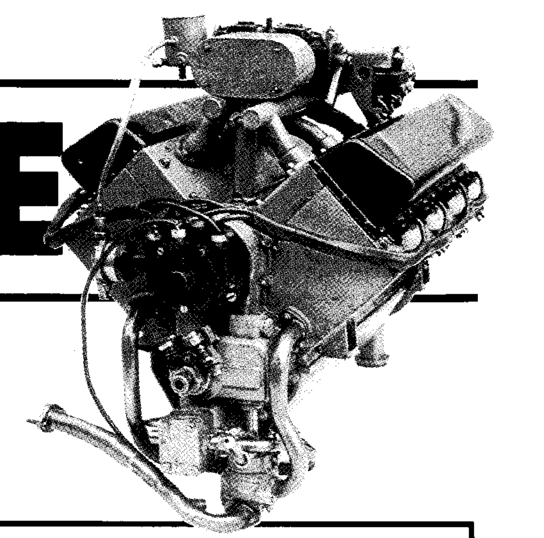
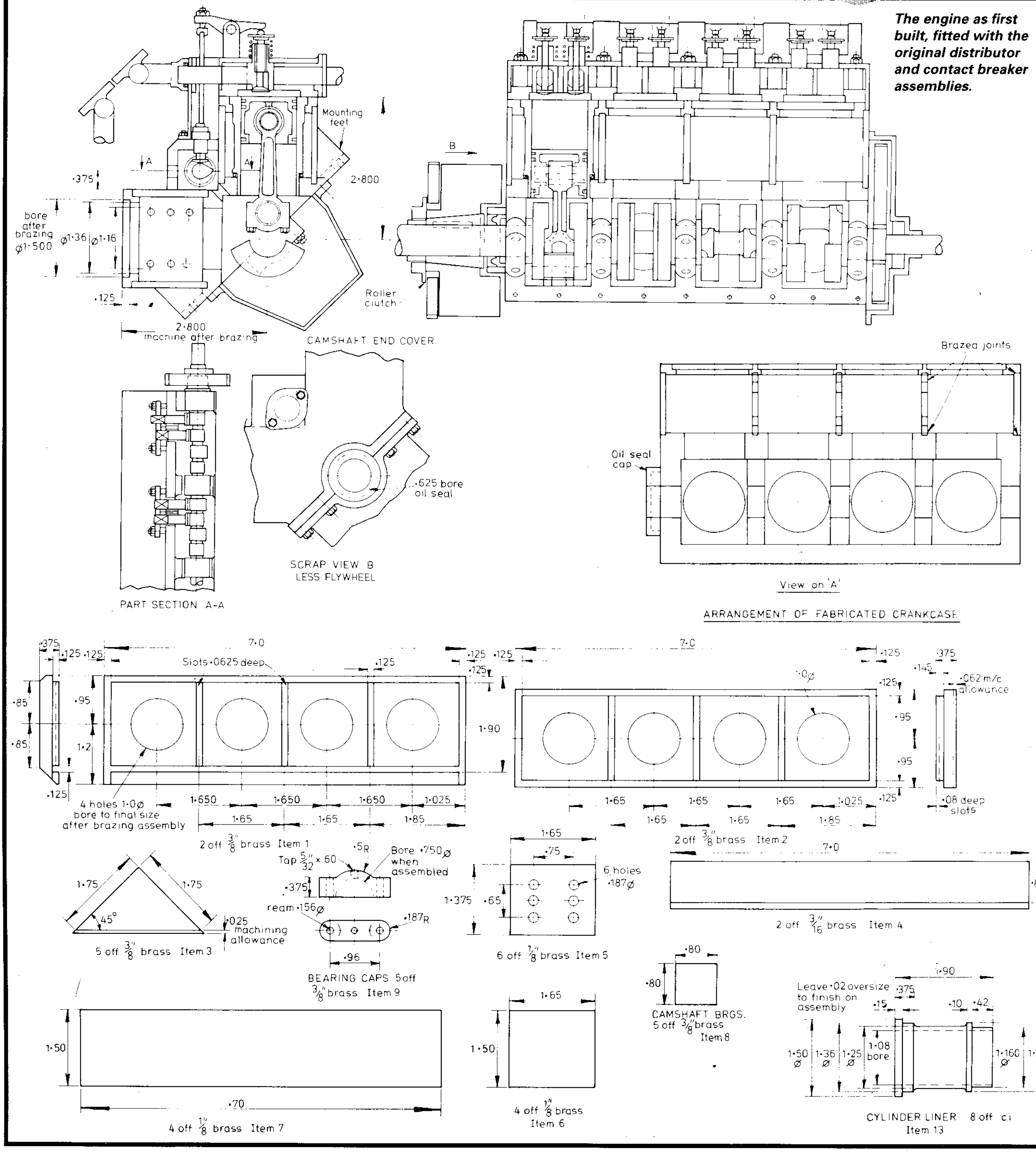
V8 ENGINE



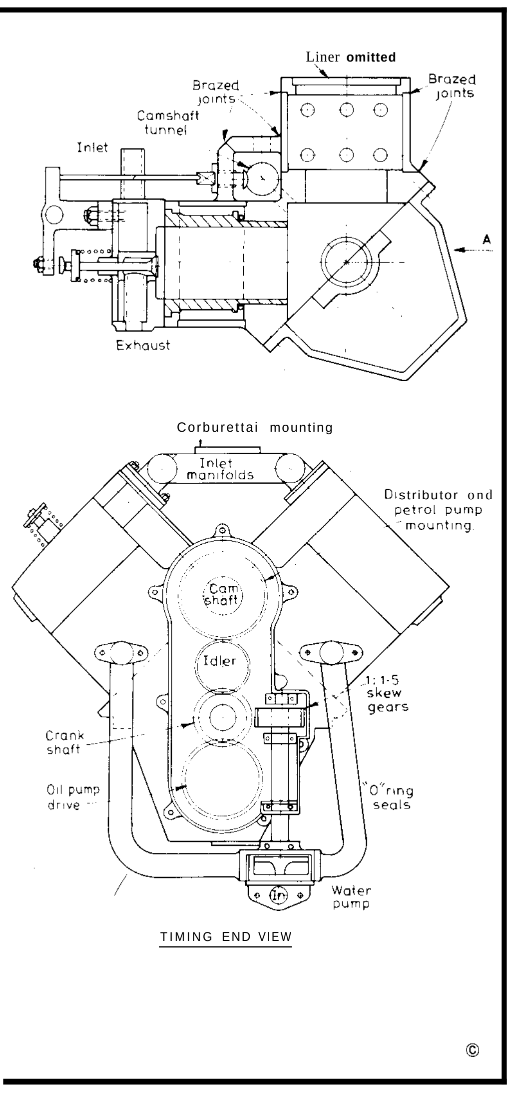
Roy Amsbury describes and details the building of a 120cc V8 i.c. engine which he developed for use with his 5 in. gauge Hymek locomotive. The engine could well have other traction applications *Part 1*

The engine as first built, fitted with the original distributor and contact breaker assemblies.



Due to pressures on space we have held over the drawings of the crankshaft and connecting rods until next issue. This is a complex project, for which full-size drawings will become available at the conclusion of the series. Meanwhile, as the series progresses it may be that when a group of components are called for to complete a sub-assembly that these will be included, and perhaps another sub assembly held over, although building instructions are given. We hope that builders will bear with us while the series runs, all components will be included in the magazine as space permits.

The engine to be described was designed with application to a 5in. gauge diesel locomotive in mind. It is a petrol engine – a true diesel being impractical in this size and is of V8 formation of 120 cc total capacity and 4 stroke cycle. No castings were used in its construction, but there is nothing to prevent a reader who likes pattern and corebox manufacture making a set of castings. With the locomotive application in mind, the main components, i.e. crankcase and cylinder heads are fabricated in brass – the extra weight being no disadvantage and one can add bits on if a minor mistake is made in design or manufacture. Bearings areas are generous to ensure a reasonable life.



The Crankcase

The logical place to start is the crankcase, so the first thing is to cut up various pieces of brass plate to make items 1-8. The edges must all be machined so that the parts fit properly together and the holes for the cylinder liners bored to about 1in. dia. to be finished off after brazing up. The items can be fixed together for silver soldering by 10 BA bronze screws in appropriate places, not many are required and they are filed off flush on completion. The two joints adjacent to the camshaft tunnel along the water jacket should be made first, using a slightly higher melting point silver solder than the rest otherwise you may get the trouble that I had, with the water jacket joint melting when the camshaft tunnel is added – and then a leak occurred which was not detected until the liners were fitted and the engine nearly complete. I would advise that you check all joints at this stage as thoroughly as possible. Any small leaks can be sealed with soft solder.

Once this assembly is completed the lower bearing caps can be made, and with the proper fitted studs, bolted tightly into place. At this stage the bolting face for the sump should be machined off and the sump made and fitted, as it will be needed to do the oil seal bore at the flywheel end. The sump is fabricated from steel or brass – the oil seal bore should be left solid at this stage.

The top of the cylinder blocks should now be cleaned up flat with a file or by milling depending on your workshop tackle, but still left over thickness. The block should now be marked out for the position of the crankshaft and camshaft bores and the idler pinion shaft ready for the next machining operation. These are best done by clamping the block by one of the cylinder faces to the lathe boring table at the correct height, pilot drilled right through and then finishing off with a boring bar between centres. The bar will be some 15in. long *so* as each bore is brought to size a steady bush should be put in the bore to support the boring bar whilst the next bore is opened out to size. The camshaft tunnel is the more difficult one, as it is not possible to see what is happening, to this end it will help if the slots for lubrication are cut through from the underside of the crankcase before the work on the camshaft bores is commenced.

Whilst the crankshaft bores are being done the same setting should be used to machine the recess for the flywheel end oil seal. To do this the sump will of course have to be fitted, so the clamps to the boring table should be arranged with this in mind. At the same setting the face for the timing cover should be faced off true. To this end it is probably wise to put the timing end towards the chuck so that a flycutter can be used to clean up this face.

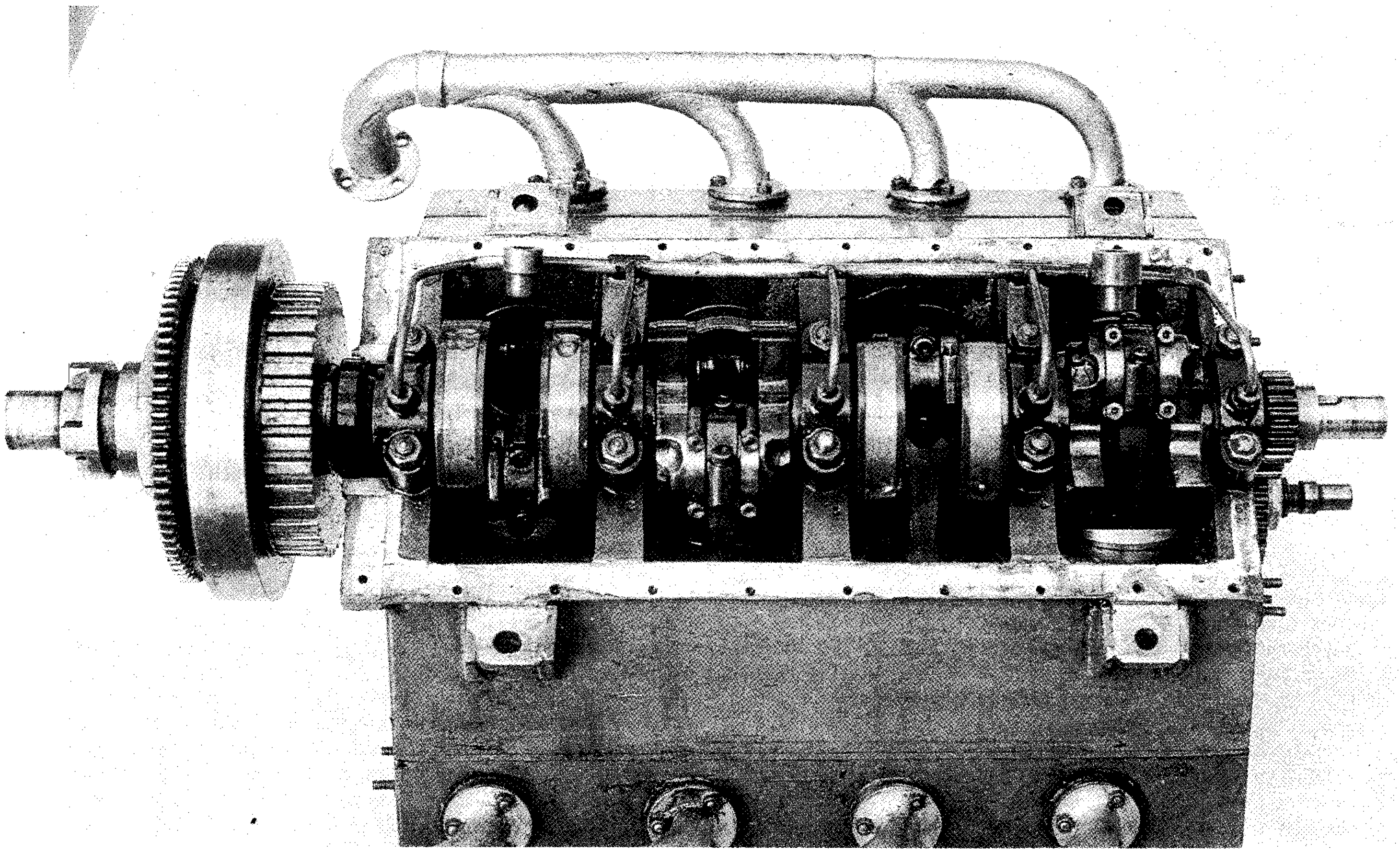
The next jobs are the cylinder block top faces and the bores for the cylinder liners. For this operation the block will need to be mounted by one set of bores, upside down with the other block facing the chuck. The crankshaft bores will now have to be set up exactly square to the lathe axis and the top face machined off with a flycutter to achieve the correct distance to the crankshaft centre line. The bores for the cylinder liners can be opened up to correct size and spacing using a boring head on the mandrel nose. The second bank is an exact repeat of the first of course. With this done the holes to take the tappet guides can now be marked out, drilled and reamed to size. At this stage the major operations on the crankcase are complete, the water passages and cylinder head stud holes should be left until the heads are done. No internal machining should be necessary on the crankcase or water jackets.

The Crankshaft

The crankshaft can be tackled next, and it should be machined from the solid, a piece of EN8 or preferably EN16T is required some 11in. long and 15/8in. diameter. It is quite a stout shaft so no undue difficulty should be had in machining it. The first job is to accurately mark and drill the five centres in both ends in axial alignment with each other. All the main bearing diameters can next be reduced to about 1in. dia. and then the crank pins should be reduced to about 5/8in. dia. in turn. Leave discs on each end about 1/4in. thick to support the centres until all crankpins have been finish turned and polished.

The main bearings can now be turned to about 0.015in. above final size and width and the first crankpin then reduced to final size and width – don't turn the 3/8in. dia. piece to size until last though. This turning in stages is necessary in case the shaft distorts during the machining. A block of metal (brass, steel or aluminum) should now be made to just fit between the webs of the first crank and fixed in place with "super glue" or soft solder. The next crankpin can now be turned to size and a second block fixed in place – carry on this way until all crankpins are done, then finish all the main bearings to size and polish. Then turn away the discs at the ends and the whole shaft down to size.

The webs must next be cut away to form the balance weights, which is best done by holding the shaft in the machine vice and end-milling the surplus away. The oil ways should be done next – and some care is necessary not to break any drills in the passages – use coolant and withdraw the drill frequently. It can help if the drill point is ground slightly offset *so* that the drill cuts oversize – a breakage can then be easier to remove, but its much better not to break one! The hole should be started radially in the crankpin for about 0.05in. deep and then the shaft can be tipped. to the required angle. I have always managed to sight the drill line up against the shaft to get the exit point where it should be – a radial hole can be drilled in the main bearing to pick up the incoming passage. Use a depth stop on the machine, and go carefully when the drill should be breaking through – that is often when it breaks, especially if there is any end float in the drilling machine spindle.



An underside view of the engine, with the sump removed, showing the construction of the crankcase.

The extra balance discs can now be made and riveted in place using countersunk iron rivets and finally the 1/4in. dia. hole for the additional heavy plugs should be drilled and the plugs fitted using Loctite and slightly riveting over the ends into a shallow countersink – they go right through the discs.

The Cylinder Liners

Cylinder liners should be made from a good cast iron such as "Meehanite" and are a straightforward turning job. Leave the flange about 0.015in. over length to be finished off after fitting in the cylinder blocks. The bores should be honed or lapped to get a true bore with a high finish.

Connecting Rods

Connecting rods are an interesting part to make. The first job is to make four blanks of ENS to 0.885in. wide by 0.45in. thick and 2.6in. long, and four more 0.745in. by 0.562in. and 2.6in. long. Two drilling jigs are now required to position the bolt holes as per items 90. It is very important that the jigs fit the ends of the blanks accurately and that the bolt holes are where they should be. To this end the holes are best located by using a vertical miller to move the embryo jig under leadscrew control.

This fixture **is** now used to drill the bolt holes in all the blanks. When this is done the ends should be cut off to form the detachable end of the rod and the cut ends machined flat and in fact the centre section can be relieved to ensure that the two halves seat tightly at the outer faces. Don't machine the little end at this stage. The sides of the rod must now be cut away to allow the bolts to be inserted and a set of high tensile slave bolts are needed, best made from Allen screws, i.e. four 9 BA and two 6 BA.

Each assembled rod can now be held in the machine vice in turn to have the big end and little end bores drilled and bored out to size. It is important to get the big end bore exactly central in the block as there is only 0.014in. of metal either side of the 9BA bolt holes. Again drilling from centre pops is unlikely to give the necessary accuracy and the vertical slide or vertical miller should be used to position the bores. With these done a simple fixture is needed, item 91 and each rod can be put on to have the outer shape cut to size. Machine the little end O.D. first and then the sides to blend in with it, then do the top and bottom and finally the fluting. Don't be tempted to leave parts over thick or you will find it impossible to properly balance the engine.

The radii around the big end bolts can be filed, or a special shaped flycutter can be made to mill them. This completes the main machining on the rods, the bushes can be made for the little ends and the next job is to do the white-metalling. A fixtnre is now required as item 92. The blade rods are metalled into the rod, and should be tinned over the bearing area using a strip of white metal. They are then bolted to the fixture in turn, heated and filled with white metal. Ensure that the metal is molten when in the fixture and poke about the metal with a thin steel wire to dislodge any air bubbles which may stick to the surface.

The fork rod clamps on to a steel sleeve which is white-metalled inside. The sleeve is of course in two halves and the easiest way to make these is to take two lengths of 5/16in. x 5/8in. BMS some 4in. long and pin them together by two 3/16in. dowels near one end. This assembly can then be held in the four jaw chuck with about 3/4in. projecting and the sleeve machined all over and parted off – the dowelled end is not used of course. These sleeves can be metalled using the same fixture as before, but the sleeve should be backed by a half cylinder of aluminium about 1/4in. thick to prevent the sleeve distorting. Clamp the backing and sleeve to the fixture with an old toolmakers clamp or similar device and fill with metal as previously described. To bore out the sleeve the two halves can be held together in a collet chuck or a split sleeve held in a 3 jaw chuck.

The main bearing shells can be made in a similar way to the above and they can be clamped by the enlarged ends in a collet to hold the halves together whilst machining the bore, so ensure that these ends are true to the centre section.

*To **be** continued*