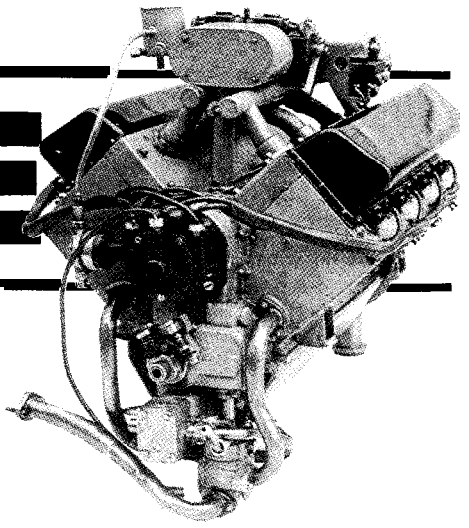
V8 ENGINE



Roy Amsbury describes and details the building of a 12Occ V8 i.c. engine which he developed for use with his 5 in. gauge Hymek locomotive. The engine could well have other traction applications ***Part IV, from page*** 47

Last time we had a very short instalment. As the camshaft is a major item, extra space has been reserved to deal with it in its entirety in this issue.

Camshaft

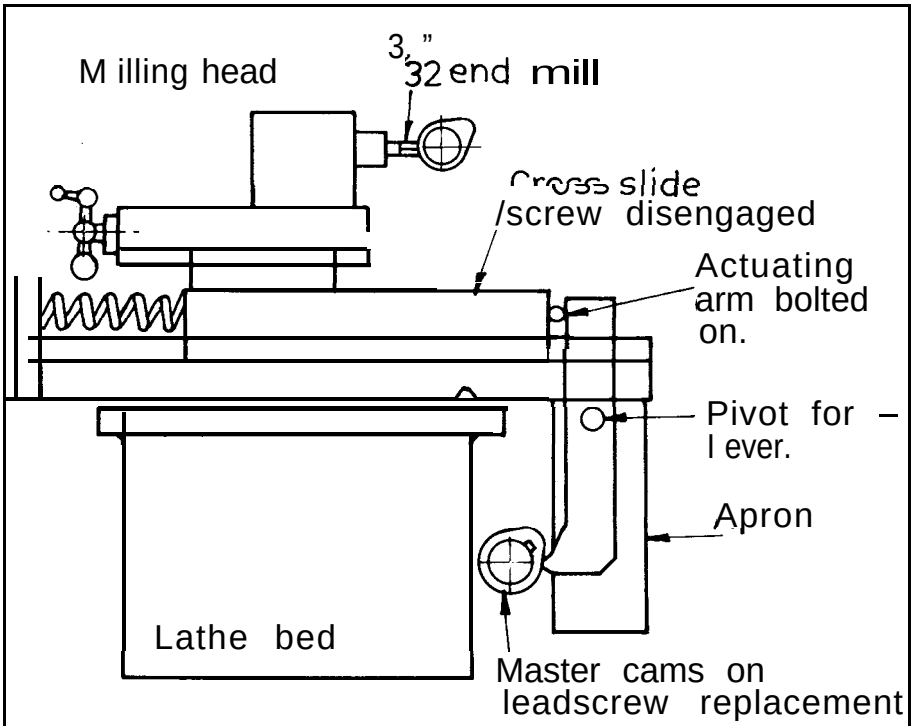
This is the trickiest component to make and 1 will describe the method that I used to make mine, other methods have been described in *M.E.* at various times. I used the lathe as a cam copying machine.

If you decide to go this way the first thing is to make one (or more) camshaft blanks -just a plain 9/16 in. bar centred each end and some two inches longer than finished size, the gear mounting features can be done when the cams have been milled.

As dimensional data for the lathe modifications would only suit my lathe a general arrangement of the layout is given. To use the lathe to copy the cams two master cams (one inlet, one exhaust) must be mounted on a temporary shaft in place of the lathe leadscrew. A lever is arranged between one of these and an arm fixed to the cross slide. This can be fitted on the top slide bolts as the top slide is not required. The cross slide nut must be disengaged and a stout spring fitted at the back of the cross slide to keep the arm in engagement with the above lever, so that as the lead screw revolves the cross slide is oscillated back and forth.

The cam is cut by means of an endmill mounted on the back of the cross slide facing end on to the camshaft blank. The lever pivot is on the side of the lathe apron (there was a convenient pair of bolt holes on mine) and should give a reduction between the master and working cams of at least two preferably three to one, the exact figure must be measured.

The slave leadscrew replacement will need a 1/8 in. keyway some 8-10 in. long to which the inlet and exhaust master cams are keyed at the same angle to each other as the final camshaft, i.e. 110 deg. A bracket will probably be needed to support the "leadscrew" close to where the cams bear on the follower. The follower is fitted with a fork bearing either side of a cam to move the cam along as the lathe saddle is traversed. The fork and follower can be lifted to engage the inlet or exhaust master cam. When you have decided how to apply this method to your machine you will need to make the master cams and this will need some graphical work. See Items 97 and 98. I cannot give exact dimensions for these as it depends on the lever ratio that you can use and the replacement leadscrew shaft diameter.

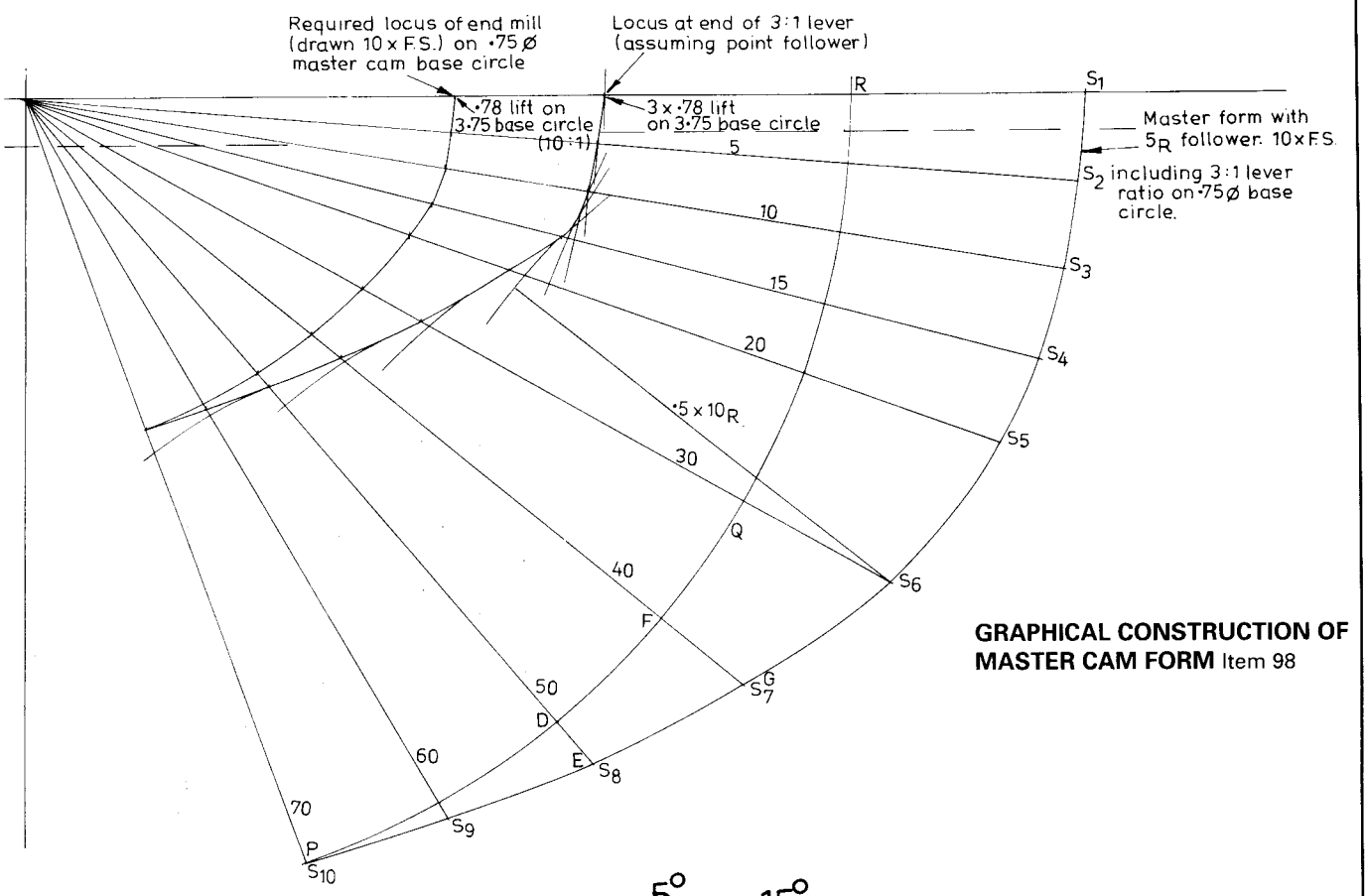


CAM COPYING ARRANGEMENT ON LATHE

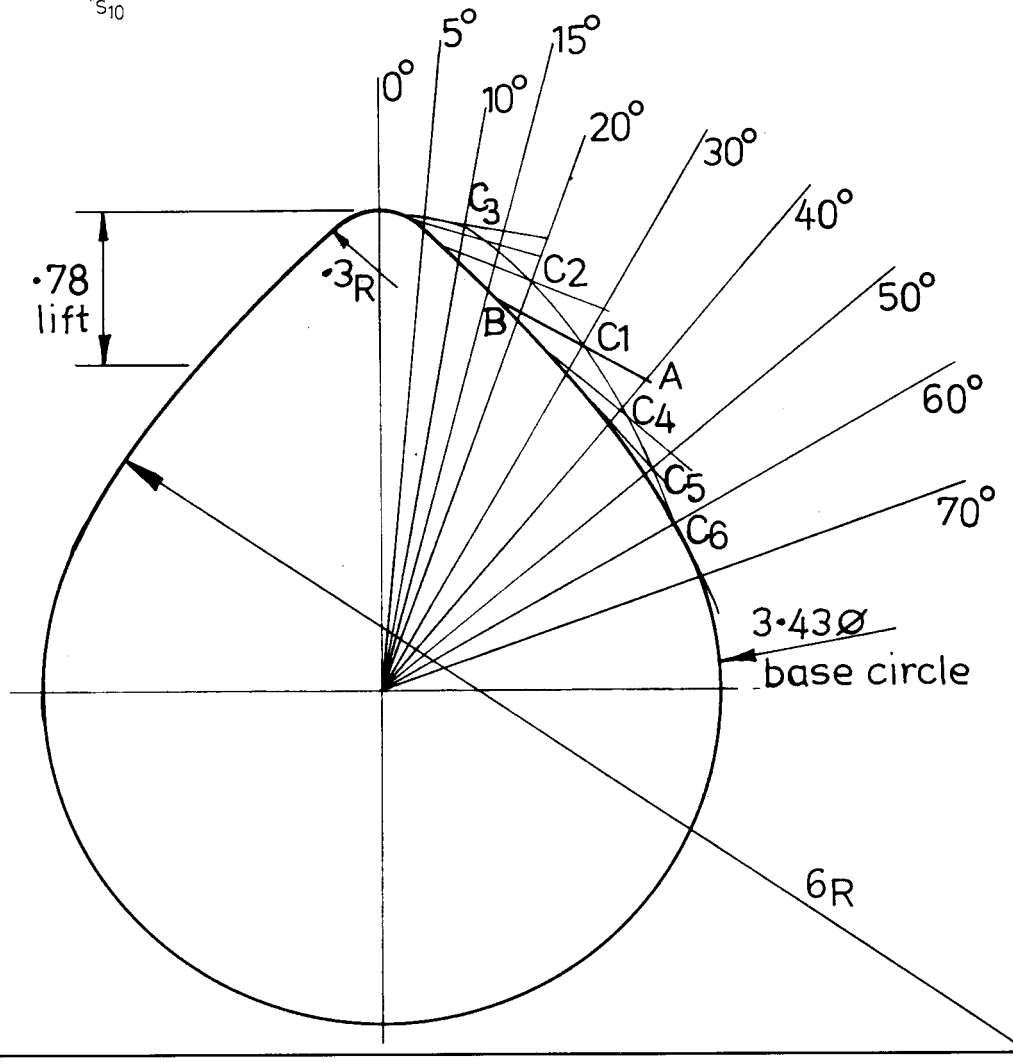
The first step is to draw the profile of one cam 10 times fullsize (or more) on large sheet of paper, and mark off every ten degrees over one flank of the cam (5 deg. if you wish to get higher accuracy). Now at each 10 deg. line draw a line A-C-B at 90 deg. to the radius of length 0.46in. (10 x cutter radius) each side of C and the end B touching the cam profile, repeat this for each 10 deg. radius (or 5 deg.). The line of centres C1, C2 etc is now the cutter locus required to give the cam form. Note: The cam lift starts at 60 deg., but the locus starts to lift nearer 70 degrees. Draw this profile out again separately but increased in radius at each point by the lever arm ratio that you can get on your machine – say 3: 1 and set it on the base circle of the master cam which will fit your leadscrew replacement (I have shown a 0.75in. dia. one for drawing convenience) but this will be too small for most machines. The master cam follower should have a radiused end – say 0.5in., so now with a compass set at 5in., at each 10 deg. radius line draw an arc to just touch this increased profile (it won't necessarily touch at the radius line). The line of centres S,, S2, S3, etc. is now the required form for the master cam at 10 times fullsize. Draw base circle P, Q, R and measure radii D, E, F, G etc., at each 10 deg. to give the cam form, dividing each by 10.

A blank is now turned up with the base circle marked on it and these increments and angles are very carefully marked out on its face. It can now be cut to size, bored to a sliding fit on the slave shaft and the locating keyway put in. A more accurate way is to mount it on a milling machine with a dividing head and take cuts every 10 deg. using the vertical traverse to set each radius value. This of course depends on your equipment but the cutter form also has to be taken into account by the same graphical method.

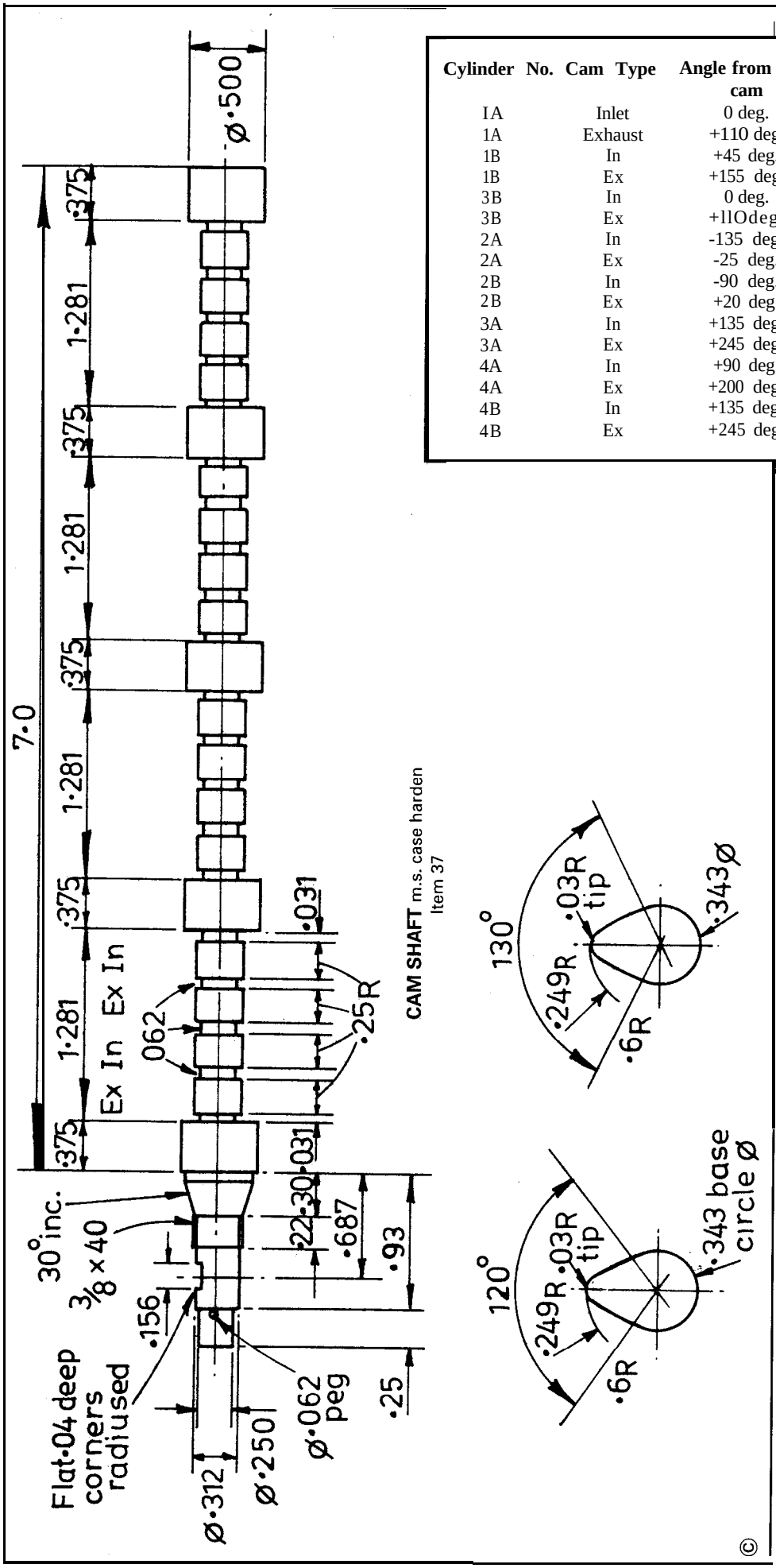
The second cam is done in the same way, but the keyway is put in 110 deg. from the first cam to give the correct angle between the inlet and exhaust cams in each case. The direction of rotation is clockwise



GRAPHICAL CONSTRUCTION OF MASTER CAM FORM Item 98



REQUIRED INLET CAM PROFILE 10 X F.S.
Item 97



Cylinder No.	Cam Type	Angle from No.1 cam	Position of cam pair down shaft	Cam No. from timing end
IA	Inlet	0 deg.	1	2
1A	Exhaust	+110 deg.	1	1
1B	In	+45 deg.	2	3
1B	Ex	+155 deg.	2	4
3B	In	0 deg.	6	6
3B	Ex	+110deg.	6	5
2A	In	-135 deg.	3	7
2A	Ex	-25 deg.	3	8
2B	In	-90 deg.	4	10
2B	Ex	+20 deg.	4 9	
3A	In	+135 deg.	5	11
3A	Ex	+245 deg.	5	12
4A	In	+90 deg.	7	14
4A	Ex	+200 deg.	7	13
4B	In	+135 deg.	8	15
4B	Ex	+245 deg.	8	16

at the timing end, so the exhaust cam must lead the inlet cam.

To set the various cams for each cylinder at the correct angles, an index disc calibrated in degrees for full circle if needed, I used one off my Quorn grinder. This was fitted by a suitable bush to the end of the camshaft blank in front of the lathe chuck. An index pointer was mounted from one of the chuck fixing bolts. Set it to zero for the first pair of cams, the following list gives the subsequent angular settings.

Cam Angles

Angle between inlet and exhaust cams is 110 degrees.

Starting at the timing gear end of the shaft (No. 1 cam) Bank A and rotation clockwise (+ve):-

The milling attachment that I used was quite small, powered by a 24v D.C. motor (W.D. surplus). It has to be fitted to a slide to give a radial cut adjustment, you may be able to use the lathe topslide for this – it depends on its design and bolting arrangements.

The lathe will have to be set to give a 1:l ratio between the mandrel and replacement "leadscrew" and the machine set to run very slowly, preferably in the range 3-5 rpm, not much power is required of course. After all the cams have been cut a thin flange will be left in between each, this can be filed off and the cam forms cleaned up with a fine file and emery paper, the remainder of the shaft can now be finished off, including the 1/2in. dia. bearing diameters.

The next job is to caseharden the shaft without distorting it. Put the shaft in a steel tube about 3/4in. bore and fill it with "Kasenit" or similar compound and put a loose plug in each end. Heat this to a red heat all over and keep it so for about 1/2 hour, then allow to cool slowly. When cold mount the shaft vertically on the drilling machine, with sufficient room underneath for a tall jar of water to bring up over the shaft. Start the machine rotating at a slow speed and with a good heat source – preferably an oxy-acetylene torch if possible, heat the lower end of

An experimental, and rejected camshaft made for the author's engine during the development work.

the shaft to a dull red heat, now gradually lift the torch and follow up with the jar of water – the rate will depend on how quickly the shaft can be heated to red heat, hence the need for a powerful torch, until one gets to the top. I have found this method quite successful in giving minimum distortion.

The shaft can now be tested between centres for any slight bend and can be corrected by gently pushing at the appropriate place with a piece of brass bar held in the toolpost. A final polish can now be given to the shaft.

If you don't wish to cut the gears, suitable steel timing gears are listed in Messr's Muffet's catalogue, the bores will have to be opened out to suit the various shafts and finally they should be case hardened. It is of course important that the gears are held true whilst the bores are machined – don't just stuff a drill down the bore! *TO be cont'd*

TRADE TOPICS

Steam Rollers

By Eric Sawford

Vintage Steam Album No.6. A4 Format. 36 pages. 77 photographs. Softback ISBN 0 907742 86 6. Published by Allan T. Condie Publications, 40 Main Street, Carlton, Nuneaton, CV 13 0R6. Price £5.25.

This album presents the reader with a really worthwhile varied view of almost the entire range of steam rollers built in this country since 1889.

The Robey Tri-Tandem – probably the ugliest conversion ever inflicted on an engine – is illustrated, together with the Aveling Shay *Drive* MLD, the Aveling

tandem single cylinder rollers, the Marshall and Aveling vertical boilered rollers and a host of other makes right up to the last steam rollers to be built, the Aveling Barford of the immediate post-war years, all shown in fine detail with captions.

Often neglected as a subject, Eric Sawford has done full justice to the steam roller and its development with his fine photographs and eye for detail. The list of British makers at the end of the book totals some 20 firms. J.H.

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Highland Railway Locomotives Book 2, the Drummond, Smith and Cumming Classes

By J.R.H. Cormack and J.L. Stevenson. Published by the Railways Correspondence and Travel Society. 174 pages, in hardback and obtainable from the Society's Hon. Assistant Publications Oficer at "Hazelhurst", Tiverton Road, Bampton, Devon, EX16 9LJ at £16.95; UK post free, Overseas plus 20%. ISBN 0 901115 72 X.

This is the third book to be published in the Society's *Locomotives of the L.M.S.* series. Following upon Book 1, *Early Days to the Lochs* by the same authors, this volume covers the Drummond, Smith and Cumming Classes of the Highland Railway, thus completing a history of Highland locomotives from 1855 to 1957, when the last locomotive was withdrawn from British Railways stock.

Following a short introduction, the locomotive classes described commence with the Small Bens, followed by a chapter on the 0-6-O Goods, the "Barneys", which includes speculation as to the source of the nickname and information regarding the bogie tenders, which six of the class received as built, but which were subsequently exchanged with the six wheel tenders of Small Bens and Big Bens.

There follows chapters on the Castles, the Shunting Tanks, Passenger Tanks and the Big Bens. The Banking Tanks and the ill-fated Rivers are covered in the next two chapters. A chapter is devoted to Snaigow and Dum, two locomotives built for the North Mails, between Inverness and Wick. The Cumming Superheated Goods 4-6-O engines are next described, then, finally, the Cumming Clan Class 4-6-O locomotives – the last engines to be built under Highland auspices.

In common with RCTS policy, as well as giving the specification for each class of engine, detailed histories are given of each individual engine within each class.

A series of eleven Appendices follow the chapters dealing with individual classes of locomotive, which include the Duke of Sutherland's second engine, and Drummond's projected designs, illustrated by a number of engine diagrams which happily have been unearthed. Here we have an unfortunate misprint, the diagram of the proposed Small Ben on Page 148 being dated 1989 instead of 1899. Among other items included in the Appendices are details of engines on loan to the Highland during the 19 14- 18 War, Highland Rly. engine allocations at July 19 19 and the Locomotive Stock at 3 l December 1922.

The book is well illustrated throughout by photographs, the majority of which are of remarkable clarity and is marred only (once again) by the lack of a comprehensive index. Apart from this, it is well researched, to the usual high standard of the RCTS and is highly recommended to all locomotive enthusiasts. D.G.M.