- 24/25/26 Perth S.M.E.E. Model and Leisure Activities Exhibition at Perth Ice Rink.

25/26/27 St. Albans & District M.E.S. St. Albans International Weekend, Verulamium.

25/26/27 Whitchurch & District M.E.S. Open day - 2 p.m. - 6 p.m. (27 10 a.m. - 6 p.m.).

25-27 G.E.C. M.E.S. (Coventry). Stoneleigh "Town & Country Festival". Exhibition and portable track.

25-27 Birmingham S.M.E. Club to exhibit at Stoneleigh Town & Country Festival.

25/26/27 Crofton Pumping Station. In steam.

26 Chelmsford S.M.E. Public running 2 - 5 p.m. Waterhouse Lane.

26 Harlington Loco Society. Public open day 2 - 6 p.m.

26 Malcen & District S.M.E. Public Running Day.

26/27 Combe Mill Society. Steam Beam Engine - In steam. At Combe Mill, nr. Woodstock, Oxon. 10 a.m. - 6 p.m.

26/27 Pamplewick Pumping Station. Engine steaming - 11 - 5 p.m. (Closed 1 - 2 p.m.), plus Chesterfield M.E.S. running their 7 1/4" gauge railway.

27 Romney Marsh M.E.S. Portable track at Dymchurch "Day of Syn".

27 St. Albans & District M.E.S. St. Albans Lake, International Weekend.

27 Peterborough S.M.E. Bank holiday - Expo 1979.

27 Malden & District S.M.E. Public Running Day.

27 Bedford M.E.S. Steam Up.

28 Stafford & District M.E.S. Track night 7.30 p.m. County Showground.

28 Chelmsford S.M.E. Monthly Meeting. "Evening Steam Up". 7.30 p.m.

29 Harrow & Wembley S.M.E. Track Meeting.

30 Leyland, Preston & District S.M.E. Meeting.

SEPTEMBER

Early September Basingstoke & District M.E.S. Society Barbeque.

1 Romney Marsh M.E.S. Portable track at William Harvey Hospital Fete, Ashford.

1 St. Albans & District M.E.S. Northolt Carnival.

1 S.M.L.S. Visit to Maidstone M.E.S.

1 Ickenham & District S.M.E. Miniature Railway - open to public. Rear of Coach & Horses P.H., Ickenham Village, Middlesex. 2 p.m. - 6 p.m. Free 5p. Admission free.

1/2 Southern Federation. Autumn Rally at St. Mellons.

1/2 Tyne and Wear County Council. Rally & Exhibition.

1/2 N.W. Leicester M.E.S. Open Weekend, Miners' Welfare Coalville. 10.00 a.m. to 8.00 p.m.

2 Colchester S.M.E.E. Invitation day.

2 Andover M.E.S. Open Day.

2 Colchester S.M.E.E. Open Day. Visitors welcome.

2 Guildford M.E.S. Running day for members.

2 Rugby S.M.E. Public Running - 2.30 p.m. - 5.30 p.m.

2 S.M.L.S. Visit to Andover M.E.S.

2 King's Lynn & District S.M.E. Open and Club R.C. Steering scale/func. 11.00 a.m. Bawsey. 25p per boat.

2 Chelmsford S.M.E. Public Running 2 - 5 p.m. Waterhouse Lane.

2 Furness M.R.C. Urmoston "Trials".

2 Hull S.M.E. Track Open Day 1 p.m. - 6 p.m.

2 Birmingham S.M.E. Proposed visit to Hilton Valley Railway.

2 Whitchurch & District M.E.S. Club visit to Worcester M.E.S. track.

2 Malden & District S.M.E. Public Running Day.

3 City of Leeds S.M.E.E. Meeting.

4 N.W. Leicester M.E.S. Bring & Buy - Auction Sales. Miners' Welfare. 7.30 p.m.

4 Milton Keynes Model Society. Cars Evening (Electric & Power) at Royal Engineer - start at 8.00 p.m.

4 S. Cheshire M.E.S. Member's Slides.

5 Peterborough S.M.E. Committee Meeting 7.30 p.m. Lincoln Road Clubhouse.

5 Harrow & Wembley S.M.E. Committee.

6 Hull S.M.E. Planing Bevel Gears by Guy Wilson. Trades & Labour Club (Room 3), Beverley Road, Hull at 7.45 p.m.

6 High Wycombe M.E.C. Club Night.

THE PADDLE STEAMER "WAVERLEY"

by S. R. Bostel

AS MANY READERS WILL KNOW, one of the last surviving paddle-steamers in the country, the P.S. *Waverley*, paid a visit to the South Coast and other parts of England early in the summer of 1978 before commencing a regular programme on the Clyde. By the courtesy of the Chief Engineer, Ian W. Muir Esq., I am able to give some particulars of this grand old ship:

Her length is 235 ft. and displacement 693 tons gross.

The boiler is of the double-ended Scotch type with three furnaces at either end. This was originally coal-fired, but in 1957 it was converted to oil-firing on the Wallsend-Howden system which has two burners in each furnace giving a very flexible control of steaming rate.

The triple expansion engine is rated at 2100 i.h.p. and takes steam from the boiler at 180 p.s.i. The cylinders have diameters of 24 in., 39 in., and 62 in. with a common stroke of 60 in. and drive Stephenson's valve gear. This is the first triple of this type I have heard of fitted with Stephenson's gear.

Other paddles on which I have travelled have been fitted with Walschaert's valve gear.

The feed, circulating and air pumps are by Weir of Glasgow and the general steam pumps by Dawson and Downie of Clydebank.

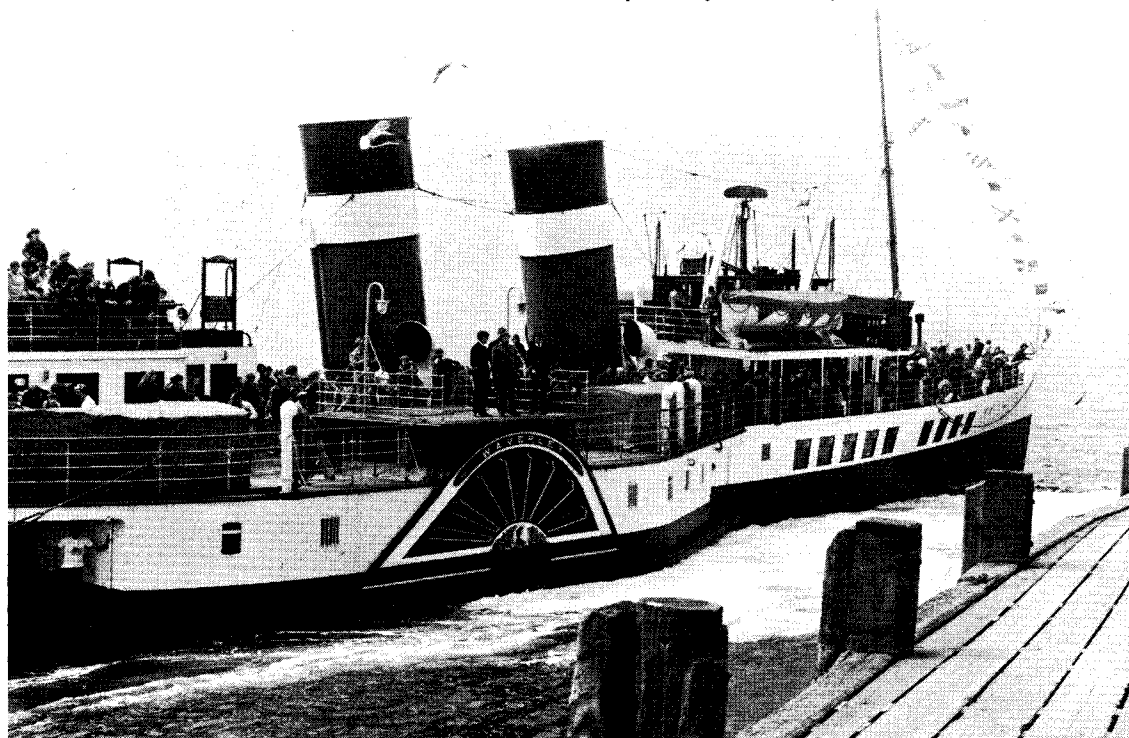
The original generator, which supplied 110 volt DC is driven by a totally enclosed compound engine constructed by Sisson & Co. of Gloucester, but in the winter of 1976/77 a second generator was installed. This provides 240 volts AC and is driven by another steam engine, this time by Robey & Co. of Lincoln, with a capacity of 13½ kilowatts. Both generating plants are situated in the lower part of the engine-room.

Waverley is scheduled to visit the South Coast again early this summer but her final programme is not yet settled. However, the final programme is sure to be extensively advertised wherever she is going, and I can thoroughly recommend her to all steam enthusiasts. To hear that beautiful diagonal triple slowly turning over with 3 sets of Stephenson's gear working will provide plenty of *wrangement* for the enthusiast to study.

The photograph below shows *Waverley* berthing at Kilgegan pier on a rather wild day in 1976 and was taken by John Goss.

For those interested in the *Waverley* or other old paddlers, the address of the Paddle Steamer Preservation Society is A.J.W. Rickner, Models Secretary, 16 Blunts Road, Eltham SE9 1GU.

This picture of the Waverley was taken by John Goss.



BULLDOG. DUKEDOG

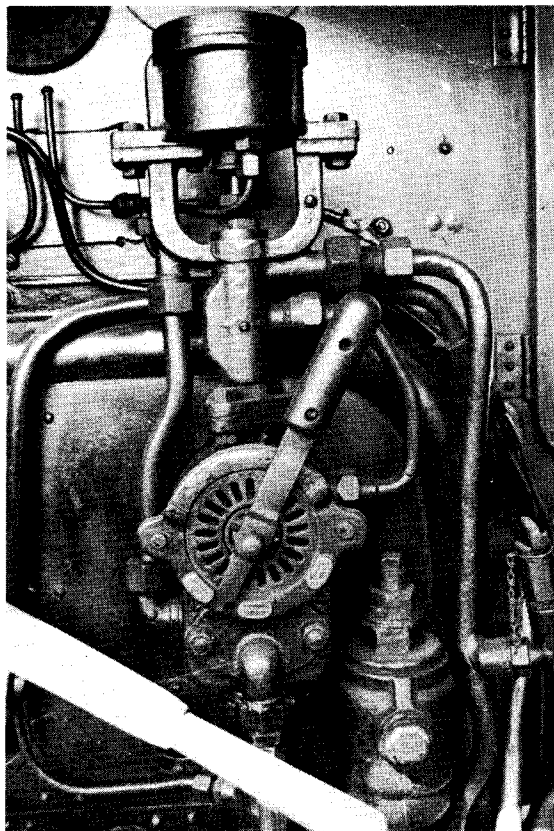
Part XIX

From page 844

Keith Wilson describes the brake gear for his 5 in. gauge G.W.R. 4-4-0s

I NOTE WITH INTEREST Mr Gale's letter, page 730, 15 June *M.E.* His explanation of the G.W.R. combination steam and "wackum" brake system was most interesting, and I have learnt a good bit more than I knew previously. I have driven locomotives with this style of brake in the sheds at Southall many years ago, but it was "light engine" and therefore the vacuum part of the system was not used.

Actually, it was a club visit to the sheds and nearly all the members had a go; it was a chuckle to see some of them change from full forward to full reverse gear; once you have got the knack it can be done single-handed in one swing, but at first it is another thing. Some looks on some faces were worth seeing! Perhaps the most intriguing was a pal of mine who changed gear correctly, but forgot to turn himself round and look the other way when it came to driving back again!



If, however, I may make a tiny suggestion to Mr Gale and other writers who refer to previous work in the *M.E.* I think it lends interest to mention the page and date of the previous notes. It took me a long while looking through my back notes to locate just where the matter was raised. (Page 952, 18 August 1978).

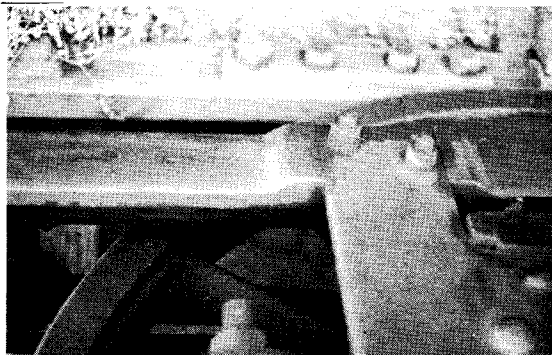
Meanwhile, herewith a photograph Fig.1 of the cab of the Bluebell *Dukedog*; shewing the brake valve concerned. The white bar across the lower left of the picture is the regulator handle, at the lower right-hand corner can be seen the water input clack valve; this particular *Dog* has not got top feeds. The details of the valve are clear, and I am glad that I now understand them a bit better. However, before builders of the design start shivering in their shoes at the very thought, I do *not* think that I shall try to make a complete *working* scale replica of this valve! I don't claim that it is impossible to do so, but I cannot but feel that the Wilson popularity might wain a bit if I specified a full working valve!

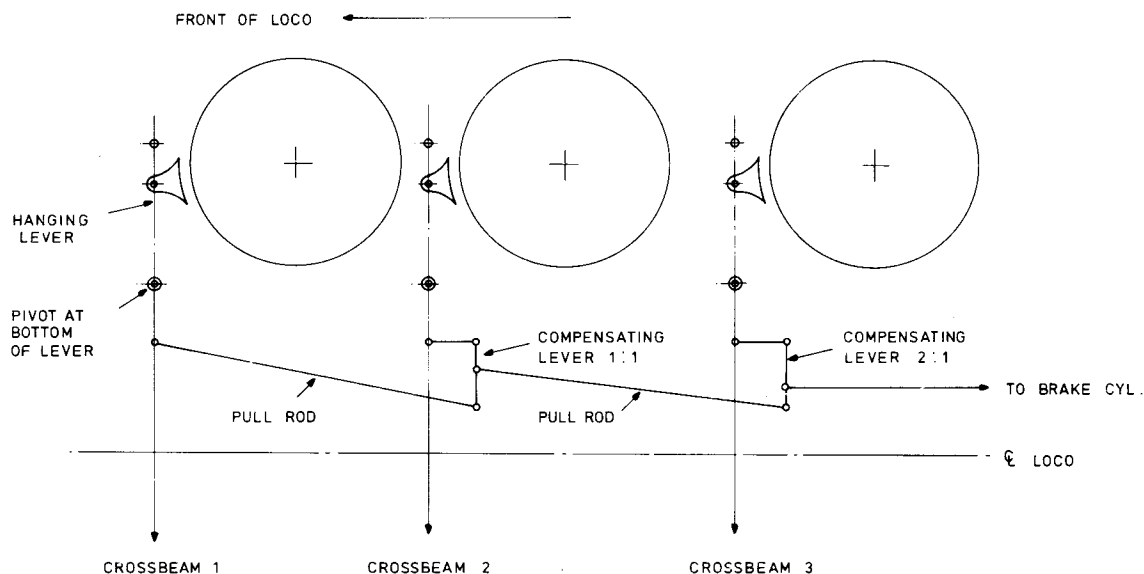
Photo No. 2 shews the lower edge of the frames of the *Dukedog*; not just how the lower frame brace (shewn detailed on Page 1076, 15 September 1978) is attached to the frames. The corner of the hornstay can just be seen on the left, and on the extreme right it is just possible to see some of the brake gear, although not as clearly as I would like. Lower bolt of springing just visible top centre.

Photo 3 shews the coupling rod, fluted type, and a little bit of the brake lever and block.

Just as a matter of interest, the photograph of the G.W.R. loco screw coupling on page 711, 15 June, is

Left. Fig. 1; Below. Fig. 2; Right. Fig. 3.





EXPLANATION DIAGRAM FOR COMPENSATED BRAKE GEAR

actually of a 7¼ in. gauge tender. So they can be made realistic!

At our Club the other night, the vice-chairman, after the usual reading of minutes, etc. asked for "matters arising". Instantly, a voice from the back said "Yes. How the ---- do you dismantle a Jacobs chuck?" I am not sure that this was "matters arising" but it could be of interest.

I may be wrong, but I think that the "Jacobs" part is actually a trade name of a particular maker rather than a name of a particular type of chuck. However, the name seems, like Hoover, to have passed into the common vocabulary so we might as well use it. For those who do not recognise the name, it is the chuck that holds drills, usually but not invariably in the tail-stock of the lathe or else in the vertical drill. Smaller versions are to be found on the ubiquitous (useful word) portable drill or hand drill.

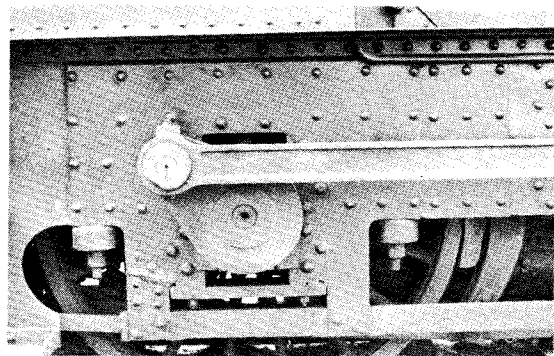
The ones that I have dealt with are assembled by

force. Force fits, that is. To get one apart, retract the jaws (if it's possible, the permanent "sticking" of the jaws usually indicates that the chuck is internally wrecked anyway and so is a ripe candidate for permanent dismantling). Then if the chuck is rested across the vice jaws, facing upwards, it is possible to persuade the outer shell to part company with the inner screwed portion.

I suggest a piece of wood as a "buffer" between the hammer (if it's not a rubber one) and the chuck. Make sure that the vice jaws are sufficiently open to just support the outer chuck shell; if you look at the rear of the chuck you should see the join. Those with access to a press of some sort have an easier task.

When the outer finally comes off, you will be certain that the inner screw has shattered due to your kind attentions. But fear not. This item is intentionally in 2 parts. Usually, they present a broken parting line anyway; they appear to be made intact and then snapped in half as a final operation. Quite a good way of doing it really, for it avoids the problem of the exact width of the groove or gap between the two parts, and also give a strong "keying" effect to add to its rigidity.

The usual breakage in these chucks is the fracture of the "screwed" edges of the jaws themselves. I am not aware of whether or not spare jaws are available, but I think that if they are, it might be as well to replace the fractured ring as well.



Brake Gear. The late LBSC (usually pronounced ell bee ess see, but I have heard it pronounced exactly as written!) usually left brakes till much later on in a series, for as he claimed, "it is time to worry about

stopping a loco after we have got it started" or words to that effect. However, if you can make the loco generally as described, you won't have to worry about its going!

But first let's deal with a remaining part of the bogie. This is the pressure pad, that actually takes the weight of the loco and transfers it to the bogie; sliding sideways as necessary to accommodate its transverse movement round curves. It is not easy to get the exact thickness of this, for it is the "final link" in the system; hence its size depends on the accuracies of previous machining operations.

I shew a cross-section of the loco at this point; with some useful reference dimensions. The size has been calculated as well as measured; the drawing seemed O.K. within 15 thou which is not bad. It is the final result of 6 other measurements, so one doesn't expect super-accuracy anyway.

Tip for readers engaged in design offices, drawing offices, etc. It is always best to draw as large as possible; paper is cheaper than metal. I have too often seen the result of drawing to small sizes to save paper; it's very false economy. I saw a drawing once where all the complicated parts for a big assembly were drawn on just one big sheet (40 in. x 30 in.) and then when the bits had to be made, the sheet was cut up into literally dozens of small parts. Admittedly the "system" of that particular firm (almost a household name) was "few, large sheets" but things could have been managed a bit better.

I never work at less than full size unless I absolutely have to; often work to 4 or even 8 times full size to get small details dealt with. Another thing that is useful, is to dimension the general layout as the Swindon drawing office did. Not fully of course, but all important dimensions are shewn as well as some others.

When detailing the separate parts, then further useful information can be on each separate drawing as

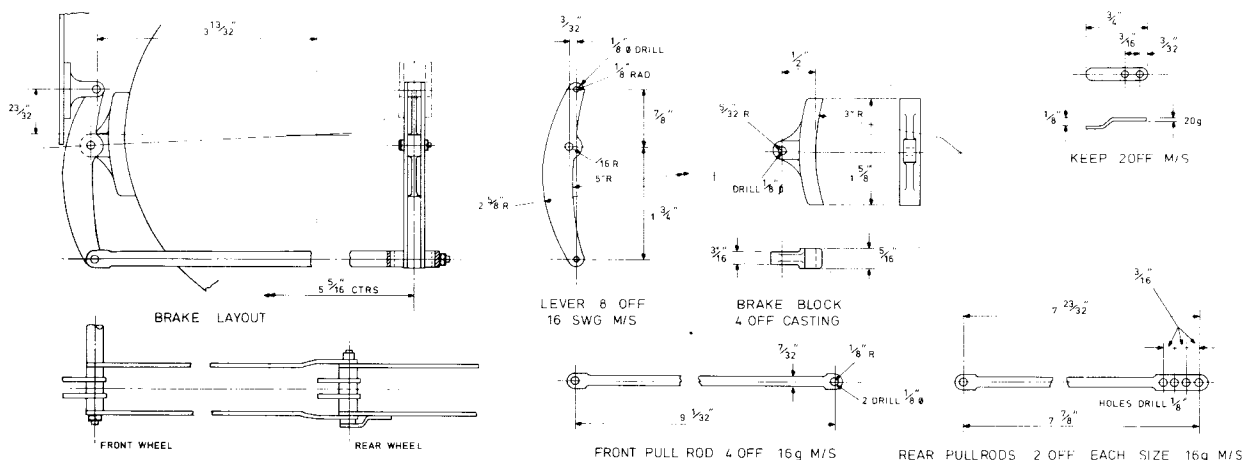
to its location on the finished article; thus for example the detail of the brackets to support the brake shaft would also contain the distance of the vertical centre line of the shaft from the nearest axle centres, likewise the vertical distance from the centre-line of motion. Saves time in the long run, as does a notebook containing principle dimensions for easy reference. (Wheel diameter, wheelbase spacings, depth of frames, centre-line of motion, cylinder and so on).

But I digress.

The full-size one has a spherical joint as I shew, but I leave it up to the individual builder (if there are any left!) to decide if it's worth the trouble. Certainly I have not noted any trouble in track holding with just a plain pressure pad. Construction is clear from the drawing; I have not drawn up the little oil-box as I think it's simple enough without drawing; it serves the dual purpose of oiling the sliding joint and holding the pressure pad in place when the loco is lifted up.

Break Gear. It is spelt that way in the very old railway books. There were two styles of brake lever in general use; the one I shew and the later straight one. To my intense surprise, I cannot locate any photographs shewing the levers; either on the *City* or the *Dukedog*. The best that I can offer shews the two varieties of straight lever; both are on tenders. Fig.4 and 5 (The Immutable Law of Cussedness makes sure that one is the *City* tender, and the other is the *Duke-dog* tender!)

Levers. The levers are cut from 16 g. mild steel. The full-size ones appear to be castings; at least the raised bosses give that impression, but I don't think castings only 1/16 in. thick are really "on" for our use. Suggest that they are made and drilled etc. in pairs and identified as such. Not easy to line up holes in bits like this unless they *are* made in pairs, or possibly a "master" jig made for the lot. To aid in marking out,



a simple template of card or thin metal is useful to get those big radii drawn.

Blocks. Castings are available; the only parts needing cleaning up are the sides where the block fits between the levers; but a minor clean-up all over will not come amiss. It is an unfortunate fact of nature that moulding sand for castings cannot be "scaled"; hence a 1/8 in. pit in the full-size casting would be hard to see, whereas the same size pit in a small casting like ours would probably go right through and out the other side.

Some years ago I had some aluminium castings that were so beautifully moulded that even the faint pencil lines used to mark the wooden pattern out were clearly visible in the casting, but that is the exception rather than the rule.

These blocks could be made out of the solid, but by the time you had finished them they would cost more than the castings so it's hardly worth it.

The rest of the bits are all plain turning or metalwork jobs. There is only one cross-rod; this goes on the front set of beams. It might be thought easier to make this cross-beam out of one solid bar, shouldered down to take the levers; but it is not easy to assemble or dismantle the works with this. At least with the thin bar and cross spacer method it is not needful to take out the hanger brackets in order to remove the crossbars.

Incidentally, the levers are pivoted in the hanger brackets with shorter versions of the bolt shewn; make four off 5/8 in. from under head to shoulder instead of the 15/16 in. shewn. It will be necessary to assemble the levers into the hangers before bolting the hangers on to the frame brackets; for the bolt is too long to "juggle" it into place after assembly.

The assembly with the spacer etc. should be clear from the drawings, I bet the bits don't all add up to the correct widths first time, so you might have to adjust a bit. It could be a good idea to remove this gear once fitted and checked as it could get in the way later.

The brake-gear on these locomotives does not appear to be compensated, so it seems likely that wear

was allowed to take up slack and make the blocks touch the wheels. Perhaps a few words on compensation in brake systems might not come amiss.

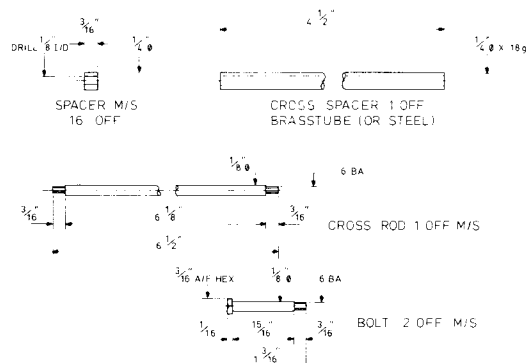
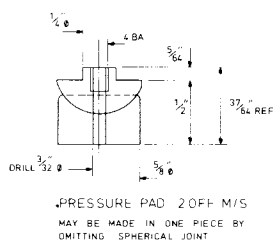
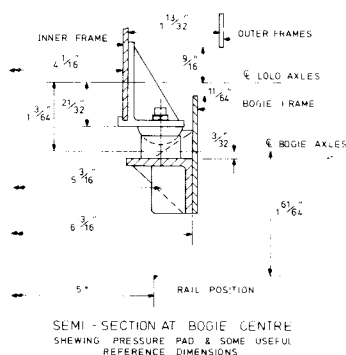
Since it is obviously not possible to make a brake gear perfectly, it follows that some form of adjustment is needed, preferably automatic. The brakes on a car for example have individual cylinders hydraulically powered, so obviously, assuming that no cylinder is broken or jammed, then the flexibility of the system ensures that all brakes bite in proportion to their cylinder size and leverage. No cylinder can push on its system until all the other cylinders push just as hard.

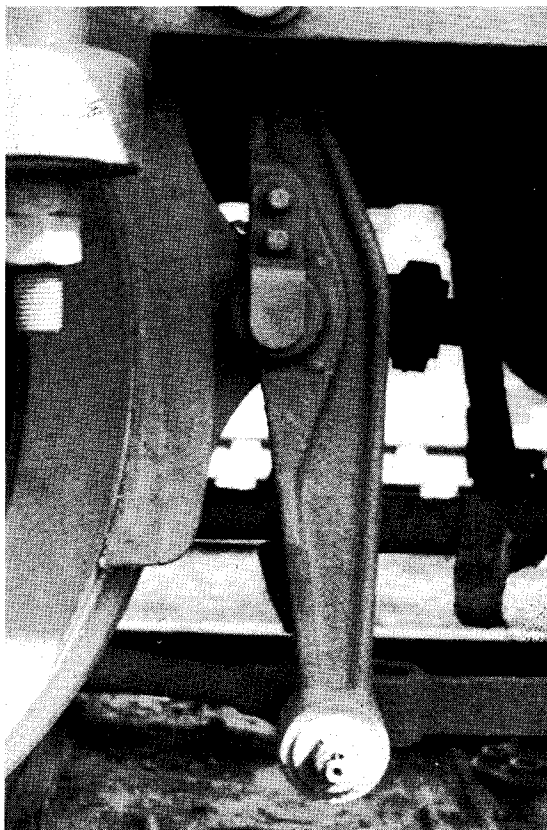
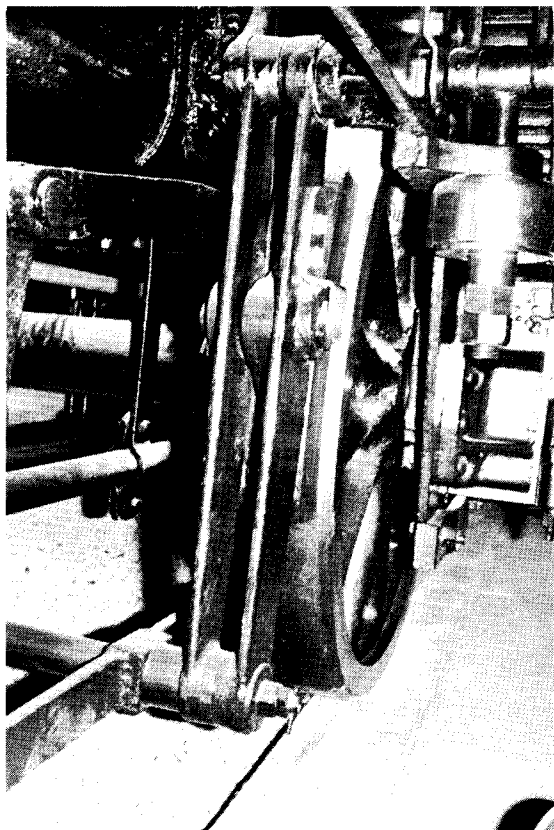
This is not so easy with a mechanical, as distinct from hydraulic, system. So we have to use some form of linkage. The drawing shows a 6-coupled wheel loco, with the brake cylinder at the rear, and the levers in front of the individual wheels. For ease of explanation, assume that all the actual levers, i.e. the bits that actually hold the brakeblocks are equal.

This is not often so in practice, for frequently the front lever has to be of different design to clear the outside cylinders. On the G.W.R. the 4-cylinder locos had this problem, also most of the 2-cylinder outside-cylinder locos. Inside cylinder engines like the 57XX, 2251 class and the *Dean Goods* types had equal levers, but offhand I am only aware of the 47XX class (2-8-0, outside cylinders) having this facility.

Starting at the front, the first crossbeam has no compensation lever. The second one has a 1-to-1 lever; one end connects via a short link to the second crossbeam, the other end to the front crossbeam via a long link. Clearly, with the "pull" of the brake rod-
ding acting on the centre of the compensating lever, its pull is divided exactly in halves. (Neglecting friction, of course).

Coming to the third crossbeam, it is a 2-to-1 type compensating lever, with the long end coupled to the third crossbeam and the short end not to any crossbeam, but to the centre of the compensating lever on the second crossbeam. Clearly this divides the "pull" into three equal portions, one of them going to the third beam and the other two going down the next stage of pull rod to the second compensating link. (For





Left. Fig. 4; Above. Fig. 5.

an 8-coupled loco, the fourth beam would have a 3-to-1 lever and so on).

To save needless arguments, I am fully aware that the pull is not really divided into three portions, but I think it makes it a bit easier to follow for our fellows who may possibly not be too happy with mathematics.

Looking at it from the other end, assume a pull of 90 lb. on the rod coming from the brake cylinder linkage. The first compensating lever (the 2-1 one) divides this into two pulls of 60 and 30 lb. The 30 lb. acts directly on the crossbeam for the trailing wheel brakes, whilst the 60 goes on to the 1-1 compensating lever.

The first compensating lever (the 2-to-1 one) divides this into two pulls of 60 and 30 lb. acts directly on the crossbeam for the trailing wheel brakes, whilst the 60 goes on to the 1-to-1 compensating lever.

This splits up the pull into 2×30 lb. portions; one pivotted to the linkage ensures that they "spread the load" equally; and if all hanging levers are equal then each wheel should receive an equal share.

Of course, with locomotives having the "odd pair out" amongst the hanging levers, then although it would be nice to have all the levers equal it is clear that some would perform more equal than others. This can be taken care of by arranging at design stage for different proportions of compensating links.

As a matter of interest, I have just been right through the compensating linkage on the G.W.R. 51XX class; the hanging levers have the second and third sets identical but the first set tucked away due to the cylinders. As far as I can tell, the force acting on each set of wheels was not quite the same, but of course what was more important was that all blocks touched all wheels before any individual block put any pressure on. That way, all wheels had a reasonable share of the brake load.

Many years ago, some of the bigger locomotives had brakes on the front bogie. The first *Castles* were designed and built this way but not the *Kings*; the practice was discontinued for it was found that the bogie brake actually reduced the overall brake effectiveness. Rather a puzzle until one realises the shifting about in effective wheel-to-rail pressure caused by the loco "leaning forward" so to speak with a brake application. A car or motorbike will do the same trick.

Had a peculiar-looking visitor a few nights ago who claimed to be the ghost of one of the old locomotive engineers. He didn't fool me, for of course I saw through him right away . . .

To be continued

A JOB OF PUMP

by Tubal Cain

A STORY ABOUT THIS was written three years ago, when the drought hit the "Tubal Cain Water Board". However, by the time it reached the Editor the crisis had passed. Mrs. Tubal Cain, who believes in Witchcraft, says it was writing the article that did it, but I am inclined to think it was either the visit of the "Minister for Drought" or the Public Enquiry held to decide whether the N.W. Water Board could take another "N" millions of gallons a day from Windermere!

That was August 1976, and here we are pumping again, so there is plenty of time for even greater need and I thought a piece might help readers in like situations — and even some abroad to whom water shortage is a chronic state. Not that the spring has dried up again; just an error of judgment, emptying the tank to clean it out. The BBC said it was going to rain! As it is, the trickle that is coming in is barely adequate.

The supply is pretty reliable. It comes from a spring up the hill which feeds a brick tank that holds 4 tons. From there it flows by gravity to a roof-tank which holds another ton — and if you think that's a lot of water, think on that on average you each use about 4 or 5 cwt. of water a day. More if you have a hose. As well as this spring, there is an even more re-

laible flow lower down the hill, but this is so low down that though it subscribes to my garden pond it can't help unless carried in buckets; and as we don't like hard work we use a little centrifugal pump to give enough pressure to hose the garden.

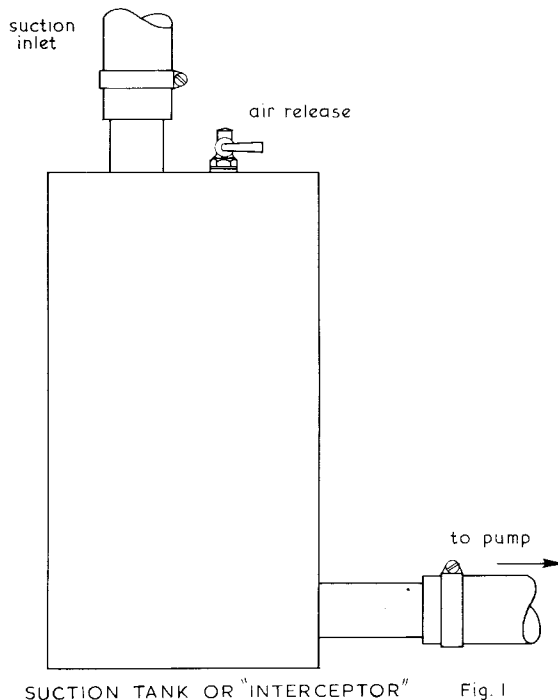
Two years ago this pump was adapted to feed the house tank from the lower spring. It was only *just* master of the work and this leads to my first point. A centrifugal pump works by first endowing the water with kinetic energy by whirling it round in the rotor. This kinetic energy is then converted to pressure by slowing it down again in the casing (Just like the working of an injector). This conversion can only be fully effective if there is a *flow* of water and when the pump starts up with all pipes already full it must first overcome the pressure (or "static head") of the column of water in the pipe.

There is a maximum head above which a pump will not start the flow, and this depends, amongst other things, mainly on the diameter of the impeller and the running speed (I'll come to this again later). My pump would "start" at 20 ft. head; but the water in the tank was 23 ft. above it! So, how to get the water moving? I used the easy way. The water from this source comes out of a bit of pipe emerging from the hillside, so we have to use a bucket to suck from.

Let the bucket get full, start the pump, raise the bucket, water, suction pipe and all, as high as possible till the pump starts the water moving, then smartly lower it under the spout again. Once the water starts flowing the conversion of energy in the pump casing was enough to give the extra 3 ft. of pressure required. Naturally, working at this head the flow was very small, but then, so was the supply, and in fact the main problem was to stop the pump from emptying the bucket and so having to be re-primed and the whole business done all over again. This was solved by fitting a G-clamp to the discharge hose and using this as a fine control valve.

Well, that was fine, but very tedious, so a larger pump was obtained for such emergencies. (The grape-vine tells me that the current sunspot maxima for the next few years are going to be real snorters, and this *appears* to be favourable to droughts). The snag now was that, even with some throttling, the pump was more than master of the flow (about 26 gallons per hour is available), and to avoid the stopping and starting problems I have mentioned, over priming etc, a "self-primer" was made up out of a can that was lying around in the workshop. Fig1.

The tank should be such that it holds at least ten times the volume of water in the suction pipe. When



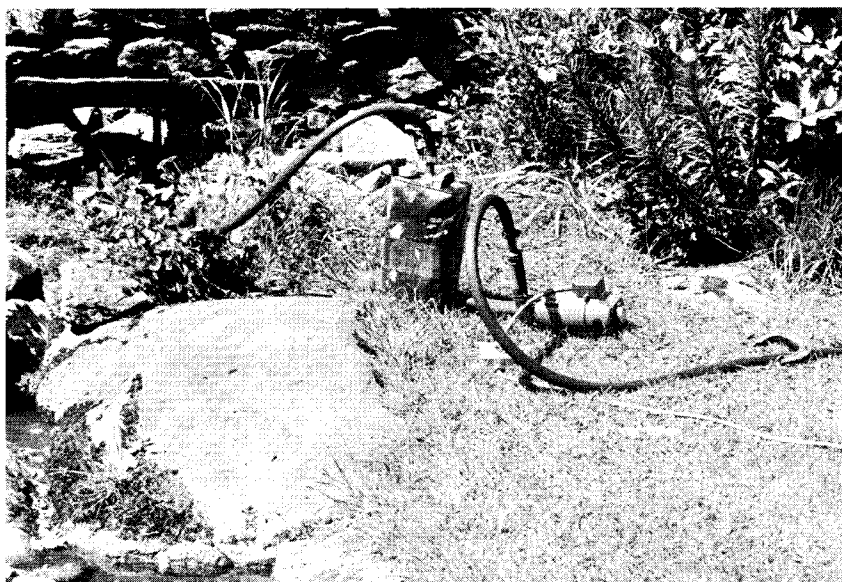


Fig. 2. Left. The pump and interceptor in action. The top cap is unscrewed a little to let air out.

Fig. 3. Below. The low level spring, delivering into an old 10 gallon cistern. Flow 26 galls./hour.

the pump is stopped, water runs back down the delivery pipe, fills the tank and, unless you have a foot valve at the end of the suction, will all run out of the suction! *With* a foot valve it will not, though you may have to fit an air-release valve on the tank. Now start the pump. It sucks water from the can, reducing the pressure, so that water is drawn up the suction pipe into the tank, and the pump then runs normally. You can see the thing in Fig.2, but I would advise a more robust vessel than this one, which bulges in and out alarmingly! Fig. 3 shows the suction under the source of water.



Now, there is a phenomenon that causes a lot of difficulty when using small centrifugal pumps. The outfit runs fine for a while, then starts to "gasp" and finally stops delivering, even though there is water enough in the suction tank. This is due to air, and I have this trouble in hot weather. Most water contains dissolved air, and under the conditions at the eye of the pump impeller, where the pressure is locally reduced due to the action of the vanes on the water, this air comes out of solution and "gags" the pump. It means that, every so often, one must let the air out; my pump has a 2 BA screw, which must be undone with the pump running — not right out! — till first air, then water bubbles forth. I'll be fixing a tap when I have time!

Naturally, most of you would rather make a pump than buy one, and castings for little pumps like these are available from our advertisers. So, a few hints. First, you must have the speed, and impeller diameter, sufficient to "start". Work out the static head (we measure this in feet-head-of-water, and 2.3 ft. is about 1 lb. sq. in. and call this "H". Then,

$$H = 0.0000003D^2N^2$$

where H in ft. D, impeller dia. in. N, speed in r.p.m.

(And to check, that is decimal six-zeros-three times D squares N squared)

Thus, a 2 in. rotor at 4200 r.p.m. will "start" at about 20 ft. head, but a 2½ in. rotor will start at 33 ft. — quite a big difference. Don't forget the suction head.

This is the "starting" head, but once the water starts flowing you will have to contend with friction as well. At the low flows I am concerned with, this is very small as the velocity is well down, but it can be far more than the static head when a pump is working at full flow. Work it out like this. Decide on the quantity, Q, in galls./minute. (This is usually given by the casting supplier; the Stuart No.1, for example, delivers about 100 galls./hour and the No.2 about 360 at typical heads) Then calculate the velocity in the pipe you are going to use in feet/second. The formula is:

$V = 0.49 Q/d^2$, where d is the pipe dia, inches. (Near enough you can say V equals Q over 2xd-squared!)

Then work out the ratio L/d of the pipe, (length

over diameter) taking care to measure both in inches or both in feet. In doing this you must add a bit for bends elbows and the like. Water doesn't like going round corners! Add 15 ft. for a normal bend, 30 ft. for a sharp elbow, and 30 ft. for a foot-valve. Call this ratio "R". Then, the friction head (to be added to the static head to get the load on the pump) is given by

$$H_f = V^2 R / 2000$$

Those of you who are hot on maths will notice that the loss varies as the *fifth* power of the pipe size — if you *halve* the pipe diameter the loss goes up 32 times! So, don't stint on pipe diameters! A good rule is to use a hose the same size as the pump discharge if its the "push on" type, or a size bigger if it has a union. Use the shortest and largest hose you have for the suction side.

Now you have to drive the pump, and these little chaps don't have a very high efficiency. The *minimum* power needed will be given approximately by:

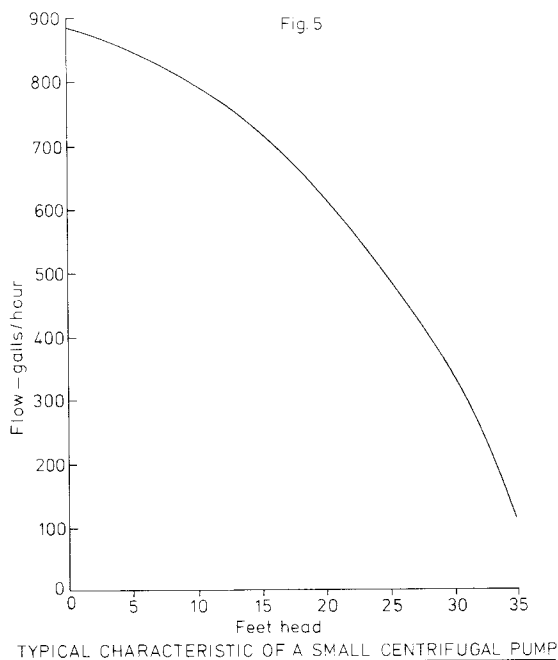
$$P = Q.H./1600$$

where P is in horsepower, Q in gals/minutes, and H is the sum of static and friction heads. You'll lose some power in the belt drive, too, and if you have a "stuffed" gland this is variable, as well, so allow a good margin. I would use ¼ h.p. even on the very smallest pump if it's to be used for serious duty.

I have mentioned "Footvalves" — merely a non-return valve at the entrance to the suction, to prevent you losing priming when the pump is stopped, or worse, losing all you have pumped if you forget to close the discharge valve! They are not essential, but highly desirable. They should be light — make the mushroom of plastic if you can — and at least twice the area of the pipe. More important in my view, fit a strainer round the valve. Tadpoles soon choke up a pump, and entrained grit will destroy it. This should have enough holes in it to offer at least 4 times the pipe area through them. Clean it frequently.

I must say a word about quantity control before I finish (Fig. 4 shows my fine control valve!) Centrifugal pumps as normally made have a head/flow

Fig. 4. The fine control valve!



characteristic as shown in Fig. 5. That is, as the head falls, the quantity discharged rises. Under no-head conditions the flow is a maximum. Now, this characteristic is a curve, not a straight line, and it means that the power required goes *up* as the head goes down. (The power required — again in a normal little pump — is lowest when the discharge valve is closed and no water is flowing).

You must keep this in mind if you decide to drive the pump with a series or "universal" (commutator type) motor, for with these as the power demand rises the speed falls, and we have the unfortunate situation where the motor must deliver maximum power at lowest speed. In other words, the risk of burning out the motor is greatest when the hose comes off the pump discharge! So, make sure all your hoses are well secured — jubilee clips and wire, to be safe!

Finally, before I go and have a bath — the pump has been running most of the day — a word about electrical safety. In the nature of things you are liable to get a lot of water about when a rigged-up pump is working, and hoses can leak as can air-release valves. Make sure your pump, switch casings, and junction-boxes are properly earthed; and if you have to attend to the "works" of pump or motor, ensure that all is isolated (Pull out the plug at the mains).

Many people use low-voltage supplies for their pumps and this is an excellent idea. Don't forget, though, that you must increase cable sizes accordingly. A 24-volt pump needs ten times the current needed by a "mains" driven one, and that means you should have at least 3½ times the diameter of cable. Good pumping! (Bet it rains tomorrow!)

A Versatile Dividing Head

Part IX

From page 891

George Thomas describes some accessories he made for his dividing head

Fig 8.1 is hardly an accessory; it is an alternative form of spindle for use with Boxford collets (Crawford No. 327) and, apart from the bore, it is identical to the standard spindle.

Screwed Nose Adaptor. (8.2). It will be seen that I made mine from two pieces of steel stuck together with Loctite. The largest diameter on the component is 1 5/8 in. and all that I had available in that size was a collection of short ends so one of these, of suitable length, was faced off, drilled, bored and reamed 11/16 in. The stem was turned between centres from 7/8 in. bar and the two parts fixed with Loctite. Next day the item was finish turned all over, using the original centres in the stem. Note the recess in the nose part; this is useful to accommodate a nut or screw as seen in Fig 9.1.

Reducing Sleeves. (8.3) These will be made to meet the anticipated requirements of the individual worker. My thoughts on the matter were: Bores from 5/8 in.

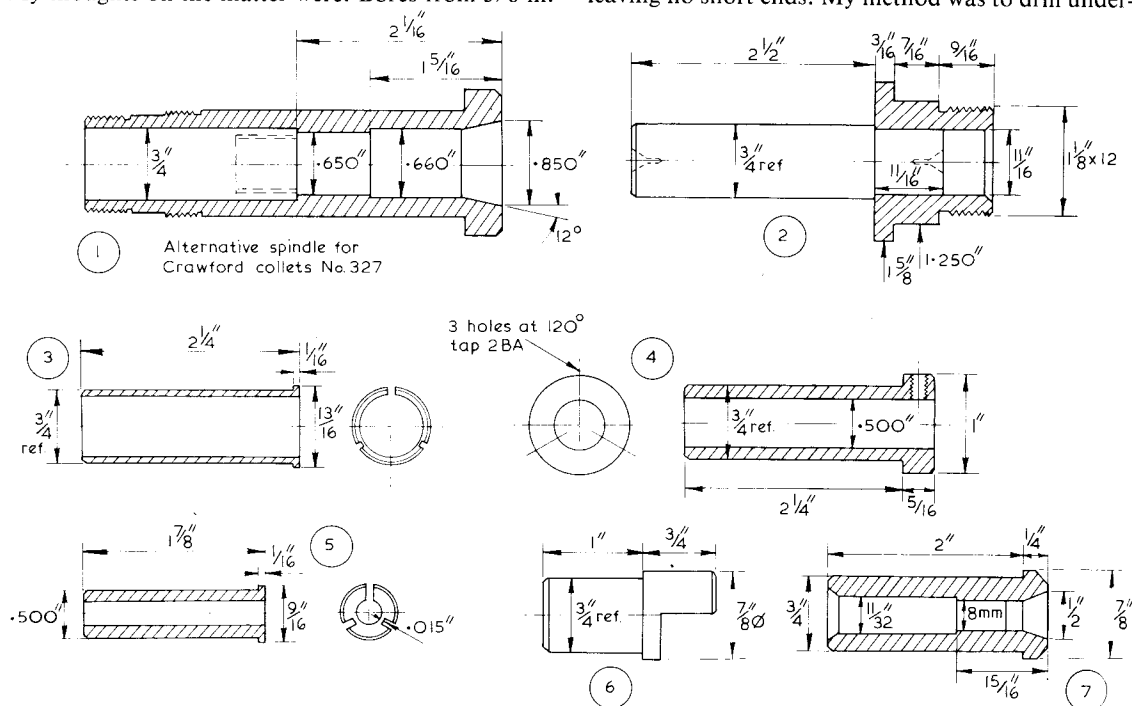
down to 7/16 in. at 1/16 in. intervals. Then introduce a master adaptor with a 1/2 in. bore (8.4) which would carry smaller sleeves down to 1/4 in. bore (8.5). For holding work smaller than 1/4 in. another master adaptor having a bore of 3/8 in. would serve down to about 1/8 in.

The two adaptors together with an assortment of sleeves have been made and are shown in one of the photos. (33). The turning is an elementary exercise in concentric turning and boring to size. The main problem experienced with these sleeves was the closing-in of the bore after slitting. This was due to the hoop stresses left in the material after the cold-rolling or drawing operations employed in the production of bright drawn bars.

When the wall thickness of the sleeve was fairly considerable it was almost impossible to force a piece of the correct sized material through the bore after slitting. The two secondary slits at 120 deg. apart effectively overcome the difficulty but they must be taken down quite close to the bore. In the case of the 3/4 in. O.D. sleeves the two partial cuts were taken down to within about .020 in. of the bore but it was found necessary to go rather further — to within .015 in. — with the 1/2 in. O.D. sleeves.

With very thin sleeves such as the 3/4 in. to 5/8 in., the secondary slits were unnecessary. When milling the slits, the two partial ones are cut first, the through slit being the last operation.

The large sleeves are turned from 13/16 in. or 7/8 in. dia. f.c.m.s. after cutting up sufficient material in lengths of 4 11/16 in., each of which will make two, leaving no short ends. My method was to drill under-



size, leaving sufficient for opening up, turn the O.D. to finish dimension, reverse in the chuck, turn the other end and then part-off through the middle. The bores were completed by holding the items from the outside.

This method was based on the use of Burnerd Super Precision chuck set to run true within one or two tenths true indicated reading. Without such a means of chucking accurately, I would turn, bore and ream each end in turn at one setting but the overall length of the material would need to be increased slightly to provide a "no-man's-land" of about $\frac{1}{4}$ in. in the middle. For those who would wish to work in this manner, and it is obviously the most accurate, the length of the blanks should be increased to about $4 \frac{7}{8}$ in.

If a reamer is used for final sizing, it would have to be a machine reamer which has only about $\frac{1}{16}$ in. of cutting taper on the end and has, usually, a M.T. shank.

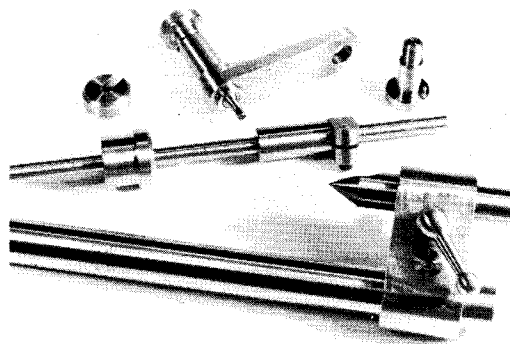
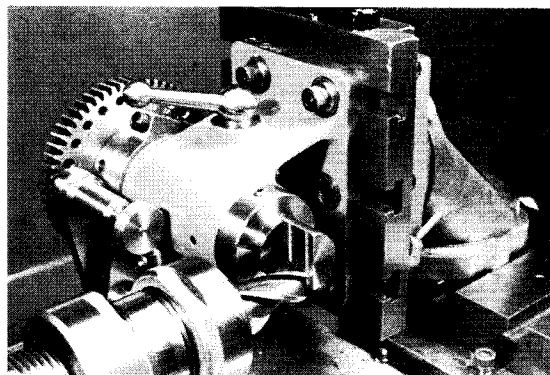
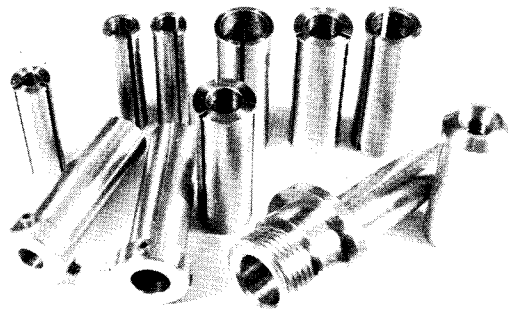
Next comes the simplest of marking-out. Hold the sleeves by about $\frac{1}{3}$ rd of their length in the dividing head and scribe three lines at 120 deg. apart along the accessible part of their lengths. If you have a centre-height finder like mine, you could use this off the bed with the dividing head sitting on the boring table.

After marking for the three slits, I would grip the sleeve endwise in a machine-vice, resting on a couple of parallels so that it stood sufficiently above the tops of the jaws to enable the cutter to pass through into the bore. (I described a set of "universal" parallels in the article "Setting-up Aids" in Vol. 143, pp 1000 and 1001).

One of the three scribed lines should be standing uppermost. Place the point of a scribe on a line and take a "square-on" look at it — you will soon have the line nearly enough "uppermost". Bring up to a $\frac{1}{16}$ in. slitting cutter and sight it to straddle the line, then, using a cigarette paper and the cutter revolving, raise the work until the paper is snatched — and visibly cut, note the readings and, after a simple "sum" you know how much to raise the table (the work) for the first slit.

Repeat for the second and then raise more for the third. Remove the burrs in the bore with a fine, small square file which will leave little chamfers along the edges of the slit.

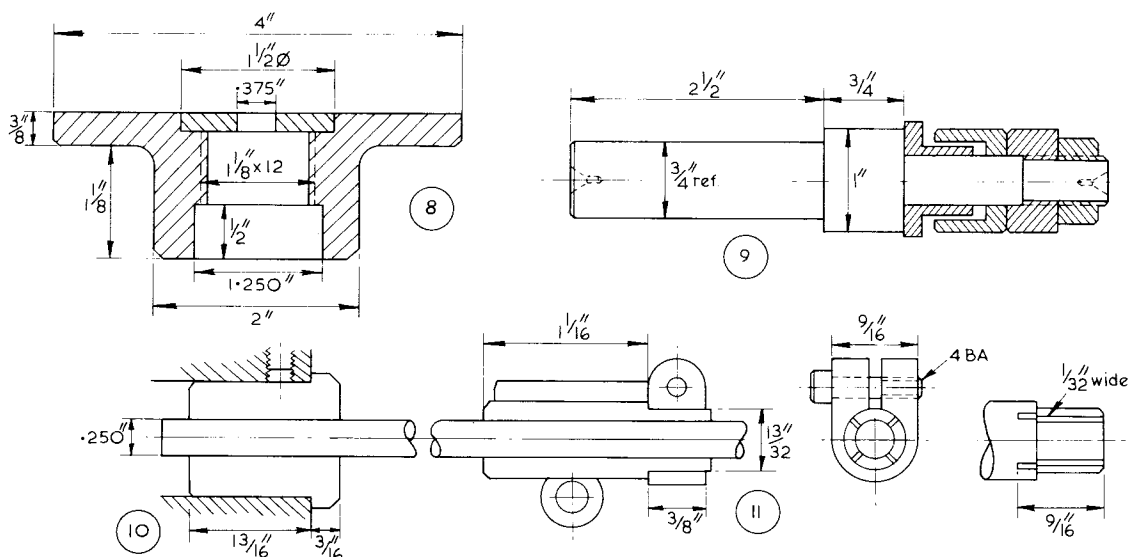
Centre Finder. The odd looking item shown at (8.6) is simply a short piece of $\frac{7}{8}$ in. b.m.s., turned at one end to a good fit in the bore of the spindle, the other end being milled away to leave a flat surface, the plane of which is dead on the centre-line of the spindle. This is used by slipping it into the bore of the spindle and, before nipping it into place, bringing the flat face upright by pushing on it with a square off the bed. When so set it constitutes a simple means of bringing the end of an end-mill or other cutter on to the centre-line as is required when making various kinds of cutters.



Top. Photo. 33. A collection of sleeves and adaptors. Middle. Photo. 34. Milling the centre finder, using the basic head. Lower. Photo. 35. The tailstock, aligning device and components.

The milling of the flat was done *in situ* with the dividing head mounted on the vertical slide on the back of the boring table as seen in photo 34.

The 8 mm. collet adaptor is shown at (8.7). As I have a considerable amount of 8 mm. gear which I



frequently use, this is very useful to me for small work. Used in connection with this is a plug for the back end of the spindle which reduces the bore from $\frac{3}{4}$ in. to a little over 8 mm. and the dimensions of this are such that one of my Lorch draw tubes can be used, thus saving the making of a special one although I shall have to do so later for use in connection with another 8 mm. adaptor to fit into the $\frac{1}{2}$ in. bore of the tailstock.

The adaptor (8.6) should be fitted with a key to match the keyways in the collets and this is most easily done by forming the key on the end of a fine-threaded grub screw made a close fit in a tapped hole situated about $\frac{3}{4}$ in. back from the front face of the adaptor.

Faceplate (8.8). This is turned from a light alloy casting and to simplify boring and screw-cutting for the Myford nose, the holes were taken right through. I made up several of these, both 4 in. and 6 in. several years ago for use as lapping plates having emery cloth glued to the surface. These were used on a special grinding head, the spindle of which was provided with a standard Myford nose.

I soon discovered that the adhesive used on the face found its way into the screw threads and caused no end of bother so I recessed the fronts and fixed discs of light alloy into them with Araldite, thus stopping the nonsense. For use on the dividing head (or the lathe) we want a true hole of some convenient nominal size bored in the centre. This provides the means for accurately locating work on the plate.

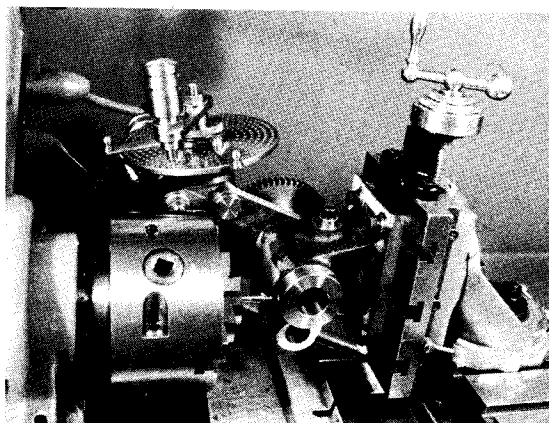
Turn the back first together with the bore and thread, drill a $\frac{1}{4}$ in. hole for a tommy bar into the side of the boss and then screw on to the lathe nose and finish turn the edge and front. Make the recess for the disc a fairly good fit but *not* tight; most of the adhesion will be provided by the outer periphery. Give

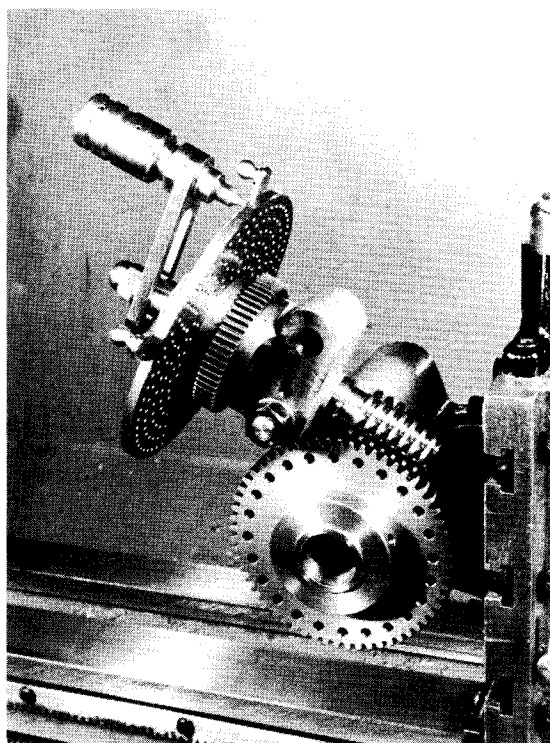
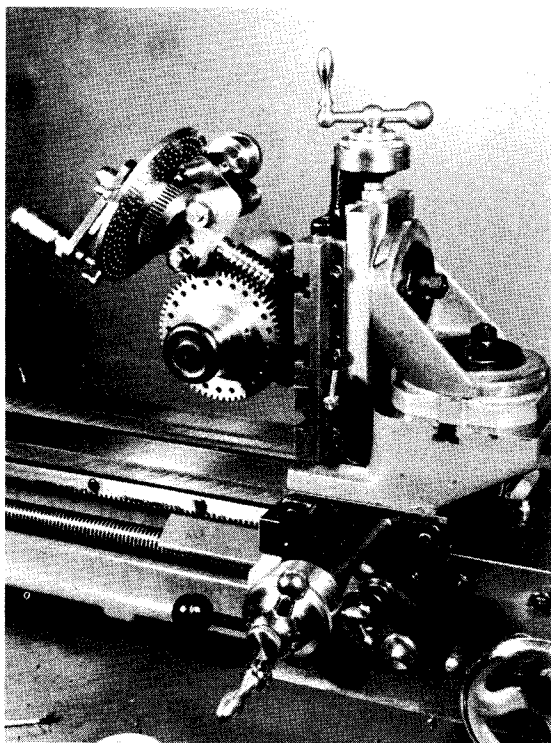
a final skim over the front and bore the central hole when the Araldite is firmly set.

The plate can be drilled and countersunk to take woodscrews; say, No. 6 (28 drill) or No. 8 (18 drill). A casting for this plate will be available but an alternative is the 6 in. light alloy faceplate for the Myford ML8 lathe; No. C1044 which costs around £5.

Stub Mandrel (8.9). This is of the same general type that I have used for a long time for turning work which has to be mounted from the bore. The whole spindle is turned between centres and the "work" end is made to some nominal size. On to this can be fitted short sleeves which increase the range of each mandrel. On the drawing I have indicated a flanged sleeve, a clamping collar, a spacer and a nut.

It will be obvious that when a gear having a special size of bore requires to be cut, all that will be needed for mounting it will be a flanged sleeve to fit an existing mandrel.





Above. Photo. 37. The head mounted on a vertical slide on the raised block. Above. Right. Photo. 38. The head with worm and plate but without micro attachment. Bottom Left. Photo. 36. The head used to mark its own punching screw holes.

As already indicated, these stub mandrels can be used, not only in the dividing head, but also in the lathe — held either in the chuck or between centres so that a gear blank can be turned on a mandrel which is then transferred to the dividing head for cutting without dismounting it.

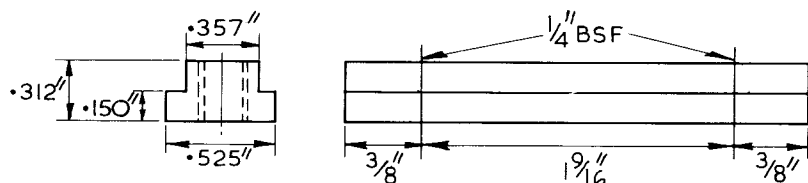
Tailstock Alignment Device (8. 11 and 12). The form in which this accessory is made was influenced by the desire to use it for other purposes. The essentials are:

- a reducing bush from $\frac{1}{2}$ in. to $\frac{1}{4}$ in. to fit in the tailstock;
- a bush to be fitted in the spindle and having an accurate $\frac{1}{4}$ in. hole truly in the centre and
- a $\frac{1}{4}$ in. rod which can be pushed through both the tailstock and the spindle bushes when the tailstock is in correct alignment.

Before I made it I realised that if it were made to the degree of accuracy that I was contemplating then its use would constitute a most searching test of much of the work that had gone before. The other use for it that I had in mind was as a reducer for the tailstock to take $\frac{1}{4}$ in. dia. runners for small work and so it was necessary to provide means for clamping the runners.

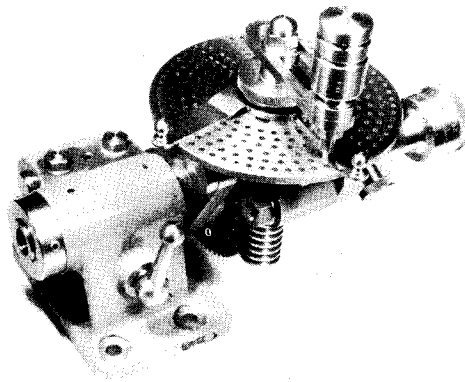
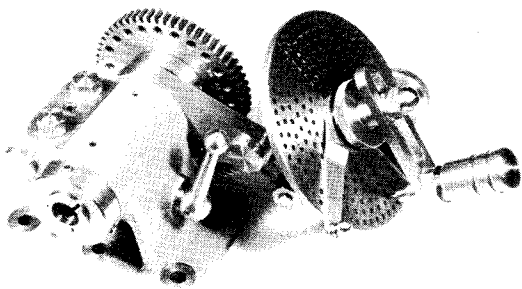
On Fig.8 is shown an assembly of the device together with a few details and dimensions. Once again, the essentials are close fits and concentricities. All parts were made to fit their mates with no clearance that could be measured or felt. Concentricities were assured quite simply by boring holes and turning O.D.s at one setting.

I was extremely lucky in that I had been hoarding up for the past few years a piece of treasure trove in the shape of a length of $\frac{1}{4}$ in. silver steel which was half a thou oversize. Where it came from I couldn't say but it is worth a guinea a foot! The two parts (10) and (11) were drilled $\frac{3}{16}$ in. followed by $\frac{15}{64}$ in., bored true to about two or three thou under $\frac{1}{4}$ in. and then reamed.



2 off as drawn
2 off with $\frac{1}{4}$ BSF
holes at $\frac{3}{8}$ crs.

12



Photos 39 and 40. The effect on the plate position of swinging the arm.

My machine reamer gives a hole as nearly as I can say .2504 in. dia. — a trifle too tight for the oversize rod so I lapped out the holes — just a few seconds with a light alloy lap and fine oilstone dust. It was with some feeling of satisfaction that I found that, on assembly, the probe slid into the hole in the spindle bush with the tailstock either close up or 3 in. away. This was the reward for all the careful work that had been put in. Small runners can be made from $\frac{1}{4}$ in. silver steel with male and female ends, either full or of half form. See photo 35.

Tee Bars are shown at (8.12). For the odd jobs and experiments that I have been doing I have used tee nuts for clamping the head down on to boring table or vertical slide but these are far from ideal for the purpose. There can be no doubt that proper tee bars as shown will save a great deal of time and will help to keep the blood pressure down.

As soon as one end is entered into the slot the bar can be pushed straight in; it cannot turn round, get out of line, or do any of the maddening things that can happen with short tee nuts — especially the second one which has to be manipulated into place under even greater difficulties. It is, of course, possible to slip the short nuts into the slots, hold up the dividing head against the face of the vertical slide with one hand and insinuate the screws into place with the other — chasing the nut which is in the slot where it can't be seen or got at . . . no, I prefer to have the screws in place in a pair of bars which can be slid into place without trouble.

The dimensions given on the end view are those taken from a tee bar made by Myford and they are slightly less than those I have used in the past.

Several photos illustrate some of the ways in which the head can be mounted on the lathe and also a few showing actual jobs being carried out. On No. 36 we see the drilling of the front collar of the spindle for the

three 2 BA screws. Note that the worm and plate attachment was in use because the index wheel had not then been drilled with its 24 holes.

The plate mounted on the head was the one which had been made by angular dividing on the drilling machines as described in Vol 144, p. 1134 (6/10/78) but in the absence of this I would have clipped a piece of steel having one hole in it to a blank plate as already described. It will be seen that the head is mounted on a vertical slide but it could just as easily have been set down on the boring table which would have given the correct height automatically.

Photo No. 37 shows the complete head mounted on a vertical slide which is, in turn, bolted to the Myford raising block (ref. 30/011) which increases considerably the capacity of the dividing head for larger work. With this set-up the centre of the spindle can be anywhere between $1\frac{1}{4}$ in. and $4\frac{1}{2}$ in. above the lathe axis and the front of the spindle nose can be 7 in. away from, and capable of being traversed right up to, the centre-line.

The black object at the end of the spindle is the hand-wheel of a Lorch 8 mm. draw-tube. When the vertical slide is bolted directly to the boring table without the use of the raising block its spindle can be adjusted between $15\frac{1}{16}$ in. below, and $2\frac{3}{8}$ in. above the lathe centre line and when the dividing head is bolted directly on the boring table without a vertical slide it can carry work 7 in. dia. when facing the headstock or $4\frac{1}{8}$ in. when placed at right angles to the axis. In photo No. 38 we see the dividing head without the micro attachment which would normally be removed and stowed away.

Photos 39 and 40 illustrate the manner in which the banjo arm can be used to bring the plate into the most convenient working position by merely swinging around the spindle and locking into place. There is further scope for adjustment by removing the attachment from the arm, turning it through 180 deg., and re-attaching it which leaves it pointing in the opposite direction. *To be concluded*

The Galston Valley Railway

by
R. Atkins



Allan Head and Max Russell checking fires before their runs.

OCTOBER 1973 saw the birth of the Hornsby District Model Engineers Society, 30 members elected Bob Farquhar as the first President. By December, the Hornsby Shire Council co-operated with a lease of 4 acres of land at Galston, some 20 miles northwest of Sydney, N.S.W., Australia. This land was sloping virgin "bush" and posed problems in designing a layout but, due to the initiative of the late Bob Cutcher, a circuit has been accommodated, retaining most of the trees and bush while taking advantage of the land contours to produce a scenic layout.

In 1974 a small exhibition was held to get the Society "on the map" and since then four exhibitions have been organised to finance the Galston Valley Railway. The nature of the land necessitated considerable earthworks apart from tracklaying, and they were the culmination of much toil and sweat. Stage 1, of the layout, i.e., the kidney shaped section was completed in 1976, including the steaming bays or "loco", zig zag access to the main line, sidings, station and footbridge, the latter commemorating Bob Cutcher with a plaque inscribed Cutchers Crossing.

All track is dual gauge $3\frac{1}{2}/5$ in. at ground level, all welded steel, rails $\frac{3}{4}$ in. \times $\frac{3}{8}$ in. on sleepers 1 in. \times $\frac{1}{4}$ in., 10 in. long at 8 in. centres, jigs being used to produce track in 20 ft. lengths. Curves vary from 35 ft. to 45 ft. radius, while the ruling grade for Stage 1 is 1 in 50. Elsewhere it is 1 in 80, with Hilltop Station being 15 ft. above Stage 1.

The completed track will consist of a continuous circuit of 3000 ft. with 800 ft. of sidings and loops, and will have used up 8 tons of steel.

The "loco" has seven radial bays 10 ft. long with a 10 ft. turntable and a 12 ft. hydraulically-operated

lifting section for transferring heavy locomotives from transport to track. Each bay has a low-voltage supply for blowers, also a water point, with other water points being located near the station. From the steaming bays, locomotives travel down to the main line via the zig zag, losing 6 ft. in height in the process.

The 240v. a.c. electrical supply is transformed to 32 and 12v. for station and other lighting, whilst a rectified supply at 12v. d.c. is provided for the colour light signals, these being interlocked with the points, all cables being underground. Cuttings have train-operated "caution" signals where visibility is limited, with catch points protecting the main line from the station. The signal box is fitted with an illuminated track diagram.

Locomotives and trolleys are privately owned, the latter varying from 5 to 8 ft. in length and having sprung bogies. These will normally be housed in the "carriage shed" under construction at the rear of the Club House, the latter having kitchen and toilet facilities plus general storage space.

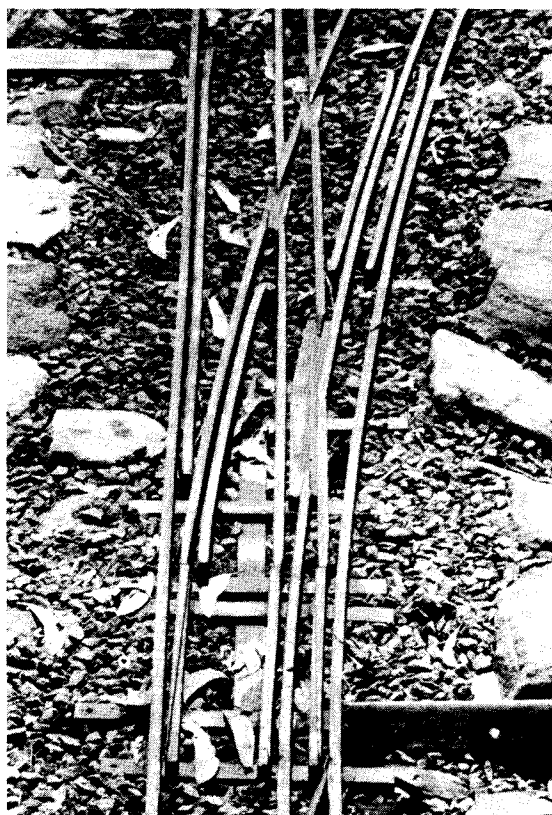
The Society became registered as a Co-operative in 1977 and is affiliated with the Australian Association of Live Steamers, a body concerned with standards. All steam locomotives using the track must have boilers which comply with the relevant Code of the Australian Miniature Boiler Safety Committee and two Society members, Jim Martin and Arthur Gee, have been appointed Boiler Inspectors.

A Board of Management member Ian Hoerlein edits and distributes the quarterley Galston Valley



Left. Bob Farquhar's 5 in. gauge 2-4-2 sugar cane loco Pauline approaching the girder bridge over a storm channel.

Below left. The foot-bridge at Cutcher's Crossing.



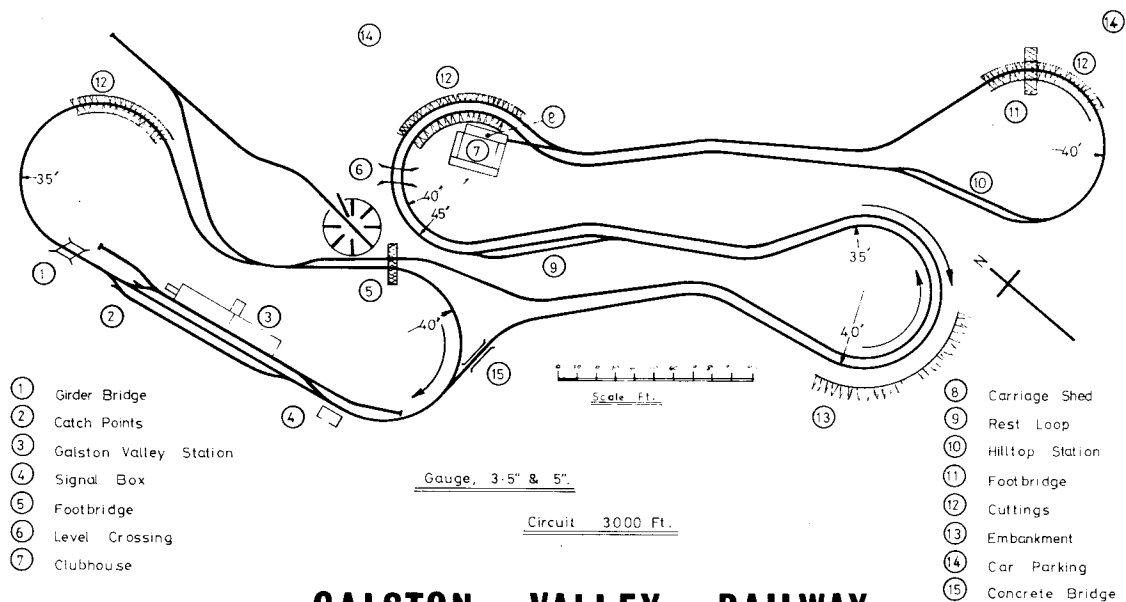
Above. A close-up view showing the typical method of dual gauge point construction.

Above Right. Galston Valley Station with the signal box at right and ticket box at left under construction.

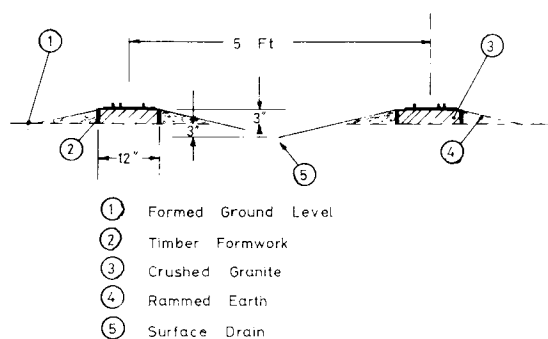
Right. The steaming bays.

News to 80 members and each month there is a general meeting two work days and one running day.

Last year's highlight was a "Steam Bonanza" which was held in perfect weather on the 12/13 August. Six trains were in continuous operation from 10 a.m. to 5 p.m. each day, barely coping with the large crowds which arrived due to press and radio publicity. 2000 adults paid for admission and over 2000 rides were given to youngsters from 6 to 60. In addition to train rides, there was a static display of models under construction, together with a group of stationary engines running on compressed air under the watchful eyes of Don Payne and Jim Martin, with the latter's "electrically fired" boiler, engine and pump running throughout. The ladies did a magnificent job dispensing refreshments and a good time was had by all.



GALSTON VALLEY RAILWAY



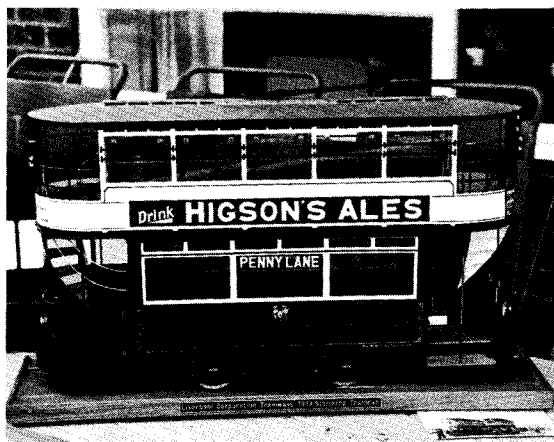
TRACK DIAGRAM



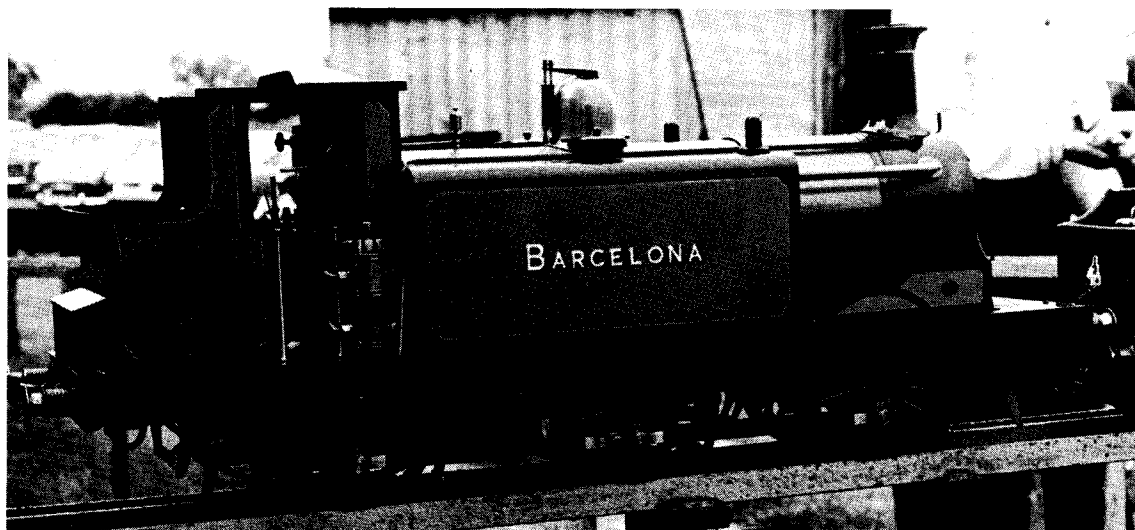
THE SOUTHERN FEDERATION RALLY BEDFORD 1979

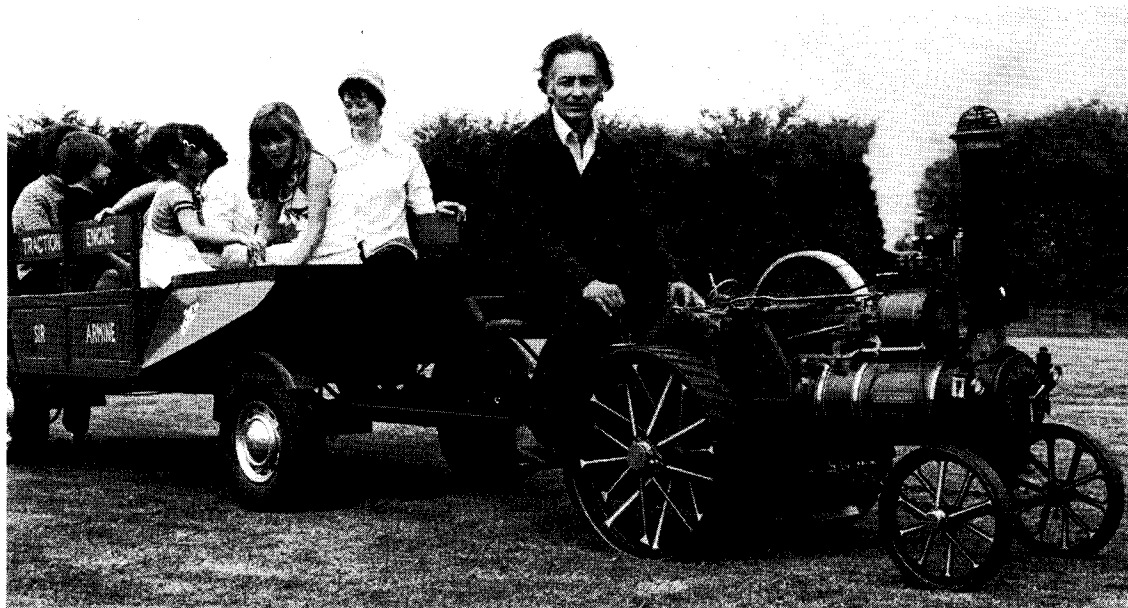
Reported by D. E. Lawrence

THIS TWO DAY WEEK-END RALLY attracted a very good turnout. I went along on the Saturday, when the sun shone and found our hosts, the Bedford M.E.S. had organised everything very well. As is now usual, the catering was in the capable hands of the helpful ladies of the club who looked after us very well. Running on the track went on until late evening and a large compound was used for two 4½ in. scale traction engines towing trailers for the kids to have rides; smaller engines also displayed their prowess. The Saturday ended with a barbecue and I am told (I had to leave before this) that everybody enjoyed that hugely. Unfortunately, Sunday was afflicted by a lot of rain, but still the visitors wrung (!) the most out of the day. The photos show some of the Saturday activities.

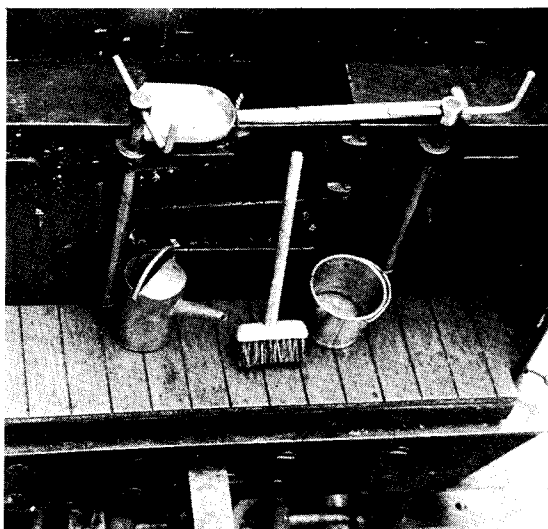
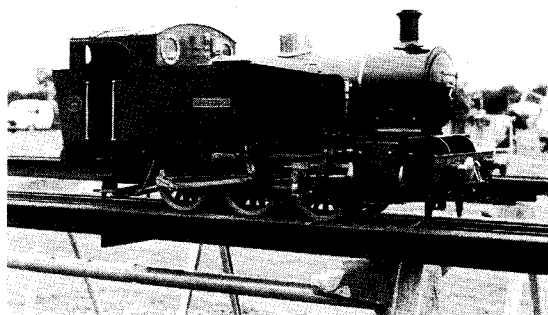
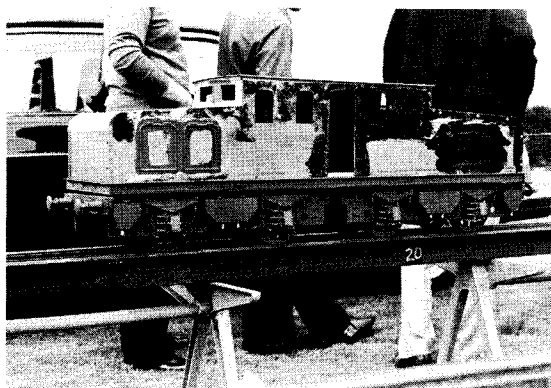


Above. The very fine ¾ in. scale tram by Leo Taylor of the host club. Below. Phil Hain's sturdy Brighton tank. Right. Federation Chairman Ray Milliken's wife Margaret is an accomplished live Steamer.





Above. Mike Hutt giving rides to the youngsters. Below. David Combes's ex-N.E.R. 5 in. gauge electric loco nearing completion. Right. A freelance 3½ in. gauge 0-6-0T by David Edgeley. Bottom Right. Les Nelson's fully-equipped tender!



Club Chat

What an interesting idea — a Model Engineering Seminar. This was organised by the Chingford Model Engineering Society on Saturday 5 May 1979. At a very modest "registration fee" we enjoyed coffee on arrival. Then Peter Dupen spoke on his garden railway, Phil Hains on steel boilers, a fine buffet lunch, Bill Carter on his *Dukedog* project and Laurie on tips to make locos go better. Some thirty "Advanced" students attended from a varied cross section of other local model engineering societies.

TILEPITS RAILWAY — Peter Dupen

Peter explained that he moved to his present house about 7 years ago and decided to build a 7/4 in. gauge ground level track in the sloping garden. Previous experience with steel and rust made him choose alloy rail and the plan is for 1100 ft. of track connecting two loops by a single main line. The house loop connects with the station, stock sidings and engine shed. The single line then rises 1:42, 1:33, 1:30, 1:60 to reach a 90 ft. long viaduct at the summit. Then the line drops 1:50 to the final curve which bottoms with 1:75 to a short 5 ft. level section, then up again. When complete, the circuit will be a good test of engine and driver.

Motive power is by Peter's dock shunter *Midge* with passenger cars on long wheel based wagons, all of which can follow the 32 ft. radius curves. With the considerable inclines and seasonal temperature changes the track started to move down the slope to the station. A satisfactory solution was found by installing tie bars between sleepers and a 1 in. dia. steel bar set in the track bed. Two such anchor points have stopped any movement.

The drawings and description were most interesting and the 5 feet high brick viaduct will be a thing of beauty and a fitting artifact to Tilepits Railway.

STEEL BOILERS — Phil Hains

Phil spoke on the subject of steel boilers, having built a 4½ in. scale traction engine, several 7/4 in. gauge *Highlander* boilers, a 5 in. gauge *Simplex* boiler, a *Mountaineer* boiler and is now well on with another 3 in. scale traction engine boiler. He certainly speaks with experience, and said that he has given up copper boilers as too expensive and difficult. The larger jobs did not prove much more difficult as long as the work is taken stage by stage. Trimming the plates takes time and a band saw is essential; thicknesses vary 3/16 in. general boiler plate, ¼ in. for firebox, 5/16 in. tube plate and 3/32 in. wall thick fire tubes. All joints are electric welded and Phil mentioned that welding is an acquired art. He gave a fascinating demonstration with a sound recording of the 'Splashing' sound of the correctly adjusted arc. Fire tubes are expanded into tube plates by a special taper roller set which gives a carefully controlled even pressure. Manholes and mud holes are most important with steel boilers and sealing is by rubber and graphited jointing. For water treatment the proprietary liquid 'Descalant' has been found very effective.

For the traction engines Phil used a kit of parts and explained that the drawings supplied required careful interpretation, nevertheless when built the boilers steamed well. However, this type of construction is not for the novice.

THE DUKEDOG PROJECT — Bill Carter

After the *Atlantic* what next? Bill Carter said that he wished to model an existing prototype so it had to be one of the preserved locos. It had to be available for detailed checking and not a general example of the class, but an authentic model of a prototype. Such a subject, a G.W.R. *Dukedog*, is preserved on the Bluebell line. Makers' drawings are available but they often obscure modifications which may or may not apply to a particular engine. They give a useful

guide and often show anomalies. Bill discovered such a difference on his example, there were two distinct designs for the valve gear links. The model will faithfully include this difference.

On the subject of bearings Bill emphasised the need for care in the choice of correct material, the *Dukedog* will have cast iron wheels with mild steel tyres shrunk on. Cast iron greatly reduces the adhesion of wheel on rails. The cylinders will have cast iron liners but otherwise be built up. The difficulty with fabrication will be overcome by first facing the cast iron with sif-bronze and then using silver solder.

The reverser was shown with its four start 3/16 in. dia. thread, which was screw cut with the tap cut at the same time. Production of connecting rods will take a month each, being cut from 1 in. square bar weighing about 13 ozs. The final rod when finished will weigh only 3 ozs. Balanced slide valves are used so proportioned that the thrust on the valve seat is only 20 per cent of an equivalent non balanced valve.

Altogether the description of the work, the methods used, the close attention to detail and finish of the model shown on the table took the audience's breath away. Like the *Atlantic* the model will be a wonderful record of a highly successful engine design.

TIPS ON MODEL LOCOMOTIVE RUNNING —

Laurie Lawrence

Laurie showed his 3½ in. gauge 2-8-0 UNRRA Liberation Class model which demonstrated several practical tips to help running. The smokebox was shown to slide off leaving plenty of space for cleaning. The blower has 4 jets inclined 4-5 deg. inward and these were found to be most effective in this position. Top water feeds were recommended and were served by two injectors each served by pipes with shapely bends, essential for reliable operation. It is difficult to put in the pin in the coupling bar between engine and tender. This, Laurie has overcome by rounding the bar and making the socket V-sided so the bar and holes are lined up automatically. Safety valves are important items and Laurie uses stainless for the main body with carefully turned seats. There must be plenty of space above the valve to allow the surplus steam to get away. The design and size of safety valves is not straightforward.

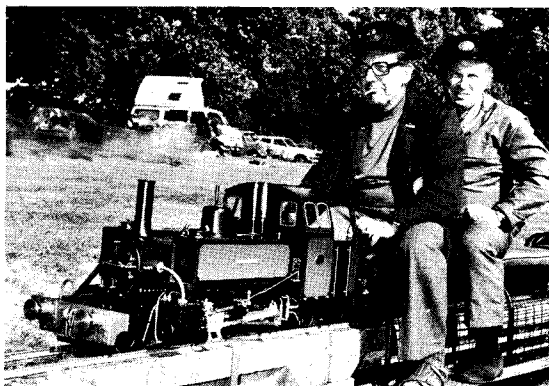
Laurie showed by using references i.e. Fowlers Mechanical Handbook, Reed Manual of British Standards, Greenly's ABAC tables and a ten figure electronic calculator that he was still not clear on the final answer. I am sure we will hear more about this subject but suffice it to say that published practical designs have proved reliable with the majority of model engineers.

Question time gave a full exchange of useful experiences.

Altogether it was a most enjoyable day ably presided over by the Chairman of Chingford Society, Ron Manning, who was assisted by Mark Phillips.

Tom Mallett

Phil Hains driving his 5 in. gauge *Mountaineer* on the Maidstone track.
(Photo: Jim Ewins)



... for your BOOKSHELF

"Lord Carlisle's Railways"

by Brian Webb and David A. Gordon

Published by the Railway Correspondence and Travel Society and available from The Hon. Assistant Publications Officer, Dept. R, Rannoch, 72 Upper Way, Upper Longdon, Rugeley, Staffs.

Price £2.95 including Postage.

The Earls of Carlisle owned large lands in Cumberland on which there was much mining activity, and by the first years of the eighteenth century a waggonway system had appeared to link the coalfields and limestone quarries with Carlisle. This system developed into a railway run by steam power—the Lord Carlisle's Railways that are the subject of this excellent book. This work was originally started by the late David Gordon; on his death, it was continued by Brian Webb who also edited the book for publication. There are many photographs and maps illustrating the text, and the book will be found of interest to all those students of industrial railways, local history and industrial archaeology.

S.A.

"The Locomotive History of the London, Chatham and Dover Railway"

by D. L. Bradley

Published by The Railway Correspondence and Travel Society and available from the Hon. Assistant Publications Officer, Rannoch, 72 Upper Way, Upper Longdon, Rugeley, Staffs.

Price £4.50 including postage.

The second edition of a classic work which paved the way for the RCTS series on the Southern Railway constituents, this book has been revised and up-dated in the light of recent research since its original publication in 1960. Mr. Bradley has presented a comprehensive, yet clear, picture of the locomotive stock of this rather neglected railway company, emphasising the difficulties under which the locomotive superintendents Martley and Kirtley had to work. Also incorporated are a short history of the line, and details of locomotive liveries, numbering and the activities of Longhedge works. Well illustrated and produced, this is a book that can be recommended.

S.A.

"The London, Brighton and South Coast Railway" Volume III Completion and Maturity.

Published by B. T. Batsford Ltd., 4 Fitzhardinge Street, London W1H 0AH.

Price £7.95

The concluding part of this most comprehensive

account of the 'Brighton Line' deals with the years following 1870. The completion of the line, the introduction of the 'elevated electric' and improvements in operating are all covered here, together with a comprehensive index covering all three volumes. Most attention is given to the routes taken by the railway for its lines and the reasons for the improvements made in the 1870-1922 period. This is a history of a railway company, first and foremost, and the more usually-covered aspects of locomotive design and performance are not to be found in any detail. This is not to be regarded as an omission, but emphasises that the author has stayed closer to his title than the writers of many another 'railway' history.

S.A.

"AEC Builders of London's Buses"

by Alan Thomas and John Aldridge.

Published by Ian Henry Publications, 38 Parkstone Avenue, Hornchurch, Essex RM11 3LW.

Price £2.95

The Associated Equipment Company was one of the major builders of commercial vehicles in Britain and, at the same time, had an indelible link with London Transport which lasted for the whole of the company's existence. This slim monograph details the trucks and buses produced by AEC, from the X-type bus of 1912 to the Reliances and Marathons which will see out production at the Southall works, now that its closedown has been sanctioned by the Leyland empire. This book is an excellent introduction to the products of AEC and does not deal exclusively with its London buses, as the title might be taken to imply. Some of the AEC products rank with the world's greatest and would repay study by any of us, in particular the bus designs such as the Regent and Regal models and Routemaster, designed in conjunction with London Transport: as an AEC enthusiast, I hope this book will encourage a greater appreciation of this dying breed.

S.A.

"Great Western in Colour"

by O. S. Nock, illustrated by Clifford and Wendy Meadway

Published by Blandford Press, Link House, West Street, Poole, Dorset BH15 1LL.

Price £6.95

A pictorial survey of the G.W.R., with most of the illustrations in colour, the originals of these being watercolours based on, usually, old photographs. There are also a number of black-and-white photographs and some line drawings illustrating the typically O.S. Nock text. Not quite the greatest book ever produced on the Great Western, especially at the price, Keith Wilson will no doubt be horrified to see that 'show' is spelt in the present manner, and not in the style applicable to the old G.W.R.!

S.A.

Post Bag

The Editor welcomes letters for these columns. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

The Kenya and Uganda Garratts

SIR,—In his very interesting article on the locomotives of the 48th *Model Engineer* Exhibition, Mr. Dupen mentions the Kenya and Uganda Railway Garratts.

He has one or two details wrong — I was with that railway and its successor E.A.R. for over 14 years and know all their Garratts extremely well.

The E.C.3. was, as Mr. Dupen says, first built in 1939. Twelve locomotives were delivered and performed yeoman service — they averaged 200,000 miles before going to shops for general repairs. The Nairobi-Kampala caboose run (a through run with two sets of crews living in a specially constructed coach — called a “caboose” in East Africa) was started by this class of locomotive. This run was 550 miles each way and the locomotive was turned, watered and the fire cleaned at Kampala in the space of one and a half hours, thereafter coming straight back to Nairobi. Mileage of 8000-9000 miles a month were common — and this on a metre gauge railway with a maximum speed of 35 m.p.h. (at that time).

Eighteen further locomotives of that same type were delivered in 1949-50 since they had slight variations from the originals they were to be called the E.C.7. This never actually happened since a complete renumbering of all locomotives took place at the amalgamation with the Tanganyika Railways and the E.C.3. became the 57 class and the new class the 58 class. Both were 4-8-4 + 4-8-4 type. This class weighed 186 tons in working order. The 59 class were delivered in 1955-6 and were much larger machines. They were 4-8-2 + 2-8-4 type and had a tractive effort of 83,350 lbs. and a total weight of 252 tons. The boiler barrel is 7ft. 6in. diameter. Most of these engines are I think still working. They were capable of hauling the same load and at a greater speed (on the ruling gradient) than two of the 90 class diesel electrics. As a design the 59 class was quite outstanding and a fitting climax to the productions of that great firm. Beyer Peacock.

As regards the model, I am in agreement with Mr. Dupen's comments, but would add one further. The K.U.R. did not paint their locomotives — they were “blackleaded” and had brass numerals much larger than those indicated by the model. However, having said that may I congratulate Mr. Wardle on tackling such an immense task. I hope the model will exhibit the characteristics of the original!

Caterham, Surrey. R.M. Davies

I.M.L.E.C.

SIR,—I noted the Rev. Gibson's letter in issue no. 3592, 1-14 September 1978, with interest. I believe that it should not be too difficult to automate the measurement functions of the observer during the I.M.L.E.C. trials without too much difficulty. The crux of the matter is to convert the output of the force measuring device to numbers (using an analog-to-digital converter) and accumulate (add) the sample values over the duration of the run. The sampling clock could also accurately measure the time of the run. One sample every second should be more than adequate. Time spent stopped or backing up would not count as an almost automatic fall-

out of the technique.

I can see one potential difficulty, namely non-linearities in the output of the force transducer. These could be compensated for either by a suitable analog compensator using an operational amplifier or by a micro-computer suitably programmed. The microcomputer could, also, do timing and other associated tasks through program.

Unfortunately, I am not aware of the costs of the required integrated circuit components in the United Kingdom but they are quite cheap in North America. The task is certainly not beyond a reasonably skilled electronics or computer hobbyist and the required techniques have been well documented for years and are in constant use in all types of test work.

Ontario, Canada

John C. Bauer

The Late Charles Nobel

SIR,—I write on behalf of my Aunt who is 90, blind and a sister of Charles Herbert Nobel of Wigan, who died early 1967.

He did, I understand, at times contribute articles published in *Model Engineer*. During his life time he made at least three live steam models of British locomotives. My Aunt, for a long time has desired to know the present ‘homes’ of these, and visiting her on her 90th birthday, she told me of this wish. I should mention, that at the time of her brother's death she was much distressed, as only a week or so before, she lost her husband, and also soon afterward she also lost her sister. These shocks, at such short intervals, affected her eyesight. I believe, that the locomotives had been exhibited during the life time of Charles Nobel, but all traces of them have not come to light since his death.

It may be that some of your readers might be able to give some information as to their present location and if so, perhaps they could communicate with my Aunt, to whom any news would be a comfort. Her name is Mrs. Nan Jackson, and present address is Towns Knap, Mappowder, Sturminster Newton, Dorset DT10 2EH.

R. Jackson

Remote Control of Steam Locomotives

SIR,—I note with interest the letter in the recent *Model Engineer* referring to remote control of steam locomotives; I also note your comment about Gauge 1 activity in this field.

Since it is evident from Basil Harley that *Model Engineer* readers are not aware of this activity perhaps a few notes on the subject may be of interest?

There are at least seven Gauge 1 locomotives that are presently radio controlled, 4 of these are live steam, 2 are electric (but steam outline) and 7th is Bob Symes-Shutzmann's well known diesel electric Brush 4. The degree of control varies on the live steam models from simple throttle control to control of blower, drain cocks, valve gear and whistle. The two of these of which I have the most knowledge are my own “*Biggin Hill*” and Alf Conrad's splendid *Hudson 4-6-4*. Both these engines are designed around and totally dependent on radio control and both have justified the additional cost and effort in construction by their ability to “please the crowds” at exhibitions. It should be noted however, that these engines are gas fired, and that to date we are not aware of anyone achieving automatic stoking with coal firing. So far only two channels of proportional radio control have been employed, these being deployed in the following manner:

- Servo 1 Regulator, blower and whistle, by means of a rotating disc with groups of holes to give the desired steam distribution.
- Servo 2 Valve gear/drain cock control. The valve gear being activated by a separate electric motor.

To date, once the initial “gremlins” were sorted out, reliability has proved surprisingly high. In fact the only problems experienced during “public” running have been conventional mechanical faults (such as fibre washers disintegrating as they are wont).

I was pleased to see that Mr. Harley understood that radio control should be rather more than having a servo on to a throttle and expecting total satisfaction. Locomotives need to be designed and built around the concept, not just adapted. (The last statement needs rather more explanation than space and time permits.)

On the question of 'Telemetry', the current position is that we have not progressed beyond the visual observation stage, although I am in the process of constructing a locomotive with this as an objective. We currently employ the "Amsbury" electric water gauge (six Gauge 1 locos) so an easy adaption should be possible here, valve gear position sensing is relatively straightforward and pressure sensing electronically does not appear to present too many problems. I have sketched out a logic design which should be capable of transmitting the data to a hand held receiver and feel fairly confident of its practicability. Alas it may require greater skills than mine to actually implement it . . . you never know until you've tried . . .

In summary then about 50% of what your correspondent calls for has already been achieved, the other 50% is under way. For those interested, two articles have appeared in "Model Railways" on the subject (October 1976 and October 1978) as well as sundry notes and "Forum" write-up in the Gauge One Association Newsletter. If you find these notes fire your imagination (gas or coal) then write to Stan Roberts, (Sec. G.I.M.R.A.) 112 Clarendon Road, Broadstone, Dorset. For a pittance you can join the association and receive lots of goodies through the post in the way of Newsletters, book-numbers, constructional articles etc. covering every aspect of Gauge 1.

In conclusion I should add that radio control is presently a minority interest (some say "lunatic fringe" interest) but attendance and interest at the two Gauge 1 forums seems to indicate a growing preoccupation with this form of control.
Roquefort les Pins
Dick Moger

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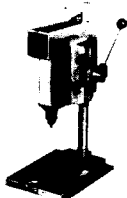
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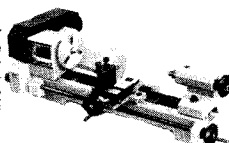
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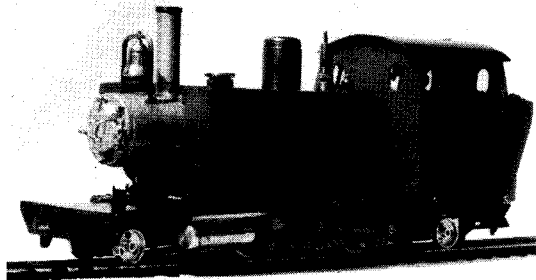
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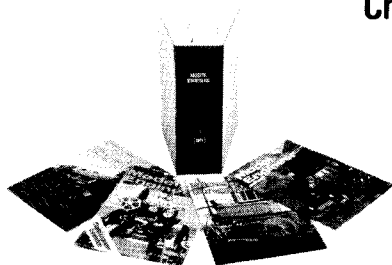
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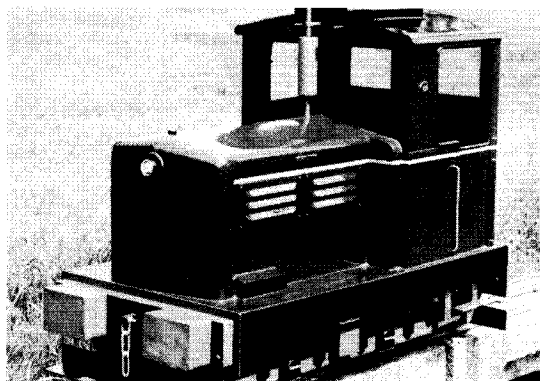
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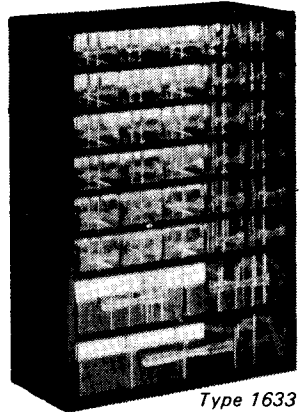
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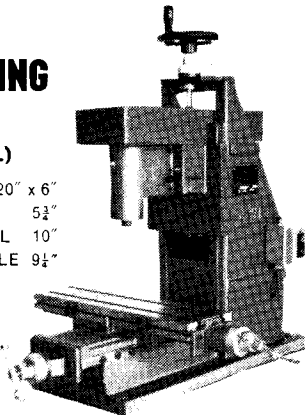
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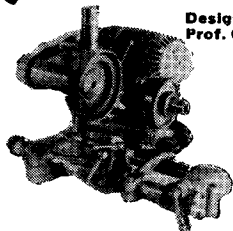
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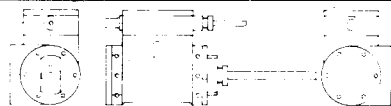
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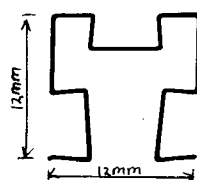
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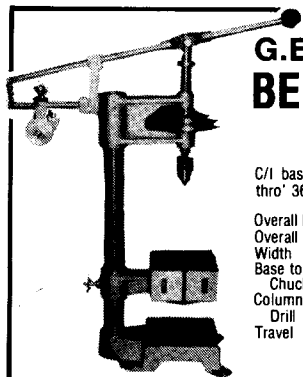
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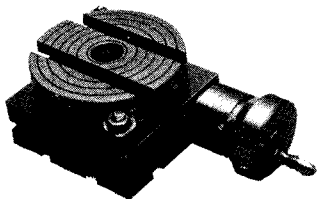
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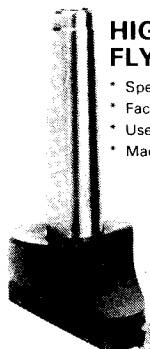
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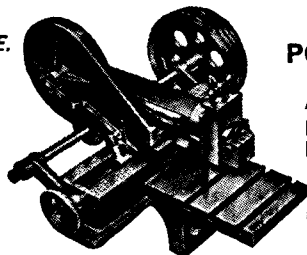
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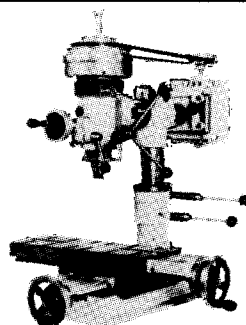
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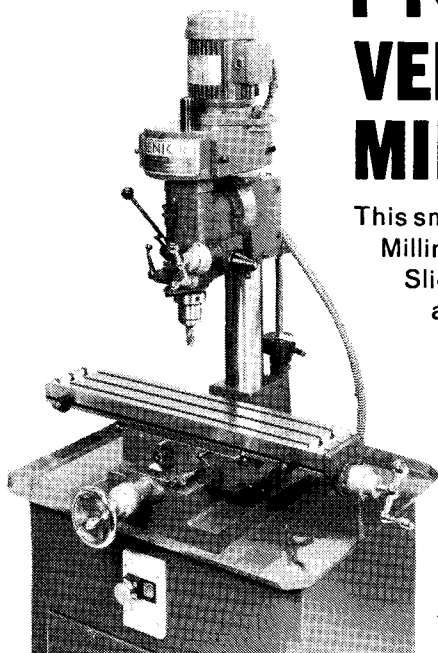
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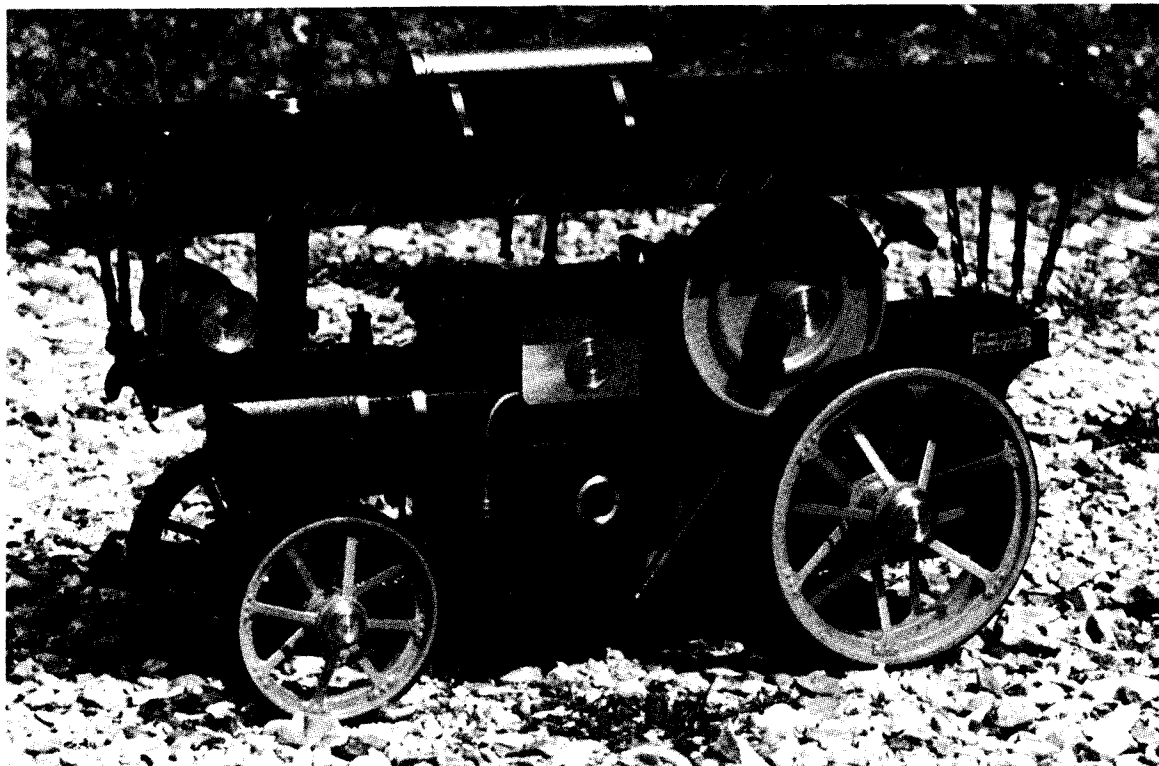
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