BOOK No. 57

GARDNER

DIESEL ENGINES

L3

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WORKSHOP TOOLS, EQUIPMENT, and INSTRUCTIONAL DRAWINGS

GARDNER

DIESEL ENGINES

HAWKER SIDDELEY

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L3 TYPE OIL ENGINES

WORKSHOP OVERHAUL INFORMATION, TOOLS & INSTRUCTIONAL DRAWINGS.

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In addition to the above the usual valve and valve seat refacing equipment is desirable. Examples of such are as follows:–

Hall valve seat grinder, type E.S.
Hall valve seat grinding wheel, C5645
Diamond dresser for above.
Hall expanding pilot, type S.P.H.9
Van Norman or Black & Decker type of valve grinding machine.

L3 TYPE OIL ENGINES

WORKSHOP OVERHAUL INFORMATION, TOOLS AND INSTRUCTIONAL DRAWINGS.

(To be read in conjunction with Instruction Book N° 43-1)

1. CRANKSHAFT: When new, the journal and crankpin sizes are $4\frac{1}{8}$" and $3\frac{5}{8}$" diameter respectively and the running clearance in the main bearings is nominally .003". This clearance due to normal wear should not be allowed to exceed .007" in any main bearing. Under average conditions this clearance may be attained after about 20,000 hours of running time when the shaft should be removed and reground to a suitable undersize in order to restore roundness and alignment of the main journals; the crankpins will, of course, require to be treated in a similar manner.

When a shaft is reground, sharp corners will be reproduced where the transverse oil holes emerge on the crankpins and journals. These sharp corners must be removed after grinding and also the original flatted portion around the circumferance of the holes at each end must be restored. The flatted portion takes the form of a $\frac{1}{32}$" wide band around the circumferance of the holes on pins and journals and can be formed by use of a small oil stone.

The radii at the junction of the journals and pins and webs is .125" and the radius of the bearings is .130"; it is most important that these sizes are maintained. It is also of great importance that all radii on the shaft are accurately formed, have a high finish and blend perfectly with the pins and journals.

2. MAIN BEARINGS: A reground crankshaft should be rebedded into new bearings which have been line bored in the crankcase. THE END AND DIAMETRAL CLEARANCES MUST CONFORM TO THE DIMENSIONS SHOWN ON THE ACCOMPANYING DRAWING No.12376, Page 20. Available main bearings from stock are in three sizes as below:-

H1. for journals of standard size.
H2. for journals from .005" to .030" undersize.
H3. for journals from .035" to .060" undersize.

RE-METALLING OF EXISTING BEARING SHELLS IS NOT RECOMMENDED.

Where line boring facilities are not available bearings can be supplied bored to suit the reground shaft; such bearings will require the judicious use of a hand scraper to remove "high spots". Whether bearings are hand scraped or line bored it is most important to ensure that the radii on journals and pins are safely clear of radii on bearing shells to permit of end clearance check on Dwg. No.12376, Page 20.

Tighten main bearing cap nuts evenly to a torque of 2,100 lb./in. and, after slackening one nut, the cap should spring open .004" to .006"

which provides the correct "nip" for the bearing shells. Having checked the "nip" in this manner both nuts must be slackened right off prior to the final tightening which should be carried out as indicated on Page 40.

3. CRANKSHAFT DAMPER (5, 6 & 8L3 Engines): These are of the spring loaded friction type and are located in the timing case mounted on a taper portion of the crankshaft.

The damper can only be removed from the shaft after the timing case has been removed or the shaft removed from the engine.

To pull the damper off the crankshaft use the special tackle to Dwg.No.SA3208, Page 22, and proceed as follows:-

1). Undo crankshaft chain sprocket nut locking screw and unscrew the sprocket nut using special spanner, Dwg.No. J9236, Page 24.

2). Remove three alternate castle nuts from damper body and replace by three special deep nuts.

3). Into each of the deep nuts screw one of the rods.

4). Over the three rods slide the circular plate into contact with the end of the crankshaft. Fit the three nuts to end of rods and tighten evenly until a good load is applied. A sharp blow on forward face of the circular plate will then release the damper.

Early 8L3 Engines: These are fitted with a second damper on the external forward end of the crankshaft. They are fixed to the shaft, which is parallel at this point, by means of a parallel bore taper exterior bush which is forced into the damper body by means of a clamp ring and six setscrews.

Usually the damper is fitted so that the larger end of the taper bush is towards the timing case. To remove these dampers a piece of steel pipe is required of about 3¼" outside diameter, 3" bore and about 10" long. Having removed all setscrews in the clamp ring the pipe should be passed over the shaft and into contact with the small end of the bush. A sharp blow on the outer end of the pipe will then release the damper from the taper bush.

In certain applications, usually where pulleys for auxiliary drives are mounted on the damper, the dampers have to be fitted so that the larger end of the taper bush is on the forward side of the damper. In such cases removal of the damper requires the use of special drawing tackle to Dwg.No.SA2285, Page 23, of the same type as that used for the removal of the inside damper except that the screwed rods are smaller in diameter so that they will screw into the tapped holes provided for this purpose in the larger end of the taper bush.

The friction members in the damper are formed by two red

fibre rings of $\frac{1}{16}$" thickness when new. The rate of wear is extremely low and rings when after very long service are worn to $\frac{1}{32}$" may safely be used again.

The correct "break away" slip torque for the L3 dampers prior to 1947 was approximately 90 lb./ft. and was produced by a load of 60 lb. from each spring at its working length of $1\frac{1}{4}$". Subsequent to this date the 8L3 engine has been fitted with one damper only, which has an increased spring load of 90 lb.per spring. This modification of spring load was also applied to the 5 and 6L3 at this date, thus all engines since 1947 are fitted with dampers having a slip torque of approximately 135 lb./ft.

To check this torque a piece of $\frac{1}{2}$" diameter round bar about 8" long should be inserted into one of the holes in the periphery of one of the damper flywheels. Apply a spring balance at a definite known distance from the crankshaft centre and pulling at right angles to the $\frac{1}{2}$" diameter bar note the load required to cause the damper to slip when the shaft, or damper body, is rigidly prevented from rotating. If the spring balance is applied to the bar exactly at a distance of 1 foot from the centre of the crankshaft, the damper should of course slip when a load of 90 or 135 (approximately) lb. load is applied.

The new 90 lb. spring may be fitted to any damper, but it is essential that only 90 lb. springs are fitted to 8L3 engines having the single damper.

NOTE: Excessive tightening of the crankshaft chain sprocket nut is unnecessary and is to be avoided.

On 5, 6 and 8L3 engines (fitted with crankshaft dampers) tighten the nut until it just makes solid contact with the sprocket by lightly tapping the spanner. From this position the nut should be tightened a further amount corresponding to 9 teeth on the sprocket, and locked. On 3 and 4L3 engines the sprocket is held up against a square shoulder on the crankshaft, there being no damper, and here the nut just requires to be firmly knocked up solid and locked.

4. CONNECTING RODS: Engines up to N°. 124241 are equipped with connecting rod bearing shells with allowance in the white metal for finish boring when fitted to the connecting rod. Procedure for renewing is as follows:-

The rods should be thoroughly cleaned and tested for cracks by any of the well known methods. Big end bolts must be examined for stretch and renewed if necessary. Split pins for the big end bolts should be used only once; they should be the correct size for the holes and sprung to give tight fitting.

Big end bearings are supplied with three thicknesses of steel shell, so that they can be bored to suit standard and various under-sizes, without an excessive thickness of white metal; these are as

below—

F1. for crankpins standard to ·005" undersize.
F2. for crankpins ·010" to ·050" undersize.
F3. for crankpins ·055" to ·095" undersize.

RE-METALLING OF EXISTING BEARING SHELLS IS NOT RECOMMENDED.

The bearing shells must be a perfect fit in the eye of the rod with the butt faces metal to metal. To ensure that the shells are tightly held, the shims between the cap half and the rod must be adjusted by careful filing or other method so that when all the nuts are tightened evenly to a maximum torque of 980 lb./in. and then the pair of nuts at one side of the rod unscrewed there appears a feeler clearance of ·004" to ·006" between the shim and the rod at the slackened side. Prior to final boring or final assembly all nuts must of course be completely slackened and evenly and gradually retightened to 980 lb./in. torque in the order as stated on Page 41.

The big end bearings should be bored or hand scraped to give ·002" to ·00275" clearance on the crankpins. When this clearance has to be produced by hand the scraping should be confined as far as possible to the cap half bearing since this is relatively lightly loaded under working conditions and does not therefore require to have such accurate bedding as does the top or rod half bearing. By this procedure the surface of the top half bearing will remain as originally bored and so have a more accurate shape and therefore more complete contact with the crankpin than could be produced by hand scraping. As in the case of the main bearing it is essential to check that the big end bearing is free from tight places adjacent to the radii, if these do exist they must of course be relieved by light hand scraping.

Having obtained the correct clearance in this way the finished big end bearing should be slightly relieved at the sides by hand scraping right through the bore of each half of the bearing adjacent to the split; this relief should extend into each half bearing for a chordal distance of $\frac{3}{8}$" from the butt face or split, thus in the final assembly there will be two fully relieved portions extending from one end of the bearing to the other and having a total width of approximately $\frac{1}{4}$".

The correct diametral and end clearances are given on drawing No.12376, Page 20.

Before final assembly, chamfers $\frac{1}{16}$" wide at an angle of 45° are to be filed at the inner edges of the cap halves for the full width of the bearings.

On engines commencing N°. 124241 connecting rods are equipped

with pre-finished big end bearing shells and are not, therefore, to be bored when fitted to the rods. These bearings are available in various undersizes to suit reconditioned crank pins as follows:-
·005", ·010", ·015", ·020", ·030", and every ·010" to ·100", i.e. these bearing shells will give the correct clearance when fitted to crank pins which have been reduced by precisely this amount from the original nominal size of 3·625" $^{+\ ·0000"}_{-\ ·0005"}$. When assembling, the following instructions must be observed:-

(a) Connecting rods and caps are stamped with a number to accord with the number of the respective cylinders. In assembly it is important that these numbers lie to the flywheel end of the engine. Rods and caps should not be interchanged; keep each cap to its respective rod.

(b) The correct torque and order of tightening for the four bolts of the connecting rod is given on page 41.

(c) Connecting rods, bolts, and nuts are stamped with the appropriate numbers 1 - 1 to 24 - 24 for eight cylinder engines and should be assembled number to number.

(d) Before assembling a pair of big end bearings in the connecting rod see that all parts are thoroughly clean and that the surfaces are free from abrasions, scratches or indentations, etc. It is not necessary to use a hand scraper to bed the bearings to the crank pins. The two halves cannot be interchanged as a locating tongue on each half-bearing ensures correct assembly. The bearing shells should be firmly "gripped" in the assembled rod; this can be ascertained by tightening each big end nut to the correct torque, afterwards releasing the nut or nuts, on one side only when there should be ·006" to ·0075" gap clearance between the abutment of connecting rod and cap. It will be noted that there are no shims fitted between the connecting rod and its cap. Nuts must be fully tightened to the correct torque and new split pins of the correct size fitted. The pins should be sprung open before fitting in order to prevent movement, and consequent wear, in service.

The nominal clearance in a correctly assembled big end bearing is approximately ·0029" and the side location of the big end of the rod is obtained directly by the side facings of the rod itself. At the Works, a number of lines are scribed on the edge of the steel shells and these correspond with the rod number and cylinder number, i.e. 1 to 8. As indicated under (a) above, these numbers also lie to the flywheel end of the engine. When the connecting rod is assembled on the crank pin it should have a minimum endwise clearance of ·003".

Small end bushes which have ·003" or more clearance with a new pin should be pressed out and new ones fitted. The running clearance between a new bush and new pin is ·00125" to ·00175". Should scraping be necessary this should be confined to the upper half of the bore so that the more accurate machined surface remains untouched on the heavily loaded bottom portion. Before finally assembling the rod the ⅛" oil duct through the centre should be thoroughly flushed out with paraffin or fuel oil.

After assembling a rod on its crankpin, the piston pin in the small end bush should be parallel to the crankcase top to within ·001" in the length of the pin.

5. VALVE CAMS, CAMSHAFT & TAPPETS: After prolonged service the tappets and possibly the cams may become slightly scored. This scoring can be removed by the use of an oil stone taking great care to reproduce the original radii. Should, however, the hardened case be worn through it will be necessary to fit new parts.

The valve camshaft and bushes should not require renewal (unless they have been subject to accidental damage) until a unit receives its second major overhaul. When new the clearance between shaft and bush bearing is ·001". Bushes are a light drive fit in the crankcase and are located by means of cheese head screws.

6. FUEL PUMP DRIVING & DRIVEN GEAR, FUEL PUMP DRIVING SHAFT, SPLINE & SPLINED GEAR CENTRE: After considerable use these parts become worn and should be replaced if they have produced excessive noise ("gear rattle") or very unsteady control, by the governor, of the fuel pump slider bar when running. Very considerable wear of these parts will not produce actual failure, only above described faults. Wear can be considered excessive when a ·010" feeler can be inserted between the teeth when the two gears are meshed in the average running position.

Similarly the splined pump driving shaft and gear hub should be replaced when slack, in the running position, has become more than ·005".

7. TIMING CHAIN SPROCKETS: These will only require renewal if the teeth have become "hooked" to such an extent that they are liable to interfere with the smooth driving of the chain. If any new sprockets are fitted care must be taken to ensure that they are in perfect alignment one with the other. This may necessitate the fitting of shims or removal of metal at the rear side of the crankshaft sprocket.

If a new chain will not wrap smoothly around a worn sprocket, i.e. if slight impact can be felt at the engagement of each tooth, a replacement is indicated.

8. TIMING CHAIN: This should not be replaced for further service if its length is ·250" greater than that of a new chain of 96 links, see drawing No.SA1885, Page 25. It is good practice to renew the complete connecting link of these chains at half the period between major overhauls; say after 8,000 hours, unless the detachable link is of the current rivetted type. In this case replacement is not required until major overhaul, when a new chain will be fitted.

9. PISTONS: The main factor, apart from damage, which decides whether or not a piston is fit for further service is the amount of wear in the ring grooves. If the maximum wear is such that when a new standard ring is fitted to any groove it is possible to insert a ·012" feeler between the ring and the groove, the piston should be replaced or the grooves machined oversize as shown on SA2913, Page 27, for the two top grooves. This will then give the desired working clearance when the pistons are fitted with new standard first oversize width rings. It is not good practice to fit new rings to worn grooves without machining the grooves to reproduce the original flat lower face. (The lower face of a worn groove is never flat).

10. PISTON PINS: These should be renewed when the maximum wear exceeds ·0015", i.e. when smallest diameter measures less than 2" − ·0015".

11. CYLINDER & LINERS: Cylinder liners must be renewed when maximum wear exceeds ·016". The wet liner can be removed from the cylinder block and a new liner fitted as described in Instruction Book No.43·1 paragraph 95·1 and 95·2. Drawing No.2998F, Page 28, gives particulars for relinering the wet liner.

When a cylinder block is dismantled all silt and scale must be cleaned from the water spaces which should then be coated with a good quality lead base paint to arrest corrosion.

Cylinder blocks should be refitted to the engine using the standard paper packing of ·004" thickness between the lower face of the block and the crankcase. At top dead centre the piston top to undersize of cylinder head clearance is as follows:−

Nominal ·083" Maximum ·096" Minimum ·072"

12. CYLINDER HEADS: The cylinder head makes a gas tight metal to metal joint with cylinder liner; if either of these joint faces are damaged they can be restored by means of the lapping tool, Dwg.No.J5945, Page 29. Valves should be renewed if the seat is worn so that the valve head does not stand out from the cylinder head more than ·060". If a new valve does not give the required standout it will be necessary to

bore out the valve seat and fit valve seat inserts. When new, valve seat width (in the head) is .135" and valve head standout approximately .120". Drawings at end of this book show:-

(a) Tool used for machining valve seat insert recesses and dimensions of recesses. — Dwg. No. 3563F, Page 30.

(b) Valve seat inserts in position in the head. — " " 1643F, " 31.

(c) Tool used for removal of inserts — " " K4240, " 32.

(d) Pilot for fitting valve seat inserts — " " 3700F, " 42.

Valves should also be renewed if the maximum wear on the stem exceeds .010". Inlet valve guides should be renewed when they have more than .006" clearance on a new inlet valve; exhaust valve guides should be renewed if they have more than .008" clearance on a new exhaust valve.

Valve guides are a light drive fit in the head and when a new guide is fitted the bore should be reamed so there is .004" clearance on a new exhaust valve stem and .003" on a new inlet valve stem.

The outer valve springs fitted to recent engines have $7\frac{1}{2}$ coils and the inner valve springs $9\frac{1}{2}$ coils. These should be replaced if their free length is less than $3\frac{3}{8}$" in the case of the outer spring and $3\frac{1}{8}$" in the case of the inner spring.

Earlier engines have outer springs of $10\frac{1}{2}$ coils and inner springs of 12 coils. Where convenient it is advisable to replace such springs by those of current type; if this cannot be done the old springs may continue to be used if their free lengths are not less than $3\frac{15}{16}$" outer and $3\frac{3}{8}$" inner.

The toe of all valve levers should be oil stoned to their original radius to remove the recess which may have formed due to wear caused by contact with the valve end. If in restoring this shape the hardened case is found to be worn through it will be necessary to renew the lever.

When a newly assembled head is refitted to an engine it is important to check that the oil feed to the valves is correct by observing that oil emerges from the small hole on the top of each valve lever when the engine is running. Failure of oil to appear at this point can only be due to incorrect fitting of the valve lever shaft whereby the oil grooves in the shaft do not line up with the holes in the bore of the levers or by relatively large particles of foreign matter which have been loosened but not removed during dismantling, causing a stoppage of the feed holes.

When assembling valve collars they must not be screwed further down the valve stem than will just permit the fitting of the split pin.

See Instruction Book No.43·1, paragraphs 75, 76, 84, 85 and 87 to 90.

Before refitting cylinder heads to cylinders it is imperative that the metal to metal joint faces on liners and heads are absolutely clean and free from all burrs. Sprayer holes and seats must also be clean. If the sprayer seat has been damaged it can be restored by use of the cutter followed by the lap shown on Dwg.No.J6648, Page 33.

13. **BALL BEARINGS:** All ball bearings should be inspected for wear and renewed where necessary paying particular attention to the bearings at the forward and aft end of the fuel pump cam box. Roughness or end slack created in the fuel camshaft by wear in these bearings can cause unsteady control, by the governor, of the fuel pump slider bar, just as mentioned under headings of Driving Gears. It is desirable that the ball bearings carrying the fuel pump camshaft, control this shaft so that it has no end play, which condition should be produced by the fitting of a thin shim washer between the inner member of the bearings and the shoulders of the shaft. Care must, of course, be taken to ensure that having taken up excessive end clearance there still remains a running clearance; i.e., the shaft must revolve perfectly freely and yet have no slack which can be detected by feel.

14. **FUEL PUMP CAM BOX:** The fuel pump tappets are of course liable to wear and these should be renewed when they have developed more than ·010" clearance in their working bore in the box.

If the tappet rollers have more than about ·005" slack on their pins the rollers and pins should be replaced, for which purpose proceed as follows:—

The pin hole in the tappet is slightly smaller at one side than at the other, thus the plain unstepped pin is a shrink fit in one side only of the tappet.

TO REMOVE PINS; heat the tappet by holding in boiling water for a moment when the pin may be tapped out using a light hammer and brass drift.

TO FIT NEW PINS: By using the new pin as a "go" and "not go" gauge, determine which is the larger of the two holes in the tappet, this should be marked by pencil. Heat tappet in boiling water, enter pin through the larger of the two holes and through the roller, re-heat tappet assembly and tap pin into tappet until the pin projects an equal amount on either side.

Whilst tappet is still hot turn pin until flats on ends of pin are square with bottom face of tappet.

NOTE: Grooved pins must be fitted with groove towards top of tappet. Later pins are ungrooved and such pins when worn may have a second life by rotating through 180°. The unworn side of the pin will then carry the load.

For correct setting of fuel pump tappet adjusting screw see Instruction Book No. 43.1, paragraph 111, and Dwg.No.SA3105, Page 34.

The tappet springs should be renewed if their free length is less than $1\frac{29}{32}$".

15. OIL PUMP AND DRIVING GEARS: The oil pump driving gears should be examined and replaced if the teeth are excessively worn, that is to say if the teeth have more than about ·012" worn from them at the pitch line. The oil pump gears proper should be replaced if there is more than about ·015" backlash between them. The end slack between these gears and the cover plate should not be more than about ·002". When due to wear this slack is greater it can be reduced by removing the metal from the end of the pump body. This has, of course, to be done carefully as the cover must make an oil-tight joint and must on no account bind the gears endways. The gears and/or the pump body should be renewed if a ·004" feeler can be inserted between the top of the gear teeth and the bore of the pump body.

16. GOVERNORS: For the governor to operate smoothly it is necessary that the various pins, bushes and rollers have no more than about ·004" diametral slack, where exceeded it will be necessary to fit new rollers and pins in the toes of the weights and new pins and bushes in the weights and body. As it is quite essential that the weights do equal work it will be understood that if one pin requires renewal all the bearings will require restoration to their new state. (See also paragraph 13).

The spring thrust ball race and the two small ball races which work in parallel to operate the vertical governor lever are easily replaced if necessary.

Service reconditioned body and weights assemblies can be obtained from the Works in exchange for the worn parts.

From maximum "in" position to maximum "out" position the weights should impart a movement of $\frac{1}{4}$" to the governor sleeve.

The governor spring should have a free length of approximately $2\frac{1}{2}$". If this spring has shortened the maximum engine r.p.m. will be reduced; this can be rectified by the fitting of a

thin washer at one end of the spring or as in paragraph 3 below. The washer should be of such thickness that it has the effect of restoring the spring to its original free length. On no account whatsoever must the spring load be increased sufficiently to permit maximum engine r.p.m., when in neutral to rise above 1,235 or 935 for a marine engine.

If, through any cause, the original setting of the various governor speed control levers and stops has been lost they can be reset by the following procedure:—

1). Undo the clamping screw in the injection control lever.

2). Set and lock the maximum speed stop Part No.11/72 so that the straight edge on the accelerator cam is leaning to the right at an angle of 27° from the vertical. Set injection pointer to "MAX". injection mark and retighten clamping screw. Return accelerator to idling position.

3). Start up the engine and whilst in neutral move the accelerator lever to the maximum speed postion, adjust screw Part No. 11/59 until engine is running steadily at 1,235 r.p.m. (this must not be exceeded) which will give 1,200 r.p.m. under full load. For a marine engine the speeds are 935 and 900 respectively.
Firmly lock the nut on this adjusting screw.

4). Return accelerator lever to idling speed and set the slow running screw to give 350 r.p.m. (idling speed for a marine engine is about 250 r.p.m.) and lock in this position. These settings should not be made with a cold engine — the sump oil should be at least 110°F.

5). The engine can now be stopped. With the accelerator lever in the maximum speed position the stop pegs, Part No.11/27, should be just ·002" off the governor case. The main function of these pegs is to prevent the overspeeding of the engine due to incompetent interference with the settings of the various stops.

If the spring has not been restored to its original length; i.e. if the washer above described is not thick enough it will be necessary to shorten these stop pegs a little to obtain the speed as described in instructions. It is desirable that the two lead seals are remade.

17. GOVERNOR SPRING DRIVE (8L3 Engines only): These springs will only require replacement if actually broken. Reduction of load due to spring "sinkage" is unimportant.

18. FUEL INJECTION PUMPS: The delivery valves should be renewed during major overhauls. The fuel pump elements are the only other components which

may require renewal at the first major overhaul. To test for wear in these parts the pumps should be removed from the cambox and refitted without the tappet springs below the 1" thick insertion plate. Couple up the fuel supply and operate the hand priming levers until fuel free from air emerges at the delivery unions on top of the pump. These unions are next closed completely by means of a blank union and nut; again operate the hand levers until solid feel is obtained. Apply a weight of 6lb.5oz. on an arm projecting horizontally from the pump priming lever. The centre of the weight should be at a distance of 11¼" from the hand lever, Dwg.No.SA2134, Page 35. Lift the weight and allow it to fall. The time taken for the slow travel of the lever, i.e. from the time at which the suction ports are closed until cut-off occurs, should not be less than 10 seconds. If the time taken is less than this the element will have to be renewed. For this test the slider bar must be in the full load position, i.e. on the trigger and not in the "cold start" position. Where required an element testing fixture can be supplied, see Illustration No.11667, Page 36.

When a new element is fitted it is essential that the pumps as a whole are recalibrated to ensure equal delivery to all cylinders and to ensure that the maximum quantity of fuel delivered by the injection pumps is not excessive. Indeed, after any lengthy period of service it is very beneficial to check and correct the calibration of these pumps, for this purpose reference must be made to the Fuel Injection Pump Calibrating Machine Instruction Book No. 45.1, see Illustration No. 1610, Page 18.

All springs should be examined for fracture and replaced if necessary; plunger springs should be also renewed if their free length is less than 2".

For power reduction by increasing length of trigger, see Dwg.No.3276F, Page 37, and for appropriate de-rating to suit adverse climatic conditions, see Dwg.No.SA3514, Page 38.

19. FUEL PUMP SLIDER BAR BUFFER: This is the small spring loaded plunger screwed into the forward end of the fuel control box. The unit should be screwed in or out of the control box to give about ·006" clearance between the end of the plunger and the end of the fuel pump slider bar when the engine is warm and set at idling speed in neutral. This clearance can be seen through the hole on the top face of the control box if a light is held on the engine side of the box.

20. SPRAYERS: Reconditioning of sprayers is fully described in the Instruction Book No.43·1, paragraphs 63 to 78 inclusive.
See Illustration No.1673, Page 19.

21. LUBRICATING OIL PRESSURE: Low oil pressure must not be rectified by indiscriminate adjustment of the relief valve as this can cut off the oil supply to fuel pump cam box, governor, chain case and oil cooler.

Instruction Book No.43·1, paragraphs 45 to 57 and particularly paragraph 52 covers possible causes of low oil pressure and gives general instructions for the maintenance of the system.

22. STRAINERS: (Fuel and Lubricating Oil). See Instruction Book No. 43·1, paragraphs 48 to 50·1 for lubricating oil strainers, and paragraphs 58 to 62 for fuel oil strainers which give particulars for testing stoppage, cleaning and recovering.

23. ELECTRIC STARTER: The correct endwise position for the starter is such that when in the disengaged position there is approximately $\frac{1}{8}$" clearance between the starter pinion and the gear ring on the flywheel.

24. ELECTRIC STARTER RING ON FLYWHEEL: As these gear rings work in conjunction with the axial drive type of starters they will have a very long life. Should it be necessary to replace a ring it should be severed by drilling and tapped off the flywheel. To fit a new ring it should be heated by blowlamp until its bore has increased about $\frac{1}{16}$" diameter (this does not require a great heat). The ring is then placed on the flywheel and allowed to cool. The resultant shrinkage holds the ring in position without other means.

25. WATER PIPES AND HOSES: These should all be examined and cleaned where necessary in their bores. The hose connections will have to be renewed where the bore has closed in — do not attempt to restore their bore by cutting the rubber.

26. THERMOSTAT UNITS: These should be removed from their housings, see Dwg.No. SA2965, Page 26, and their opening and full open temperatures checked by immersion in water which is gradually heated. The units fitted to engines operating under high duty conditions, such as rail-car, should commence to open between 120°F. and 130°F; at 158°F. the main valve should be fully open and by-pass port completely closed.

The comparable temperatures for shunting locomotive and intermittent duty are 150°F. — 156°F. opening and fully open 185°F.

27. WATER PUMP: If the carbon ring has worn so that the blades of the impeller are less than $\frac{1}{32}$" clear of the internal face of the pump body it should be renewed, at the same time any score marks in the mating face of the impeller spindle should be removed by skimming in a lathe.

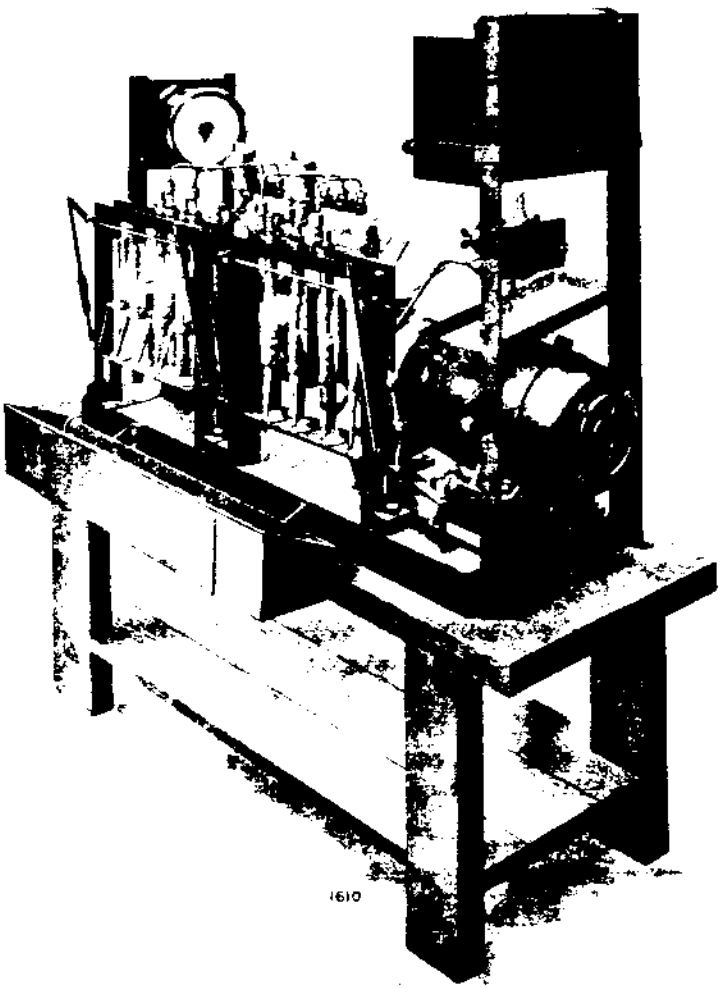
If, after pressing the impeller against the carbon and rotating by hand, an unbroken line of contact is not obtained the spindle may, with advantage, be lightly lapped against the carbon ring using a little fine pumice powder and water which of course must be carefully removed prior to final assembly. Care must also be taken to ensure that the face of the carbon and impeller spindle are completely free of all grease or oil when finally assembled.

Carbon rings may be fitted and extracted by use of the tool Dwg.No. SA2211, Page 39.

The self aligning ball bearing which supports the spindle has a long life and is not likely to require renewal until the second major overhaul.

IN GENERAL: These instructions are intended to be used in conjunction with the engine Instruction Book No. 43·1 where all normal maintenance requirements are fully stated and reference made to Marine Engines.

For CORRECT TIGHTENING TORQUE OF VARIOUS NUTS see Dwg.No. 2752F, Page 21.



VIEW OF CALIBRATING MACHINE SHOWING MEASURING GLASSES, SPEED INDICATOR AND FUEL COLLECTING TROUGH.

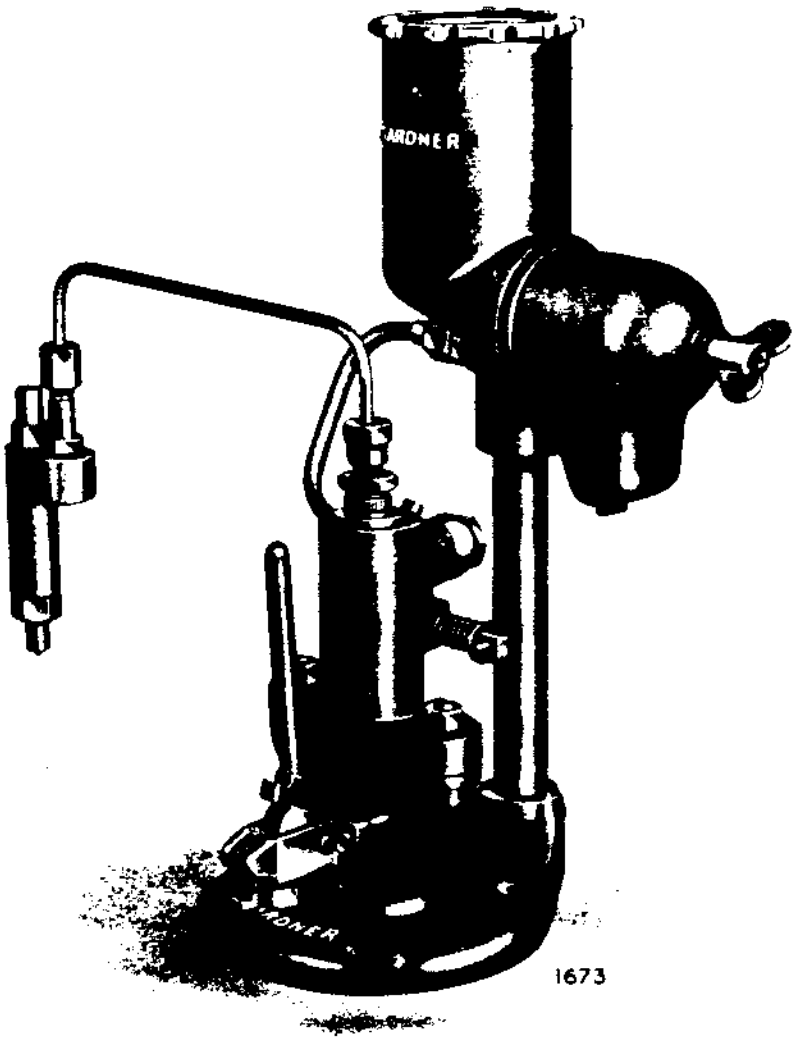
"L" TYPE ENGINES

FUEL INJECTION PUMP CALIBRATING MACHINE

Illustration No. 1610.

PURPOSE. For the calibration and setting of maximum output of fuel injection pumps.

METHOD. This is fully described in the Instruction Book supplied with each machine.



"L" TYPE ENGINES

SPRAYER TESTING APPARATUS

Illustration No. 1673

PURPOSE. For the hand testing of sprayers when on the bench.

METHOD. This is fully described in the Engine Instruction Book.

END CLEARANCE MUST BE CHECKED BY THE FOLLOWING PROCEDURE.

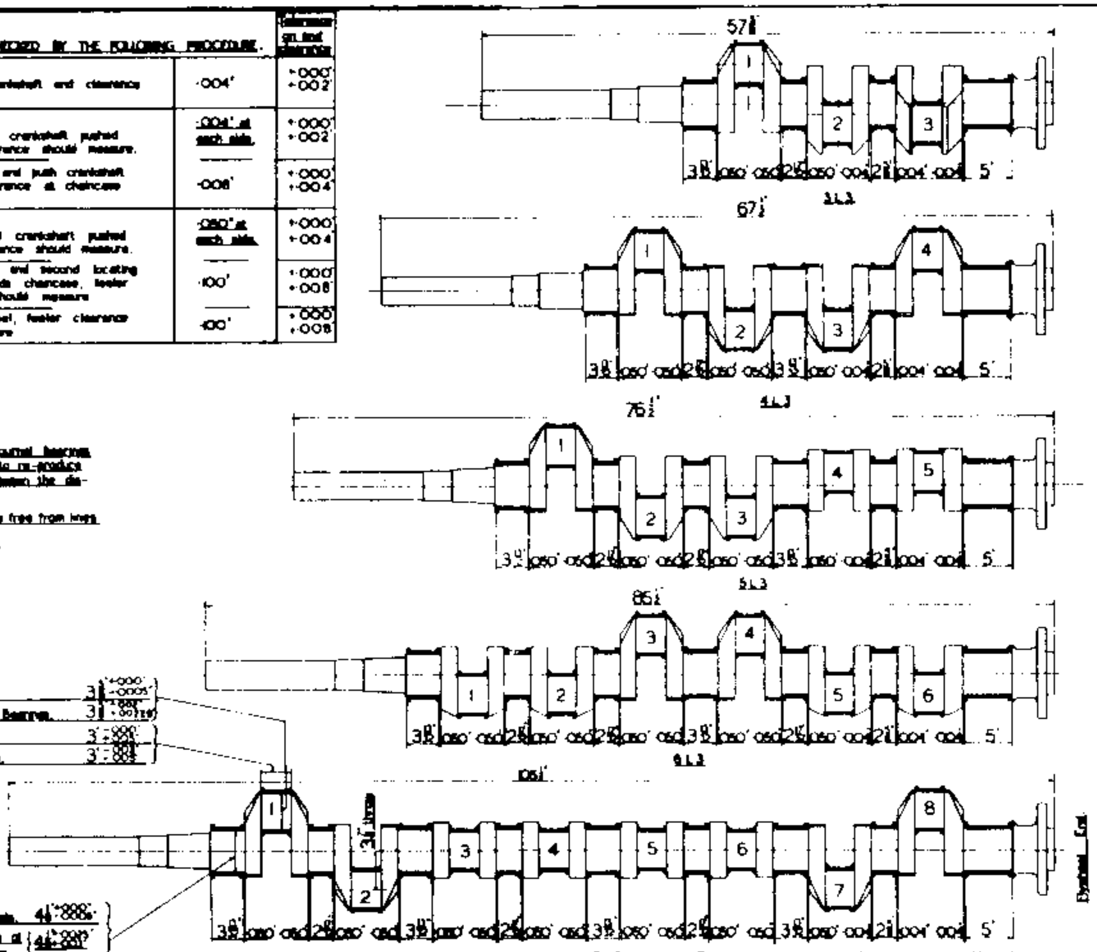
		Tolerance on end clearance
FLYWHEEL END BEARING. With all bearings in place, crankshaft end clearance should indicate	·004"	+·000" +·002"
SECOND LOCATING BEARING. With all bearings in place and crankshaft pushed towards chaincase, feeler clearance should measure.	·004" at each side.	+·000" +·002"
Remove flywheel end bearing and push crankshaft towards chaincase, feeler clearance at chaincase side should measure	·008"	+·000" +·004"
ALL OTHER MAIN BEARINGS. With all bearings in place and crankshaft pushed towards chaincase, feeler clearance should measure.	·050" at each side.	+·000" +·004"
Remove flywheel end bearing and second locating bearing, push crankshaft towards chaincase, feeler clearance at chaincase side should measure	·100"	+·000" +·008"
Push crankshaft towards flywheel, feeler clearance at flywheel side should measure	·100"	+·000" +·008"

IMPORTANT.
When re-sizing crankshaft journal bearings or crankpins, it is essential to re-produce the original radius blend between the diameters and adjacent webs.
Radii to have high finish & be free from lines.

RADII SIZE { Journal to web ·125"–·130" / Crankpins ·125"–·130" }

Dia. of Crankpins. 3¼" +·000" −·0005"
Finished bore of Crankpin Bearings. 3¼" [illegible]
Width of Crankpins. 3" [illegible]
Width of Crankpin Bearings. 3" [illegible]

Dia. of Journals 4½" [illegible]
Finished bore of Main Bearings. 4½" [illegible]



For tolerance on end clearances see table above.

RD 1201

DWG. Nº 12376	L. GARDNER & SONS, Ltd. PATRICROFT, Nr MANCHESTER.	TYPE ..... L3 ENGINES. DESCRIPTION CRANKSHAFT BEARING CLEARANCES. SCALE QUARTER FULL SIZE.	DWG. Nº 12376

NOTE - ALL TORQUE INDICATING SPANNERS SHOULD BE CHECKED REGULARLY BY MEANS OF A SPRING BALANCE, USED TO APPLY A KNOWN LOAD ON THE HANDLE OF THE SPANNER, AT A KNOWN DISTANCE FROM THE NUT CENTRE

LETTER 'E' INDICATES THAT USE OF A TORQUE SPANNER IS ESSENTIAL

WHEN MODIFYING SEE DWG No 6929H

NUT	THREAD SIZE	\	CORRECT TIGHTENING TORQUE - LB. IN.
CRANKCASE - CLAMP - VALVE TAPPET GUIDE	7/16" WH.		460
" - VALVE CAMSHAFT - FORWARD END (BRASS NUT)	1 1/8"-12 THDS/1"	E	1300
" - POINTED SCREW - VALVE CAM	1/2" B.S.F.		800
" - CHAINWHEEL - VALVE CAMSHAFT	3/8" B.S.F.		400
" - NUT - MAIN BEARING CAP	3/4" B.S.F.	E	2100
" - LOWER TO UPPER HALF - SETSCREWS	5/8" WH.		1600
" - " " " " " - "	7/16" WH.		750
" - LOWER - DRAIN PLUG	7/8"-11 THDS/1"		900
" - " " - " "	1/2" B.S. PIPE THD.		700
CRANKSHAFT - CONNECTING ROD - BIG END	9/16" B.S.F.	E	980
" - BALANCE WEIGHT TO CRANKSHAFT (3L3 ONLY)	5/8" B.S.F.	E	2600
" - DAMPER TO CRANKSHAFT (INTERNAL SPRING TYPE)	7/16" B.S.F.		600
" - FLYWHEEL TO CRANKSHAFT	3/4" B.S.F.	E	2700
CYLINDER - FOOT	7/8" B.S.F.	E	L3 1900
" - "	7/8" B.S.F.	E	L3B 2750
" - HEAD	3/4" B.S.F.	E	1800
CYLINDER HEAD - MANIFOLD CLAMP	5/8" WH.		650
" " - SPRAYER CLAMP	5/16" WH.		80
" " - UNION STOCK - SPRAYER DELIVERY	3/8" B.S. PIPE THD.	E	625
" " - CAP - SPRAYER NOZZLE	3/4"-14 THDS/1"		380
" " - ADJUSTER - VALVE TAPPET	7/16" B.S.F.		L3 500
" " - " " "	3/8" B.S.F.		L3B 350
" " - VALVE LEVER SHAFT - POINTED SCREW (L3 & EARLY L3B ENGS.)	0/BA		130
" " - VALVE LEVER SHAFT - POINTED SCREW (L3B LATER ENGS.)	5/16"-28 THDS/1"		200
FUEL PUMP - VALVE HOLDER - DELIVERY	20 x 1 1/2 mm	E	C.I. BODY 700
" " - " " "	20 x 1 1/2 mm	E	ALUM. " 500
" " - SPRAYER PIPE - UNION (PUMP END)	18 x 1 1/2 mm		450
" " - " " " (SPRAYER END)	1/4" B.S. PIPE THD.		450
" " - LOCKNUT - CAMBOX TAPPET SCREW	3/8"-24 THDS/1"		300
" " - POINTED SCREW - CAM TO CAMSHAFT	5/16"-28 THDS/1"		350
" " - DRIVEN GEAR	5/16" B.S.F.		400
" " - CAMSHAFT - DRIVING SHAFT COUPLING	3/8"-24 THDS/1"		550
" " - SCREW (SCREWDRIVER SLOT) CONTROL QUADRANT & SLEEVE	4.5 x .75 mm	E	150
FUEL SECOND FILTER - UNION STOCK - SPRAYER OVERFLOW	1/4" B.S. PIPE THD.		750
" " " - CAP NUT TO FILTER COVER	3/8" WH.		180
GOVERNOR BODY - POINTED SCREW	3/8"-24 THDS/1"		550
" " - SPRING DRIVE	5/16" B.S.F.		15
LUB OIL DELIVERY FILTER - CAP NUT TO FILTER COVER	1 5/16"-12 THDS/1"		800
" " " " - DRAIN PLUG	3/4" B.S. PIPE THD.		800
LUB. OIL PUMP - GEAR & SPINDLE NUT	1/2" B.S.F.	E	500
WATER PUMP DRIVE - CENTRIFUGAL TYPE PUMP	7/16" B.S.F.	E	500

DWG. No. 2752F

SUPERSEDES / SUPERSEDED BY / DRAWN BY / TRACED BY / CHECKED BY / INDEXED BY / DATE

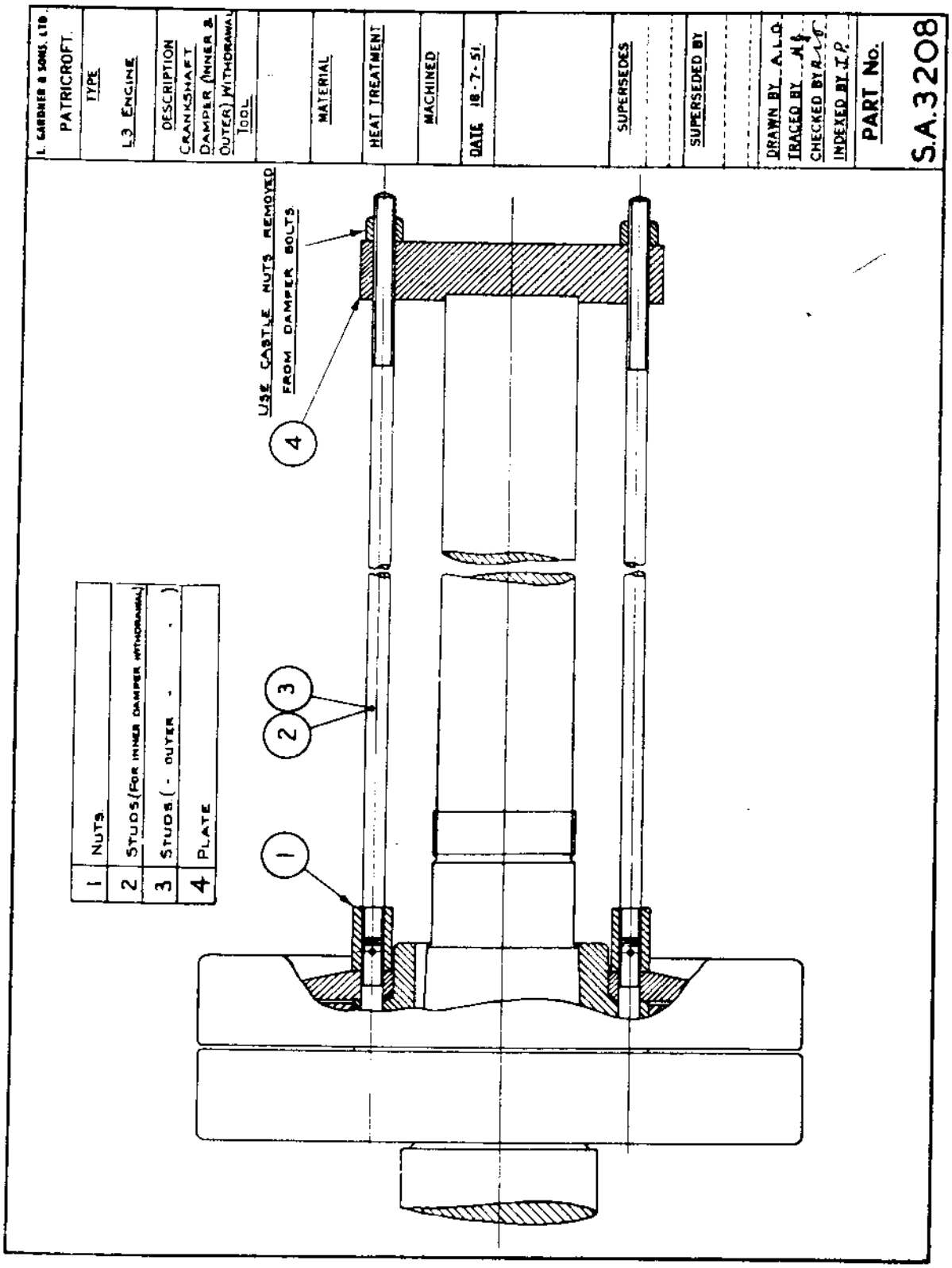
MATERIAL / MACHINED

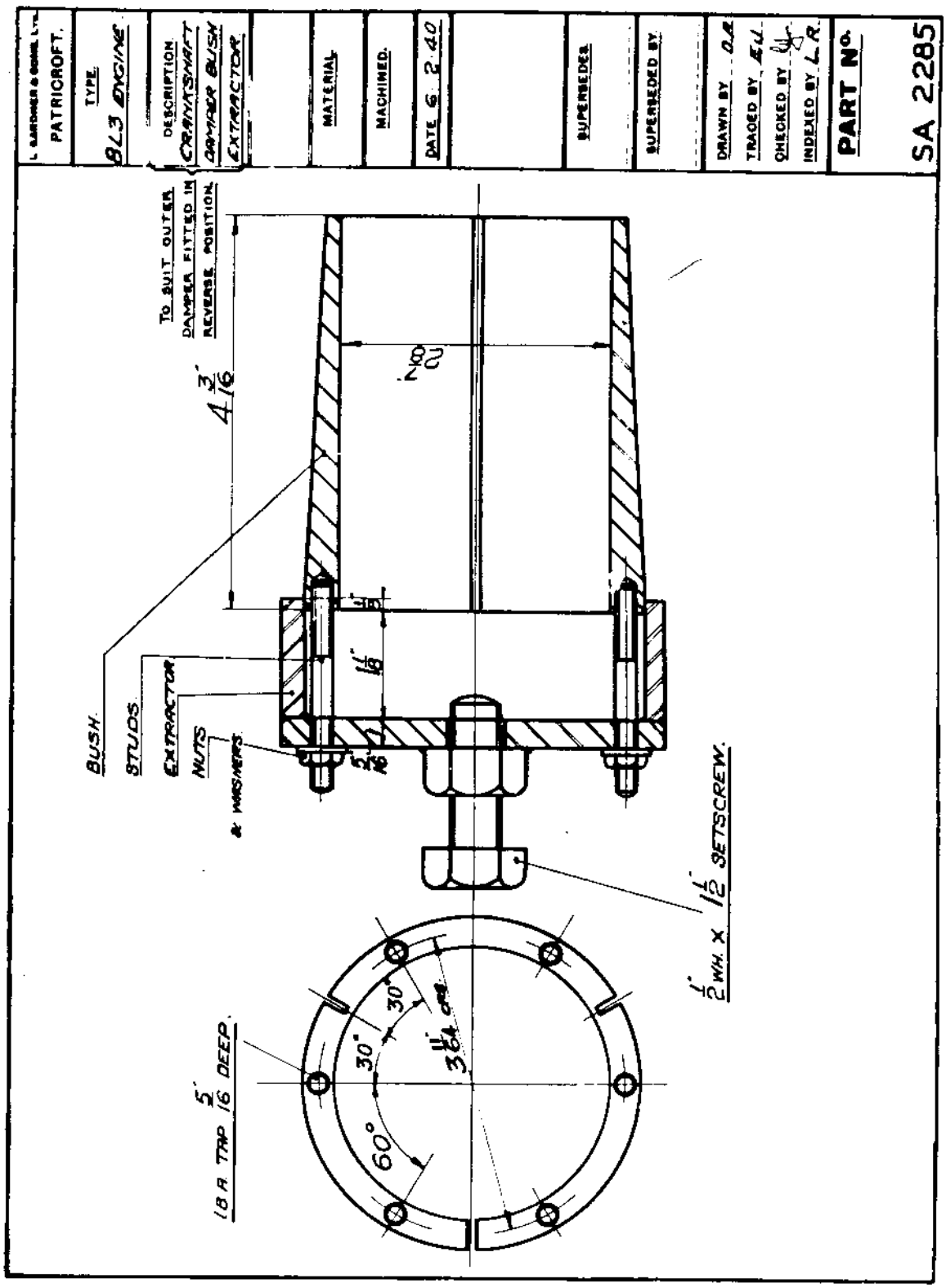
TYPE:- L3 & L3B ENGINES.

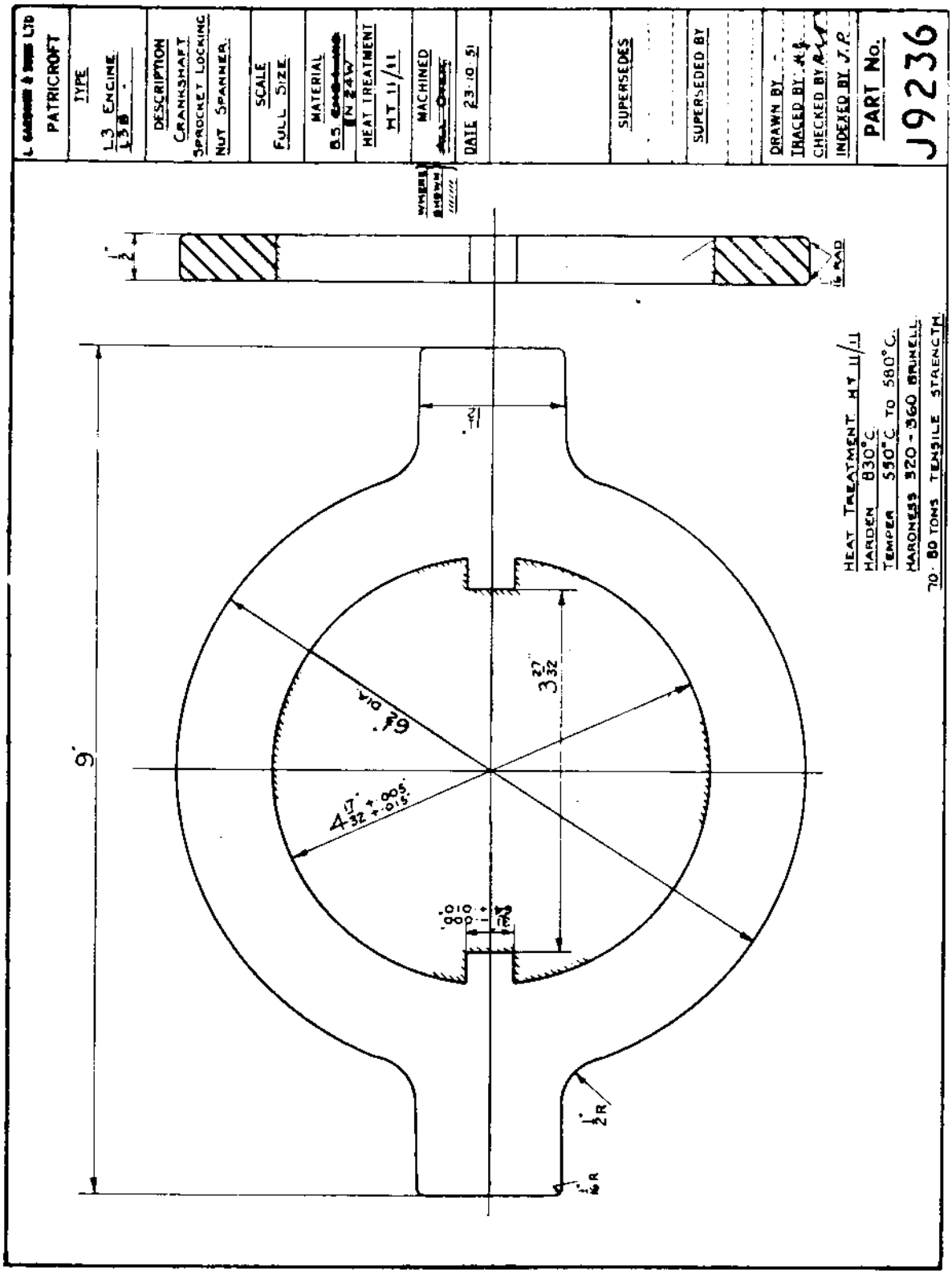
DESCRIPTION:- CORRECT TIGHTENING TORQUE FOR VARIOUS NUTS

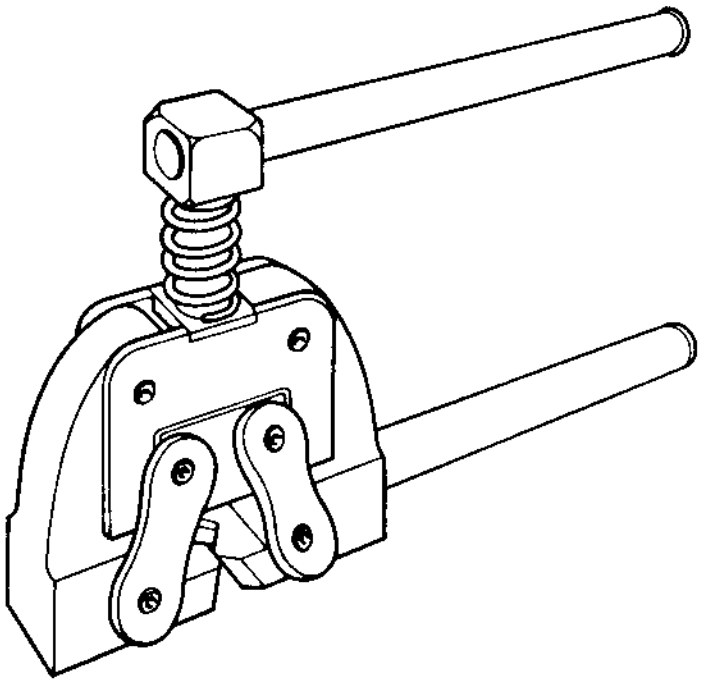
SCALE:-

L. GARDNER & SONS LTD. PATRICROFT, NR. MANCHESTER


L. GARDNER & SONS, LTD.
PATRICROFT.
TYPE
L3 ENGINE
DESCRIPTION
CRANKSHAFT DAMPER (INNER & OUTER) WITHDRAWAL TOOL
MATERIAL
HEAT TREATMENT
MACHINED
DATE 18-7-51
SUPERSEDES
SUPERSEDED BY
DRAWN BY A.L.Q.
TRACED BY M.J.
CHECKED BY R.V.G.
INDEXED BY J.P.
PART No.
S.A.3208
USE CASTLE NUTS REMOVED FROM DAMPER BOLTS
1 NUTS
2 STUDS (FOR INNER DAMPER WITHDRAWAL)
3 STUDS (" OUTER ")
4 PLATE


L. GARDNER & SONS, LTD.
PATRICROFT.
TYPE
8L3 ENGINE
DESCRIPTION
CRANKSHAFT
DRIVER BUSH
EXTRACTOR
MATERIAL
MACHINED.
DATE 6.2.40
SUPERSEDES
SUPERSEDED BY
DRAWN BY O.A.
TRACED BY A.U.
CHECKED BY
INDEXED BY L.R.
PART No.
SA 2285
TO SUIT OUTER DAMPER FITTED IN REVERSE POSITION.
4 3/16"
1.100 DIA
1 1/8"
5/16"
BUSH.
STUDS.
EXTRACTOR
NUTS
& WASHERS
1/2" WH. x 1 1/2" SETSCREW.
18 A TAP 5/16" DEEP.
30°
30°
60°
3 11/64" DIA


L. GARDNER & SONS LTD
PATRICROFT
TYPE
L3 ENGINE
L3B
DESCRIPTION
CRANKSHAFT
SPROCKET LOCKING
NUT SPANNER.
SCALE
FULL SIZE
MATERIAL
BS EN 24T
HEAT TREATMENT
HT 11/11
MACHINED
DATE 23:10:51
SUPERSEDES
SUPERSEDED BY
DRAWN BY
TRACED BY
CHECKED BY
INDEXED BY J.P.
PART No.
J9236
HEAT TREATMENT HT 11/11
HARDEN 830°C.
TEMPER 550°C TO 580°C.
HARDNESS 320-360 BRINELL
70-80 TONS TENSILE STRENGTH.
9"
.69 DIA
3 27/32"
4 17/32" +.005 -.015
1/2 R
1/16 R



USE 'RENOLD' EXTRACTOR TOOL No. 311 006.

L. GARDNER & SONS, LTD
PATRICROFT

TYPE
'L' TYPE

DESCRIPTION
REMOVAL OF TIMING CHAIN SIDE PLATE

SCALE

MATERIAL

HEAT TREATMENT

MACHINED

DATE 17-11-72

SUPERSEDES

SUPERSEDED BY

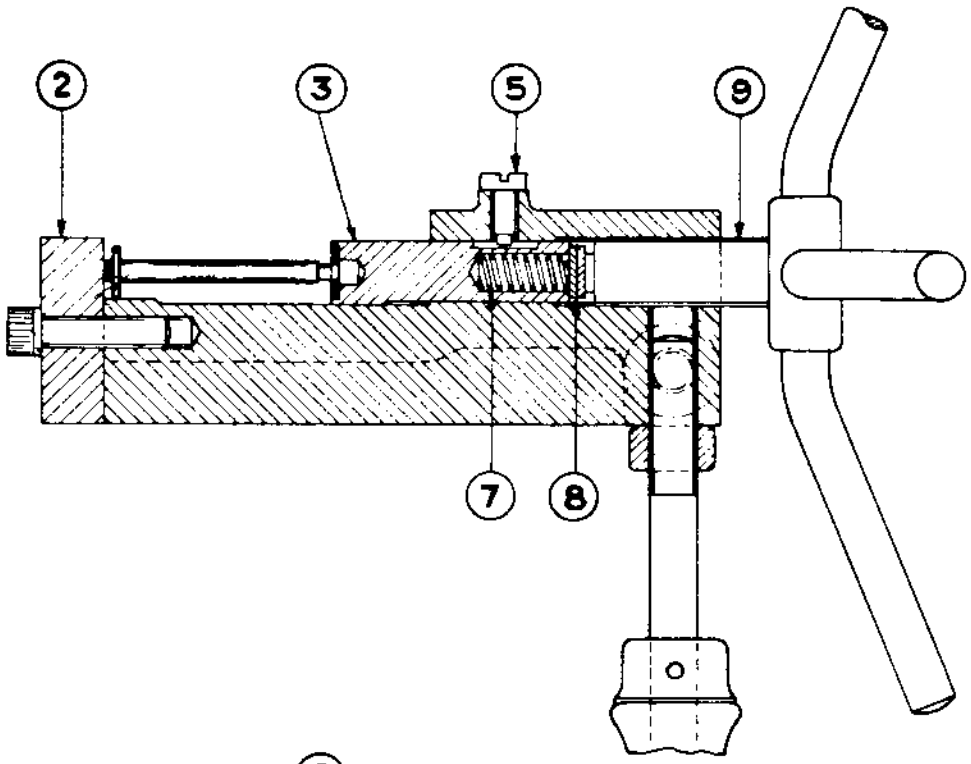
DRAWN BY
TRACED BY P.A.A.
CHECKED BY
INDEXED BY E.L.

S.P. No

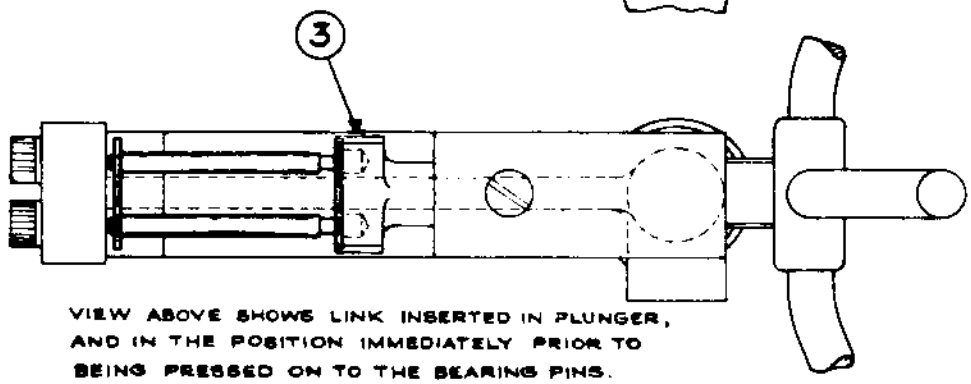
PART No.
SA5666

GARDNER

A

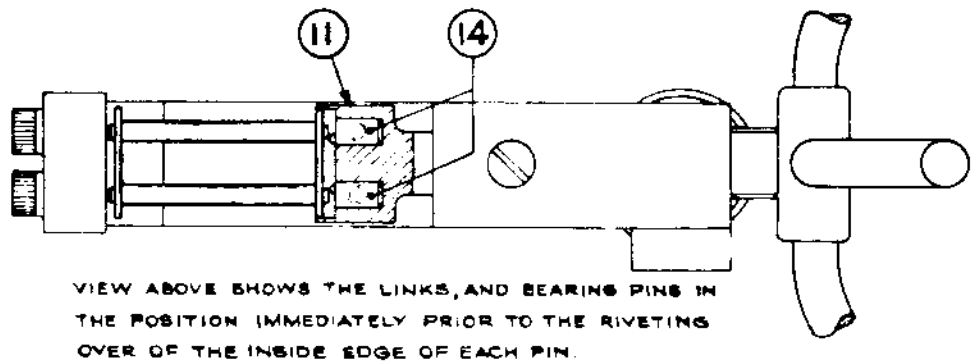


B



VIEW ABOVE SHOWS LINK INSERTED IN PLUNGER, AND IN THE POSITION IMMEDIATELY PRIOR TO BEING PRESSED ON TO THE BEARING PINS.

C



VIEW ABOVE SHOWS THE LINKS, AND BEARING PINS IN THE POSITION IMMEDIATELY PRIOR TO THE RIVETING OVER OF THE INSIDE EDGE OF EACH PIN.

LW, HLW, & L3 ENGINES

TIMING CHAIN SIDE PLATE PRESS TOOL & STUD RIVETING TOOL.

PURPOSE:- When joining the ends of a chain which has been fitted to an engine this tool should be used to press the side plate firmly and squarely up to the shoulders on the two studs. By changing press plunger for the riveting plunger the two stud ends can be riveted to provide additional means of retaining side plate in position.

METHOD (as PRESS TOOL):-

Apply a little stiff grease to recess in end of plunger (3) and place side plate in this recess; the plate will be retained by grease.

The spring load on the plunger will press the side plate on to the ends of the two studs; by slight movement of the tool it will be felt when the two holes in the side plate have registered with the ends of the studs.

The plunger is spring loaded so that when it is pressed against the forward side of the chain, the plunger will recede into the boss of tool, allowing the end plate (2) to take up a position behind chain as shown at "B".

Having attained this position, force the plate on to the studs by means of the large fine thread screw (9) until the plate is felt to be firmly in contact with the shoulders on the studs. Release screw and remove tool.

METHOD (as RIVETING TOOL):-

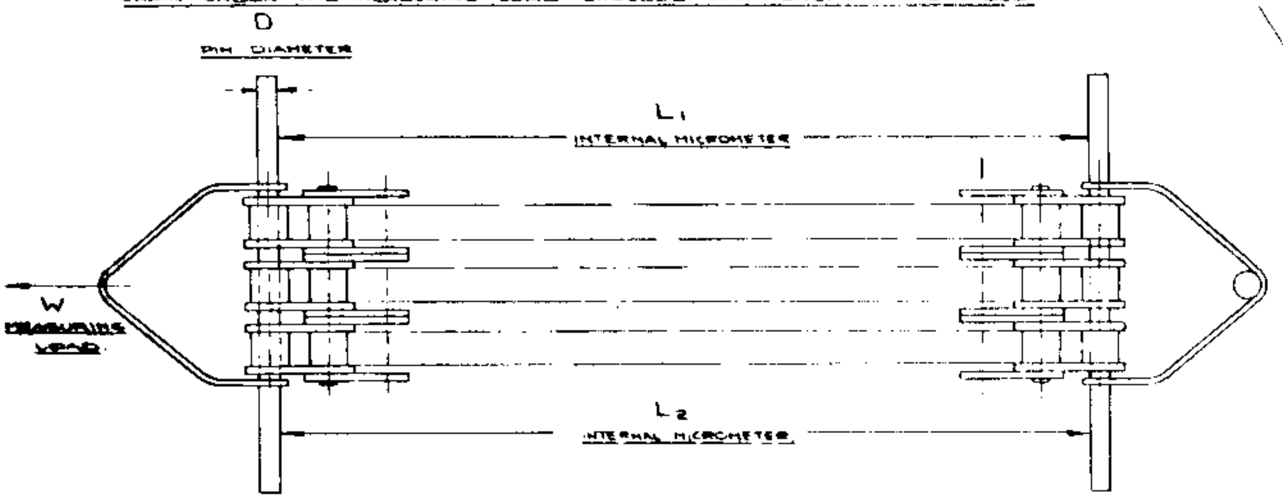
Remove retaining screw (5) in boss of tool, remove press plunger (3) and replace by riveting plunger (11), taking care to refit spring (7) and two hardened steel discs (8) as shown at "A". Apply tool to the chain in the same way as described for pressing side plate. Screw up fine thread screw, until definite resistance is felt, and rotate screw a further ½ to ¾ of a turn. This forces the two punches (14) into the ends of the two studs sufficiently to turn over the metal at one point on the end of each stud. This provides a means, in addition to that of interference fit, of retaining the side plate.

NOTE:- Where a number of engines are involved the operator may wish to have two tools, one permanently fitted with the press plunger, and the other permanently fitted with the riveting plunger.

NOTES. 1. TO OBTAIN ACCURATE MEASUREMENT OF LENGTH CHAIN SHOULD BE WASHED & EITHER HUNG VERTICALLY OR LAID ON FLAT SURFACE WITH CORRECT LOAD APPLIED.

2. THE METHOD SHOWN OF ANCHORING THE CHAIN & APPLYING THE MEASURING LOAD IS DIAGRAMMATIC ANY OTHER CONVENIENT ARRANGEMENT MAY BE USED BUT BENDING OF THE PINS MUST BE AVOIDED.

IMPORTANT.
WHEN RECONDITIONING AN ENGINE FOR A FURTHER LONG PERIOD OF USE, IT IS RECOMMENDED THAT A NEW CHAIN BE FITTED IF THE LENGTH OF THE OLD CHAIN UNDER THE MEASURING LOAD EXCEEDS THAT GIVEN IN THE TABLE.



ENGINE TYPE	CHAIN: MAKERS NO	CHAIN: TYPE	CHAIN: PITCH IN	CHAIN: NO OF PITCHES	PIN DIAMETER D IN	MEASURING LOAD W LB	MICROMETER READING = $\frac{L_1+L_2}{2}$: NEW NOMINAL LENGTH IN.	MICROMETER READING = $\frac{L_1+L_2}{2}$: WORN PERMISSIBLE LENGTH MAX. IN.	
LK	118510	TRIPLEX	.4375	92 94	.155	65	39.658 40.533	39.857 40.736	SINGLE IDLER DOUBLE IDLER
2-4L2	110046	SIMPLEX	.50	68	.175	28	33.825	33.495	
5-6L2 2-4L2 (SPECIAL)	114046	DUPLEX	.50	68	.175	56	33.825	33.495	
LW-HLW-LW20-HLW20 LX-HLX LXB-HLXB L3-L3B	116046	TRIPLEX	.50	96 98	.175	84	47.325 48.325	47.563 48.568	SINGLE IDLER DOUBLE IDLER

L. GARDNER & SONS LTD [illegible]
PATRICROFT [illegible]

TYPE L3, L3B, LK, 2-4L2, 5-6L2, LW, HLW, LW20, HLW20, LX, HLX, LXB, HLXB.

DESCRIPTION: PERMISSIBLE CHAIN STRETCH

SCALE.

MATERIAL.

MACHINED.

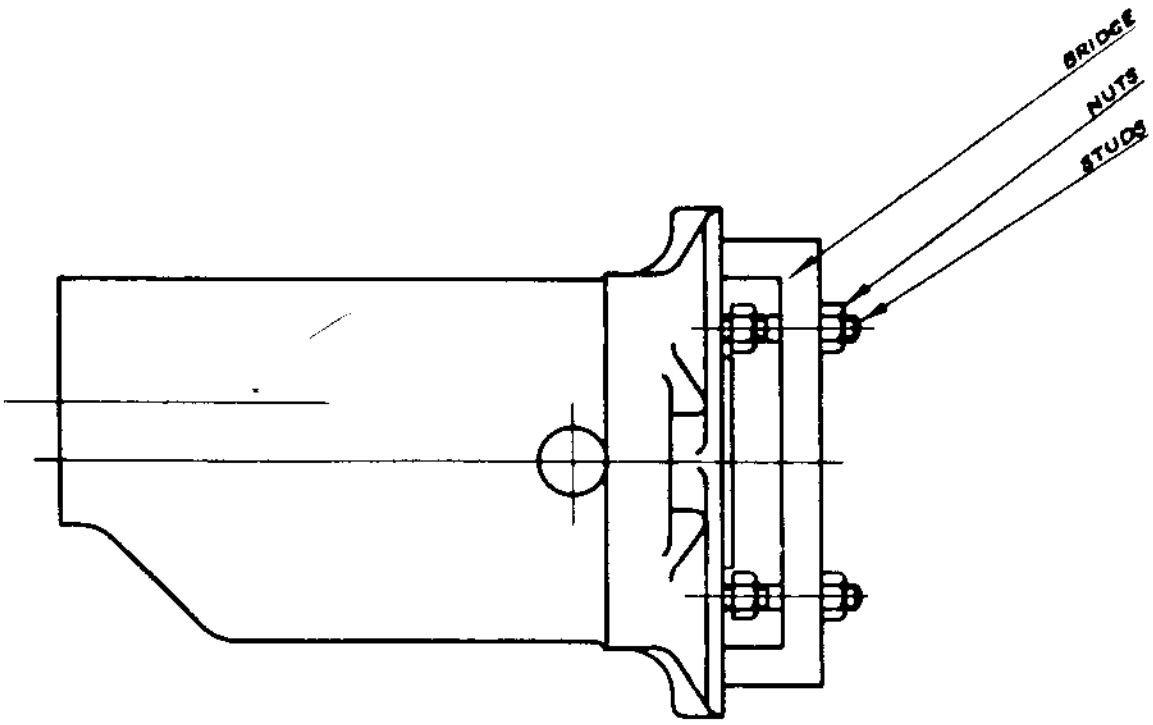
DATE 6 4 36

SUPERSEDES SA 1759

SUPERSEDED BY

DRAWN BY
TRACED BY
CHECKED BY
INDEXED BY

PART No SA1885



L TYPE ENGINES

EXTRACTOR FOR THERMOSTAT UNIT

Illustration No. SA.2965

PURPOSE. For extracting thermostat unit from aluminium housing.

METHOD. Remove outlet hose connection from forward end of housing. Fit extractor as shown. Screw loose studs into tapped holes in brass thermostat unit.

Screw up outer nuts until unit is withdrawn.

NOTE: The two nuts shown adjacent to the unit are provided as a means to retain the studs when tool is not in use.

"L" TYPE ENGINES.

INSTRUCTIONS FOR THE ASSEMBLING OF PISTONS IN ENGINE

L2, LW, L3, L3B & 6LX ENGINES.

Different pistons are required for engines rotating in clockwise or anti-clockwise direction (as viewed on flywheel end of engine).

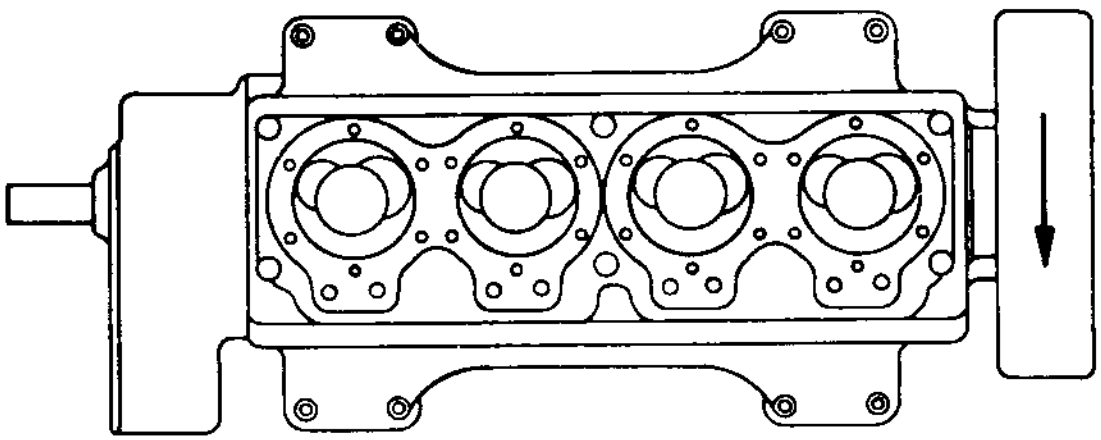
The pistons are distinguished by an "Engine Rotation" arrow stamped on piston top faces in addition to the words "Tappet Side".

The correct pistons are those on which the "Engine Rotation" arrow points in the direction of rotation of the crankshaft when assembled in the engine and viewed in plan as illustrated in sketch. "Tappet Side", of course, being also correctly positioned.

HLW, HLX, 6LXB & 8LXB ENGINES.

There is only one type of piston for each of these engines as they rotate in one direction only, i.e. anti-clockwise when viewed on flywheel end.

Thus, it is only necessary to ensure that pistons are assembled in an engine in accordance with the words "Tappet Side" stamped on the top face.



PISTON RINGS

"L"TYPE ENGINES

LW,HLW,LX,HLX, L2,LK,L3 & L3B ENGINES. Please note, sets of spare piston rings include two pressure rings only. The ring fitted to the No. 1 groove is chromium plated on its periphery and side faces. The ring fitted to No. 2 groove is plated on its periphery only and can be identified by a phosphated etched section on each side of the gap. These rings should not be interchanged.

LXB & HLXB ENGINES The ring fitted to No.1 & 2 grooves are the same and are plated on the periphery and side faces.

See table for location of rings and respective part numbers:-

SPARE PART NUMBER

LOCATION	LW,LW20 & HLW	LX & HLX	L2	LK	L3 & L3B	LXB & HLXB
Groove N°.	3 Groove Piston	3 Groove Piston	3 Groove Piston	3 Groove Piston	3 Groove Piston	3 Groove Piston
N°. 1	MA 618	LX/3/3012	MA 618	LK/3/223	L3/8/148	LX/3/3012
N°. 2	MA 168	LX/3/3013	MA 168	LK/3/136	L3/8/78	LX/3/3012
N°. 3 (Scraper)	MA 807	LX/3/3064	MA 807	LK/3/229	L3/8/160	LX/3/3064

NOT NOW AVAILABLE

USED WHEN RE-CONDITIONING PISTONS WITH WORN GROOVES

HLW

1-6L2 & 2-6LW ENGINES (STANDARD CYL. BORE.)

GROOVE	FIRST OVERSIZE WIDTH. WIDTH ·0156" OVERSIZE.					SECOND OVERSIZE WIDTH. WIDTH ·0312" OVERSIZE.				
	WIDTH OF GROOVE.	WIDTH OF RING.	RING CHROMIUM PLATED DWG. No.	ENG.	S.P.No.	WIDTH OF GROOVE.	WIDTH OF RING.	RING CHROMIUM PLATED DWG. No.	ENG.	S.P.No.
1	·1119" / ·1114" *	·1094" / ·1089"	J8362	IL2	MA170	·1275" / ·1270" *	·1250" / ·1245"	J8363	IL2	MA171
				2-6L2	MA170				2-6L2	MA171
				LW HLW	MA170				LW HLW	MA171
2	·1144" / ·1134"	"	"	"	"	·1300" / ·1290"	"	"	"	

L.K ENGINES (STANDARD CYL. BORE.)

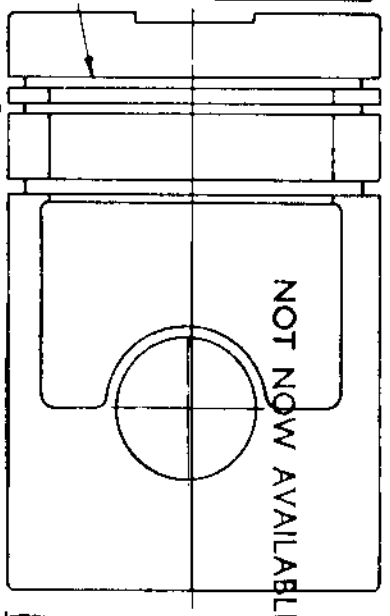
GROOVE	FIRST OVERSIZE WIDTH. WIDTH ·015" OVERSIZE.					SECOND OVERSIZE WIDTH. WIDTH ·030" OVERSIZE.				
	WIDTH OF GROOVE.	WIDTH OF RING.	RING CHROMIUM PLATED DWG. No.	ENG.	S.P.No.	WIDTH OF GROOVE.	WIDTH OF RING.	RING CHROMIUM PLATED DWG. No.	ENG.	S.P.No.
1	·0995" / ·0990" *	·0970" / ·0965"	J8367	LK	3/142	·1145" / ·1140" *	·1120 / ·1115"	J8368	LK	3/143
2	·1010" / ·1000"	"	"	"	"	·1160" / ·1150"	"	"	"	"

L3 & L3S ENGINES (STANDARD CYL. BORE).

GROOVE	FIRST OVERSIZE WIDTH. WIDTH ·020" OVERSIZE					SECOND OVERSIZE WIDTH. WIDTH ·0312" OVERSIZE				
	WIDTH OF GROOVE	WIDTH OF RING.	RING CHROMIUM PLATED DWG. No.	ENG.	S.P.No.	WIDTH OF GROOVE.	WIDTH OF RING.	RING CHROMIUM PLATED DWG. No.	ENG.	S.P.No.
1	·1477" / ·1472"	·1450" / ·1445"	J8182	L3	8/80	·1589" / ·1584"	·1562" / ·1557"	J8183	L3	8/81
2	·1510" / ·1500"	"	"	"	"	·1622" / ·1612"	"	"	"	"

NOT NOW AVAILABLE

WHEN OPENING OUT N° 1 GROOVE THE UPPER FACE MUST ONLY JUST BE CLEANED UP. THE REMAINING METAL TO BE REMOVED FROM THE LOWER FACE.



NOTE:- IT IS IMPROBABLE THAT THE OTHER GROOVES WILL REQUIRE OVERSIZING DURING LIFE OF PISTON.

L. GARDNER & SONS, LTD. PATRICROFT.

TYPE: 'L' TYPE ENGINES

DESCRIPTION: PISTON STANDARD BORE GROOVES. OVERSIZE IN WIDTH.

SCALE

MATERIAL

MACHINED

DATE 23-1-50

1|W 3040.

SUPERSEDES

SUPERSEDED BY

RE-DRAWN BY T.H.P.

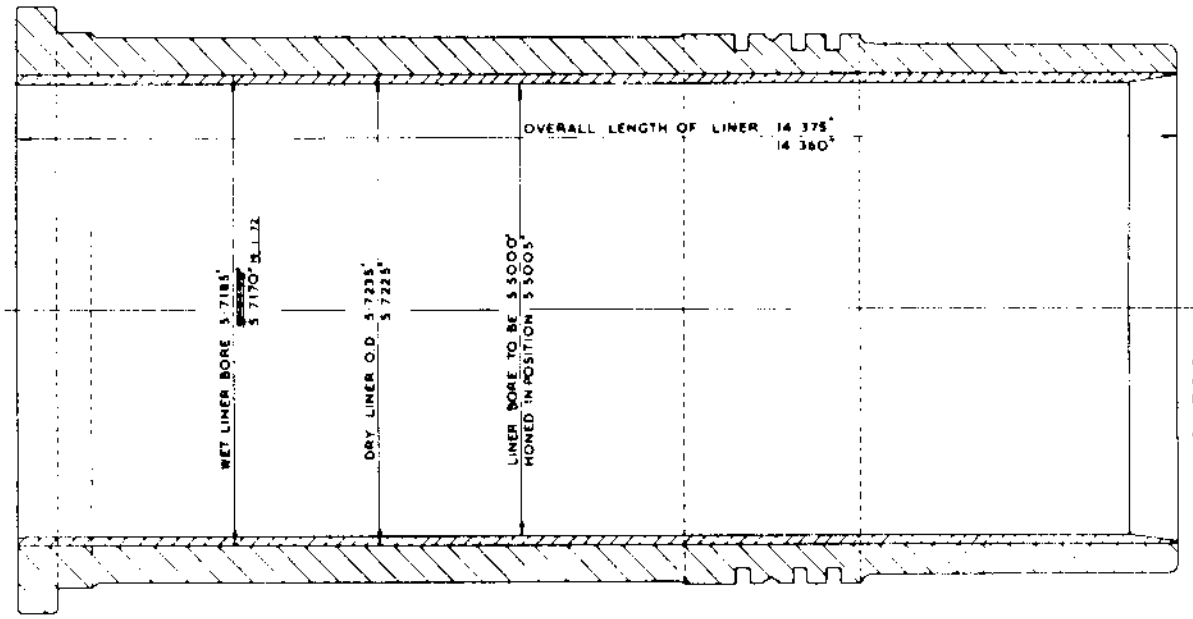
TRACED BY H.L.

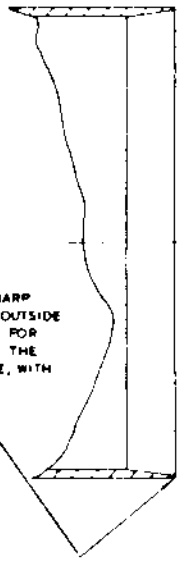
CHECKED BY J.W.

INDEXED BY K.G.L.

PART Nº

S.A. 2913





NOTE :-
REMOVE THE SHARP CORNER FROM OUTSIDE EDGE OF LINER FOR THE WHOLE OF THE CIRCUMFERENCE, WITH AN OIL STONE

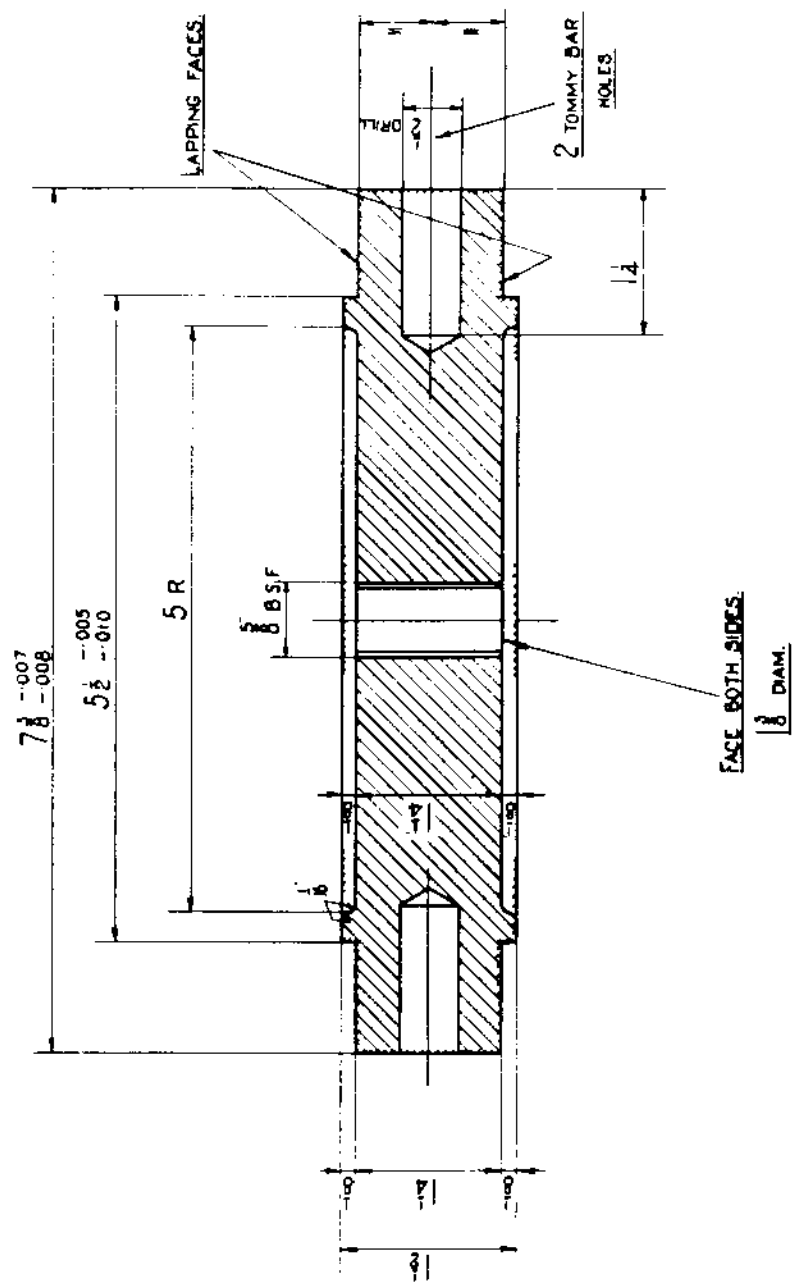
INSTRUCTIONS.

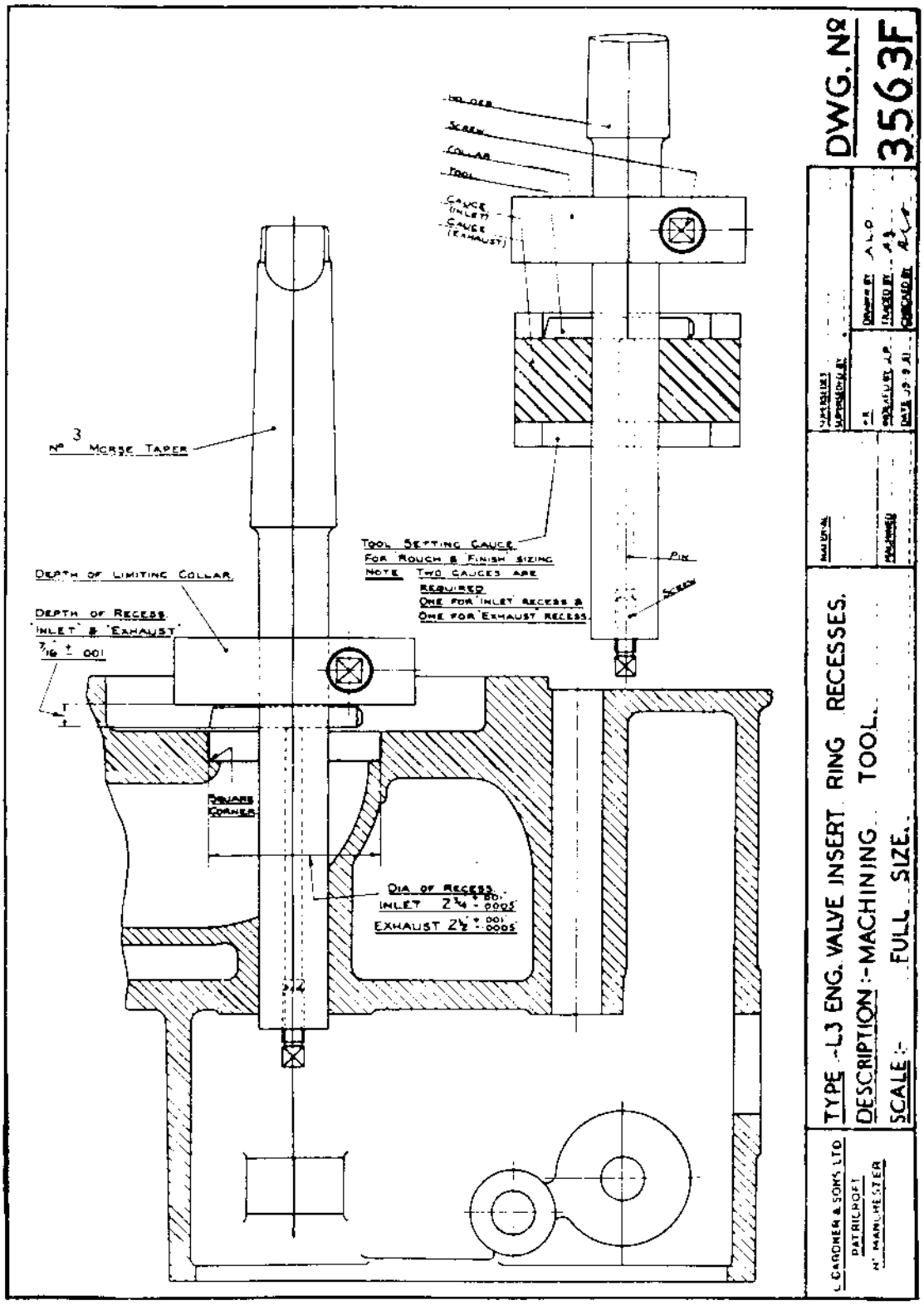
1. PRESS OUT THE EXISTING LINER
2. REMOVE THE SHARP CORNERS ON THE LINER AS INDICATED IN VIEW ABOVE.
3. SMEAR TALLOW LIBERALLY OVER THE SURFACE OF EACH WET LINER BORE & THE EXTERNAL SURFACE OF EACH DRY LINER IT IS IMPORTANT THAT TALLOW IS USED & NOT LUBRICATING OIL. PRESS IN THE LINERS UNTIL THE UPPER EDGES ARE LEVEL WITH THE TOP FACE OF WET LINER.
   THE APPROXIMATE PRESSURE REQUIRED IS A MAXIMUM OF 6 TONS & A MINIMUM OF 3 TONS
4. HONE THE BORE OF THE LINER TO FINISHED SIZE = $5\frac{1}{2}"^{+\cdot000"}_{+\cdot0005"}$

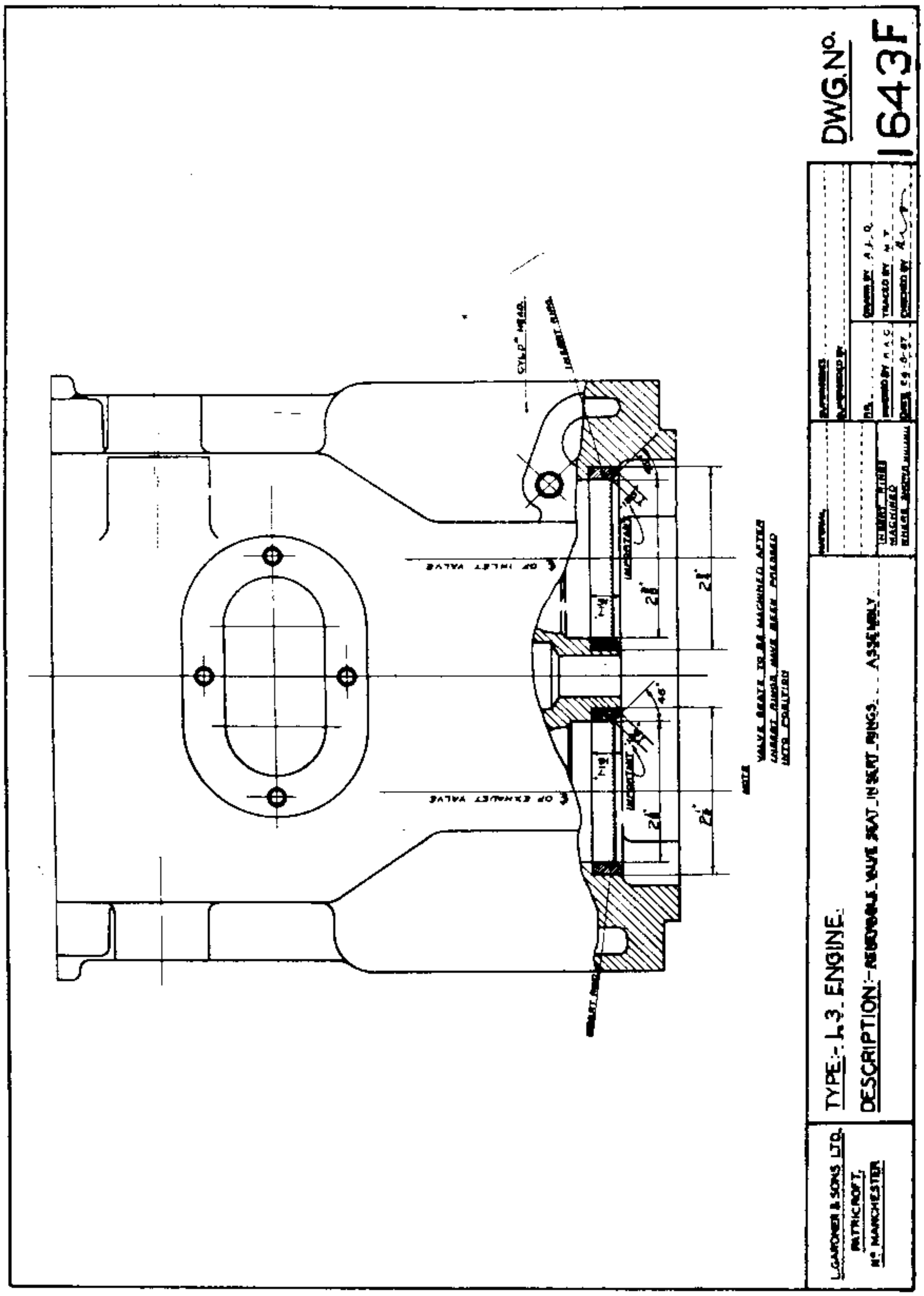
R.D.164

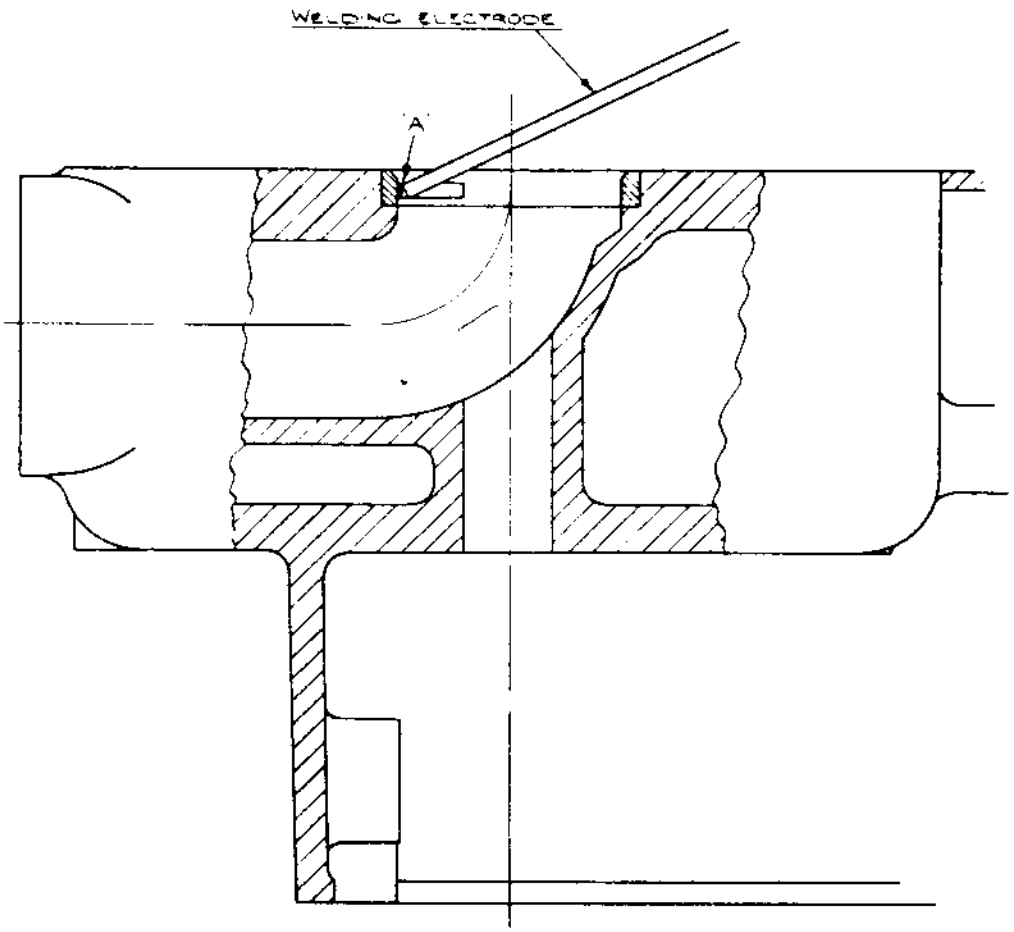
L. GARDNER & SONS LTD. PATRICROFT NR. MANCHESTER	TYPE: L3 & L3B ENGINES.	MATERIAL	SUPERSEDES ... SUPERSEDED BY ...	DWG. No. 2998 F
	DESCRIPTION: INSTRUCTIONS FOR CYLINDER DRY LINER RENEWAL.	MACHINED ...	RE- 3·9·68 DRAWN BY A.L.W. TRACED BY L.M.P. CHECKED BY W.J.B.	
	SCALE:-		INDEXED BY E.L. DATE 14·5·47	S.P. No

L. GARDNER & SONS Ltd. PATRICROFT	
TYPE	L3H, L3B ENGINES
DESCRIPTION	CYL. HD. & CYL. LINER LAPPING DISC.
SCALE	FULL SIZE
MATERIAL	CI
MACHINED WHERE SHOWN	
DATE	23-2-44
	NEW PATTERN.
SUPERSEDES	
SUPERSEDED BY	
DRAWN BY	A.L.D.
TRACED BY	M.L.
CHECKED BY	A.C.C.
INDEXED BY	T.C.
PART No.	J5945




DWG. Nº 3563F
TYPE :- L3 ENG. VALVE INSERT RING RECESSES.
DESCRIPTION :- MACHINING TOOL.
SCALE :- FULL SIZE.
L. GARDNER & SONS LTD
PATRICROFT
Nr MANCHESTER
Nº 3 MORSE TAPER
TOOL SETTING GAUGE
FOR ROUGH & FINISH SIZING
NOTE TWO GAUGES ARE REQUIRED
ONE FOR 'INLET' RECESS &
ONE FOR 'EXHAUST' RECESS
DEPTH OF LIMITING COLLAR
DEPTH OF RECESS
'INLET' & 'EXHAUST'
7/16 + .001
ROUND CORNER
DIA OF RECESS
INLET 2¾ +.001 -.0005
EXHAUST 2½ +.001 -.0005
PIN
SCREW
GAUGE (INLET)
GAUGE (EXHAUST)
COLLAR
TOOL
SCREW


DWG. No.
1643F
TYPE:- L3 ENGINE.
DESCRIPTION:- REMOVABLE VALVE SEAT INSERT RINGS. ASSEMBLY.
L. GARDNER & SONS LTD.
PATRICROFT,
Nr MANCHESTER



LX, HLX, LXB, HLXB, LW, HLW, LW20, HLW20, L3 & L3B ENGINES.

VALVE SEAT INSERT WITHDRAWAL TOOL

Illustration No. K4240

PURPOSE. For withdrawing worn valve seat inserts from the cylinder head.

METHOD. To remove valve seat inserts from a cylinder head apply a welding electrode as shown above. Deposit a small thickness of weld as shown in section at "A" for about a quarter of the circumference of the insert bore. The insert will then collapse and can be lifted out.

NOTE: The arc must not be allowed to strike the metal below the insert and any metal particles which have adhered to the valve port must be carefully removed.

"CAUTION" When undertaking this operation it is considered necessary to have some form of shield to protect the operator as on occasions the valve seat insert can spring out of the cylinder head with considerable force.

L. GARDNER & SONS LTD.
PATRICROFT.

L3B TYPE
LW, LH, L3 ENG.
SPRAYER, SEAT

DESCRIPTION
CORRECTING CUTTER & LAP

SCALE
FULL SIZE

MATERIAL
SEE DETAILS

HEAT TREATMENT

MACHINED
SEE DETAILS

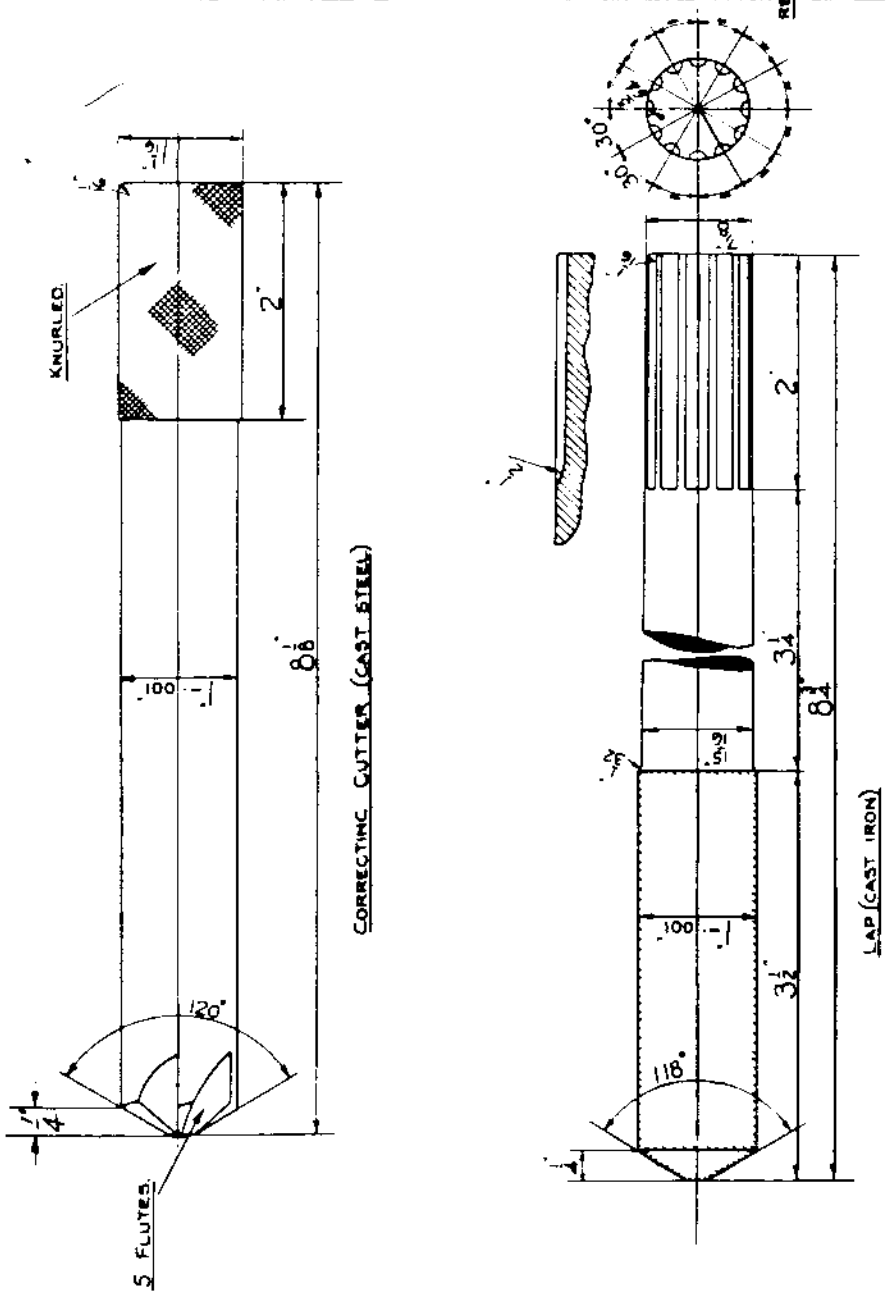
DATE 1-9-46
12-10-53

SUPERSEDES

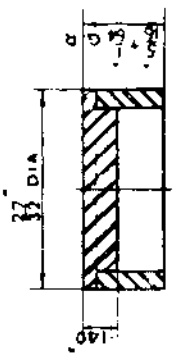
SUPERSEDED BY

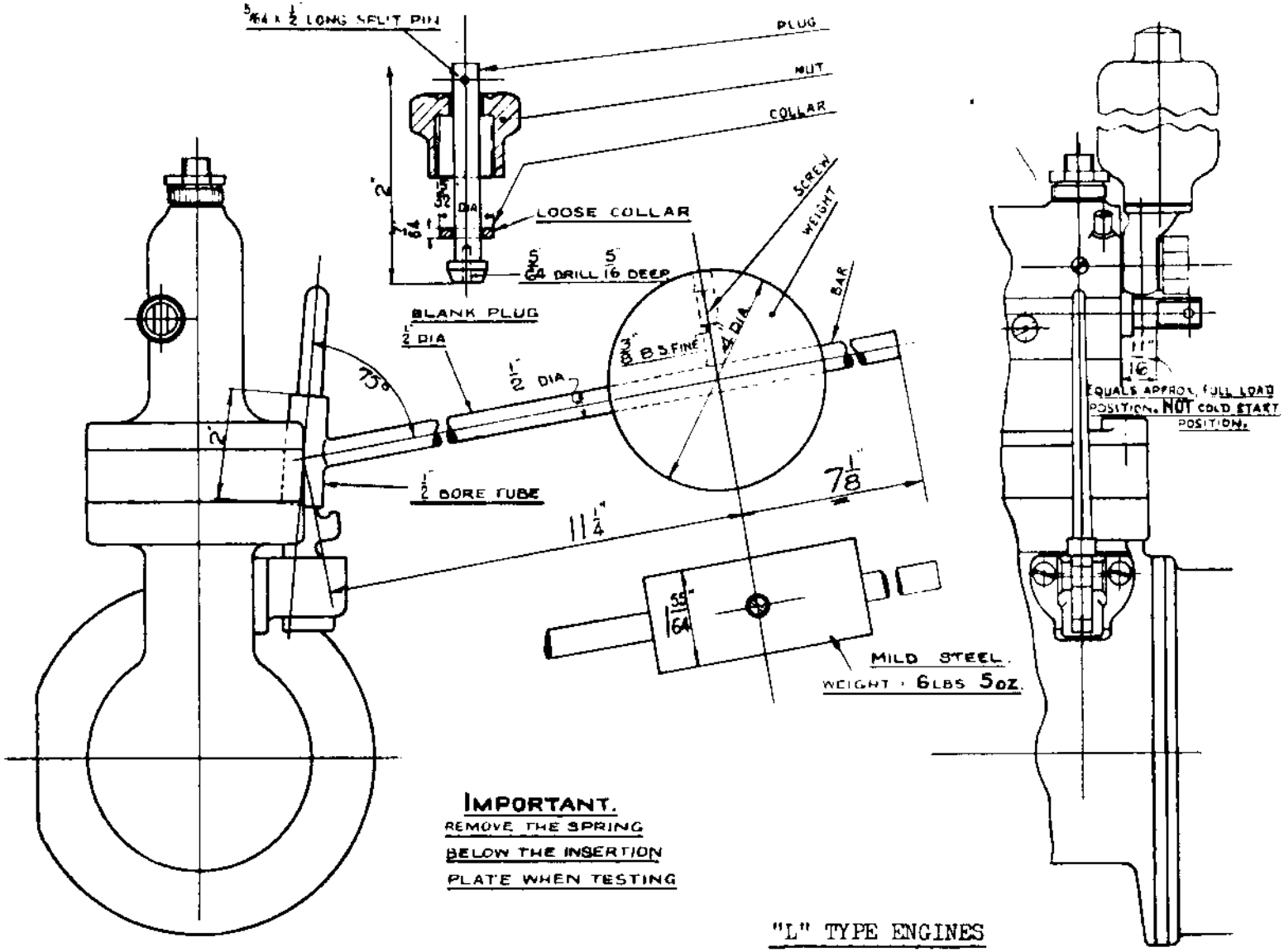
RE-DRAWN BY A.L.O.
TRACED BY
CHECKED BY A.L.O
INDEXED BY E.M.

PART No.
J6648



GARDNER & SONS, LTD.	PATRICROFT.
2-GL2 TYPE 4 & 6 CYLINDER ENGINES LW (TYPE 6 LE) Inc.	
DESCRIPTION	FUEL PUMP TAPPET GAUGE.
SCALE	TWICE FULL SIZE.
MATERIAL	
HEAT TREATMENT	
MACHINED	
DATE	14 · 9 · 50
SUPERSEDES	J 2021
SUPERSEDED BY	
DRAWN BY	A.J.H.
TRACED BY	
CHECKED BY	J.A.
INDEXED BY	S.W.
PART No.	S.A.3105



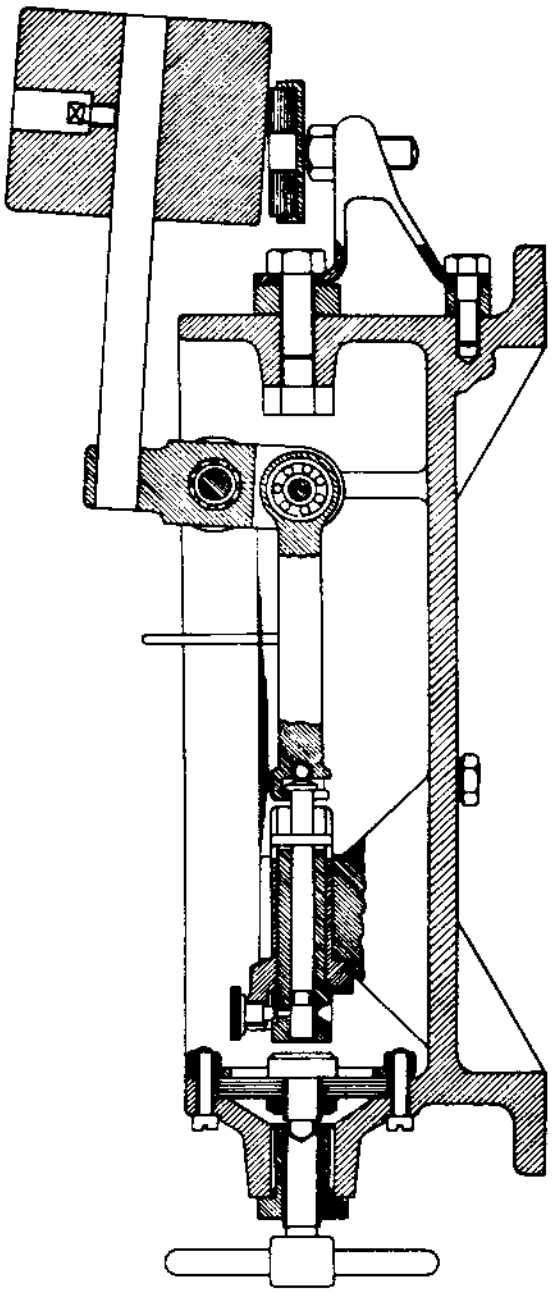


IMPORTANT.
REMOVE THE SPRING
BELOW THE INSERTION
PLATE WHEN TESTING

"L" TYPE ENGINES

Fuel Pump Element Testing Tool

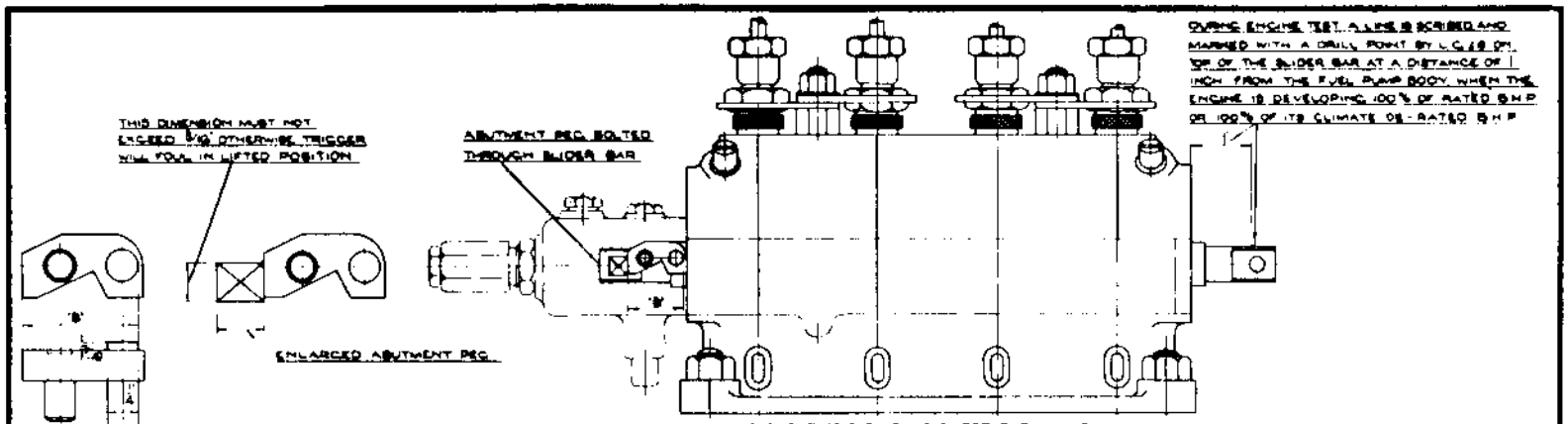
Illustration No. S.A. 2134



L TYPE ENGINES

Fuel Pump Element Testing Fixture

Illustration No. 11647



TRIGGER DIMENSION B MAY BE INCREASED PREFERABLY BY THE FITTING OF A NEW TRIGGER, OR BY THE FOLLOWING.

(1) ADDITION OF WELDED METAL TO THE END OF THE EXISTING TRIGGER.

(2) BRAZING OR CAREFULLY SOLDERING A STEEL SHIM TO THE END OF THE EXISTING TRIGGER. (AFTER HEATING, CARE MUST BE TAKEN TO ENSURE THAT THE 1/4 DIA. PEG PRESSED AND RIVETTED IN THE TRIGGER HAS NOT BECOME LOOSE)

(3) FITTING A NEW ENLARGED ABUTMENT PEG SO THAT A MICROMETER MAY BE USED TO ACCURATELY MEASURE DIMENSION B. IT IS NECESSARY TO INSERT A FITTING PARALLEL 1/4 DIA P.N. INTO THE HOLE IN THE TRIGGER. THE ORIGINAL DIMENSION B IS STAMPED ON THE SIDE OF EACH TRIGGER.

AMOUNT BY WHICH TRIGGER DIMENSION B HAS TO BE INCREASED TO REDUCE B.H.P

INCREASE IN TRIGGER DIMENSION B	PERCENTAGE OF FULL POWER AVAILABLE (APPROXIMATE PERCENTAGE OF FULL POWER FUEL SUPPLY								
	L K	LW(E)	LW(K)-HLW	LW/20-HLW	LK-HLK	LKB-HLKB	L 3 600/900 RPM	L 3 1200 RPM	L 3B 1000-900 RPM
0	100	100	100	100	100	100	100	100	100
010"	97 5	96 0	97 6	98 7	97 5	97 6	96 1	97 2	97 3
020"	90 6	83 5	95 3	97 0	95 3	95 5	91 2	95 0	94 1
030"	84 1	80 2	92 7	95 1	92 5	93 0	87 1	90 8	90 8
040"	91 4	88 2	90 7	93 0	89 9	90 6	82 5	87 9	87 6
050"	87 8	85 4	88 2	90 6	87 0	88 3	78 7	84 5	84 6
060"	88 2	83 1	85 7	88 2	84 2	86 0	75 7	81 0	81 2
070"	81 4	79 7	83 3	85 5	81 2	83 5	71 7	77 3	78 0
080"	78 2	76 2	80 8	82 7	78 3	80 3	68 5	72 7	74 9
090"	75 2	72 5	78 5	79 8	75 4	78 6	64 7	69 0	71 6
100"	72 9	69 9	76 3	76 5	72 5	76 0	60 9	65 3	68 5

FOR CURVES SHOWING ENGINE PERFORMANCE AT HIGH ALTITUDE AND HIGH ATMOSPHERIC TEMPERATURE, SEE G.A. 3514

NOTE. A REDUCTION IN THE TRIGGER DIMENSION (OR INCREASE IN THE FUEL SUPPLY) MUST IN NO CIRCUMSTANCES BE EFFECTED.

L. GARDNER & SONS LTD. PATRICROFT Nr MANCHESTER.

TYPE:- 'L' TYPE ENGINES

DESCRIPTION:- POWER REDUCTION BY LENGTHENING OF FUEL LIMITING TRIGGER.

SCALE:-

MATERIAL

MACHINED

SUPERSEDES

SUPERSEDED BY

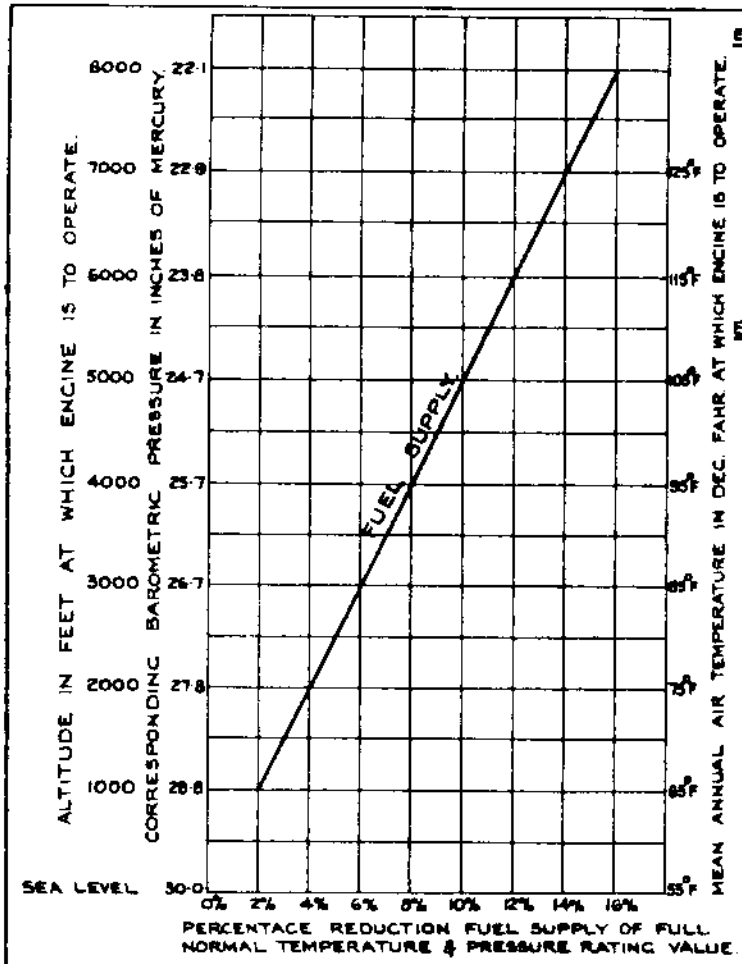
PR RE-DRAWN BY A.J.O

INDEXED BY TRACED BY A.B

DATE MAR/70 CHECKED BY A/C

DWG. No. 3276 F

S.P. No.



REDUCTION IN FUEL SUPPLY FOR ALTITUDE AND TEMPERATURE CONDITIONS.

EXAMPLE:-GIVEN THAT AN ENGINE HAS TO OPERATE AT 2000 FT. ALTITUDE WITH A MEAN ANNUAL ATMOSPHERIC TEMPERATURE OF 75° F. FROM THE GRAPH ON THE LEFT HAND SIDE WE READ THE FOLLOWING REDUCTIONS:-

FOR ALTITUDE 4%

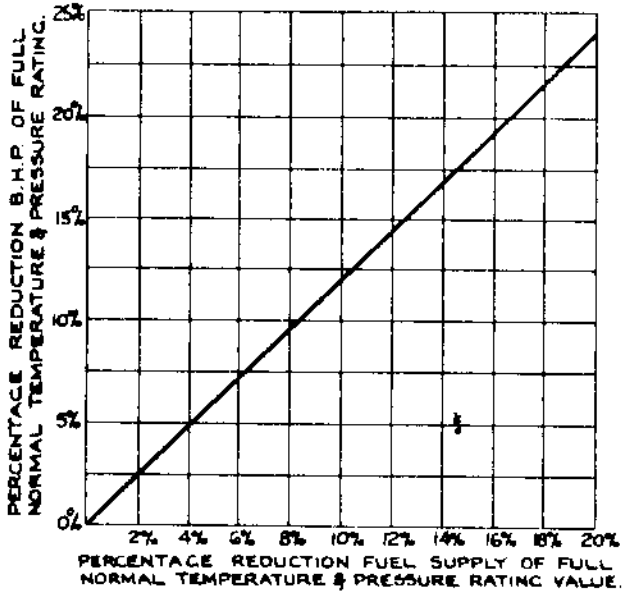
FOR TEMPERATURE 4%

COMBINED REDUCTION 8% OR 0·92 NORMAL TEMPERATURE AND PRESSURE RATING FUEL SUPPLY.

THE GRAPH ON THE RIGHT HAND SIDE SHOWS THE APPROXIMATE REDUCTION IN B.H.P WHEN THE FUEL SUPPLY IS REDUCED UNDER ALTITUDE AND TEMPERATURE CONDITIONS.

EXAMPLE-COMBINED REDUCTION FUEL SUPPLY 10%.

REDUCTION B.H.P. OF FULL N.T.P. RATING 12%



REDUCTION IN B.H.P. WHEN FUEL SUPPLY REDUCED UNDER ALTITUDE AND TEMPERATURE CONDITIONS.

ENGINE PERFORMANCE AT HIGH ALTITUDE & HIGH ATMOSPHERIC TEMPERATURE.

DRAWN BY T.H.P TRACED BY H.G 20-4-56. SUPERSEDES S.A.1922. S.A.3514.

ENGINE PERFORMANCE AT HIGH ALTITUDE AND HIGH ATMOSPHERIC TEMPERATURE

As is well known, the density of air is lower at both high altitude and high temperature and since a given amount of fuel requires a given amount of air for its combustion, it is necessary that the injected fuel supply to an engine operating under conditions of lower air density be restricted to a value satisfactory for combustion and operation with a smokeless exhaust.

Engine Catalogue powers are known as the 100% rating, and are those developed with a satisfactory fuel/air ratio under conditions of normal temperature and pressure. These conditions, namely, a barometric pressure of 30" HG., and an atmospheric temperature of 55°F. normally obtain at the manufacturer's works at Patricroft, Lancashire.

Conditions of reduced air density encountered both as a result of high altitude and high atmospheric temperature, each separately have an effect on engine performance such that for every 1000ft. altitude and each 10°F. increase over sea level and 55°F. mean annual temperature respectively, it is appropriate to reduce the fuel supply 2%.

When it is intended that an engine shall operate permanently at 1000ft. altitude or 65°F. mean annual ambient temperature, or in excess of either of these figures, it is necessary that the length of the fuel pump output control trigger be increased in order to reduce the injected fuel supply appropriately according to altitude and temperature shown on the graph.

When site operating conditions are known, new engines are appropriately set during test at the makers works, and the setting clearly stamped on the fuel pump rating plate. When, however, it is necessary to adjust spare or reconditioned fuel pumps the work can be accomplished only by use of the Gardner fuel pump calibrating machine and by observing precisely the provisions of Instruction Book 45·3. On page 9 of Book 45·3 will be found the average delivery from each plunger in cubic centimetres and the values quoted are to be reduced according to the graph.

L GARDNER & SONS LTD
PATRICROFT

TYPE
HLW, LK, 2·6L2, LW AND 3·6L3 ENGINES

DESCRIPTION
WITHDRAWAL TOOL

SCALE
FULL SIZE.

MATERIAL

MACHINED

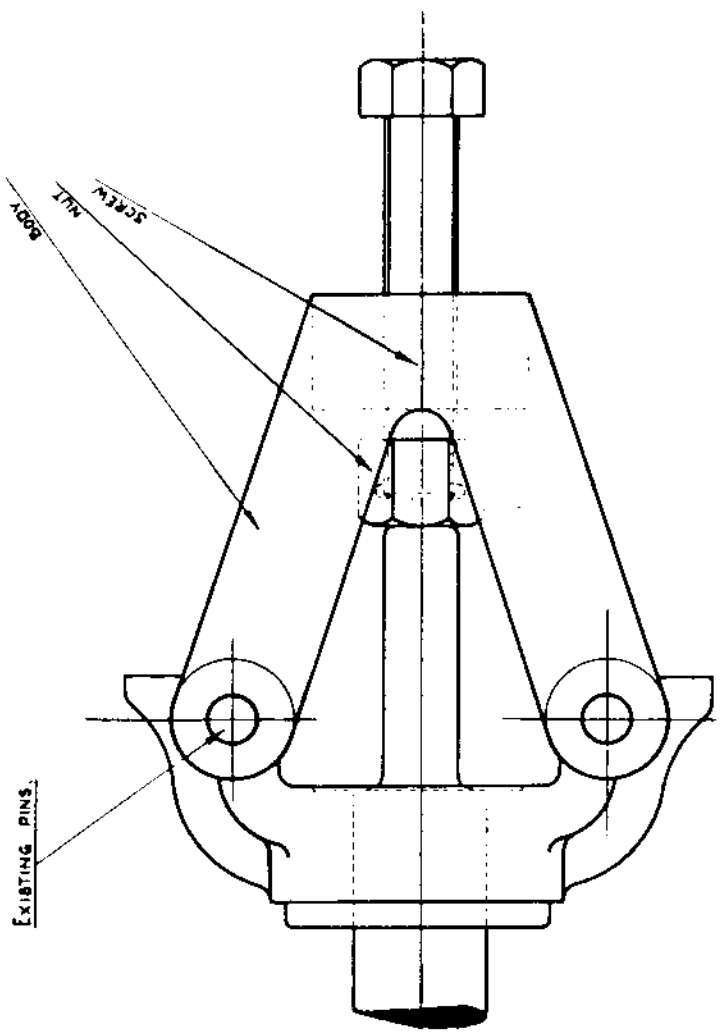
DATE 18·4·45

SUPERSEDES

SUPERSEDED BY

DRAWN BY A.L.O.
TRACED BY M.
CHECKED BY
INDEXED BY

PART No.
SA2728



L. GARDNER & SONS, LTD.
PATRICROFT.

TYPE
L3 ENGINE

DESCRIPTION
CENTRIFUGAL WATER PUMP CARBON RING ASSEMBLING & EXTRACTING TOOL

SCALE
FULL SIZE

MATERIAL

MACHINED

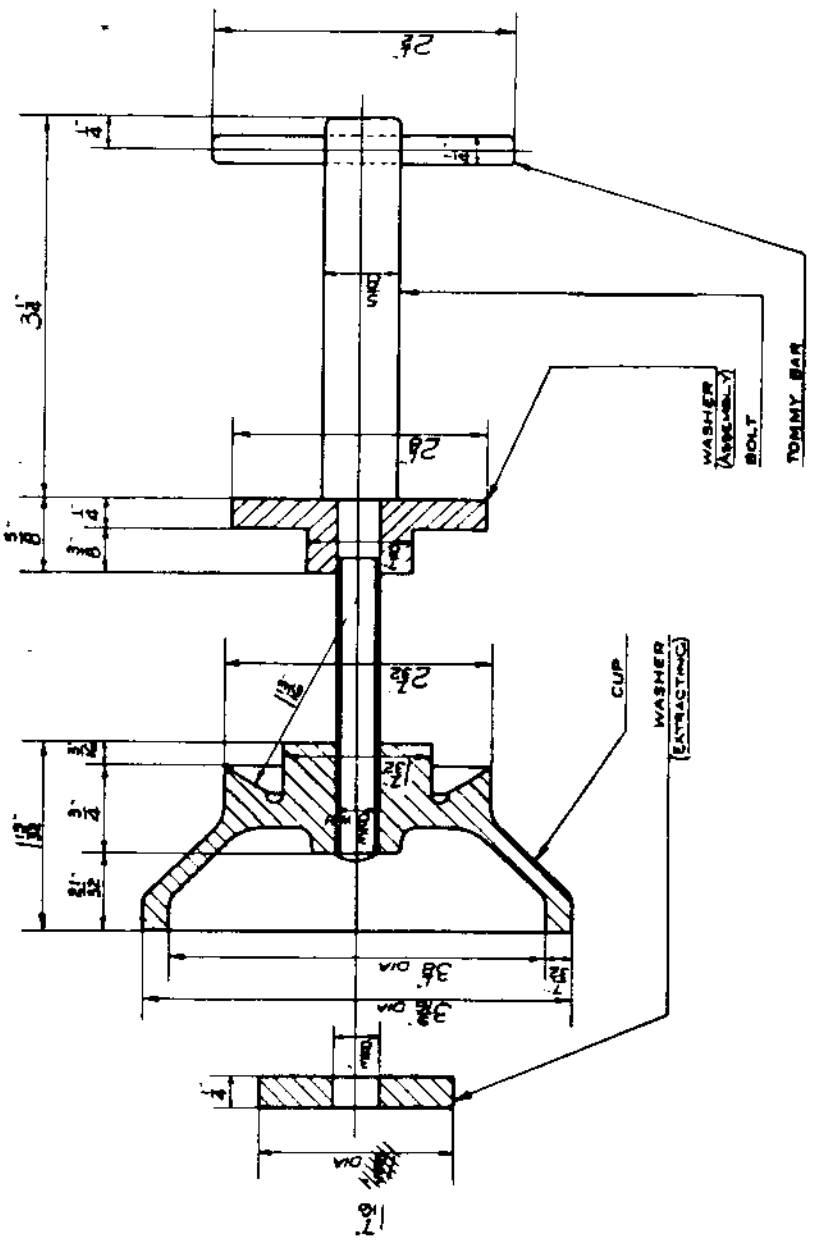
DATE 27-3-39

SUPERSEDED

SUPERSEDED BY.

DRAWN BY T.H.P.
TRACED BY
CHECKED BY
INDEXED BY

PART No.
SA2211



"L" TYPE ENGINES

INSTRUCTIONS FOR THE CORRECT TIGHTENING OF MAIN BEARING CAP NUTS

As the procedure for the tightening of the above nuts has a slight but highly important effect on the bearing bore size and shape, it is essential that these nuts are re-tightened in exactly the same order and to the same degree of tightness every time the bearings and caps are assembled. FOR THIS PURPOSE IT IS NECESSARY TO ESTABLISH A STANDARD PROCEDURE, WHICH MUST BE OBSERVED BY EVERY OPERATOR AT EACH STAGE OF THE JOB.

This standard procedure must be as follows:-

1st STAGE. Run each pair of nuts down until they just slightly nip the bearing cap (or steel bridges in the case of the LW & HLW)

2nd STAGE. Tighten number side nut to about half the final tightness.

3rd STAGE. Tighten opposite side as above.

4th STAGE. Tighten number side to final tightness.

5th STAGE. Finally tighten opposite side.

NOTE: the 6LW engine incorporates a four-bolt centre main bearing and the correct procedure for this particular bearing is as follows:-

1st STAGE. Run each pair of nuts down until they just nip the steel bearing bridges.

2nd STAGE. Tighten nut No. 9 followed by nut No. 11, to about half final tightness.

3rd STAGE. Tighten nut No. 10, followed by nut No. 12, as above.

4th STAGE. Tighten nut No. 9, followed by nut No. 11 to final tightness.

5th STAGE. Tighten nut No. 10, followed by nut No. 12 as above.

General use of this method will ensure that the size and shape of the bearing bore as produced by line boring, or hand scraping, will be maintained, which is of course vital.

The correct tightness for these nuts on the various engines is as given by the following loads on a spanner of 3ft. effective length :-

L2	-	41 to 43 lb.
L3, L3B	-	55 to 58 lb.
LK	-	41 to 43 lb.
LW, HLW LX, HLX	-	55 to 58 lb. ($\frac{1}{2}$" B.S.F. at Fly.End. 19 to 20 lb.)

"L" TYPE ENGINE

INSTRUCTIONS FOR THE CORRECT TIGHTENING OF CONNECTING ROD BIG END NUTS

As the procedure for the tightening of the above nuts has a slight but highly important effect on the bearing bore size and shape, it is essential that these nuts are re-tightened in exactly the same order and to the same degree of tightness every time the bearings and caps are assembled. FOR THIS PURPOSE IT IS NECESSARY TO ESTABLISH A STANDARD PROCEDURE, WHICH MUST BE OBSERVED BY EVERY OPERATOR AT EACH STAGE OF THE JOB.

This standard procedure must be as follows :-

LW & LK

1st STAGE. Run each pair of nuts down until they just slightly nip the bearing cap.

2nd STAGE. Tighten odd number side nut to about half the final tightness.

3rd STAGE. Tighten opposite side as above.

4th STAGE. Tighten odd number side to final tightness

5th STAGE. Finally tighten opposite side

L3

NOTE: the L3 engine incorporates a four-bolt connecting rod and the correct procedure for this particular bearing is as follows :-

1st STAGE. Run each pair of nuts down until they just slightly nip the bearing cap.

2nd STAGE. Tighten nut No 1, followed by nut No. 3, to about half final tightness.

3rd STAGE. Tighten nut No. 2, followed by nut No. 4, as above.

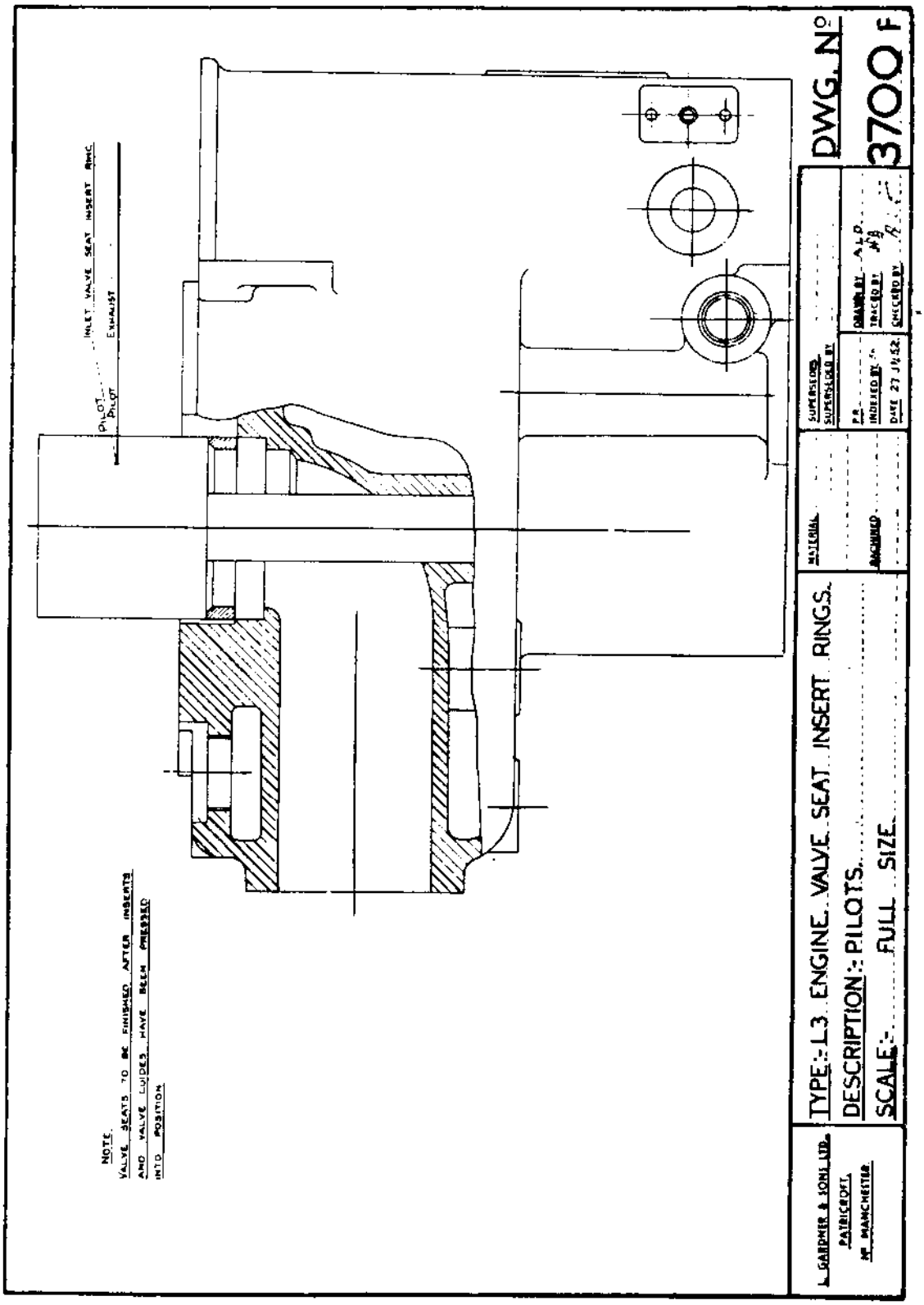
4th STAGE. Tighten nut No. 1, followed by Nut No. 3, to final tightness.

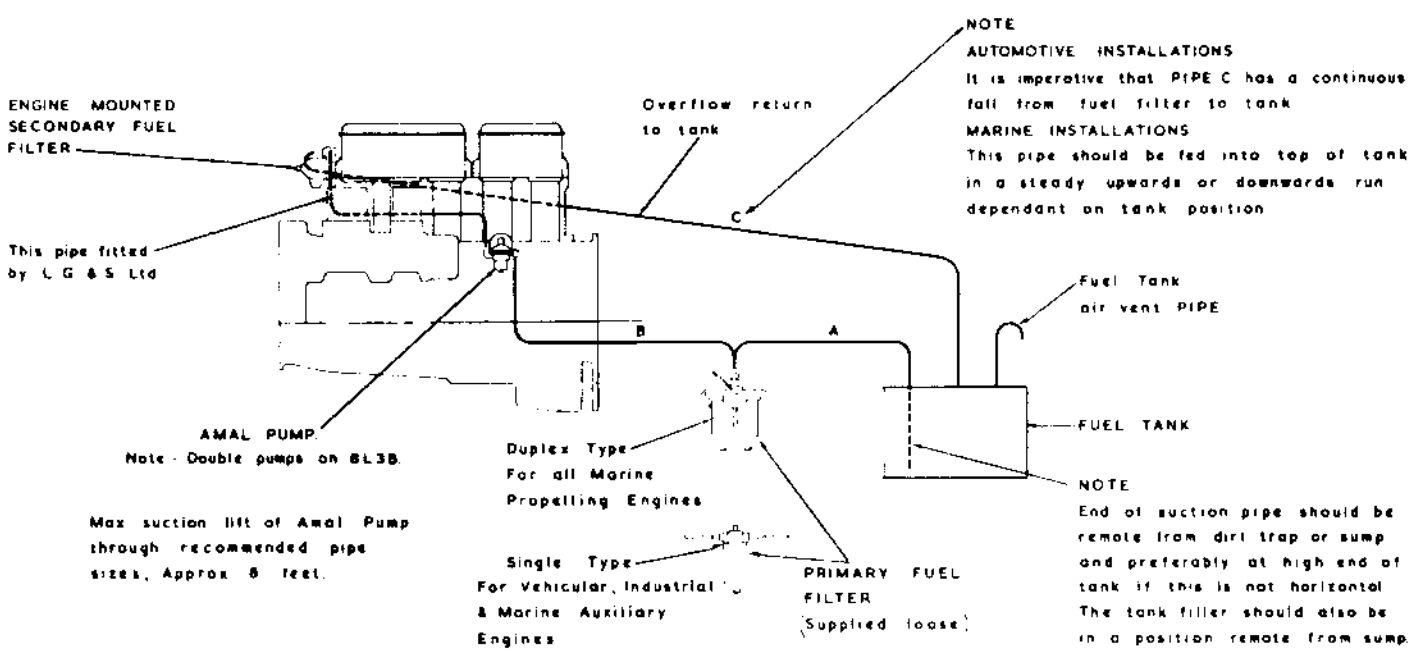
5th STAGE. Tighten nut No. 2, followed by nut No. 4, as above.

General use of this method will ensure that the size and shape of the bearing bore as produced by line boring, will be maintained, which is of course vital.

The correct tightening torque for these nuts on the various engines is as given by the following table : -

L3 - 980 lb. in.
LK - 980 lb. in.
LW - 1250 lb. in.


INLET VALVE SEAT INSERT RING
PILOT
PILOT
EXHAUST
NOTE:
VALVE SEATS TO BE FINISHED AFTER INSERTS AND VALVE GUIDES HAVE BEEN PRESSED INTO POSITION
L. GARDNER & SONS LTD.
PATRICROFT
MANCHESTER
TYPE:- L3 ENGINE VALVE SEAT INSERT RINGS.
DESCRIPTION:- PILOTS.
SCALE:- FULL SIZE
MATERIAL
MACHINED
SUPERSEDES
SUPERSEDED BY
INDEXED BY
DATE 27 JY 52
DRAWN BY
TRACED BY
CHECKED BY
DWG. No
3700 F



ENGINE TYPE.	A	B	C
LW, LW2O, 6LX, 6LXB, HLW, HLW2O, 6HLX, & 6HLXB.	½" O D 16s Gauge	3/8" O D 18s Gauge	3/8" O D 18s Gauge
All L3 Engines & 8L3B. Types	5/8" O D. 16s Gauge	5/8" O D 16s Gauge	3/8" O D 18s Gauge

NOTE Pipe sizes for 'A' should never exceed 3/4" O D x 16s copper pipe, particularly if a suction lift of over 5 ft is involved.

RD 150-1

TYPE:- 'L' TYPE ENGINES (DRAWN FOR LW. ENGINE)
DESCRIPTION:- DIAGRAMMATIC ARRANGEMENT OF FUEL SYSTEM WITH MECHANICAL FUEL LIFT PUMP
SCALE:-

DWG. No. 6883H