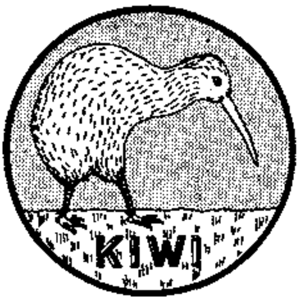


INTRODUCING KIWI MARK II

Among small petrol engines Kiwi is the beginner's favourite. EDGAR T. WESTBURY who designed it twenty years ago brings it up to date in this new series

READERS interested in internal combustion engines, and aware of the rapid improvements in their development in recent years. may find it difficult to believe that an engine which was described in MODEL ENGINEER over 25 years ago could be brought into line with modem practice by relatively small modifications in its design.

There is, however, nothing incongruous m this, for although the types of engine in full-size practice, with which we are all familiar, have been vastly improved in performance during this period, their basic design and exterior appearance have usually changed very little. In specialised fields, new types of engine have evolved, and the present line of advanced research indicates that there may be revolutionary changes ahead but the older types are by no means superseded for normal duties, and are likely to be with us for many years yet, in more or less improved form.

The original engine, which was later given the distinctive title of ***Kiwi,*** was introduced at a period when interest in the home construction of engines was at its height. Many model engineers wanted petrol engines, mostly for the propulsion of-prototype or racing boats, and as there were no engines available ready made many attempts were made, with varying degrees of success, to design and build them. Some constructors were much pleased if they succeeded in producing an engine which would run at all. Even when a moderate degree of success was attained, there were often faults in design--obvious ones, in the light of later experience which caused mechanical breakdown, overheating, and other troubles which made the engines inconsistent and unreliable. The miniature i.c. engine,therefore, acquired a bad reputation which it has never yet lived down entirely.

Objects of design

In the design of the ***Kiwi***. my aim was to produce a fully reliable engine, straightforward in design and reasonably simple to construct. No attempt was made to copy so-called advanced design,. which, though many do not realise it. is full of unexpected nitfalls: all salient features had the backing of experiance and could be guaranteed as sound. Spectacular performance was not the main aim of design, but the engine was intended to produce quite a reasonable power output for its size, and, more important, to hold it during the period of running likely to be required. A serious attempt was made to ensure flexibility of control.

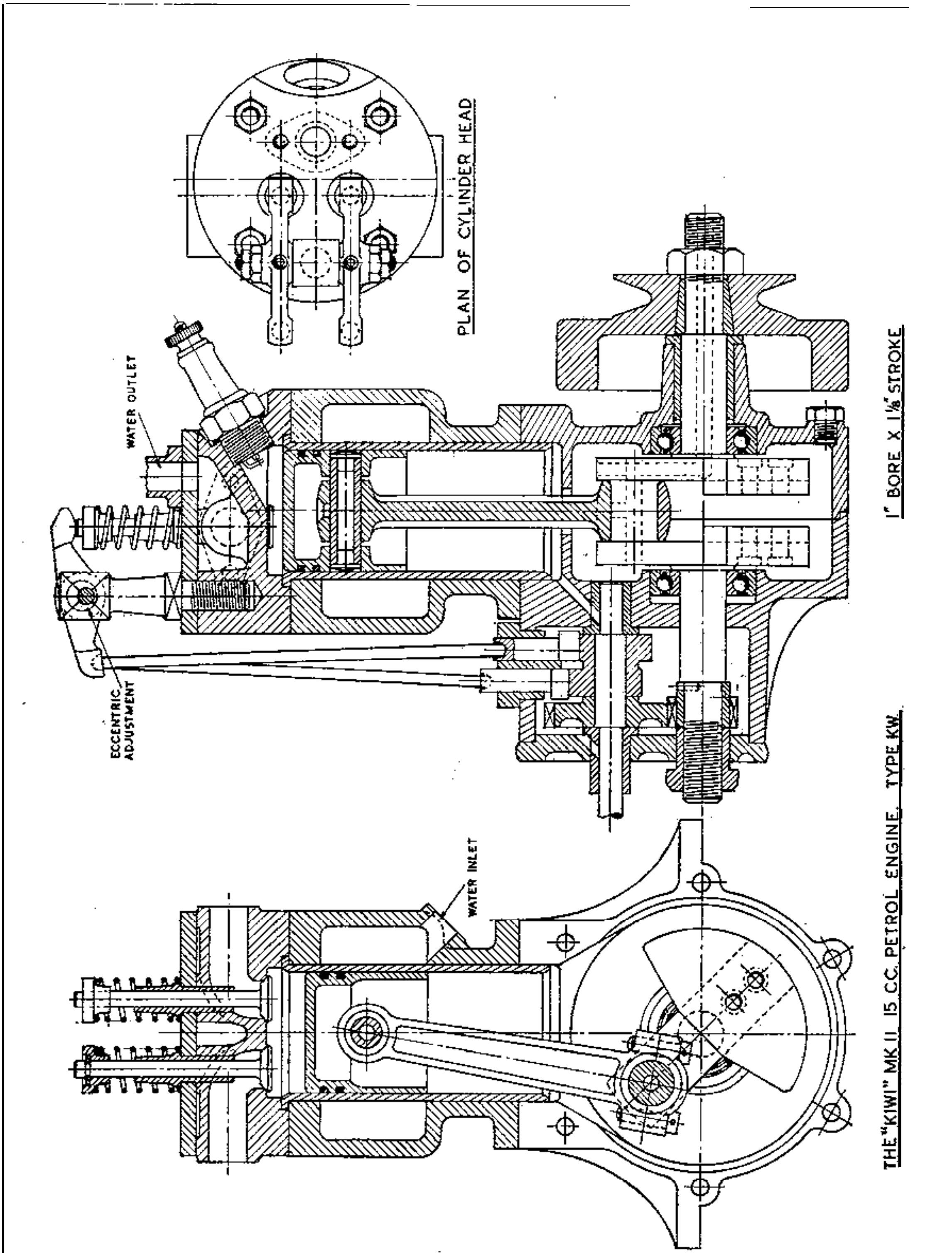
It is not necessary for me to eulogise this modest engine design, as its record can be recapitulated from accounts of its performance in MODEL ENGINEER, and from the testimonies of innumerable readers who have built and used it. For many years castings and parts for the engine were marketed by Messrs Geo. Kennion and Co., and in later years the designs of the ***Kittiwake*** and ***Kittyhawk*** engines, with inclined valves and forced lubrication, were evolved for the benefit of the more advanced constructor. But the ***Kiwi*** has always been the favourite of the beginner, who could be fairly sure of making it and getting it to run successfully. Until well after the war, it was still being built, mostly for prototype boats (the two-stroke had by then become predominant for racing hydroplanes). Since the retirement of the late George Kennion, castings have not been available, and as there have been many requests from readers I decided to redesign the engine and give it a new lease of life.

Some readers may wonder why the ***Kiwi*** has always been so popular, and indeed I have often wondered myself. I have designed several other engines having what are ***intended*** to be improved features, and simplified for maching onerations. but thev have not caught on to the same extent as the ***Kiwi.*** One possible reason is that these later designs (I refer particularly to four-stroke singles such as the ***Kinglet, Apex,*** and ***Dolphin) are*** decidedly unconventional in appearance, whereas the ***Kiwi*** and her sisters look more like orthodox and familiar types. We are all influenced by eye-appeal much more than we realise, and manufacturers of commercial products find that to sell them nowadays they not only have to be good, but also to ***look*** good.

The overhung crank

Some constructors have a deep-rooted objection to engines with overhung cranks, which they consider are not only mechanically unsound, but also look lop-sided. The former objection is not really valid if the structure and working parts of the engine are well designed, but unfortunately there have been many engines in the past which were very badly designed, and, therefore, unsatisfactory, in this respect. The two-journal or full crank has at least one practical advantage over the overhung type, in that both ends of the shaft are available for ***power take-off,*** auxiliaries and starting gear, but its success depends just as much, or even more, on good design and execution.

In the ***Kiwi*** Mark II engine, all the salient features of the original design are retarined, but among other things the structure has been generally stiffened up, and metal added where there is reason to believe that local stresses may be high. This makes the engine a little heavier than before, but is in keeping with modem tendencies generally, and is a logical policy to cope with the increased efficiency obtainable from minor improvements in functional design, improved fuels, and so forth. The main journals are now fitted with ball


PLAN OF CYLINDER HEAD
WATER OUTLET
ECCENTRIC ADJUSTMENT
WATER INLET
1" BORE X 1⅛" STROKE
THE "KIWI" MK II 15 CC. PETROL ENGINE. TYPE KW.

races, to reduce. friction under load, but this is optional, and plain bearings, as in the original design, may be used if preferred.

Two alternative cylinders and cylinder heads are now provided for in the design, for air and water cooling respectively. In the former, a finned aluminium jacket with inserted liner is specified in place of the original one-piece cast iron cylinder, which was found rather difficult to cast (except in the form of an unfinned block) and tedious to machine. The number and projected area of the fins on both the cylinder barrel and the head are greatly increased, to facilitate cooling in conditions where natural air flow is limited.

Alternative materials for the cylinder head are aluminium or gunmetal, the latter being more durable for heavy duty, especially in respect of the valve seatings. It is not considered that many constructors will favour the idea of fitting inserted seatings, though it can be done if preferred. No increase has been made in the size of the valve ports, despite the opinions which have often been exoressed on this matter: the fact is that, under test, aspiration efficiency has been found fairly satisfactory at the maximum speeds for which the engine is intended to run under load, and larger valves would only increase the work required to operate them. Flexibility is also liable to be impaired by increasing port sizes, as high gas velocity is essential to good carburation and exhaust extraction. If really high speed is considered necessary, extensive re-design of the head and valve gear, as in the ***Kittiwake*** engine, is recommended.

Water-cooled version

In the water-cooled version, as illustrated in the general arrangement drawings, pains have been taken to ensure a good circulation of water over both the barrel and the head of the cylinder. I know that many engines have been cooled more or less satisfactorily by jacketing the barrel only, and leaving the head to look after itself; but this cannot be regarded as sound practice, because there must inevitably be a wide variation of temperature in the respective zones which, though it does not affect the mechanical working or lubrication, is bound to restrict maximum performance in any substantial running periods. If we are going to water-cool the engine at all, let us take the trouble to direct the water flow where it is most needed.

The timing gear and valve operation are laid out as before, but design is improved by using convex flanked cams and flat based tappets, thereby reducing working load without reducing the mean valve opening. Push rods and rockers have not been altered, as the original type have always worked remarkably well, including the eccentric-bush adjusters? and lubrication could only be improved by greatly complicated design. I have not found enclosure of valve gear advantageous on small engines, and it may sometimes impair the cooling of the vavles to such an extent as to affect the temper of the springs.

No special provision for lubrication is incorporated in the engine itself,, as most constructors do not favour the idea of making and fitting an engine-driven pump, and a simple drip or suction feed has been found sufficient for the normal requirements of the engine. The crankshaft is, however, drilled to enable oil to be fed directly to the big end bearing, as I consider this a necessity to avoid heavy wear and risk of seizure. It is not possible to use the banjo lubricator, as fitted to the original ***Kiwi,*** because of the presence of the ball race adjacent to the crank web.

The original ***Kiwi*** carburettor is retained, though here also minor improvements have been made; the float chamber is modified so that a commercially available metal float can be fitted if desired, and to provide more fuel space. It is possible to dispense with float feed. if the limitations of direct feed. systems are accepted. This carburettor gives quite reasonably good speed control on the throttle, from tick-over to flat out, if properly made and adjusted. A contact-breaker for coil ignition is fitted to the projecting end of the camshaft, designed to make use of commercially available ignition parts.

With regard to the performance of the ***Kiwi*** in its new form, I prefer to make no specific claims, but 1 would remind readers that the original engine produced over 5/8 b.h.p. at 8,500 r.p.m. in a carefully observed dynamometer test. Engines of this type have propelled prototype boats up to 6 ft in length, and lighter craft up to 4ft., attaining speeds up to 8 m.p.h. Hvdroolanes fitted with ***Kiwi*** engines produced speeds up to 40 m.p.h. before the war, and with the present-day type of hull considerably higher speeds might reasonably be expected.

*** To be continued on August 18***

GREAT EASTERN

Continued from page 133

placement, and so on, is as accurate as could be ascertained from the research.

It should be brought out at this point, and probably should have been mentioned sooner, that an article in **MODEL ENGINEER for *4*** December 1958 by T. Leon Cook, on the modelling of the ***Great Eastern*** was extremely helpful and should be referred to when this article is read. Nearly all of Mr Cook's observations and statements are applicable to the ***Great Eastern*** model that I made. I corresponded with Mr Cook on this subject. The only significant changes are in the funnels and lifeboats, there are two more boats on my model.

After roughing out the hull, I used a file to get the final shaping done, and then used a great deal of all grades of sandpaper to get a final smooth finish. I should have used a filler type of compound here also, but I didn't-much to my embarrassment later, when I had to remove a lot of material and apply a filler to seal up all the joints between layers and the blemishes caused by handling the model.

I applied several coats of shellac, each sanded smooth between applications as a paint base, and then used a white undercoat as a working coat while assembling the model components. After that, I applied between three or four coats of a black enamel of an eggshell texture and finish to get the best representation of the way the original ship looked.

The ***Great Eastern*** had a large number of skylights in neat rows and many entryways and hatches into the interior of the hull. These were ma& from shaped pine, cut to size. Again, I resorted to the sepia prints to represent the entryway tops and the windows of the skylights. There were four small skylights almost flush with the deck and one large skylight amidships. The sepias were used for this.

The funnels were fashioned from copper water tubing, slightly flattened to an oval shape; threads were glued around at intervals to represent the original joints. The top had a thin piece of-copper wire soldered on to simulate the wider cross section. The larger lower section of the funnels was formed by wrapping drafting tape around the funnel base. The funnels were securely fastened by using a great quantity of glue on the inside to hold them on the decks. There were also two tubes fore and aft of each stack or funnel, were simulated by small hollow brass tubing fastened to the funnel by a twist of wire and a dab of glue inside the funnel. The inside of the funnels was painted black the outside a cream or buff color.

**** To be concluded on August 18***

KIWI MARK II

Continued from 4 August 1960. pages 15 to 17

Machining the crankcase castings of the famous small petrol engine in its new up-to-date version

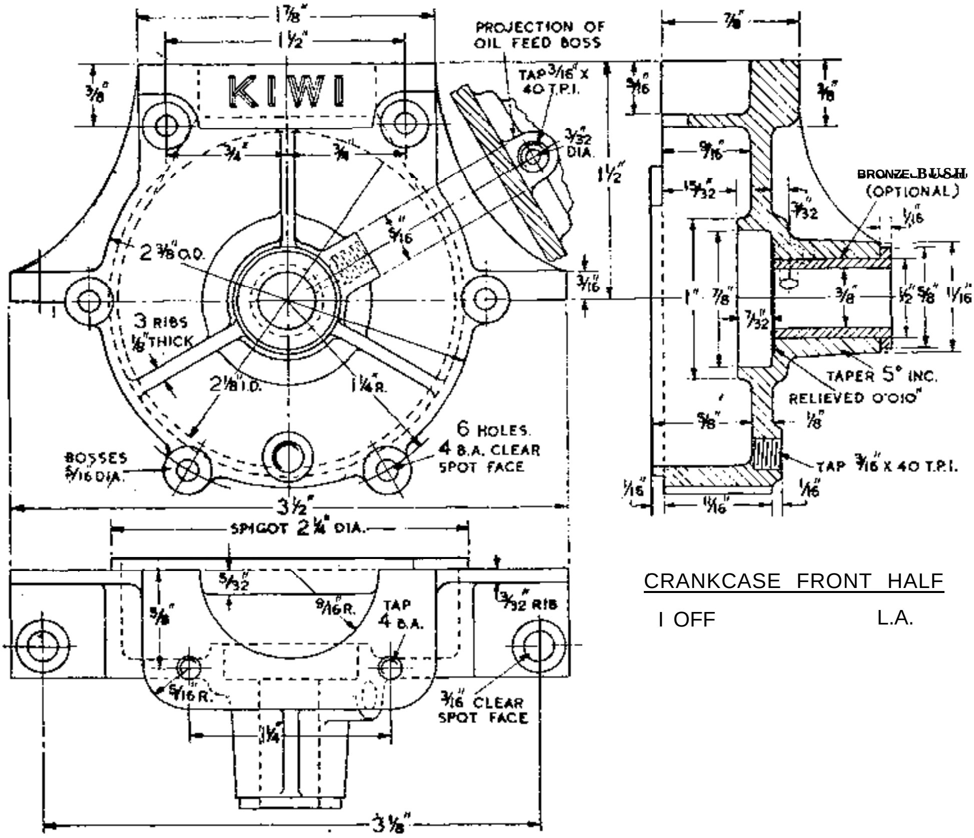
By Edgar T. Westbury

IN the design of the main structural components of the engine, several concessions have been made to popular modern trends, including general stiffening-up of sections, as already mentioned. The crankcase, which broadly follows orthodox motor cycle engine practice in being divided on the vertical transverse centre line, has a ribbed main bearing housing on one half and on the other an extension which forms a casing for the cams and timing gears.

The original *Kiwi* had plain bearings throughout, but most constructors nowadays prefer ball races. for the main journals at least, and I agree that these have certain advantages for machinery running at high speed with heavy load. But they cannot give their best service unless they are properly fitted, truly aligned, and adequately supported in rigid housings. It can be stated that the plain bearings gave very good service and showed very little wear after years of hard use and, at times, even abuse. If readers do not wish to go to the trouble of fitting ball races, the main housings can be bored parallel to 1/2 in. dia., and bushes 1 in. long fitted in each half, the flanges now on the inside, and the bosses in the castings being either machined back or recessed to take them.

Machining operations on the front half of the crankcase are fairly straightforward, as the facing, boring and recessing can all be done at one setting, and indeed must be, if positive accuracy is to be ensured. The casting has an extended boss on the main bearing which can be used as a chucking piece, but care must be exercised in setting up, as there may be some roughness or inaccuracy which would throw the whole thing out of truth or impair the security of the grip of the chuck, unless precautions are taken.

Generally speaking, I am against the use of chucking pieces on castings; I avoid them except where they are absolutely necessary. I have found by experience that they often encourage slovenly setting-up, as many lathe operators will assume that if



CRANKCASE FRONT HALF

I OFF L.A.

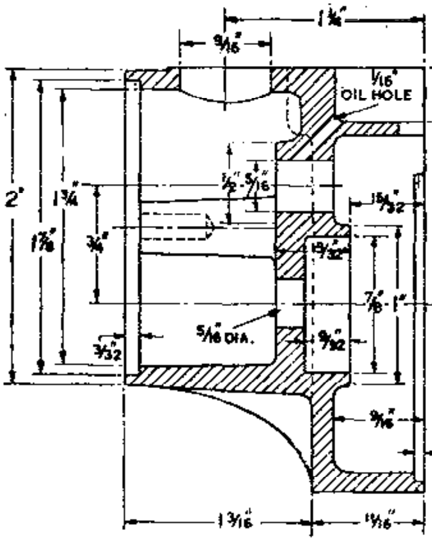
the job is held by the chucking piece in the three-jaw chuck, it must be near enough. Nothing could be more fallacious, and I have seen many castings which have been ruined for all practical purposes by lack of care in this respect. The truth of chucking pieces should never be taken for granted; they are nearly always improved by trimming up with a file, and in many cases it is possible to reverse the job and turn the chucking piece true and parallel as a preliminary to using it for its intended purpose.

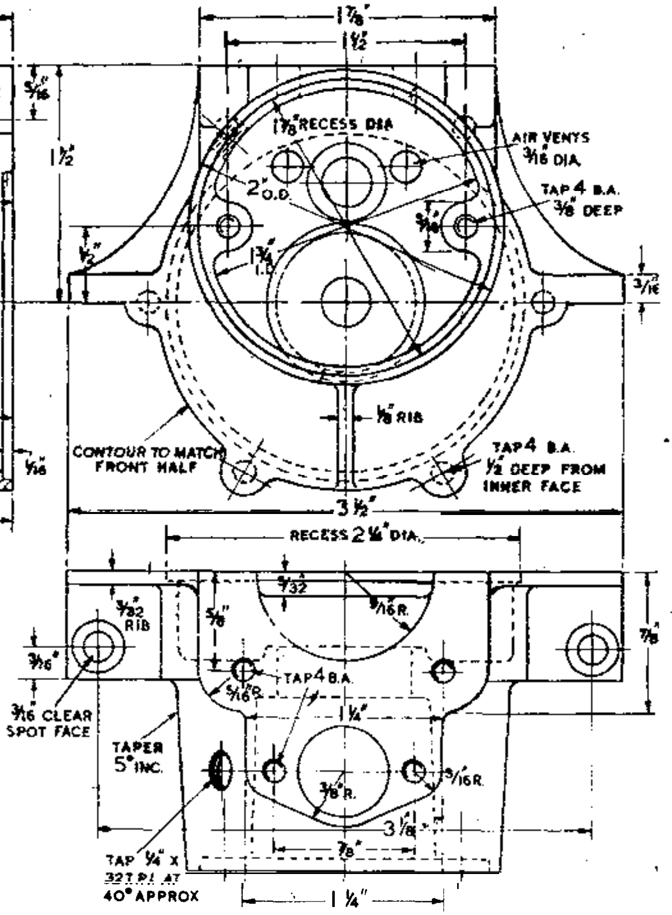
In any case, the casting should run reasonably true on such surfaces as can be checked, before machining begins. These include the housing boss, the front face, and the ***external*** contour of the casing between the bolting lugs. Do not set up from inside surfaces; these, being cored, or cast in the reverse half of the mould to the outside, may not always be in perfect alignment with it. This is a point which is often forgotten, but one cannot take it for granted that moulding boxes line up within fine limits.

The front face and spigot should be machined first, taking dimensions from outer face or cylinder platform, as this gives a datum point for measuring internal depths; if not finished at this stage, the amount allowed for the final cut should be added to depth measurements. An undersize drill should be put through the bearing housing as truly as possible, and opened out with a boring tool to within about 5 thou of finished size, when it can be finished with a reamer or D-bit.

The fitting of a bronze or gunmetal bush is optional, as this ***bearing*** does not take excessive load, and the shaft will run quite satisfactorily in the aluminium casting; but a bush can always be renewed when wear has taken place. Some readers may question whether any bearing at all is necessary here, as the load is taken on the ball race; but this bearing serves two very important functions: first, as a steady to support the overhung weight (and possible unbalance) of the flywheel and second as a seal against the escape of oil fed into the crank journal. The alternative would be to fit an oil sealing ring, but apart from the difficulty of obtaining one of suitable type and size, I have found that this is liable to increase friction to an undesirable extent in small engines. About 1 thou interference should be allowed for pressing in the bush.

The diameter and depth of the crankcase barrel are not critical, and any error should be on the plus side to ensure clearance, but both the diameter and depth of the ball race housing should be accurate. I recommend fitting the races to 1/2 thou interference, to cope with differential expansion and possible hammering of the relatively soft metal. To ensure correct dimensions, it is a

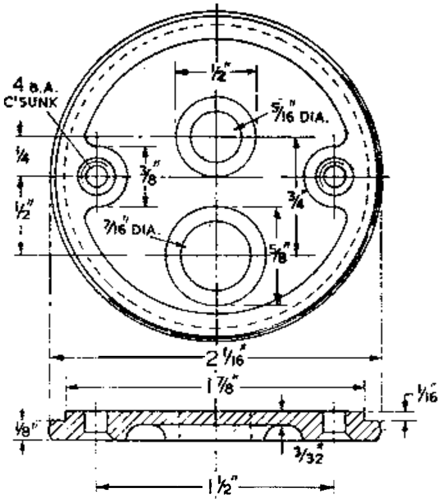




CRANKCASE REAR HALF
1 OFF L.A,

MODEL ENGINEER INDEX

THE index for Vol. 122 (January to June, 1960) is now available. This lists the titles of articles during the past six months and also includes subject and authors' indices. Send 1s. postal order to the Sales Department, Percival Marshall Ltd, 19-20 Noel Street, London Wl, for your copy.



TIMING ENDPLATE 1 OFF L.A.

good idea to turn up a simple plug gauge from any odd bit of material, 12 thou less in diameter than the ball race, and to bore the housing so that this will just enter. a tight vush fit. A slight -taper on. the extreme end will help to show when the bore is approaching the correct size. Do not forget to relieve the inner face of the recess.

When the ball race is inserted, it is advisable to make a mandrel to fit closely in the bore, with a pilot to fit the bush or the bore of the housing, to guide it squarely into position. The ball race should be pressed in, or drawn in by means of a screwed mandrel, and it will go in easier if the casting is heated in an oil bath. But this should be the last operation on this component, as otherwise there is a risk of swarf getting into the race, and this is difficult to remove. The radial oil hole in the bearing housing may, however, be drilled and tapped before laying the casting aside.

Operations on the rear half of the casting are somewhat more involved; and as it is hardly practicable to provide a chucking piece, setting up is rather more difficult. It is vossible to hold the timing case extension eccentrically in the four-jaw chuck, but as this is tapered to facilitate moulding, care must be exercised in tightening the jaws. Tapered slips of hardwood or fibre would be helpful here. A more secure method of holding the casting would be by mounting it on an angle plate by the platform surface, having first tiled or machined this flat and square with the joint face.

The main machining, including the fitting of the ball race, is carried out in the same way as for the front half, but it should be noted that here the race is not located endwise, but is free to find its own location, or float. This might be taken to imply that it should, therefore, be made an easier fit in its housing than the other, but I have not found this necessary if it is located by the crankshaft in a way I shall describe later.

From some points of view, it might be found desirable to machine this half of the crankcase first, as it may be easier to fit the locating spigot to the recess than ***vice versa.*** The fit should be really good, as it must be relied upon to align the two halves concentrically. The outer face may be left proud for the time being, and either the spigot or the recess (as the case may be) turned slightly taper at first until the required size is ascertained. While there is spare metal available, it is possible to make good a sloppy fit by peaning the edge with the ball of a light hammer, and re-machining; still, of course, at the same set-up. Contact should be made on the outer face, not on the spigot.

The casting may now be set up in the reverse position for facing and recessing the seating for the timing cover. Although the location of the two bores in the cover is rather critical. the position of the cover itself is less so, if the methods of machining which I propose to describe are observed. It will be quite satisfactory if the casting is mounted on the faceplate, held by clamps over the, ends of the bearers, and set up so that the outside of the timing case runs truly. But constructors who have their own ideas on how the job should be done may prefer to fit a bar or plug across the end of the timing case and to mark out the centres of the crank and camshaft on it, as specified on the drawings, by dead reckoning.

At this stage it is advisable to machine the timing cover casting and fix it temporarily in position by the two countersunk screws. As before. the register should be a close fit, and it is also desirable to take care in drilling, tapping and countersinking the screw holes, as these must locate the cover positively, though it is possible to fit dowels or steadv vins if preferred. After fitting, the cover is removed for the next setting operation.

The crankcase casting is now set over on the faceplate so that the bore of the shaft housing runs dead true. The use of a test indicator is helpful here; alternatively, a locating mandrel, socketed in the lathe mandrel, and turned to fit closely in this bore, may be used, but it must be capable of removal without taking the job off the faceplate, to enable further setting up to be done later. Having centred the bore, and before proceeding further, you should bolt a straight guide strip to the faceplate, in contact with the platform surface of the casting. The timing cover is now secured in position and bored and faced, with- the positive assurance that' the bore will line up exactly with the crankshaft bearing.

To set the casting over for boring the camshaft bearings, a gauge piece exactly 3/4 in. wide should be prepared; it may be in the form of a flat bar or a roiler, correct in dimensions to within about 1 thou, to ensure correct meshing of the gears. The casting is then moved bodily, with the cover in position, till the gauge piece will just go between the guide strip and the platform. Take care that it is not displaced sideways when making this adjustment, as this would not only affect the horizontal location of the camshaft bearings, but would also introduce a plus error in the centre distance. The cover is then centre-drilled, drilled, and bored to size for the camshaft bush, but the drilling should not be followed through into the main casting, as there may be difficulty in ensuring that it starts truly in the inner boss. The cover should be removed, so that it is possible to enter a centre-drill in the face of this boss.

It remains now to bolt the two halves of the crankcase together for machining the cylinder platform and other horizontal locating surfaces.

* ***To be continued on September 1***

KIWI MARK II

Continued from 18 August 1960. pages 203 to 205

By Edgar T. Westbury

Further operations on the crankcase and cylinder castings

FOR the remaining work on the crankcase, the two halves should be fitted together and secured by temporary screws.

The positions of the holes should be marked out on the front or flywheel half; the exact locations are not of primary importance, but the radius and spacing should be as uniform as possible, if only for the sake of neatness.

After drilling and spot facing the holes, the halves may be held together by clamps while spotting the tapping holes in the rear half. If preferred, bolts may be used except in the case of the' two upper holes, which would emerge in the edge of the timing case, but it will not be found as easy as it looks to drill holes right through the depth of the two castings so that they come out central with the lugs.

Setscrews or studs are quite satisfactory so long as they are a good fit and the holes are carefully tapped, using a cutting lubricant and backing out frequently to clear the chips.

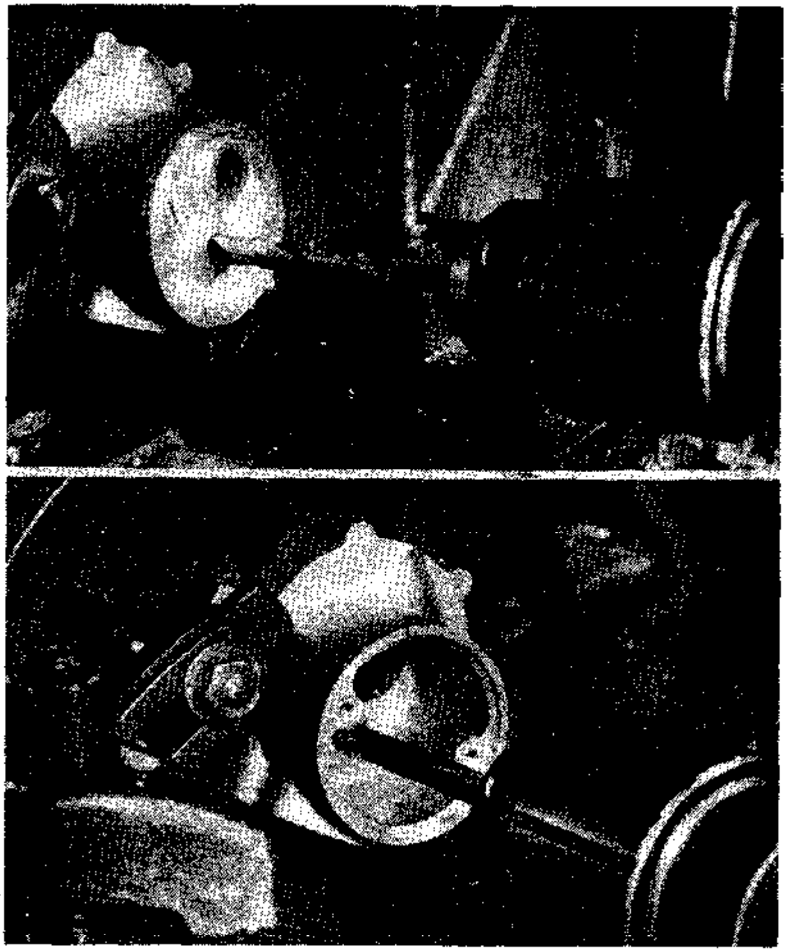
The most important operation now to be done is the facing and recessing of the cylinder platform, the bore of which registers the skirt of the clyinder liner. As this should be a good fit, some constructors may like to defer this operation until the liner is machined and inserted in the cylinder; alternatively, it may be made to dead measurement, or slightly on the tight side, and the liner eased down at the end to fit.

It is, of course, essential that the platform should be exactly parallel with the crankshaft axis, and there are two or three ways of ensuring this. The crankcase assembly may be set up on the surface plate, either upright or inverted, and packed up to level the two bearers and locate the horizontal centre line, using centred plugs in the flywheel end housing and timing case bores. A centre line is then marked along the edges of the bearers, thus providing a guide for filing or machining the underside surfaces, which may then be used as datum faces for mounting on the faceplate, with parallel packings of sufficient thickness to provide clearance under the bottom crankcase lugs.

Another method, which I believe to be simpler and more positive, is to turn a mandrel to pass through the crankcase and fit the bores of the flywheel end housing and timing case. The ends of the mandrel are screwed and nutted, $\frac{3}{8}$ in. BSF, and used to clamp angle brackets by which the assembly is secured to the faceplate.

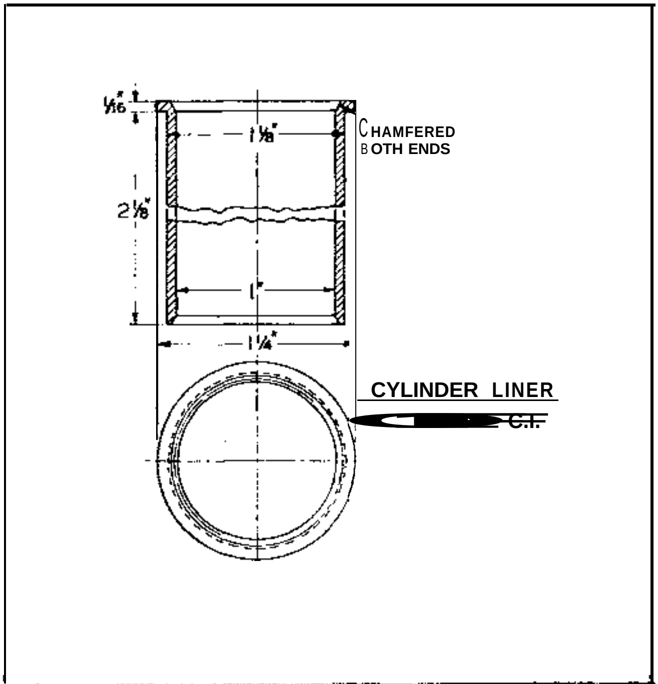
Any angle section material of suitable size may be used for the brackets, so long as the bolting faces are true and the holes for the mandrel (which should be a &ad fit, not clearance) are exactly the same distance from the base surface.

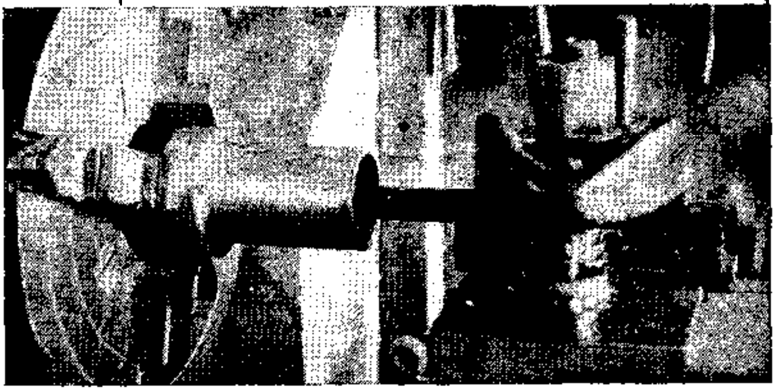
As shown in the photograph, the assembly, when secured to the faceplate, can be moved as required to centre the cylinder platform, which



Operations on the timing end of crankcase: Top: Boring outer camshaft bearing with timing case in situ. ***Bottom:*** *Timing case removed for access to inner camshaft bearing*

Crankcase set up for machining cylinder platform and seating





Rough boring' and turning the cylinder liner

is marked out so that the seating is symmetrical to the sides and the division line of the halves.

Hardwood packings of equal thickness are fitted under the crankcase bearers, and only need to be a tight push fit. These are not absolutely necessary if the work is properly clamped between the brackets,. but they act as steadies, and positively ensure against shifting of the job during the machining operations. This method of setting up utilises practically the full length of the crankshaft as a positive datum line for parallel accuracy.

The distance of the cylinder platform from the crankshaft centre influences the compression ratio, in conjunction with the dimensions of other components. Some constructors may wish to produce an engine to run under load at relatively low speed-not more than 2,000 to 3,000 r.p.m., for instance-and if so, the compression ratio may be reduced, either by leaving more metal on the platform surface, or by fitting packings under the cylinder platform, which is more adautable but less positive.

Low compression is recommended if the engine is to be used for driving a heavy boat such as a tug or cargo liner; the beginner may find it easier to deal with, as it promotes docility and easy starting, and all adjustments are less critical than when the compression is high.

While set-up for machining the platform, the casting may be moved over to bore the seating for the tappet guide. Constructors who have milling equipment available may invert the assembly,. and after checking that the platform is parallel with the faceplate, mill the underside surfaces of the bearers to a uniform level.

It is not essential that this should exactly coincide with the level of the shaft axis, but it may facilitate lining up of the engine when it is installed, if this condition is observed. Further operations on the crankcase are the drilling and spot facing of the four holes in the bearers, drilling and tapping the drain plug hole-not absolutely necessary, but useful-and drilling and tapping the six holes for cylinder and tappet guide securing studs, but the latter should be left until they can be marked off from the respective mating parts.

Cylinder liner

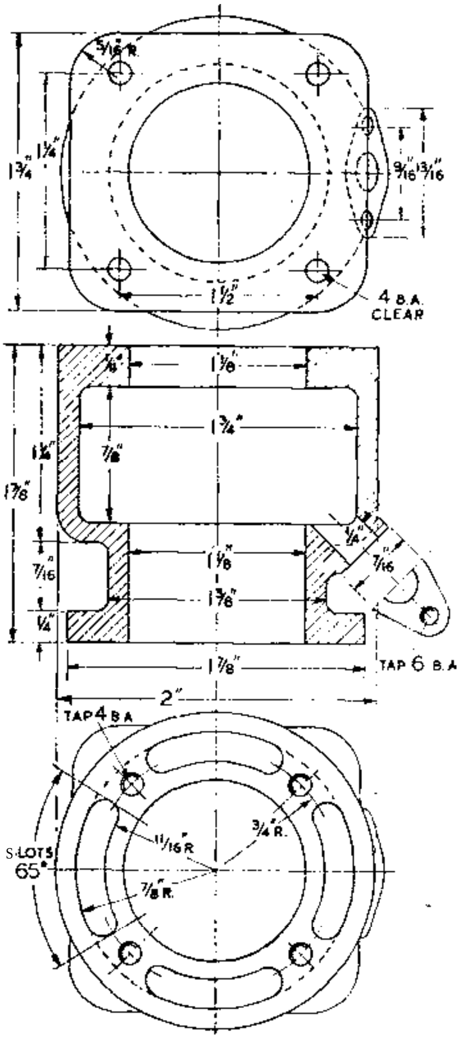
Two alternative types of cylinders and cylinder heads are provided on this engine, for water and air cooling respectively. The former is characteristic of marine practice, and is preferred by many constructors who fit the engines to boats. I can, however, assure readers that from the practical aspects, air cooling is quite satisfactory unless the engine is so closely confined that no breath of air can gain access to cool its fevered brow.

The actual working surface of the cylinder in each case ***is*** in the form of a liner, made in cast iron and machined all over, inside and out. It is advisable to rough machine this first, and leave it for the time being, as cast iron may often be subject to some distortion, after the skin is machined away and internal strains thereby relieved..

The liner casting is provided with an enlarged extension which may be utilised as a chucking piece, so that all the machining may be carried out at a single setting, and the component ultimately parted off. Apart from the avoidance of " second op " re-chucking, this also eliminates risk of distorting the thin liner by the pressure of the chuck jaws.

I am often asked to recommend alternative materials to cast iron for cylinders or liners, either because no suitable cast iron is available or because of real or imaginary difficulties in machining it. Steel is often used, and may give more or less satisfactory results, but it is very liable to scuffing and generally has a short working life. High-tensile or work-hardening alloy steels are better, but are often difficult to obtain, and do not simplify machining. Stamless steel is treacherous, and nitriding steels involve complicated heat treatment.

To the cobbler " there's nothing like leather for good boots," and similarly, to the engineer, there's nothing like cast iron for good cylinders. The machining of this material is not really difficult if proper methods are employed: it will usually be necessary to run the lathe at bottom or second backgear speed for getting under the hard skin of the metal, and tool wear may be heavy during this part of the operation, but afterwards the speed may be increased, though not to anything like the speed normally employed for steel or other metals.



CYLINDER JACKET
1 OFF L.A.

In the case of the cylinder liner illustrated, the final operations on both the inside and outside surfaces were carried out at bottom direct speed,, with fine self-act feed of about 0.005 in. per inch, using high-speed steel tools, keenly honed, and having minimum clearance and no top rake.

A boring bar ½ in. dia. with an inserted cutter was used for boring, and when approaching finished size, several passes were made without putting on more feed, with the object of eliminating any spring in the tool. Difficulties in obtaining a smooth, accurate bore are often directly due to using too slender a boring tool or cutter bar. The bore was left about two thou undersize to be finally finished by lapping after insertion of the liner, in the cylinder.

When machining the outside of the liner, a large " pipe " centre was used in the tailstock to support the outer end, the mouth of the bore having been chamfered at 60 deg. inc. beforehand. After parting off, the top face of the lip was faced and similarly chamfered internally.

Some constructors may prefer to carry out external turning by mounting the liner on a mandrel, but there is some risk of damaging the bore in mounting and removing it, especially if heavy work is carried out. Whatever method of machining is employed, it is of paramount importance that the liner should be accurate, and this cannot be assured by trying to " lap " a badly machined cylinder with a strip of emery cloth round a broomstick !

Always attain the. highest possible tool accuracy before applying any finishing process; this precept cannot be too strongly emphasised.

The water-cooled cylinder

The machining of this casting is quite straightforward, as it can be held in the four-jaw chuck by the base flange for boring and facing. Not more than about one thou interference is necessary for fitting the liner, but it is desirable to take just as much care in boring the seating in the cylinder as the liner itself. Check the location of the top surface

Continued on page 282

wheel arrangement-4-4-2 ? The true Atlantic has outside cylinders, whereas L and YR "Atlantic" type had inside cylinders.

I think MODEL ENGINEER is a good magazine with pieces for all tastes. Please do not alter it.

Chatteris, Cambs. K. DOBBY.

***Mr Dobby is right, of coarse. The genuine Atlantic has outside cylinders.* - EDITOR.**

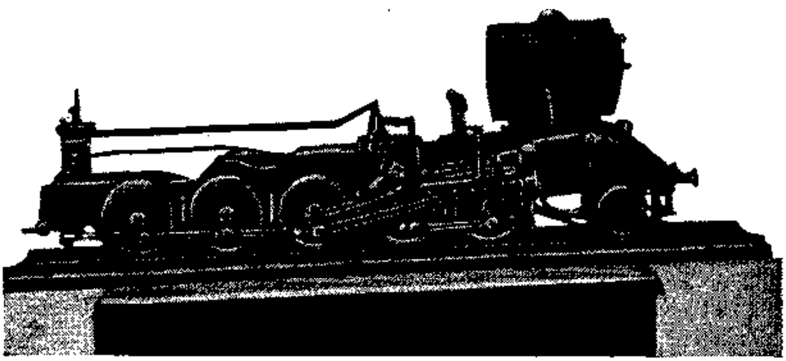
FOLLOWING PROTOTYPE

SIR.-The accomnanvina picture shows my Class 9 under construction.

I would like to thank members of your Query Service for their assistance in answering my queries. I scaled the outline drawing in ME which had all the elementary measurements up to 3/4 in. to 1 ft. The yoke over the leading truck axleboxes got me guessing, so I obtained the drawings of this from the PRO at Euston. I was surprised to find 12 springs embodied in this part. That gave me something

I have departed from prototype by fluting the coupling rods, otherwise I have got as near as I can to prototype.

Isle of Sheppey. H. CROFT.



Side view of Mr H. Croft's class 9 which he is making as near to full-size detail as possible

SHEFFIELD WINNER

Sir,--Qn reading ME for August 4. I was startled to learn that the Ivatt Atlantic locomotive, built by my father and myself, and which won first prize in the locomotive section at the Sheffield SMEE exhibition, is stated by your correspondent "Northerner " to belong now to Mr Douglas Miller of Brighouse.

I should be extremely interested to learn where " Northerner " obtained this information, as it is completely incorrect

Brighouse, Yorkshire. S. S. IBBOTSON.

Apparently " Northerner," who is at present in hospital, was misinformed. He referred, however, to " the Ibbotsons' 7-1/4 in. gauge Zvatt Atlantic " and said that it won them the first prize. We are glad to make it knwn that the ownership of this handsome model has not changed. -EDITOR.

COMPRESSED AIR TRAMS

Sir,-With reference to Mr H. E. Rendalls letter [Postbag, June 161 and the comments - by John H. Ahern [July 14] on the subject of compressed-air tramways, I have some books dealing with this subject, translated from the French, containing many technical details *circa* 1890 from which I can quote.

Illustrated details are shown therein of the charging of the air containers at stops by the wheel flange operating a valve in the centre of the rails as the car reached the right spot and making connection with the car reservoir.

This was the Popp-Conti system. Trains ran through St Quentin, Angoulevme, Lyons, etc., at an average speed in towns of 7-1/2m.p.h., and 18 m.p.h. in the open country. The train consisted of three cars, if required, or one alone.

Air pressure was 355 p.s.i. (25 kgs. per sq. centimetre) which followed Boyle's Law. The boiler referred to by Mr Ahern was the Serpollet semi-flash coiled-tube type. Many of the compressed-air systems also had steam propelled cars as well. Most of the makers of these became well-known 20 years later as motor-car manufacturers-De-Dion-Bouton, Leon-Bollec, etc.

The " Rowan " car had a detachable power unit, coke-fired, fire-tube vertical boiler that would run 12 miles on one stoking from the undertype firebox. Outside cylinders, mounted as a self-contained unit on a separate four-wheeled bogy, could be removed and replaced with another workshop serviced unit in a matter of minutes. A similar car and system was used on the Caladonian Railway as a raicar some 50 years ago.

" Rowan " tramcar was reputed to be of British make, but to judge by the illustration, it reminds one of Wells Fargo. It ran between Fours and Vouvray in 1892-4, and carried 50 passengers. Sometimes a doubledeck trailer was attached carrying 70 passengers, at a speed of 9 m.p.h. A condenser was carried on the roof of the motive-power car.

The French steam systems were tried on the horse-tramways that ran along the seafront through Southwick, Fish&gate, Shoreham, Sussex, about 60 years ago. These connected with the narrow-gauge tramways that started near Seven-Dials, Hove (then Aldrington).

Brighton, Sussex. G. GOLDRING.

KIWI . . .

Continued from page 262

from the external shoulder of the jacket, but make certain that the top and bottom faces of the base flange will clean up to give the specified dimensions.

For facing the underside, the casting may be reversed in the chuck, but care must be taken to bed the top face firmly aaainst the chuck face. or take other-precautions to ensure that it is square with the bore; concentric truth is less important.

The edges of the base flange may be squared by mounting the -casting on an angle plate, base outwards, by a single bolt through the bore, and checking by means of a try-square against the faceplate as each face in turn is brought into position. To face and drill the water inlet flange, the casting may similarly be attached to the vertical slide or an angle Dlate. mounted on the lathe cros-slide at 45 deg., and machined with a fly cutter, prior to locating centrally for drilling.

Although the water communication slots in the ton face of the cylinder do not coincide with similar slots in the head, their object is to bring the water into contact with as much of the surface of the latter as possible. They may be end milled, or formed by drilling holes as close together as possible and filing them to join up with each other. Leave sufficient metal between these slots to give adequate anchorage for the cylinder head studs.

To be continued on 15 September

KIWI MARK II

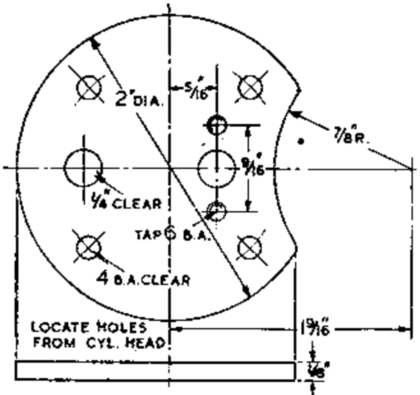
By Edgar T. Westbury

Continued from I September 1960, pages 260, 261 and 262

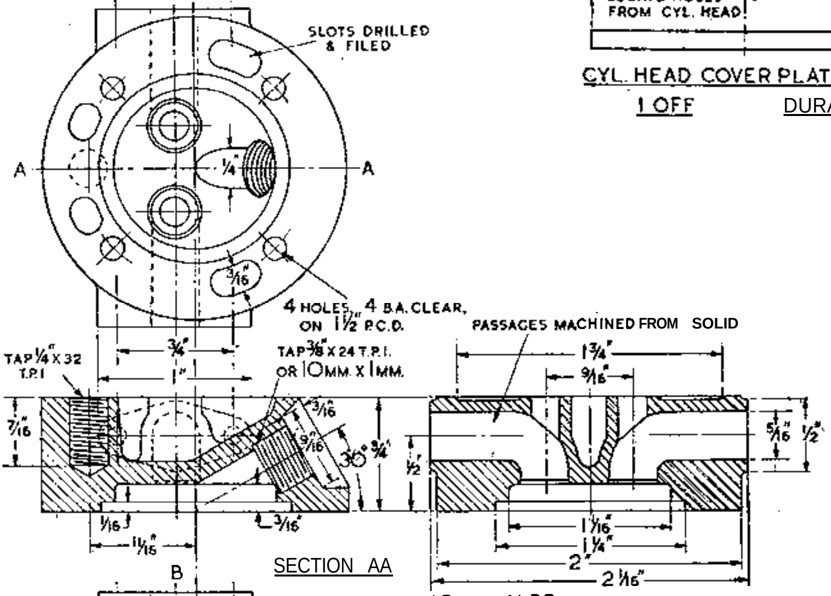
Water-cooled or air-cooled ? In this instalment EDGAR T. WESTBURY deals with both types of cylinder for the modern version of his famous little petrol engine

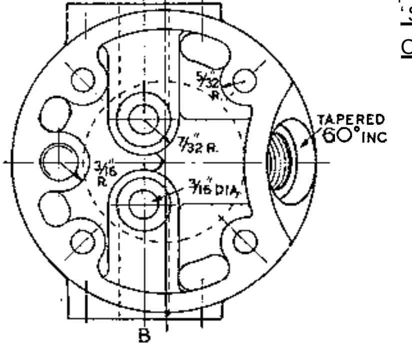
THE casting for either the water-cooled or the air-cooled cylinder head may be made in aluminium alloy or bronze. While bronze has some advantages both in wearing properties and heat conductivity, its weight may be objectionable; the lighter material has been found quite satisfactory in practical tests.

Some constructors fear that valve seatings in relatively soft aluminium alloy may give trouble or may wear rapidly, but if the metal is of good quality and homogenous it appears to have the property of work-hardening, and its durability is much better than might be expected. Inserted bronze or stainless steel seatings are practicable, but they are rather finicky things to fit properly in so small a size, and they sometimes prove to be more trouble than they are worth.



CYL. HEAD COVER PLATE
1 OFF DURAL





CYLINDER HEAD 1 OFF
L.A. OR BRONZE

The top face of the casting should first be machined, by holding it in the four-jaw chuck, the surface of the outer rim with stud bosses, and the inner bosses for the valve guides being all faced off to the same level, leaving the cavity as deep as possible, and a definite clearance over the top of the valve passages to allow free water circulation. It is better to increase

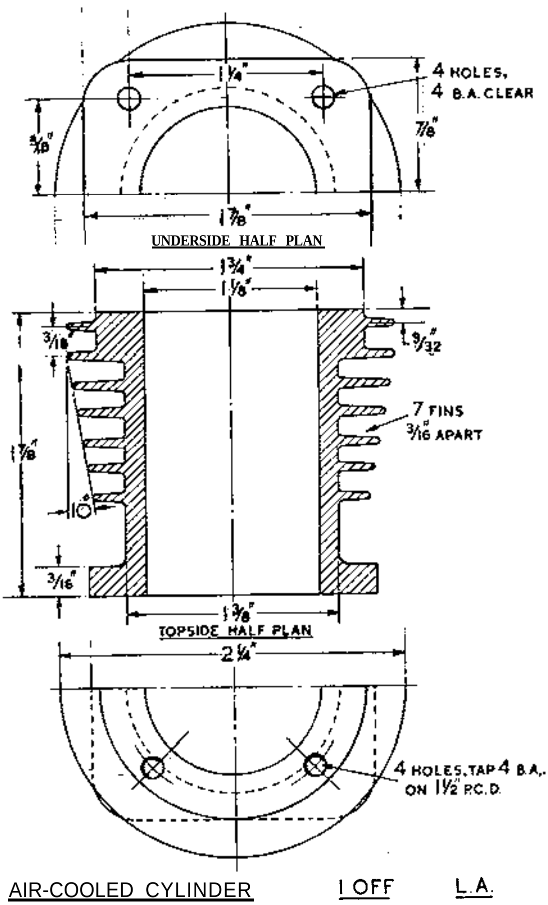
Boring the water-jacket casting

the vertical thickness of the head than to restrict the water space, as this dimension is not critical, so long as it is allowed for when fitting valve guides and other components.

After reversing the casting in the chuck, the bottom face is similarly dealt with, and the recess which registers with the spigot of the cylinder liner, and also that which forms the combustion space., are machined. A tight fit on the spigot is not necessary, and the depth of the recess should be adjusted so that it bears hard on the liner and shows barely perceptible clearance, just enough to insert the thinnest feeler guage, between the outer faces. In final fitting, the spigot is lapped into the recess until the outer faces make contact. This assumes that no packing is to be used between the head and water jacket; if it is, the *compressed* thickness of the packing must be measured, and allowed for.

Of course, the depth of the combustion head affects the compression ratio. Either this or the overall length of the cylinder, as already explained, may be varied to suit the duty for which the engine is required. Some constructors make a major issue out of calculating the compression ratio, but it is quite easy to find by test the ratio which suits the working speed range of the engine. High compression is good for efficiency, but it puts heavy load on working parts, makes control more difficult, stresses plugs and ignition generally, and may make starting more difficult. If your engine does the job required at moderate output, it will work more comfortably and last longer with lower compression. The dimensions shown give the highest ratio recommended for general purposes.

It is not generally convenient to core out the valve passages in small cylinder heads. In most of my engines I have found it quite easy to machine them from the solid. To mark out the positions for the valve ports and passages, the casting may be held vertically in a small machine vice, or other fixture on the surface plate, in such a way that access to both sides is obtained, so far as possible. Set it first with the centre line of the long passages vertical, and mark out the centre of the combustion head; then turn it at right angles and mark the



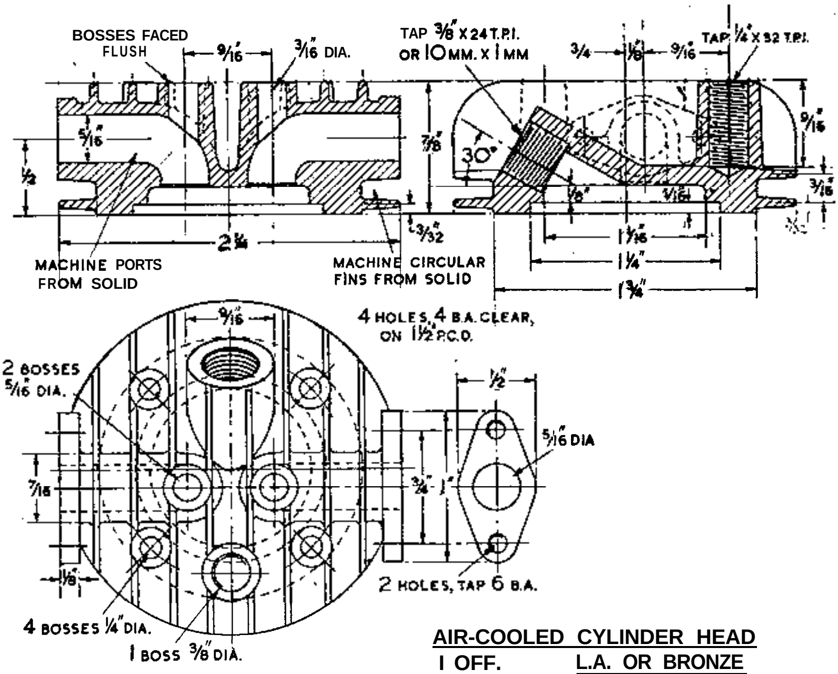
Top: Air-cooled cylinder head, attached to a flat plate, set up in the A-jaw chuck for boring valve parts; note the use of a round-nose D-bit. Above: Cylinder head set up on angle plate for facing flanges and boring passages cross centre line. Set the scriber point 1/8 in. higher (or lower, as the case may be) and mark the centre line of the valve ports on the inside, top, and the faces of the inlet and exhaust flanges. The casting is now turned back to its former position. After checking on the centre line already made, scribe further marks 9/32 in. above and below this line, on the inside and top surfaces. In this way, not only are the essential centres for drilling operations located, but a check is made on the position of the valve guides, in relation to the bosses on the upper side. The intersections of cross lines are then lightly centre-punched.

The casting may now be set up, either in the four-jaw chuck or clamped to the faceplate, and each of the valve ports in turn be centred for drilling and boring. Although critical tool room accuracy is not necessary, some form of centre-finding device, such as the simple "wobbler" described in the ***ME Lathe Manual, will*** be found very useful for setting up to a centre-dot.

After the port has been deeply centre-drilled, it should be drilled right through undersize for the valve guide, and cotmterbored, also undersize, for the port. Unless one can be certain that there is no deviation of the drills, it is advisable to finish both bores by means of a single-point boring tool, as it is highly essential that they should be true and concentrically aligned. It is better to open the guide bore out and fit an oversize guide than to risk any inaccuracy here.

It will be seen that the port has a rounded comer instead of a sharp right angle where it joins the horizontal passage. Constructors are often in some difficulty to understand how this can be found. While the engine would work with right-angled passages, it is clear that they offer a good deal of resistance to smooth gas flow and, in the case of the exhaust passage, form a heat trap which may affect cooling efficiency. The first stage in producing this passage is to use a round-ended bottoming tool in the vertical port; a simple D-bit, 5/16 in. dia., with the end formed to the radius of the comer (approximately 3/8 in. r.) will be quite suitable. It is not necessary to machine the 45 deg. seating at this stage as it can best be done later with a piloted hand tool after the guides are fitted; if preferred, a very slight chamfer can be put in the mouth of the port with the boring tool.

The casting can now be set on an angle plate for facing the flanges, and boring the horizontal passages, from each side in turn. To ensure that they are wrrectly aligned, the centre line



AIR-COOLED CYLINDER HEAD
I OFF. L.A. OR BRONZE

previously marked out should be squared off from the faceplate before clamping the casting down; setting up is then carried out by shifting the angle plate bodily. After facing and centre drilling, a hole about 3/16 in. dia. is drilled until it just barely breaks into the valve port. This is followed by a 5/16in. drill for a depth of about 1/2 in.

A simpler way, which gives quite satisfactory results, is to centre-drill the flange faces either in the drilling machine or by a hand drill, and to mount the head crosswise between the lathe centres. This will enable each flange in turn to be faced, after which, with a drill in the lathe chuck and the opposite centre against the tailstock centre, the head can be held by hand for drilling and opening out as before. In either case, the rounded D-bit is used for finishing the passage; by holding the work with the valve ports uppermost, the exact point at which the bores fair nicely into each other can be observed and controlled. This will leave superfluous metal in the inner side of the comer, which can then be removed by means of a riffler or a rotary file, after other major operations are completed.

The hole for the sparking plug may now be drilled, tapped and faced. While it is possible to carry out this operation in the drilling machine, using an adjustable angle plate or packing block, I strongly recommend setting it up in the lathe, for reasons which I have explained on several occasions. The precise angle at which the hole enters the head is not critical, but some care is necessary in locating it so that there is no danger of approaching too close to either the valve seatings or the joint recess, as it emerges on the inside of the combustion space. It will be seen from the drawing that the centre line of the hole meets the vertical centre line of the head at the level of the bottom surface, but it is not easy to mark this out on the outside of the casting to ensure correct location of the starting point.

A metal or hardwood packing block, with the top face cut to an angle of 30 deg., may be attached to an angle plate for mounting the casting. The simplest way to clamp it in position is to drill the holes for the holding-down studs and use temporary screws. Before attaching the casting, the position of its cross centre line should be marked out on the surface of the packing block, and, either on the surface plate or the lathe faceplate, a scribing block should be adjusted for height so that the scriber point is exactly level with this mark. When the casting is fixed in position, the outside of the plug seating is marked out at the same level; the mark, in conjunction with a vertical cross line, locates the centre hole both ways. After centre-punching at the intersection, it is set up by shifting the angle plate on the faceplate, so that the dot runs truly.

● *Continued on page* 346

workshop and the new job turned out verv well.

Thank you for all you have taught me. The Ford people in Cork have driven the car and were impressed by its behaviour.

Dublin. J. F. HICKIE.

HELP FROM LUTON

SIR,-A Newhaven reader has asked for drawings of a triple-expansion engine [ME June 9]. In about 1930 I bought a copy of a drawing of a triple-expansion marine engine from Thomas Reed and Co 184 high Street West Sunderland nautical publishers. It is highly unlikely that the drawings are still in print, but M.I.B. may be able to obtain one of them.

The details of the engines are: h.p. 14 3/4 in., i.p. 27 in., l.p. 39 3/4 in. x 27 in. stroke; air, feed, circulating and bilge pumps worked by levers from the i.p: crosshead; steam-reverse; 450 i.h.p. The drawinas are on two sheets in 1 in. scale: section elevation. front elevation, side view, plan of boiler engines and pipe layout.

If M.I.B. is interested in these drawings and cannot obtain one, would he please write to me here at 37 Nunnery Lane ?

Limbury, Luton, Bedfordshire. R. A. BOXFTELD.

HAPPY DAYS

Sir-This week I found on the tray of new acquisitions in the Cambridge University Mr J. N. Maskelyne's splendid book Loco-*motives I Have Known.*

I am a humble contemporary of Mr Maskelyne-he was born in the early Nineties, and I in 1889, in S.W. London. It is possible that we were both watching the Brighton trains on Tooting Bec and Wandsworth Commons at the same time.

In the autumn of 1900 I made my first journey on the GWR, when I went to Devon bv the down " Dutchman " with my parents. From then on the GWR had the first place in heart, and I spent many happy days at Paddington, at the end of No 8 platform, whence could be seen all the trains arriving and departing-except those which went by Bishop's Road on to the Metropolitan.

The suburban and Windsor trains were headed by 2-4-0 tank engines with only a weatherboard for the protection of the enginemen, who must have been a hardy lot. Many of the engines were fitted with forward cabs-which afforded no protection when the engine was travelling bunker first.

I am sorry Mr Maskelyne makes no mention of these famous little engines. Like the Stroudley 0-4-2 tanks they had a tine turn of speed. They headed Windsor trains, some of them first stop Slough, reaching speeds of 50 to 60 m.p.h.

These wonderful little engines were just as famous, and equally capable of hard work at high speeds. as the Stroudley engines.- A complete account of them is given in The ***Locomotives of the GWR,*** Part 6, published by the Railway Correspondence and Travel Society in 1959.

Stapleford, Cambridge. REVD H. P. HART.

HOME TO BED

SIR,-When I was ten years old I used to watch the showmen's engines at work as the fairground was at the end of our street and my father, who was a fitter and turner, used to drag me home to bed. He was iust as thrilled with them as I was; and he often had to make new parts for them if there was a breakdown.

Gateshead, Durham. T. G. WHEATLEY.

KIWI.. .

Continued from page 324

The seating for the plug may now be faced and centre-drilled, and an undersize drill about 3/16 in. dia. run through. If there is any doubt about the correct location of the hole, the casting may be removed from the packing block for inspection of the inside; any error, which may then be found can be corrected by re-setting, before opening up the hole to tapping size by means of a small boring tool. Note that the tap is not run right through the full depth of the hole; for one thing, it would be liable to deflection bv cutting on one side only. and, for another, it% very undesirable to have the serrated edges of the thread exposed on the inside of the combustion head, to collect carbon and form a possible focus for pre-ignition.

Both in the drilling and tapping operations, an oblique hole like this calls for more than ordinary care, as it is very easy to run out of truth, but if the work is tackled in the way described there should be no real difficulty. The outside of the hole is recessed to clear the body of the plug, and tapered at about 60 deg. included angle to give access to a tube spanner. Either 3/8 in. x 24 t.p.i., or 10 mm. x 1 mm. plugs may be used; the 10 mm. being designed for full-size engines, are likely to be the more reliable, but their abnormal length is a disadvantage. It may be noted that the angle of the plug has been reduced, compared with that of the original Kiwi engine, to improve appearance and economise in overall vertical space.

The cylinder head cover plate is just a plain disc which may either be machined from a casting or trepanned from sheet metal; it is, of course, important that it should be ***flat*** and true, especially on the underside joint face. After the positions of the holding-down studs from the cylinder head. have been slotted, it may be bolted to the cylinder head and the holes for the valve guides and the rocker pillar located and drilled. These holes may be opened out slightly oversize so that there is no risk of misalignment, which might possibly throw the valve guides out of truth.

Air-cooled

The operations on the air-cooled cylinder and head parts differ only in detail from those described for their water cooled counterparts, the liner being identical, and fitted to the same limits, though it may be somewhat tighter if means are available of pressing it in quickly while the casting is heated to a moderately high temperature. Too tight a fit, will only result in a risk of cracking the barrel when it cools, and I have found that about 0.001in. interference is quite sufficient. The casting for the barrel, set up in the same way as the water jacket, is turned all over the circular portion, and after gashing in the fins with a parting tool, the parts should be finished with a tapered form tool having a rounded nose; both the taper and the radius at the root have an important bearing on cooling efficiency. Use plenty of lubricant for operations of this nature.

With the air-cooled cylinder head casting, the same procedure, starting with the facing of the top to level off all the bosses, should be followed; but while in the reversed position for machining the underside. the circular fins are machined from solid. Further operations are identical with the water-cooled head.

If it is intended to make ***interchangeable*** cylinders and heads for water and air cooling, it is advisable to make jig plates, with suitable registers, for drilling the holes for the holding-down studs, both at the head and base; otherwise there may be some difficulty in locating them sufficiently accurately for an easy changeover. They are worth while in any event,. at least for the cylinder base, as it is not as easy as it looks to locate holes which cannot be spotted through from mating parts.

** To be continued on September 29*