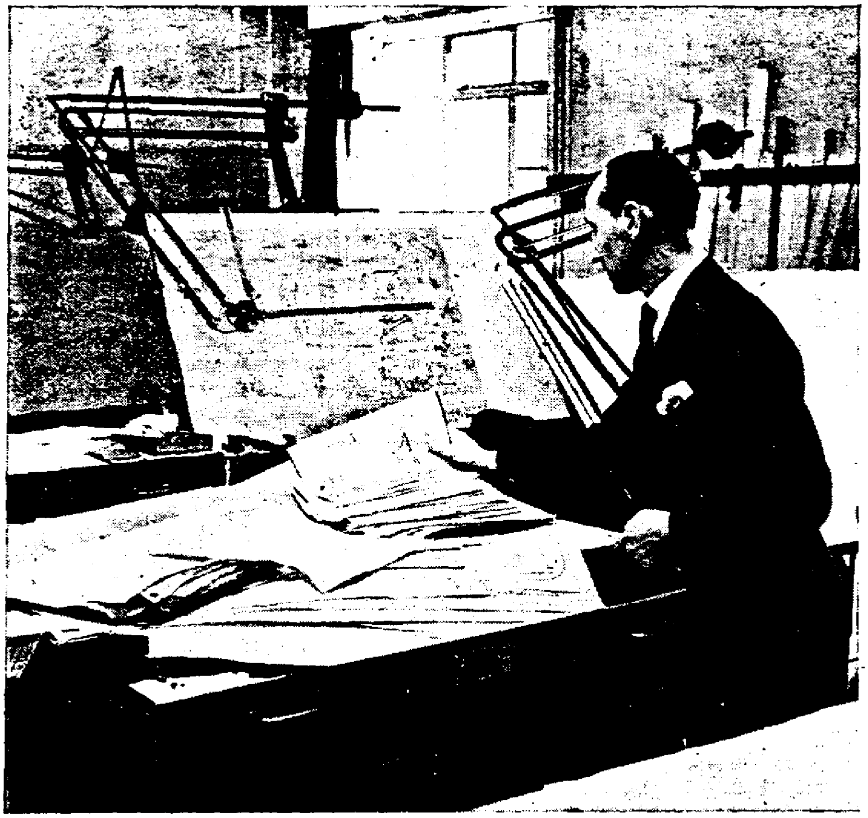
WHAT MANUFACTURE

"Torrens" Takes the Reader Behind the Scenes and Reveals a Little of What Making a Motor Cycle Means



This photograph shows the pile of drawings involved in the manufacture of a well-known and very popular motor cycle. "Torrens" says: "Not counting those covering nuts and bolts, there are 305 separate sheets of drawings, each with twenty, perhaps fifty dimensions marked on it"

A CAR manufacturer has given three years as the length of time necessary to get a new-model motor car on to the market. Obviously, a motor cycle will not take so long. My guess is probably just as good as, and no better than, that of the next man, and what I am going to do here is to place some facts before you and leave you to assess things for yourself.

First, of course, a manufacturer has to decide the broad outlines of the new design. What is the machine to be? To whom is it to appeal? Is it to be a machine designed as a whole or use made of existing components? Are all the components, other than, say, magneto and carburettor, to be made in the factory or specialist manufacturers utilised, as, for instance, of gear boxes, brakes, front forks and even engines? If the latter, is the proposal to employ units which are new and special or mate in with the requirements of other motor cycle manufacturers?

These are only some of the factors, though on them depends, of course, the length of time it will take to get the prototype machines on the road and that required to prove them previous to going ahead with production for the public. In the accompanying picture you see the pile of drawings involved in the manufacture of a well-known and very popular motor cycle of to-day. Not counting those covering nuts and bolts there are 305 separate sheets of drawings, each with twenty, perhaps fifty dimensions marked on it. I show two of the drawings as examples.

Heart-searching Decisions

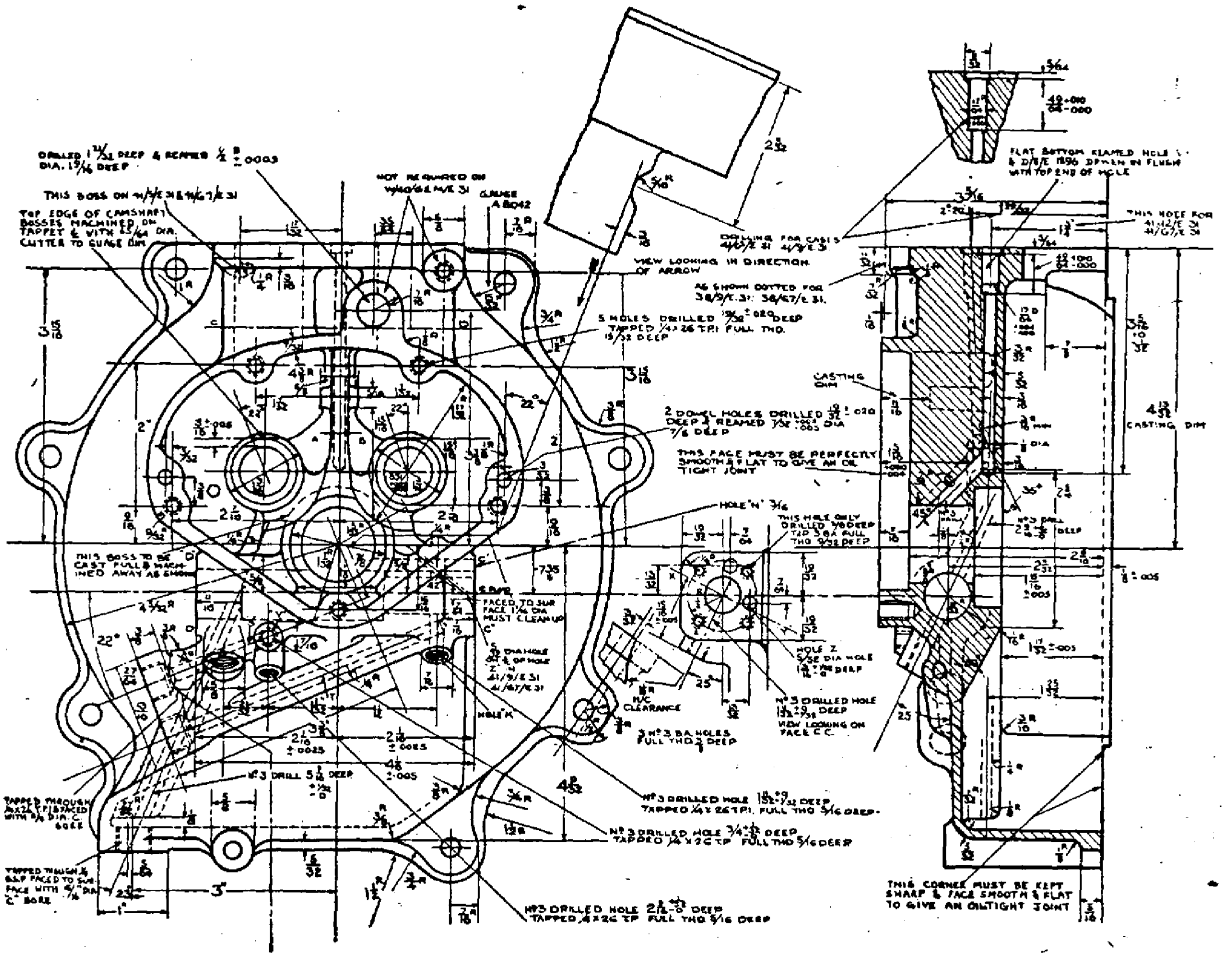
All these drawings have to be made, each calling for skill and each occupying time, and this work is not the first stage, but follows heart-searching decisions regarding this and that, and general-arrangement drawings. The drawings apply to a machine for which the gear box, the saddle, the electrical equipment, the carburettor and the petrol taps are "bought out." If the drawings applicable to these components and fittings were included, the number, of course, would be even larger.

After the general layout has been planned there may be a mock-up—a "machine" made largely of wood and sheet metal, which the directors, sales side and agents can examine from every angle in order to see whether the final machine is likely to have the necessarily alluring looks. Maybe artists will be called in to give their views: to suggest a modified curve here, a different line there: In any case, the firm's advertising agents will be brought into the picture. One manufacturer used to make a practice of spurring his advertising agents to fresh heights in his pictorial advertisements—of encouraging them to make machine and scene as appealing as they could—then he examined the drawings, and, if he liked the fresh curves with which his models were endowed, proceeded to copy the lines in his next year's design!

Machines for the Testers

That, however, is by the way. What I want to give is an indication of what lies behind the production of a motor cycle. I have touched on the preliminary stages. When the drawings are completed there are the prototypes to be made—the machines which are to be tested day after day, week after week and, maybe, month after month, in order to discover weaknesses, iron these out and to develop the design so that it performs and behaves, if possible, even better than the designer dared hope. Making these machines, with almost every part "two off" or, perhaps, "six off," takes time—a lot of time, because there are patterns, castings, forgings, parts to be machined from the solid and nearly all the work of manufacturing the bits has to be car-

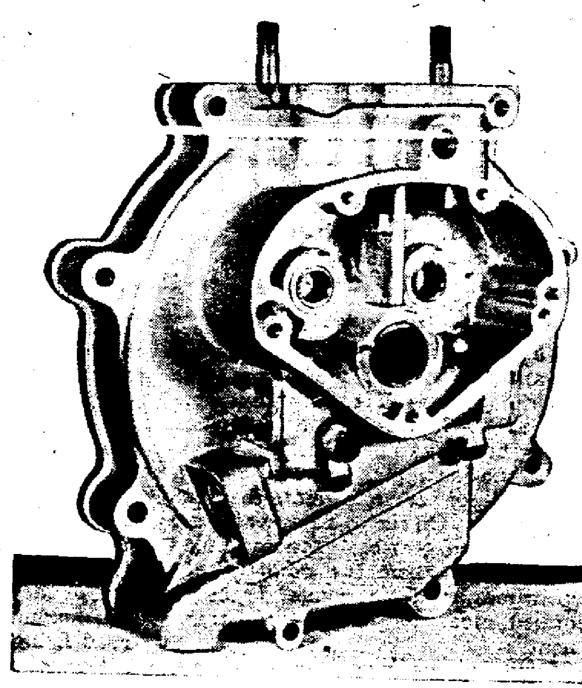
INVOLVES ——



ried out in the tool-room. No doubt, after the present business, some time will be saved as a result of the way the technique of fabricating parts by welding has developed, but the process will still be much too long drawn out for the likes of a manufacturer yearning to launch a brand-new model. This time, however, there must be no marketing a new model until it has been proved in its entirety, of that manufacturers are agreed. Hence, even when the prototypes have been made, several months are likely to be absorbed in testing—how many depends upon how much of the machine is new and how the machines shape on the bench and on the road.

Meanwhile, however, the maker, satisfied with the general conception of the machine, can get ahead with the jigs, tools and fixtures for the production of the machine on a commercial scale. Those drawings, therefore,

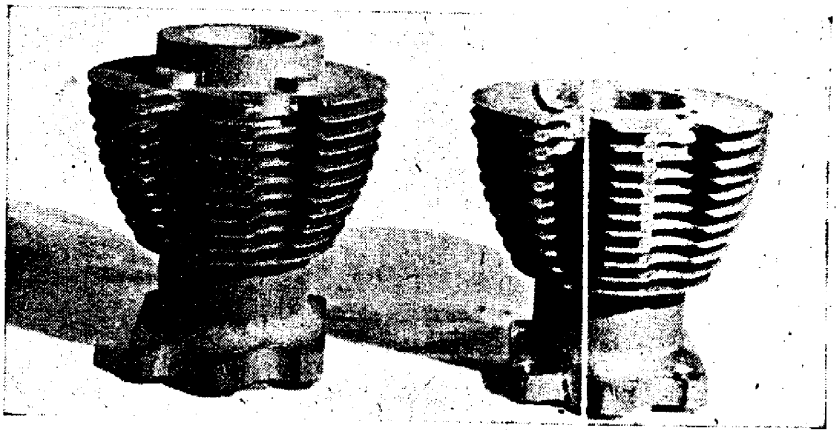
(Above) A working drawing of the timing-side crankcase half. This reproduction gives a slight idea of the work involved in producing a single component



(Right) Here is the casting after the 29 separate operations enumerated by "Torrens" on the following page

What Manufacture Involves—

are not the only ones. The jigs have to be designed. Possibly, special machine tools have to be acquired. When everything has been planned, costed and set up and everyone put wise as regards his or her task, with the raw materials ready and waiting in the factory, manufacture of the finished product gets under way. Probably, if you have not actual factory experience, you have little idea of the number of operations involved in the manufacture of that apparently simple piece of mechanism, your motor cycle.



(Left) The cylinder casting for an overhead-valve engine as received from the foundry; and (right) the finished barrel, which calls for no fewer than ten operations

What They Make

I have already mentioned some of the articles which the firm producing the motor cycle I have in mind do not make, but buy out. They carry out no forging or casting, and the figures I shall give do not cover the winning and processing of raw material, nor extruding tubing, butting tubing, making spokes, producing brake linings, and manufacturing pipe unions, such as for petrol and oil pipes. They make the majority of their own nuts and bolts, bend their exhaust pipes and handlebars, make up their own control cables, and manufacture petrol and oil tanks and silencers. They even make their own big-end bearings, other than, in normal times, the rollers, which are bought from specialists. You will realise from this that they are motor cycle manufacturers in the true sense, not assemblers.

Having told you all this I will now give the number of operations involved in the manufacture of the parts which they make and in the assembly of the machine. It is no fewer than 1,900. This, I must add, does not count each and every nut of a given size, or each and every set-screw; the figure covers solely the number of different operations—machining, manipulating and assembling.

Gear Box Parts

If every nut and bolt was included the figure would be very much higher. As an instance, let us consider the proprietary gear box. In this there are 208 parts which the gear-box maker buys in a finished state—studs, nuts, bearings, etc. On these parts there will, of course, be more than 208 operations. On the 97 parts which are made in the gear-box manufacturer's own factory there is a total of 460 operations, and this figure, I am informed, does not include heat treatment.

I will not endeavour to delve into the number of operations involved in producing the carburettor, the saddle and the tyres, nor the many that must be required to produce a magneto, dynamo, head lamp, tail lamp, switch, wiring, etc. I do not want to make the figures astronomical. Instead, I will touch upon two parts, one essentially simple and the other about as complex as one can find on the particular machine. We will take the simple article first. As you will see, I have picked on the cylinder barrel. The engine is of overhead-valve type and a single-cylinder, so the barrel is, on the face of things, little more than a ribbed tube of cast-iron with flanges at the top and bottom.

Multi Operations

Our simple cylinder barrel calls for ten operations, and some of these are of a many-things-at-once type. Assume that we have a cylinder casting in front of us just as it has come from the foundry. The first operation consists of rough boring the cylinder a distance of about 2in. up barrel, machining the flange and spigot that form the cylinder base, chamfering the mouth of the barrel and radiusing the back of the flange. For this multi operation the cylinder casting is held by means of a spigot at the cylinder-head end. A roller steady then goes in the rough-bored portion and operation No. 2 is performed. This comprises removing the spigot at the cylinder head end which is no longer required, having fulfilled its mission, facing the head end and forming the small internal chamfer. Next comes the twin tasks of roughing and finish boring the cylinder bore, leaving 2/1,000in. to 3/1,000in. for honing. Operation No. 4 is drilling the requisite holes at each end of the barrel—those for the cylinder holding-down studs and for the head fixings.

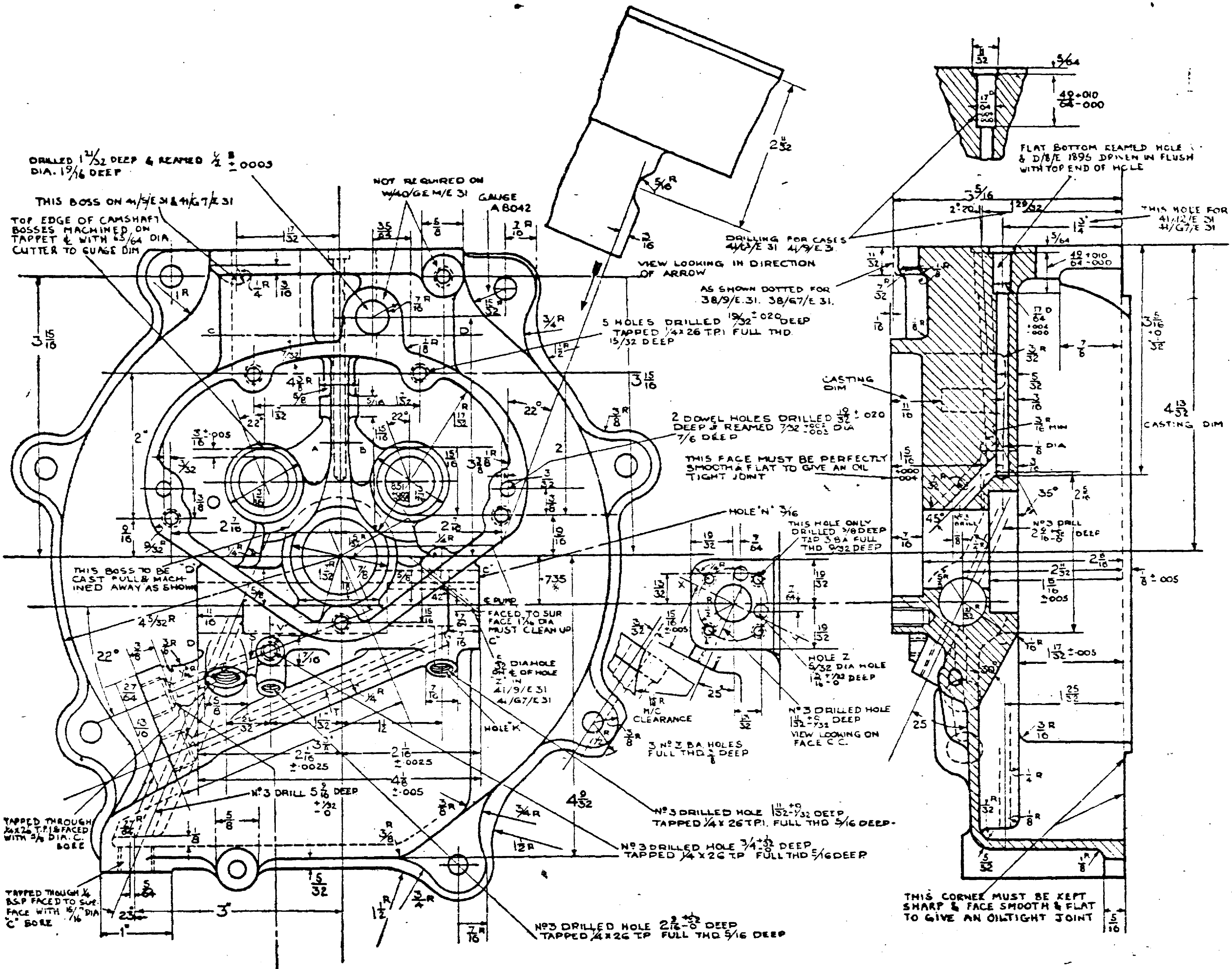
Nos. 5 and 6 are respectively facing the holes for the cylinder holding-down studs and countersinking the holes in the top of the barrel—which is necessary if, when the studs are screwed in, the metal is not to tend to bell out and perhaps prevent the cylinder head seating perfectly. Now two oil holes have to be drilled in the base of the cylinder flange. This is operation No. 7. Next the bore is honed to its mirror finish. Now we have the only hand work: the slots in the casting provided for connecting-rod clearance have to be cleaned up, a task which is carried out by filing. Finally operation No. 10, the cylinder is enamelled.

That, as I say, is one of the simple items—just a cylinder barrel. Would you care for something more complex, the timing-side crankcase half or do you cry, "*Pax!*" (which is what I feel inclined to do)?

Complex Crankcases

On second thoughts I will set out the 29 separate operations, but put them in small type, which you can read if you are so inclined, and which, if the spirit does not move you, will mean that not much space is wasted! You see the picture of the timing side; well, here goes as regards the work involved:—

(1) Bore and turn main crankcase, including spigot, main-bearing housing and plain-bearing housing. (2) Face main-bearing boss on the other (timing-chest) side; this face is used for location purposes as regards further operations. (3) Mill timing-cover face (4) Profile all the crankcase fixing bosses. (5) Drill all crankcase-bolt holes and the fixing holes for the timing cover. (6) Countersink the inner ends of the crankcase holes to get a perfect bed-down of the two crankcase halves. (7) Mill cover faces at end of oil pump. (8) Bore pump housing—one end 23/32in. and the other 9/16in. (9) Drill the cylinder lubrication hole upwards from the oil distributing bush that encircles (or will encircle!) the mainshaft. (10) Drill four angle holes: three upwards into pump housing and the fourth, the suction hole running from the drain plug right up to the mainshaft bush. (11) Drill and tap the cover plate holes at both ends of the pump and one oil hole at the delivery side of the pump. (12) Press in oil-distributing bush. (13) Press in main-bearing roller bush. (14) Ream oil-distributing bush. (15) Drill and ream holes for cam-pinion bushes and the holes for the two timing cover dowel pins. (16)


DRILLED 1 21/32 DEEP & REAMED 1/2 + .0005 DIA. 19/16 DEEP
THIS BOSS ON 41/5/E 31 & 41/G7/E 31
TOP EDGE OF CAMSHAFT BOSSES MACHINED ON TAPPET & WITH 63/64 DIA. CUTTER TO GUAGE DIM
NOT REQUIRED ON W/40/GE M/E 31
GAUGE AB042
VIEW LOOKING IN DIRECTION OF ARROW
DRILLING FOR CASES 41/G7/E 31 41/9/E 3.
FLAT BOTTOM REAMED HOLE & D/B/E 1896 DRIVEN IN FLUSH WITH TOP END OF HOLE
THIS HOLE FOR 41/12/E 31 41/G7/E 31
AS SHOWN DOTTED FOR 38/9/E.31. 38/G7/E 31.
5 HOLES DRILLED 15/32 ± .020 DEEP TAPPED 1/4 x 26 T.P.I FULL THD. 15/32 DEEP
CASTING DIM
2 DOWEL HOLES DRILLED 19/32 ± .020 DEEP & REAMED 7/32 DIA 7/16 DEEP
THIS FACE MUST BE PERFECTLY SMOOTH & FLAT TO GIVE AN OIL TIGHT JOINT
CASTING DIM
HOLE 'N' 3/16
THIS HOLE ONLY DRILLED 3/8 DEEP TAP 3 BA FULL THD 9/32 DEEP
Nº 3 DRILL DEEP
THIS BOSS TO BE CAST FULL & MACHINED AWAY AS SHOWN
℄ PUMP
FACED TO SUR FACE 1 1/16 DIA MUST CLEAN UP
5/32 DIA HOLE ON ℄ OF HOLE 'Z' IN 41/9/E 31 41/G7/E 31
HOLE 'K'
HOLE Z 5/32 DIA HOLE DEEP
M/C CLEARANCE
Nº 3 DRILLED HOLE DEEP
VIEW LOOKING ON FACE C C.
3 Nº 3 BA HOLES FULL THD 3/8 DEEP
Nº 3 DRILL 5 9/16 DEEP
TAPPED THROUGH 1/4 x 26 T.P.I & FACED WITH 5/8 DIA. C. BORE
Nº 3 DRILLED HOLE 1 11/32 DEEP TAPPED 1/4 x 26 T.P.I. FULL THD 5/16 DEEP
Nº 3 DRILLED HOLE 3/4 DEEP TAPPED 1/4 x 26 T.P. FULL THD 5/16 DEEP
TAPPED THOUGH 1/8 BSP FACED TO SUR FACE WITH 15/16 DIA 'C' BORE
Nº3 DRILLED HOLE 2 9/16 DEEP TAPPED 1/4 x 26 T.P. FULL THD 5/16 DEEP
THIS CORNER MUST BE KEPT SHARP & FACE SMOOTH & FLAT TO GIVE AN OILTIGHT JOINT