Balancing

When you have got this far no doubt you will have assembled some or most of the items, however a few points to note may not come amiss. If you wish to ensure that the engine is properly balanced - it runs very smoothly then, you can check by doing a bit of weighing.

First check that the crankshaft is statically balanced by resting it on a pair of truly horizontal knife edges. Any appreciable unbalance can now be corrected by a bit of filing at the heavy spots and little should be needed.

As we cannot detach a crank web from the shaft to weigh it, the weight can either be calculated (it is rather an awkward shape) or do as I did by making a single crank web from a bit of steel plate. Make it as close to the same shape and size as one crank web as you can, including the brass weight and the heavy metal plugs. Put a 1/16in. hole through the middle on the shaft axis and another through the centre of the big end, i.e. at Min. radius. Put a bit of 1/16in. dia. silver steel through the centre and rest the assembly on the horizontal knife edges. Attach a piece of cotton to the big end hole and pull this vertically down with a sensitive spring balance until the throw axis is horizontal, and note the spring balance reading. This is half of the balance weight available (two crank webs per throw).

Now weigh each end of the two types of connecting rod by resting one end on a suitable surface and lifting the other with a piece of cotton and a spring balance at the centre line of the bearing until the rod is horizontal, and noting the spring balance reading. Also weigh one piston, complete with rings and gudgeon pin.

Add up the weight of the big end of a fork rod and a blade rod, plus the sleeve and crank pin. Also add to this the weight of ***one*** little end plus *one* piston assembly. This sum should equal the sum of the two crank web balance weights found above. If they don't add up reasonably closely, say within about 5 grammes, the weights will need adjusting to suit, either by reducing the plug weights or lightening the connecting rod and piston assembly.

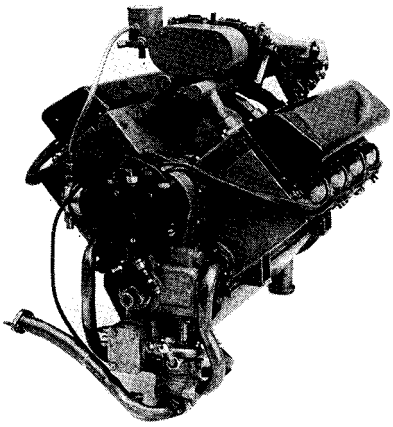
With this done the main and big end bearings can be fitted and bedded in, a bit of scraping will probably be required to get the crank shaft and big ends to run reasonably freely. I have not used any locking devices on the main and big end bolts, but small spring washers will be adequate if everything is pulled up tightly.

Assembly

The first bits to assemble are the tappets and guides – the tappets have to be put in from the camshaft tunnel and the bush slipped over each from the outside in turn, long forceps will reach in to coax the tappets down the hole, and don't turn the cylinder block the right way up until all the tappets are in place and the camshaft is fitted. The tappet bush clamping plates should now be fitted, these will also prevent the tappets rotating, hence one should ensure that they are in the correct orientation at this stage.

So far the description of this engine has dealt with the manufacture of the various parts. With all these completed this concluding episode deals with the assembly, running in, and eventual start-up of the completed unit.

Part VII (conclusion), from page 394 (4 October 1991)



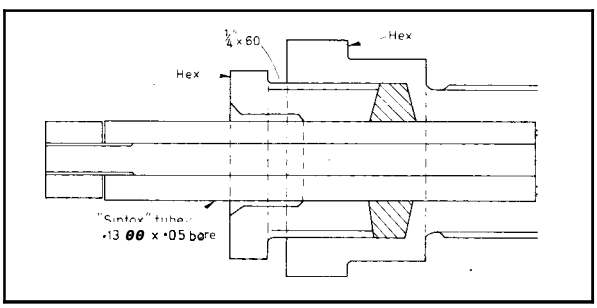
V8 engine

Assembly and Balancing

Pistons and rings can next be put in the bores, with the con. rods on of course. A ring compressor will be needed to get these small rings into the bores without breakage. They can be fitted from the top of the cylinder block. The ring compressor is easily turned up from an odd bit of 1/2in. plate about 1/2in. square made of any convenient material. Just bore out to cylinder size, drill two holes for pinch bolts and then cut in half. The crankshaft can now be put in and the big end bearings fitted and checked for any excessive stiffness as each one is assembled. The engine will be quite stiff to turn when all eight pistons are in and the bearings bolted up properly.

The timing gears can now be fitted and the valves timed, the easy way to do this is to set a piston on TDC, rotate the camshaft until the appropriate tappets are just rocking – i.e. inlet opening and exhaust closing and then tighten up the camshaft gear clamp nut. No trouble has been experienced with this gear moving without any key. The timing cover can now be fitted with its oil pumps, which of course should have previously been assembled and checked. The main oil pipes can then be fitted and then if everything is O.K. the sump can be put on. Cylinder heads should be looked at next, the valves fitted – the seat touched with a bit of fine grinding paste if the seating looks doubtful, but take great care not to get any on the valve stem and guide, clean off thoroughly afterwards.

Some sort of gasket will probably be needed between the heads and blocks; the best I have come across is about 0.010 in. lead foil. It can easily be cut with a knife and holes pushed through to match the cylinder head. I made mine by rolling a strip of1/16in. lead sheet in my bending

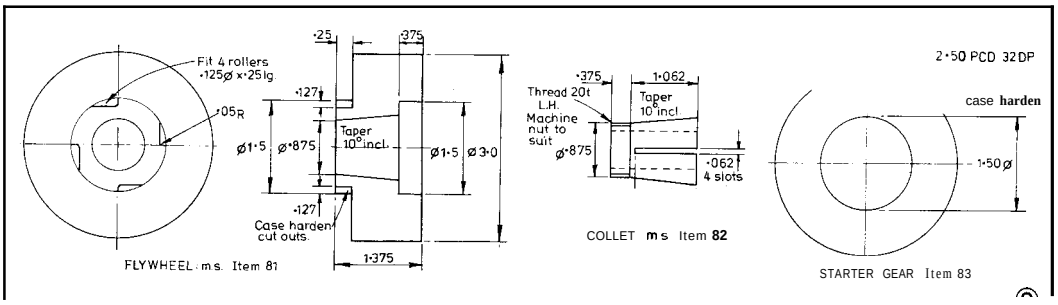


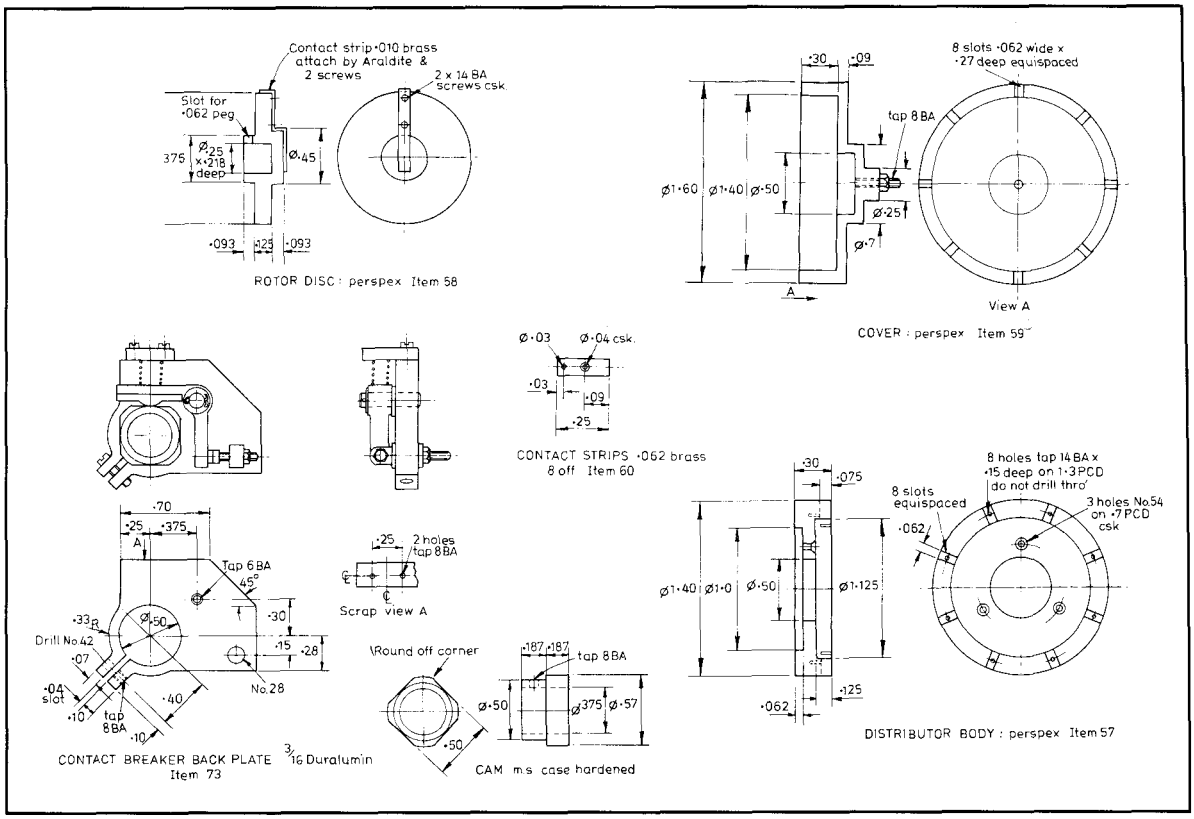
rolls until it was the required thickness. Rocker gear comes next, and the push rods can be fitted and valve clearances adjusted so that the rockers have just a small amount of play on the compression stroke.

Running in and final assembly

At this stage the engine can be given a bit of running in with a slave motor – or mounted on the lathe to drive it. Before any turning over is done however the oil system should be completed, including the filter - it is amazing how much grit etc. seems to get in however careful one is in cleaning items before assembly. The pressure relief valve can be set at this stage to give an oil pressure of about 10 p.s.i.

If this is O.K. and the engine is not excessively stiff to turn, the remainder of the parts can be fitted and tested, i.e. inlet





The photograph shows the starter ring on the flywheel of the engine, This engine is fitted into the author's 5in. gauge Hymek locomotive. Although designed with a locomotive in mind the engine would be suitable for many other applications, e.g. road vehicles, stationary plant or marine use.

manifolds, carburettor, petrol pump, water pump, distributor and contact breaker.

The firing order is - 1A, 1B, 3B, 2A, 2B, 3A, 4A, 4B. A signifying the left hand bank from the timing end.

Exhaust manifolds will also be needed, these are made from 3/8in. and 1/2in. copper tube, bent and silver soldered together. Silencers will depend on the application of the engine; I am using three expansion chambers about I 1/2in. dia. and 2-1/2in. long, one on each bank and one commoning the two banks.

Sparking plugs will of course be required, these can be commercial ones or homc made – I find the latter ones work best. The main point is to keep the electrode very thin so that it runs hot enough to burn off the oil which always seems to get by the pistons. You will (or should!) find that the engine takes quite a bit of effort to turn over when the plugs are in.

Initial start-up

At this stage, if not before. the engine will need to be mounted on a suitable test bed with a means of driving it for starting. For the latter I mounted a Vee pulley on the flywheel and fitted a 1/4hp electric motor at the side of the test stand such that the motor could be pulled up to release the belt tension when the engine begins to run on its own.

The overflow chamber should he filled with petrol before starting and the jet tubes fully lowered. Some experimenting with different jet needle tapers may be required; I made about six different ones before getting something that behaved reasonably. Mine have a straight taper, full size commercial ones have a curved profile. but not much curve can be put along about 1/4in. active length with only a few thou' difference between the ends.

Once a bit of running ha5 been done things will bed down and the compression improve considerably. Due to the small flywheel the engine will not run much less than about 1500 r.p.m. and stops very rapidly when switched off. This concludes the engine construction.

The starter

When I designed this engine I was determined to have an electric starter of some sort and I experimented with several designs of motor. The most successful was an ex-aircraft motor which is 2-1/2in. ODx 3 in. long and has an armature stack 1 in. long by 1-1/2in. dia., it also har a fairly large commutator and brush gear. The motor was rated at 24V 20A, obviously for a very short time. The armature was rewound for 12 volts by halving the number of turns on each coil and using wire of twice the cross-sectional area. The field windings were reconnected in parallel with each other – still in series with the armature of course.

A gear reduction of about 6:1 is used between the motor and flyweel and the engine turns over at a good speed. I think an increase in ratio to about 10:1 would reduce the motor current and still give sufficient engine speed for starting, but this would entail a double reduction between the armature and flywheel or a very big flywheel gear. The motor diameter is too large for the engine shaft to pass down the side of it unless an idler gear is interposed between the armature and flywheel gears. this gear can be slid axially to engage and disengage the starter. In my locomotive this is done by a small air cylinder and an electrical contact inside this cylinder ismade when the gears are fully engaged to switch on the starter motor.

Ignition

I found after quite a bit of running that the ignition was not entirely satisfactory pushing the rocker arm whilst it was running improved its performance. **As** I had by then transistorised the remainder of the ignition system, 1 decided to try a contactless timing system. I had by me a small optical unit, ex a servo motor pulse generator. **A** four slot disc about 3/4in. dia. was mounted in place of the cam in the contact breaker and the L.E.D. (light emitting diode) of the optical unit was mounted one side of the disc with the photo cell opposite it. **A** small transistor amplifier was fitted between the photo cell and transistor ignition unit. This improved matters considerably although the close proximity the photo cell and high voltage distributor contacts can cause interference problems in the cell and amplifier, so careful screening from the high voltage is required. The only thing it now lacks is an automatic advance and retard.

As there now need be no rubbing elements in the "contact breaker", i.e. optical unit, nor in the distributor – (the rotor arm needs to be advanced as well as the spark timing), a quite small and light centrifugally operated weight and spring system will do the job. This bit has not yet been tested on the engine and I am at present working on a suitable design.