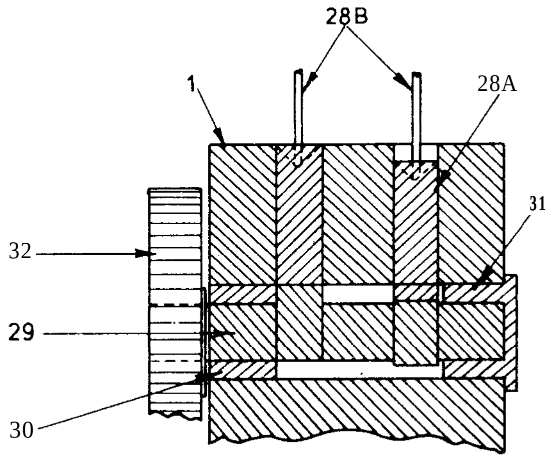
"HAWK 40" A 6.5cc GLOW PLUG ENGINE

by Australian reader G. Punter

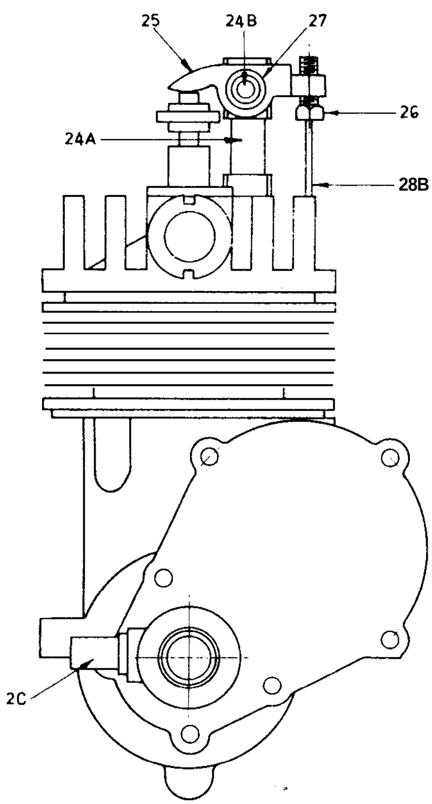
Part I

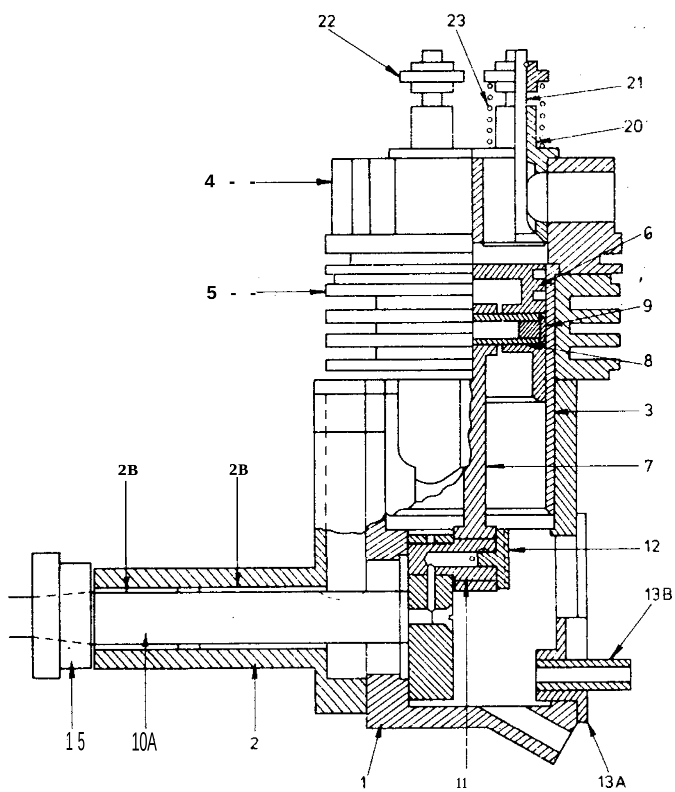
THE HAWK 40 has been developed over the past four years and so far four engines have been made. Each engine is slightly different from the others and takes about 150 hours to make — this does not include the making of the dies for casting. The first engine took over four hundred hours from designing to working engine.

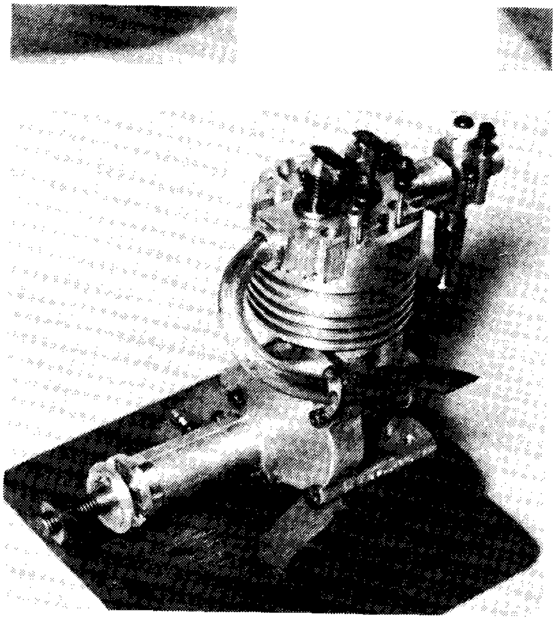


Specifications

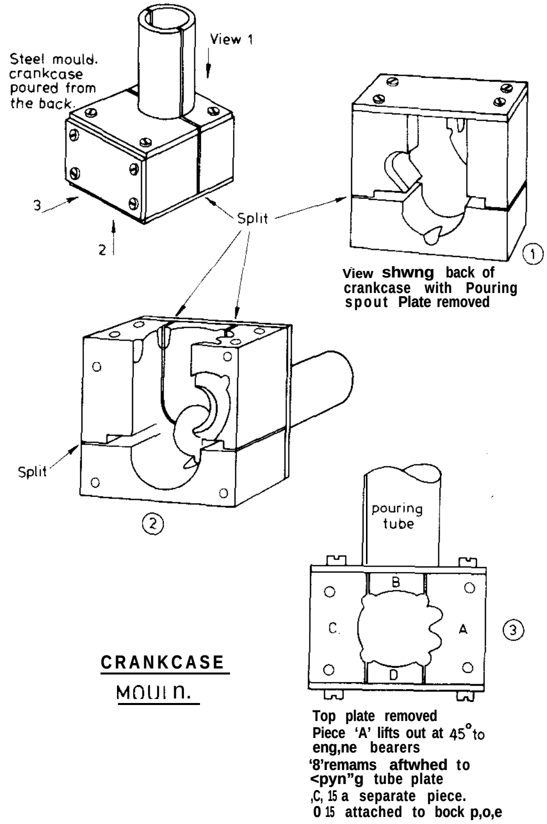
Engine Type — Overhead valve four stroke.
Bore — 7/8 in. Stroke — 1 1/16 in. Capacity — 6.5cc.
Weight — 15ozs with oil tank, 14ozs without.
Plug — Glow, any long reach without idle bar, (Could be adapted to spark).
Oil — Castrol M. Fuel — Shell 'A' Methanol.
Propellers — 10 x 4, 12 x 4.
Carburettor — From O.S. 15.





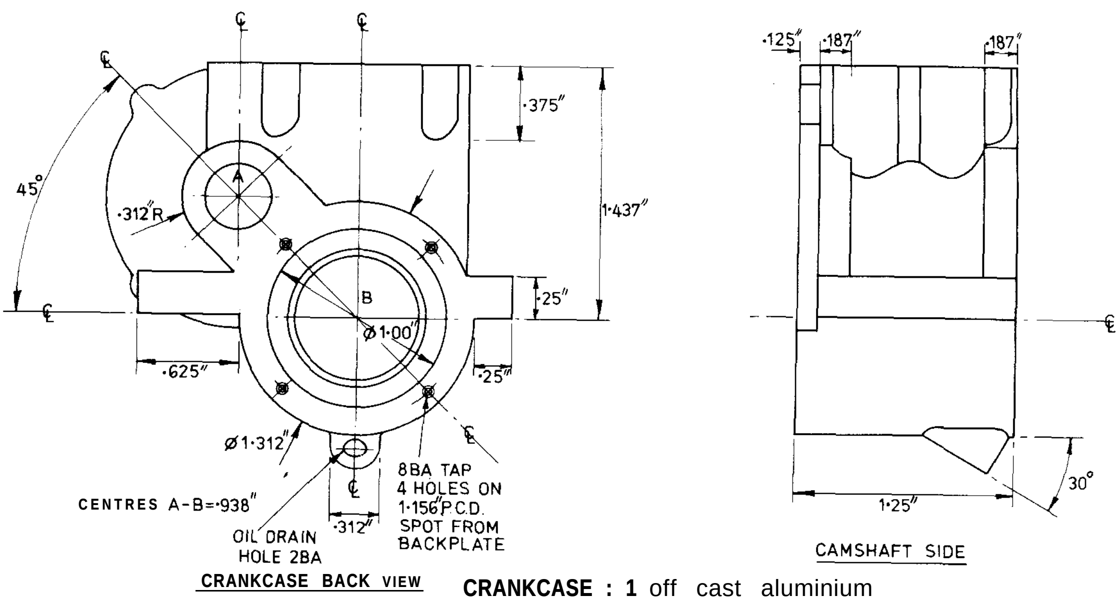


The Author's Hawk 40 engine

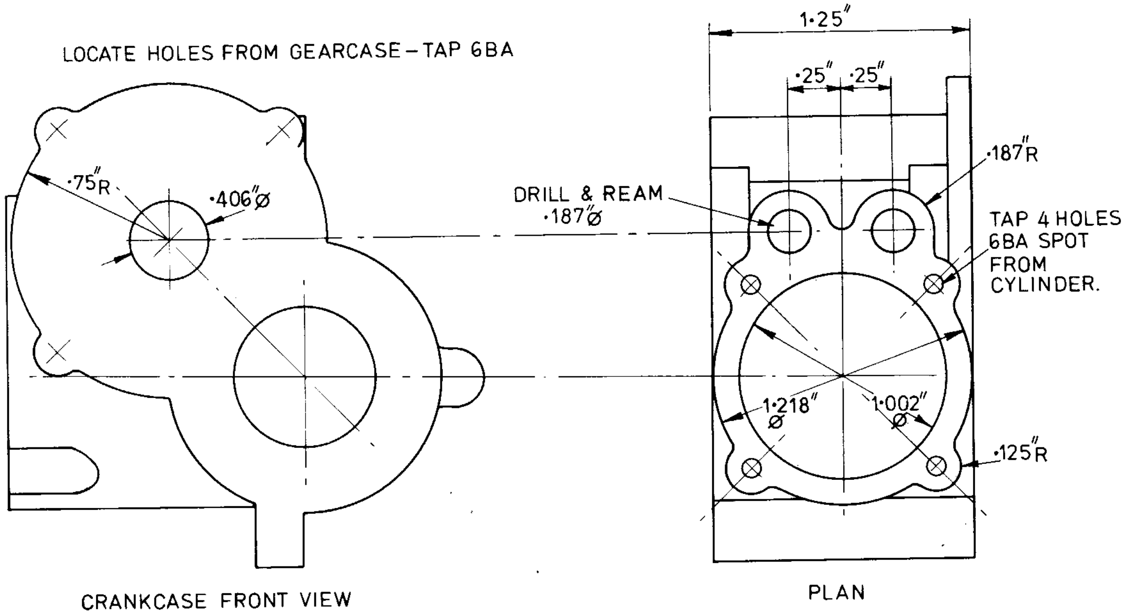


Crankcase

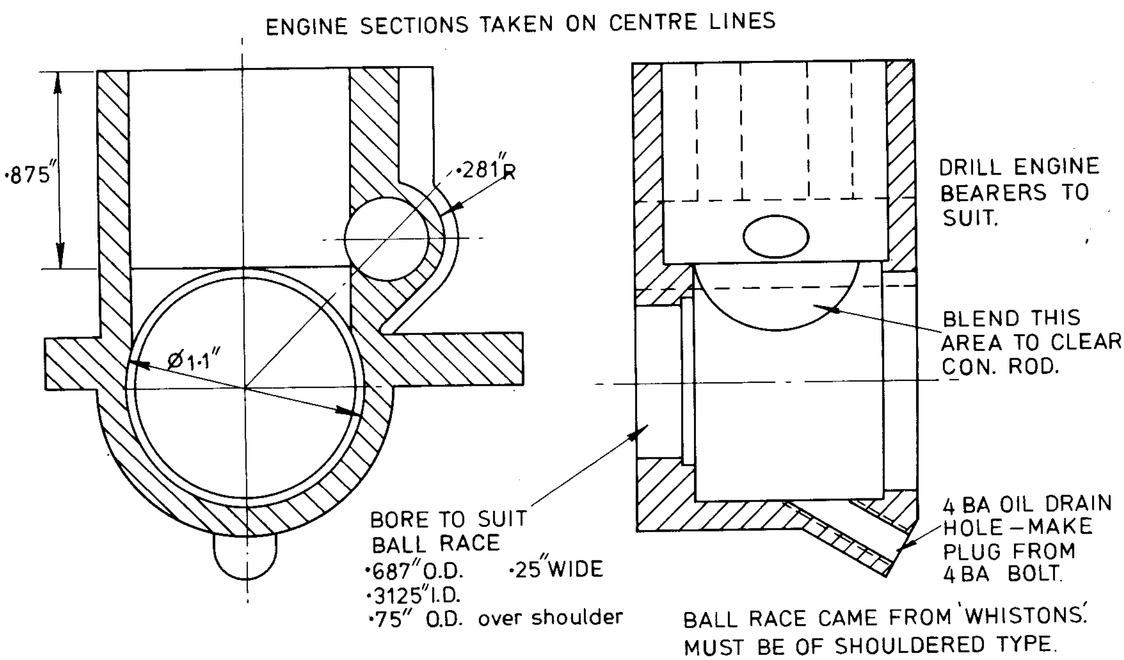
The crankcase is a diecast light alloy part. It could probably be made as a sand casting, but at the time I wanted to experiment with this aspect of casting. The die started of as a block of mild steel 4 in. x 4 in. x 1 1/4 in. and the crankcase was machined out in the negative — plates were then bolted to the back, front and top. **These plates** hold the mould together when casting takes place. The main block was then cut up using a piercing saw, each cut enabling a part of the mould to be removed from the finished casting. A pouring tube was made up and likewise split down the middle to enable it also to be removed — this tube was attached to the split plate which was bolted on to the



CRANKCASE : 1 off cast aluminium



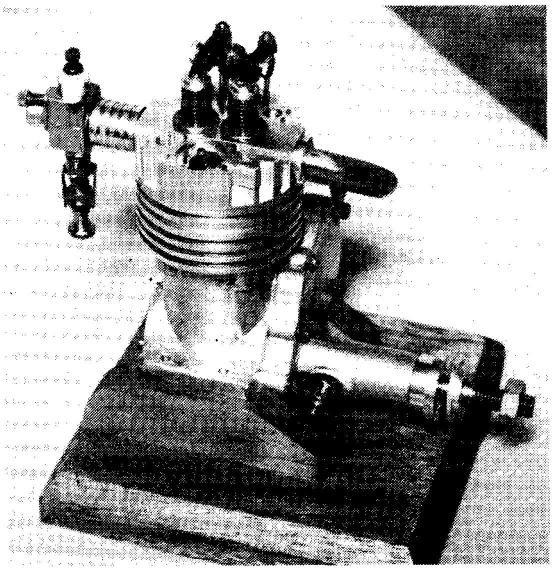
CRANKCASE aluminium



CRANKCASE

back of the mould. Before casting, all rough edges were removed and the inside of the mould polished. A coating of black from a candle flame was then applied and the mould assembled — all holes and saw slits being covered with metal strips to prevent the molten metal from escaping. Before any metal was cast, I did try a casting using candle wax as a material — this proved that the finished casting could be removed from the mould!

Another view of the completed Hawk 40.

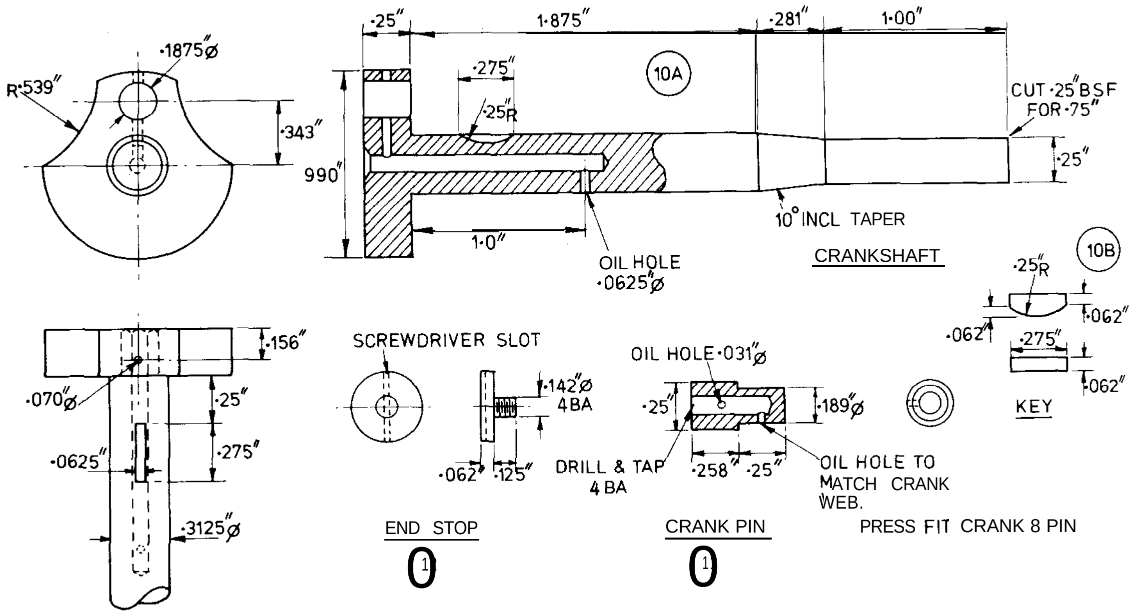


The engine was designed so that the camshaft would run in small ballraces, but on later engines both plain bearings and needle rollers have been used with success. The early engines used the oil drain hole as a return to the oil tank but later engines have used a modified backplate for the oil return and the oil drain hole is now blocked off with a4 BA screw. This should ensure that some oil will be retained in the crankcase. When machining has been completed some hand work may be needed to blend the area between the upper and lower crankcase to clear the connecting rod. The ballrace used came from Mr Whiston and was of the shouldered type. Plain bearings could be used but the ballrace does help to reduce friction and also allows oil to flow freely to the gear case. The gear case was also diecast but could be made as a sand casting as an alternative. The bearings are a press fit into the case. There is a space left between the two bearings so that oil may collect and act as a reserve supply to the shaft.

Crankshaft

I have used many methods of producing the crankshaft — all have been successful but some have taken longer than others to produce. Methods used have been: turned from solid including the crank pin (this takes many hours). Turned shaft and disc and pressed in pin was the second method used and lastly a completely fabricated unit with shaft and disc silver soldered together and the crank pin pressed in. Loctite is used both on the press fits and on the end stop screw thread — the latter have to be done on assembly. The crank pin is heat treated after all machining has been completed and before being pressed into the disc.

Continued



CRANKSHAFT : steel

"HAWK 40" A 6.5 cc GLOW PLUG ENGINE SUITABLE FOR AERO OR MARINE USE

by Australian reader G. Punter

Part II

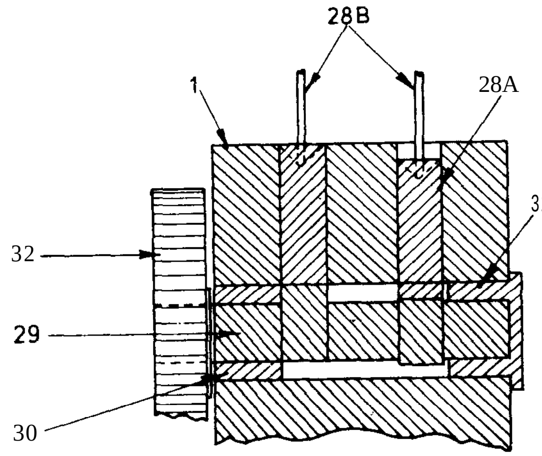
From ***Page*** 1393

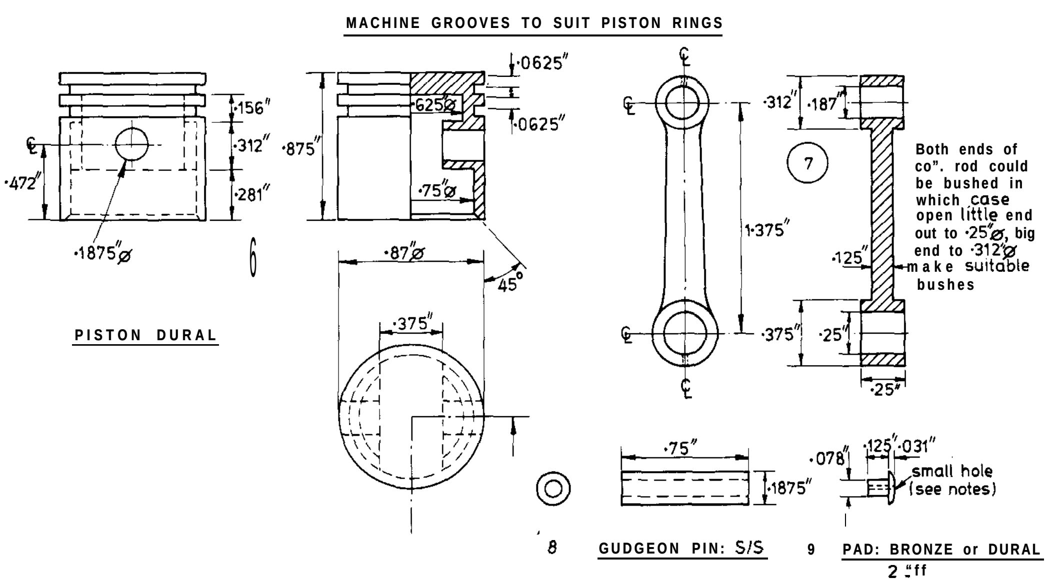
Piston Unit

Both the piston and connecting rod are made from Dural. Check the width of the piston rings used before cutting the slots. The gudgeon pin is made from silver steel and is hardened and tempered and has bronze or Dural pads on each end. A small hole could be drilled in the end of one of the pads to allow the air to escape when they are pressed in. Likewise oil holes could be drilled in each end of the connecting rod.

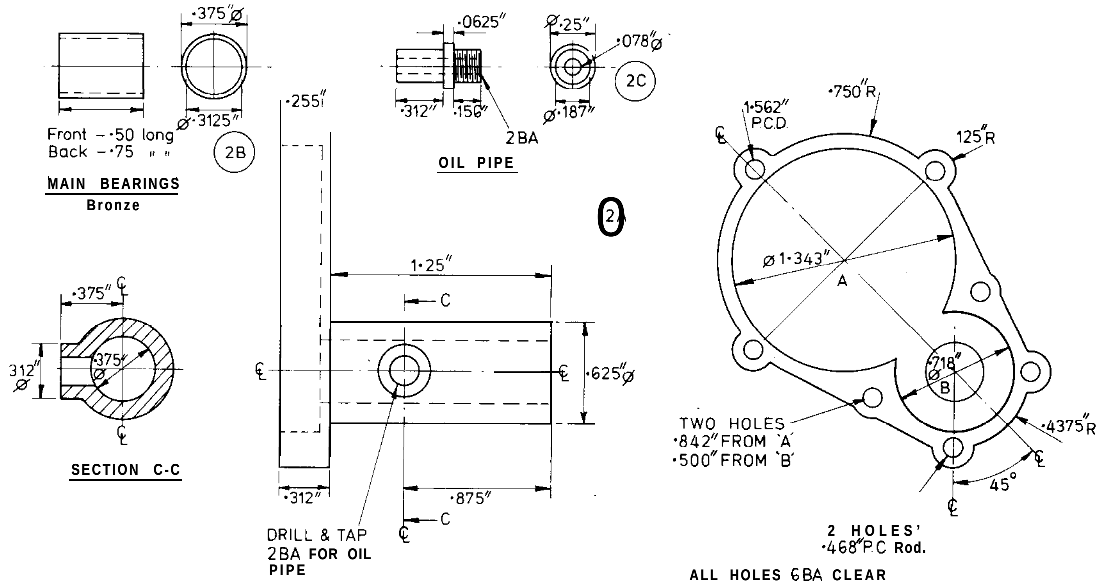
Cylinder Head

This part is machined from Dural stock bar. Each head on each engine has been slightly different. The first engine used a down-draught intake port and brief details of this are given on drawing No. 12. This type of head, while being harder to make, does give a better intake angle for the gas and does promote turbulence. The head shown on drawing no. 6 works well but may not have quite as many revs as that on drawing no. 12. Various fin arrangements have been tried and all have worked (photographs may show this). The underside of the combustion chamber should have all sharp





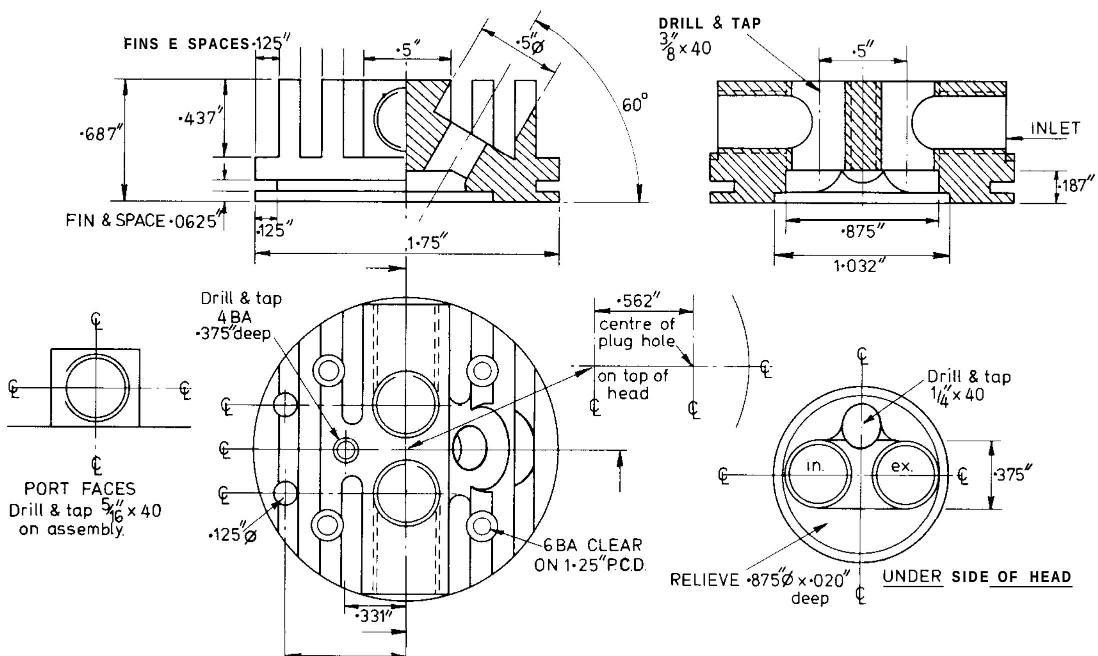
PISTON UNIT (X2)



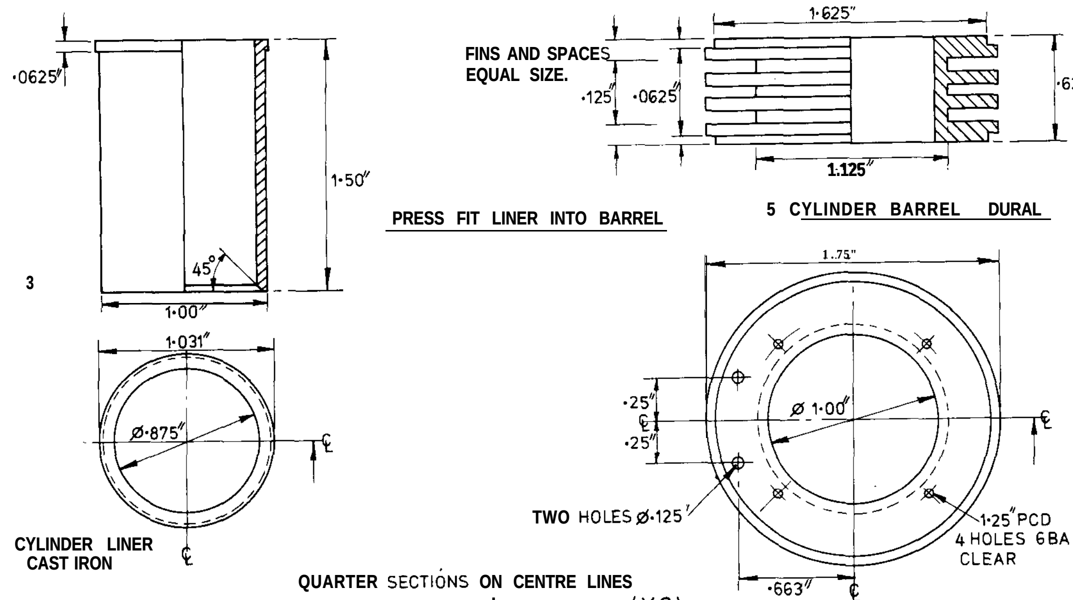
GEARCASE: loff aluminium
(X2)

edges removed — I use a Dremel tool for this and find that it is just the job. The exhaust port may be of two sizes depending on the type of exhaust pipe fitting used, these are given on drawing nos. 8 and 8B.

The valve guides are made from cast iron and are screwed into the cylinder head using a 3/8 in. x 40T thread. The valves are made from silver steel and use a small spring collet to retain the valve spring collar.



CYLINDER HEAD: 1off aluminium
(X2)

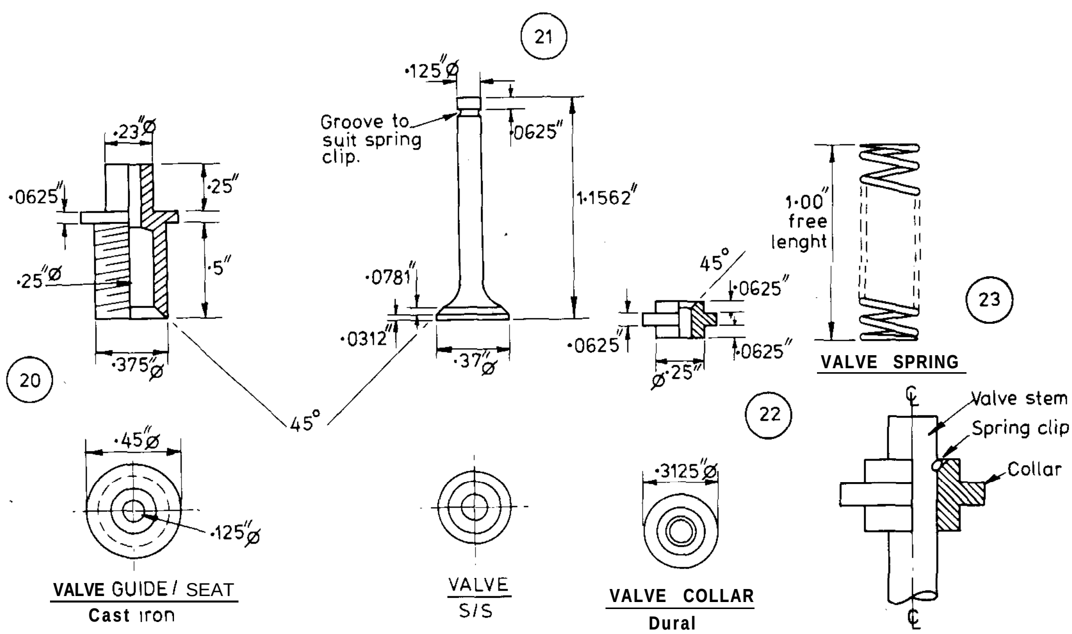


CYLINDER UNIT: C.i, aluminium (X2)

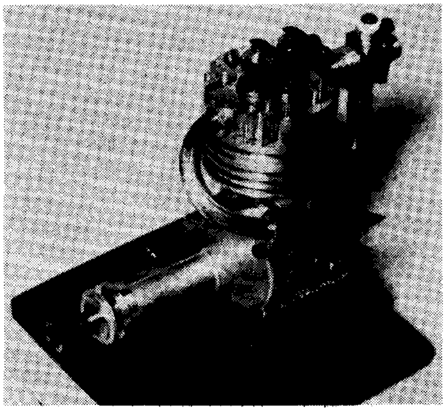
Cylinder Barrel and Liner

The cylinder barrel is made from Dural stock bar. The fins could be made thinner and more of them but care will be needed. On some engines I have opened out the push rod holes to 3/16 in. dia. and inserted short aluminium tubes — this looks good and it does offer protection for the rods (mind you they are already well protected). The cylinder liner is machined from cast iron and is made a press fit into the cylinder barrel. I lap the cylinder liners with a copper lap and feel that this is a very essential part of the procedure. *Note:* A 3/4 in. dia. bore gives an optional capacity of see.

To be continued



VALVE UNIT (X2)



"HAWK 40"

A 6.5 cc GLOW PLUG ENGINE Suitable for Aero or Marine Use

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Part III (Conclusion)

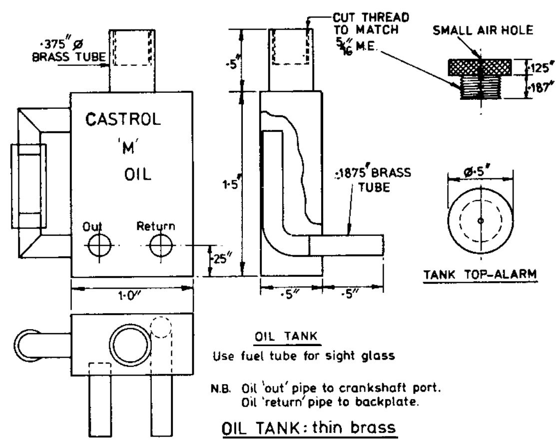
From Page 1512

Rocker Unit

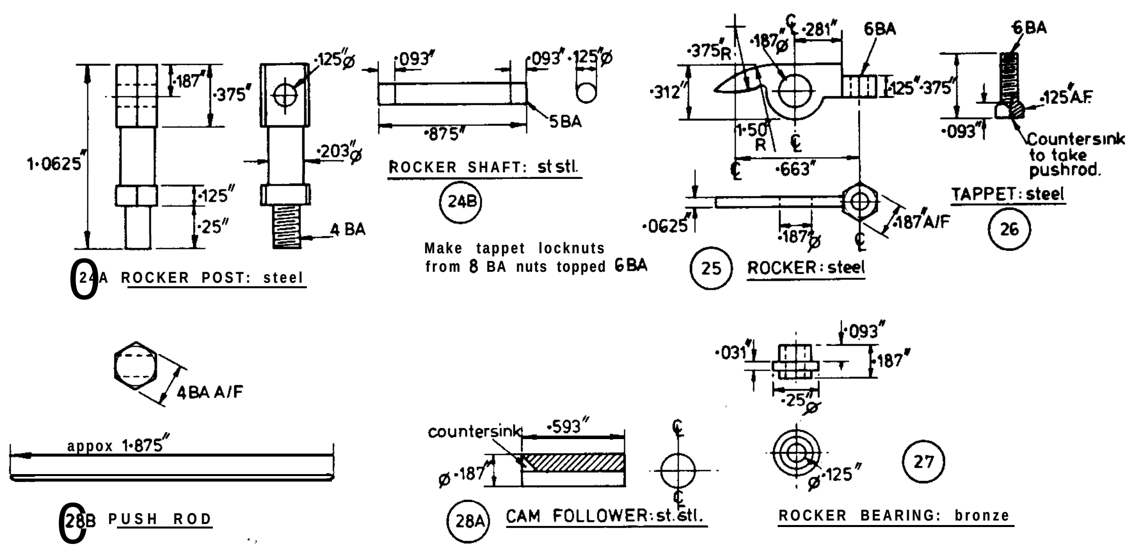
The rocker shaft is made from silver steel and is heat treated. The ends have a 5BA thread cut on them for rocker retaining screws – these could be replaced by circlips of a suitable size (if you can find any!) The cam followers are also of silver steel and are left hard. The recess in the end is for the push rod to fit in and is made by centre drilling and then counter-sinking the hole. The rockers are made of mild steel and are fabricated. The end in contact with the valve stem is case hardened and the tappet end is silver soldered on – care will be needed when heat treating to prevent the soldered end from becoming too hot (shield this end). The rocker bearing is a tight press fit into the rocker. Make the tappet locknuts from 8BA nuts tapped 6BA. The push rods are from piano wire of 16 or 17 s.w.g.

Cam Unit

The camshaft is the "lung" of an engine and controls the breathing. The shaft blank is made from

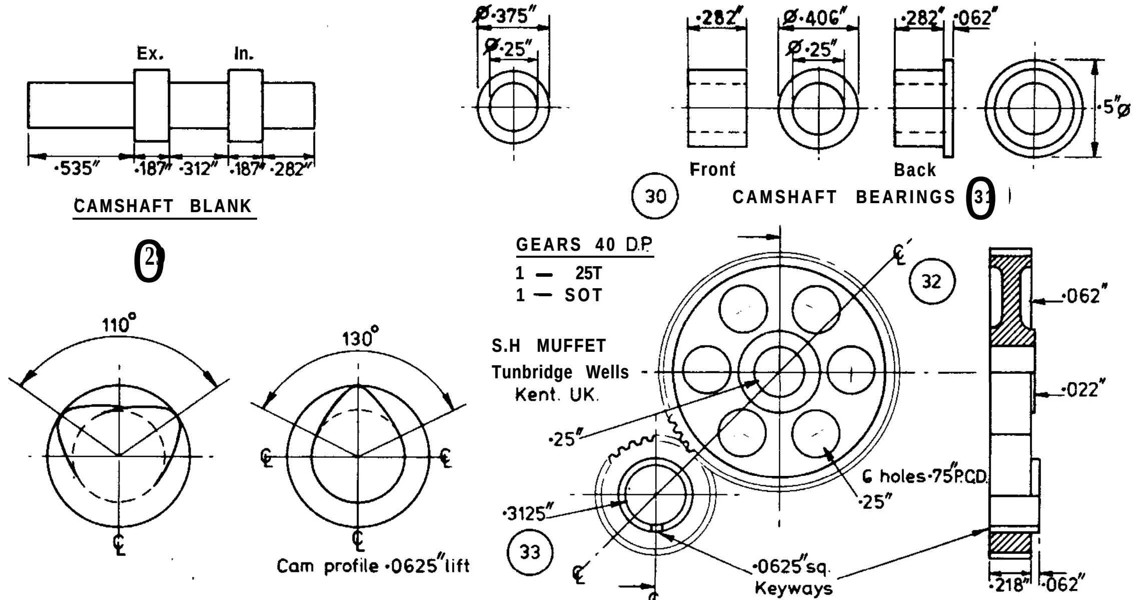


Drawing No. 1



ROCKER UNIT

Drawing No. 9



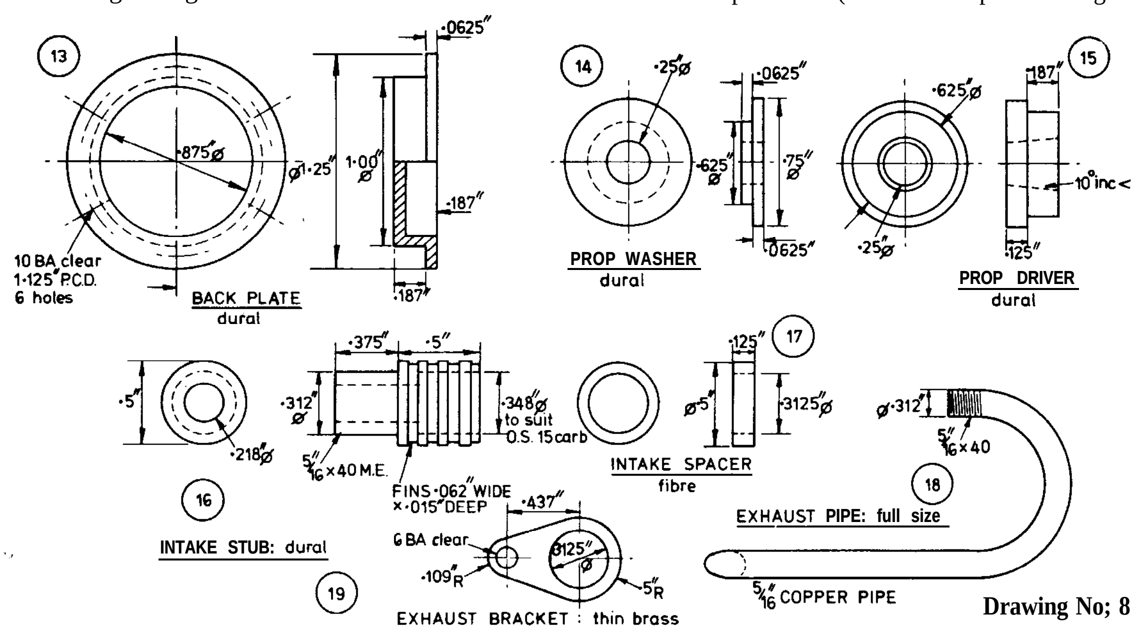
CAM UNIT : steel

Drawing No. 10

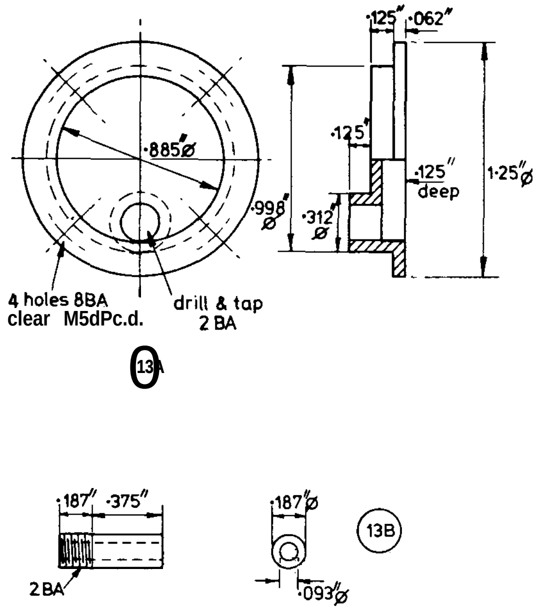
silver steel and is heat treated after it has been shaped. The cam shapes shown are the ones I have used – but others could be tried. To produce the cam shape I have made a cam grinding jig which utilises an old food mixer motor (3 speed type – again with Whistons!) but they could be made by the methods explained in other articles on the subject (Some background reading may be needed here). There is sufficient room in the crankcase to take plain, needle roller or small ball races on the camshaft, but check sizes before machining. The gears used came from S. H. Muffet Ltd and are lightened as shown. The large gear is a press fit onto the camshaft (use Loctite) and use either an 8BA grub screw or a roll pin as a key. Assemble the gear on the shaft and drill the hole so that half the hole is in the shaft and half in the gear – thus forming a type of key. The small gear is located with a keyway and Woodruff key. Note that the back bearing is blind.

Exhaust Pipe and Intake Stub

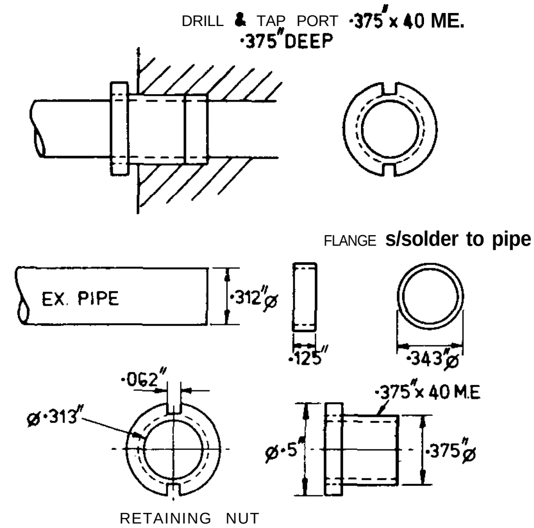
The exhaust. pipe is made from thin brass tube and is bent to the shape shown. (Use drv sand packed in tight



Drawing No; 8



ENGINE BREATHER/ OIL RETURN PIPE



ALTERNATIVE EXHAUST FITTING

BACKPLATE MOD : dural

Drawing No. 8b

to prevent distortion, and work in the flame).. If a thread is to be used as shown in part no. 18, make this part separate and silver solder onto the main pipe. Part 19 is an exhaust pipe steady and bolts onto the gear case front. The intake stub is made from Dural and is machined to take an 0.S.15 carburettor — the other end screws into the cylinder head with the fibre spacer in between to reduce heat transfer. Use Loctite on assembly and the O.S. carburettor screws supplied.

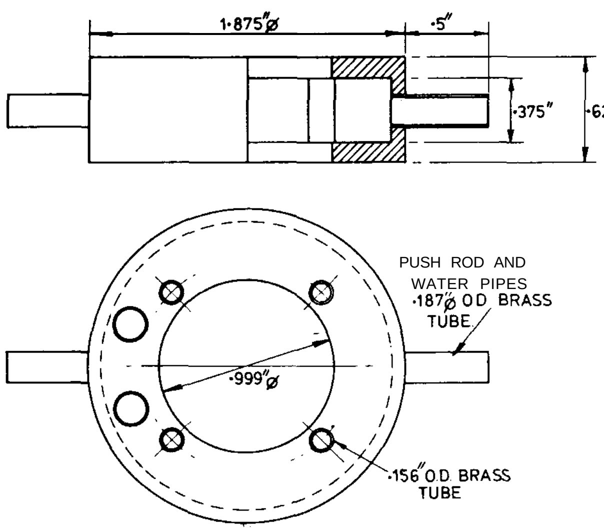
General Notes

Fabricate the oil tank from thin brass sheet — note that the return pipe points up. Use fuel tube for the sight glass and make the top from Dural bar.

The water cooling unit, for boat applications, is shown on drawing no. 12 and is a press fit over the cylinder liner. All pipes are silver soldered in — all parts being made of brass. A suitable flywheel could be made to replace the prop. driver.

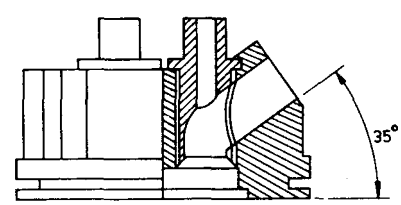
Gaskets used have been of the silicon jelly type and have been successful in operation.

The backplate has been modified and is shown on drawing no. 8B. It now includes the oil return breather and has therefore been thickened locally to take the 2BA threaded pipe.



ALL TUBES SILVER SOLDERED INTO BRASS BARREL

WATERCOOLED CYLINDER BARREL



CYLINDER HEAD WITH 35° DOWN DRAUGHT INLET PORT

CYLINDER HEAD MK 2

See notes

Valve guides and seats will need to be modified for this type of cylinder head

NOTE — Glow Plugs are normally ¼ in. x 32 t.p.i. and Cylinder Head should be tapped to suit plug available — see p. 1151.

Drawing No. 12