

ENGINE

SERVICE INSTRUCTION LEAFLET

ISSUED BY
BENTLEY MOTORS (1931) LTD.



BM/E1.

SB/NM.2/DJ.

Subject :

Engine - Tappet Clearances
3½ and 4¼ Litre Bentley.

Date
of
Issue

22nd Nov. 1945.

Owing to the continued use of Wartime Fuel it is important that the Exhaust Valves have adequate clearance.

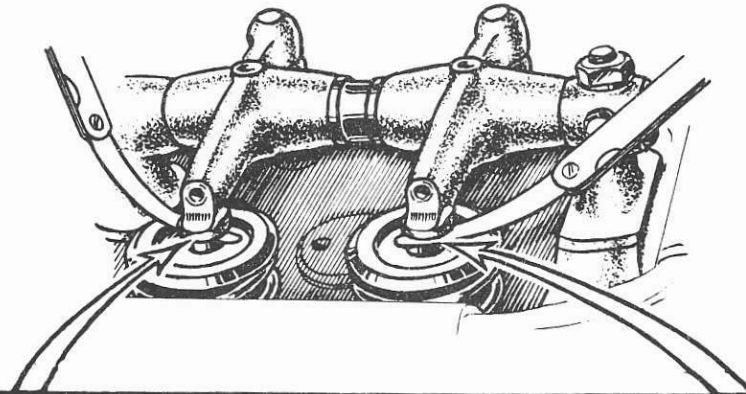
It is recommended, therefore, that the following clearances should be adopted. These figures override any other figures quoted in the relevant Handbooks or in Service Instruction Leaflet BM.1.

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EXHAUST

INLET



Exhaust Valve.	Series.	Inlet Valve.
.006"	3½ Litre All series	.004"
.006"	4¼ Litre All series except MR and MX	.004"
.010"	4¼ Litre Series MR MX	.010"

SERVICE INSTRUCTION LEAFLET

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BENTLEY MOTORS (1931) LTD.



BM/E2

SB/CM. 2/IP.

Subject :
CONNECTING ROD BIG END BEARINGS.
Bentley $\frac{3}{2}$ Litre.

Date
of 12th August, 1946.
Issue

The original 2.000" bore connecting rod big end bearing shells (Part No.E.55613) carried an external oil groove in the upper half which conveyed oil through the shells to the connecting rod for the feed to the gudgeon pin.

In order to avoid cracking of the white metal which might occur due to local distortion in the vicinity of the groove, the original type shells will be no longer manufactured, and for replacement purposes, shell EB.3463* will be used.

This shell has no external groove and it is most important to machine the connecting rod so as to incorporate the necessary oilway as shown in Fig 1.

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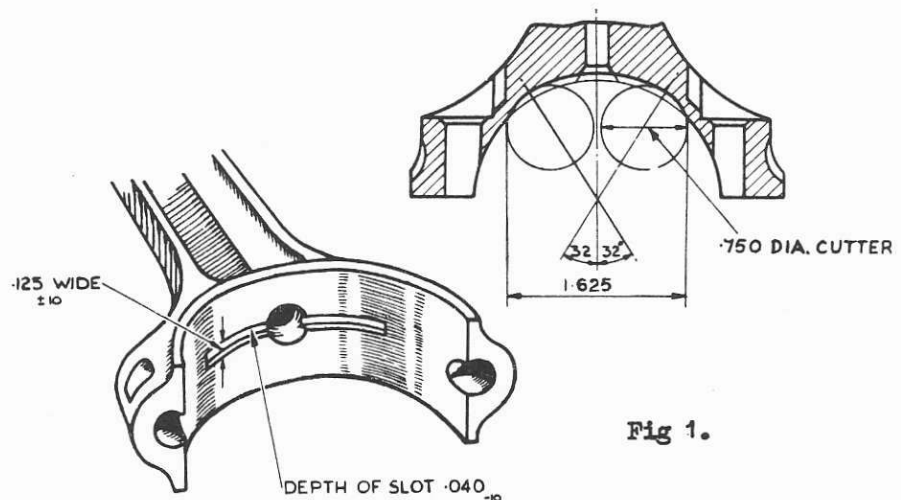


Fig 1.

On connecting rods fitted with an external oil pipe, an additional counterboring operation is necessary to connect the groove with the oil hole. This is shown in Fig 2.

* An alternative shell, Part No. R.3231, may be used. This is sufficiently small in the bore for use with undersize crankpins up to a maximum of .040 on diameter.

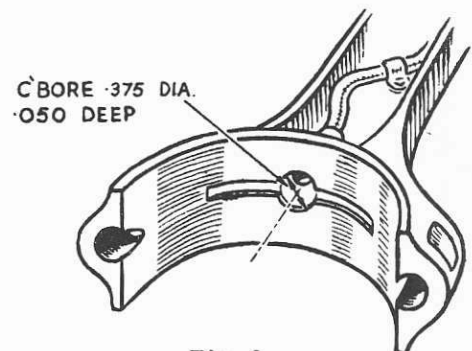


Fig 2.

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BM/E3

SB/GS.2/JM.

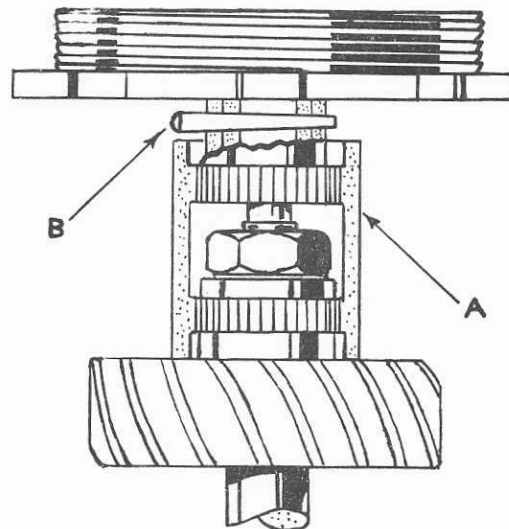
Subject : DISTRIBUTOR DRIVE,
3½ and 4¼ Litre.

Date
of 2nd December, 1946.
Issue

It is necessary to draw attention to the following point in connection with the distributor drive on the above models. The splined sleeve shown at "A" in the sketch is free to move vertically on the splines, but complete dis-engagement is prevented by the taper pin "B" on which the sleeve butts after a limited amount of vertical travel.

If the pin is short, the condition may arise in which the sleeve ceases to engage the splines, and complete ignition failure will occur on the road.

It is therefore essential, when a distributor is removed or dismantled to make sure that the head of the pin projects to an effective extent. A new pin must be used if the existing one does not project sufficiently when driven into position.



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SERVICE INSTRUCTION LEAFLET

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BM/E4.

SB/LT.1/SF.

Subject : ENGINE
MAIN AND CONNECTING ROD BEARINGS
BENTLEY $3\frac{1}{2}$ AND $4\frac{1}{4}$ LITRE.

Date of Issue
31st March, 1947.

This leaflet is intended to give information relating to the fitting of new main and connecting rod bearings.

POLICY.

Before entering into technical detail, it is thought desirable to lay down a general policy in regard to the overhaul of engines.

In the production of the $3\frac{1}{2}$ and $4\frac{1}{4}$ litre Bentley, a high degree of interchangeability of parts was not an essential factor with the result that minor variations occurred in units nominally of the same type.

Selective assembly and fitting were the accepted procedure.

From the Service replacement point of view, this procedure did not, at that time, present undue difficulties, since it was customary to have all chassis repaired at the Company's Service Depots. In the light of the Post-War policy under which our Retailers will undertake reconditioning, this practice now leads to certain difficulties with the supply of suitable spare parts.

Our spare parts stocks, relatively large by comparison with those which our Retailers will consider desirable to hold, enable us to provide for selective assembly in replacements, but it would be impracticable to apply this procedure to individual replacement requirements outside the organization.

It will be clear, therefore, that although the Retailer may be fully equipped to undertake engine overhauls, there still remains the difficulty of obtaining satisfactory spare parts.

This leads us to recommend that engines on which an extensive overhaul is necessary should be returned to the Rolls-Royce Service Depot whenever possible.

This leaflet is for use in cases where this course is difficult or undesirable.

GENERAL.

Reconditioning Period.

Progressive improvements in bearing material and lubrication particularly on the $4\frac{1}{4}$ litre have gradually increased the period to be expected between overhauls.

With normal usage and provided that no lubrication or mechanical failure has occurred, a $4\frac{1}{4}$ litre engine without the latest modifications will probably need reconditioning at about 40,000 - 50,000 miles. An engine built to the present standard will not require overhaul at less than 60,000 - 70,000 miles.

The $3\frac{1}{2}$ litre, in which the bearing stresses are lower, has a "life" which is approximately equal to a fully modified $4\frac{1}{4}$ litre. As will be seen subsequently in the technical data, satisfactory lubrication of the big end bearings, in particular Nos. 2 and 5, is largely dependent on the condition of the main bearings. This is especially the case when Hall's Metal

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Continued:

BM/E4.

bearings are fitted with their increased running clearance. In view of this condition, we strongly advocate that both sets of bearings should be dealt with simultaneously.

When the engine has been dismantled sufficiently for examination of bearings, $3\frac{1}{2}$ litre engines which have White Metal bearings throughout should be inspected for condition of the White Metal. Renewal should be carried out in cases of undue disintegration or separation from the steel shell. On the $4\frac{1}{4}$ litre, which, with the exception of the rear main, has Hall's Metal bearings, a dimensional clearance check should be made. Some earlier types of $4\frac{1}{4}$ litre Bentley were fitted with a Hall's Metal rear main, if one of these is found, it is advisable to fit a White Metal replacement, in which case the remainder will also require reconditioning.

GENERAL SPECIFICATION.

A pressure oil pump, situated externally on the lower half crankcase and taking its supply from the sump through a gauze strainer, feeds oil at a pressure controlled by the relief valve incorporated in the pump, to a connection on the crankcase. From this connection an internal oil gallery takes oil to each of the seven main bearings.

The crankshaft journals and crankpins are bored and act as oil conduits, the ends of the holed being plugged with caps. Communication between the crank journal and crankpin conduits is through smaller holes drilled in the webs. A proportion of the oil to the main bearings passes through radial holes in the journals into the conduits and lubricates the big end bearings through further radial holes in the crankpin. The upper halves of the connecting rod bearings are drilled and communication for oil feed to the gudgeon pin is made through longitudinal holes in the connection rods.

Thus all crankshaft, connecting rod and gudgeon pin bearings are pressure oil fed.

$3\frac{1}{2}$ LITRE ENGINE.

Series: AE. AH. BL. BN. CR. CW.

DG. DK. EF. EJ. FB. FC.

These engines are fitted with White Metal bearings throughout. The rear, centre and front main bearings have circumferential grooves in the bore which align with a hole in each journal to feed the big ends through the conduits. The original intermediate main bearings had no grooves but there was one hole in each journal coinciding once per revolution with the main oil supply giving additional big end lubrication. There was no change in this specification throughout the $3\frac{1}{2}$ litre series, except that the replacement intermediate bearings now have a groove for part of the bore circumference.

The original connecting rods had an external oil feed pipe attached to the rod to supply oil to the small ends, the lower end of this pipe was arranged to coincide with a circumferential groove in the back of the upper half bearing shell. At each end of this groove there was a hole through to the crankpin for oil supply.

The external oil pipe was superseded by an internal drilling in the rod and later a small "squirt hole", was provided which projected oil in to the cylinder wall to assist lubrication of the bores.

All replacement bearings are now supplied without the groove in the back and connecting rods must be modified as indicated in the relevant section.

Continued:

BM/EL.

4 $\frac{1}{4}$ LITRE ENGINE.

Series: GA. GP. HK. HM. JD. JY.

KT. KU. LS. LE. MR. MX.

The present specification on the engines varies considerably from that originally required. We propose therefore to describe this specification followed by a brief outline of earlier requirements. This will clarify the position in regard to the various conditions found on dismantling engines. Most of the changes were made to improve lubrication to the big end and main bearings and are consequently of considerable importance.

CURRENT SPECIFICATION.

Hall's Metal AC7 to main bearings Nos. 1 to 6
White Metal rear main bearing.
Large capacity oil pump.
Extra holes in main journals and crankpins
Hall's Metal AC9 to connecting rod bearings.

Specification of Earlier Series.

Oil Pump.

Original engines were not fitted with a high capacity oil pump; this came in at the beginning of K series but has subsequently been fitted to many earlier engines. The difference between the original pump and the high capacity can be recognized externally, the latter having an aluminium body, the former a phosphor bronze one.

Bearings.

Bearing material was Hall's AC7 for mains and big ends up to K series when a change was made for a short time to Hall's Metal AC2. No bearings of this type will now be found in engines. This was followed in the last series by Hall's Metal AC7 for all main bearings except the rear main which was White Metal and Hall's Metal AC9 for connecting rod bearings. All replacements now conform to this specification.

Connecting Rods.

From the first 4 $\frac{1}{4}$ litre engine to late in K series all connecting rods were internally drilled for the small end oil feed and there was a circumferential groove in communication with the lower end of the hole into which oil was fed through two holes in the bearing shell. From K series onwards the groove was deleted, the bearing shell having a single hole in the upper half, and an oil squirt hole similar to that in the 3 $\frac{1}{2}$ litre was added. Replacements are supplied with one hole or two holes according to requirements, but both types are now in Hall's Metal AC9. A few engines in M series will be found with the grooved connecting rod, but no modification of either type is necessary.

Continued:

EM/EA.

Crankshaft.

Original crankshafts had one hole in each main journal and crankpin for big end oil feed through the conduits. Late in J series and onwards an additional hole was added to improve big end lubrication. This hole was diametrically opposed to the existing one. Concurrently with this change there were modifications to the main bearing shell grooving culminating in a full groove in all main bearings, which is the present practice.

Oil Squirt Hole.

The squirt hole was introduced to improve cylinder lubrication when the tapered skirt piston was fitted in K series and it is essential to retain it with this type although it may be deleted in an engine with parallel skirt pistons.

For recognition purposes it will be found that a tapered skirt piston has a continuous slot behind the scraper ring and the parallel skirt piston has a series of holes behind this ring with a narrow slot just beneath it.

DETAILED SPECIFICATION.

3½ and 4¼ Litre.

Crankshaft.

All Bentley crankshafts are "nitride" treated. This process gives the requisite degree of surface hardness, but owing to changes in manufacturing procedure and conditions at various times, the exact depth of hardness on any particular crankshaft may not be ascertainable.

Therefore, while it is extremely unlikely that penetration of the hard surface will occur on the first regrind, we recommend that the hardness should be checked on all crankshafts reground in excess of .015" below nominal size and that crankshafts should be retreated at .020" below nominal size.

The minimum hardness figure is 600 V.P.N. If a Vickers hardness tester is not available, a test may be made with a smooth file. There should be no tendency for the file to make any impression on the crankshaft. As this method is less accurate than the use of a Vickers machine any shaft which appears doubtful should be "re-nitrided".

The finish must be free from chatter and grinding fur and should be polished.

Nominal Sizes.

Main Journals.	2.2495" (-0.001") dia.
Crankpins.	1.999" (-0.0005") dia.
Radius on Journals.	0.200"
Radius on Crankpins.	0.125"
End float (controlled at No.7 bearing)	0.0025" (+0.005")

Continued:

Permissible Wear Limit.

Maximum ovality and taper.	0.001"
Maximum permissible wear.	0.003"
Maximum permissible crankshaft end float.	0.007"

Regrind.

in stages of 0.005" undersize to a maximum of
0.040" for crankpins.
0.060" for main journals.

Maximum permissible regrind limits are based on the minimum safety factor and do not in any way affect the observation on "Nitride" depth.

Oil Holes.

This information applies to 4 $\frac{1}{4}$ litre only.
Journals. Nos. 2, 3 5 and 6 must be modified as follows:-

If there is only one hole as in Fig.1, an additional hole must be drilled diametrically opposed as in Fig.2.

Drill .218" dia. with a small radius on the journal.

Some crankshafts may be found with three holes in the journals as in Fig.3, but no alteration is required to these.



FIG 1.



FIG. 2.



FIG 3.

Crankpins.

An additional hole is necessary if only one is found. This must be drilled diametrically opposed.

Drill .125" dia. with a small radius on the crankpin.

Oil Pump.

4 $\frac{1}{4}$ Litre Bentley only.

It is essential to fit the large capacity oil pump in conjunction with the latest type bearings and additional crankshaft oil holes.

Note:

It is assumed that the crankshaft will be correctly cleaned during the overhaul, but particular attention must be given to the removal of all "Sludge" from crankpin conduits. It will be found to collect on the outer portion of the bore where it is deposited by centrifugal action and may obstruct the big end feed holes if it is not cleaned out.

Continued:

Connecting Rods.

Alignment.

The following information refers to the maximum permissible mal-alignment in three directions of the small end bore in relation to the big end bore. This operation is done after boring the big ends.

Horizontal Alignment. (See Fig.4)

0.0005" per inch from the gudgeon pin bush centre line measured along the axis of the mandrel.

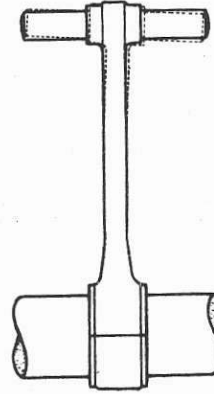


FIG. 4.

Axial Alignment. (Twist see Fig.5)

0.001" per inch from the gudgeon pin bush centre line.

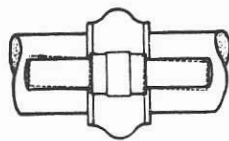


FIG.5.

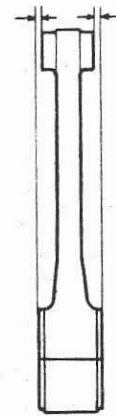


FIG.6.

Vertical Alignment. See Fig.6.

.010" tolerance is allowed as between the vertical centre line of the gudgeon pin bush and that of the big end. This is available for use in centralising the big end on the crankpin during engine assembly.

Small End side clearance.

.005" - .015"

Big End side clearance. (Controlled at the small end)

.040" - .050"

Note: All 3½ litre connecting rods must be modified in accordance with Service Instruction Leaflet BM/E2.

Continued:

Each half shell should then be checked for parallelism of the butt faces in relation to the bore centre-line, by placing it on a surface table face downwards and "clocking" each side of the back adjacent to the flanges at the highest point. Inequalities should be corrected by lightly filing the butt faces, removing as little metal as possible. There should be no perceptible "rock". (See Fig.7)

The shells may then be assembled in pairs in the housings together with the shims.

Hall's Metals AC7 and AC9.

Tighten down normally on both sides, slack off one side completely and re-tighten to finger tightness. A gap will now be apparent between each side of the shim and the housing butt faces. The shim is held centrally by the pressure of the shell on its inner edge. (See Fig.8)

For the "pre-crushing" operation, these gaps should now be adjusted to .008" each by filing the butt faces of each shell equally taking particular care to maintain parallelism and truth.

The assembly should be retightened on completion of this operation and left for a few hours or overnight, during which period the "settling down" takes place.

When the period has elapsed, undo one side, re-check the gaps and adjust to .002" each, then retighten for boring. The main bearing shell locating dowel may interfere to some extent with the measurement of "nip" if it is too tight a fit in the hole. Slight radial clearance should therefore be given. No lateral movement is permissible.

Whitemetal.

The procedure is precisely the same as for Hall's Metal except that the "pre-crushing" is omitted.

Bolt Tightness.

The tommy bar length recommended for tightening both big-ends and main bearings is 6", and this should be centrally placed in the spanner. On the connecting rods the correct condition can be obtained by measuring the bolt length before and after tightening. The stretch should be .005" - .006". The nut must be tightened to the next split pin hole if the castellations do not register. Direct measurement of the main bearing stud stretch is impracticable, but using the connecting rod as a basis for comparison, the nut should be slightly tighter.

We append the torsion spanner figures for those who prefer to use this method, but our view is that this type of spanner is no substitute for an experienced fitter by whom we would naturally prefer the job should be done.

Big-ends. 225-lbs/ins. + 50.
Main Bearing. 300-lbs/ins. + 50.

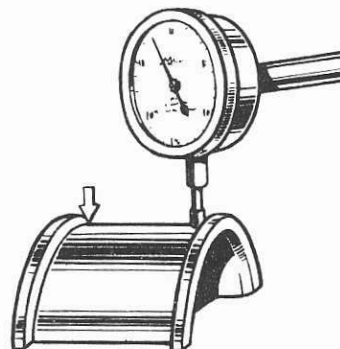


FIG.7.

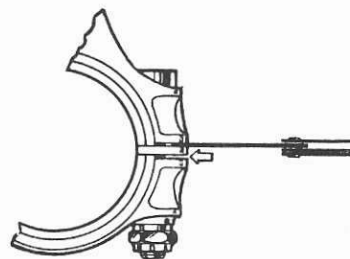


FIG.8.

Continued:

EM/E4.

Boring.

When the "nip" and bolt tightness are correct, main and connecting rod bearings may be line-bored to journal and crankpin dia. plus the running clearance. In this operation, special attention must be given to the concentricity of the bearing bore in relation to the bore in the housing. This will ensure that the engine gear centres will be the same as originally fitted. Discrepancies in this respect will give rise to excessive gear noise, and at the rear, will affect the alignment of the gearbox. After boring, the connecting rods should be given the correct alignment of big-end to small end.

Crankshaft End Float Adjustment.

Face off the rear thrust face of No.7 main bearing sufficiently to produce a good bedding surface and cut the forward face to obtain the required end float, which should be 0.0025" (\pm 0.0005")

Oil Flow Test.

An oil flow test should be carried out after the crankshaft and connecting rods have been assembled in the engine. The purpose of this operation is to prove the oil tightness of the crankshaft conduit blanking caps and the oil gallery connections to each main bearing and to ensure that there is a free flow of oil to all bearings. All leaks found should be corrected.

It may be necessary to rotate the crankshaft to check the oil flow as all the conduit oil holes will not coincide simultaneously with feed holes.

It is more convenient if the test is carried out with the cylinder blocks and pistons assembled as this simplifies the rotation of the engine and controls the small end oil flow.

An oil pump capable of maintaining a pressure of 30-lbs/sq.in should be connected to the main oil supply point of the crankcase and an inspection made with this pressure maintained.

SERVICE INSTRUCTION LEAFLET

ISSUED BY

BENTLEY MOTORS (1931) LTD.



BM/E5A.

SB/VK/JSL/NT.

Subject :

CYLINDER LINERS
DRY LINERS FOR BENTLEY ENGINES.

Date
of
Issue

6th March,
1953.

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In cases where it is necessary to rebore and fit replacement pistons to an engine which has already been bored to the maximum permissible oversize, a dry liner may be fitted.

This liner may be either:-

- (a) A full-length parallel type to restore the bore diameter to the original size.
- (b) A stepped liner, the lower part of which constitutes a "skirt" or bore extension. This can be used to salvage any block having a broken extension, irrespective of bore size.

MACHINING INSTRUCTIONS FOR BLOCK:

FULL LENGTH LINER - Each liner must be treated individually, and its external diameter measured, taking a micrometer reading across the diameter at six points; then bore to the mean reading, allowing an interference as shown below.

STEPPED LINER - Machine off the broken skirt flush with the bore of the cylinder. Measure the liner and bore out as above. Chamfer the inside edge of the cylinder bores as shown in the diagram.

LIMITS OF INTERFERENCE:

Bentley $3\frac{1}{2}$ litre } 0.002" to 0.0025".
Bentley $4\frac{1}{4}$ litre }

FITTING THE LINER:

The load required for pressing in is (approx.) $2\frac{1}{2}$ to $3\frac{1}{2}$ tons.

BORING OUT LINER:

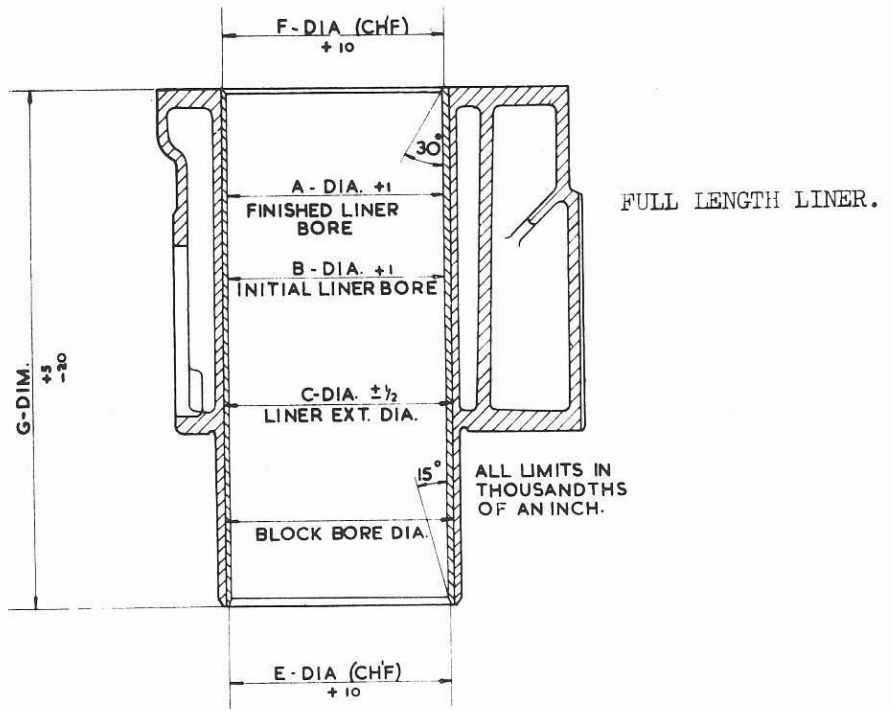
After pressing in the liner, bore it out to 0.002" undersize and hone finish to size, a matt finish being obtained by using FC.320-L-VGN stones or an equivalent.

LUBRICANT:

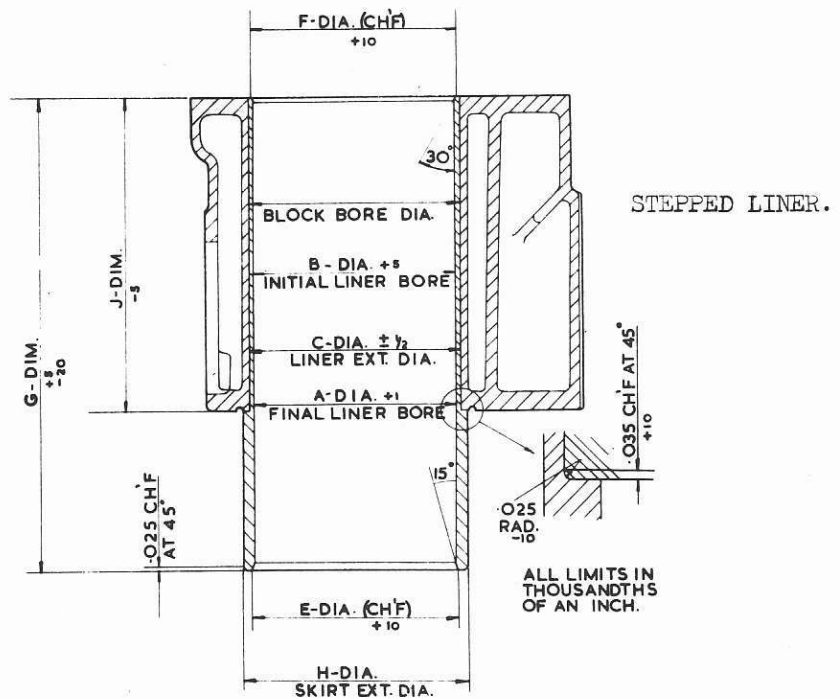
The recommended lubricant is "Dixol Soluble Oil", supplied by:-

W. B. Dick & Co.,
Rotherhithe,
London.

used in proportion 25% Dixol to 75% paraffin.



MODEL	A-DIA	B-DIA	C-DIA	E-DIA	F-DIA	G-DIA	LINER PIECE No.
B 4½ & B 5	3.500	3.480	3.6275	3.550	3.550	7.625	R 3691
B 3½	3.250	3.230	3.3775	3.300	3.300	7.625	R 3690



MODEL	A-DIA	B-DIA	C-DIA	E-DIA	F-DIA	G-DIA	H-DIA	J-DIA	LINER PIECE No.
B 4½ & B 5	3.500	3.480	3.6275	3.550	3.550	7.625	3.750	5.000	R 3699
B 3½	3.250	3.230	3.3775	3.300	3.300	7.625	3.575	5.000	R 3698

Material: Centrifugally Cast Iron.

SERVICE INSTRUCTION LEAFLET

ISSUED BY
BENTLEY MOTORS (1931) LTD.



BM/E6

SB/GF.5/SF.

Subject : PISTONS AND RINGS FOR USE IN BENTLEY ENGINES
TYPES AND SIZES USED.

Date
of
Issue 15th June, 1948.

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The information included in this leaflet is intended to be of assistance in deciding the appropriate replacement pistons and rings required to meet individual requirements.

GENERAL INFORMATION.

PISTON SIZES:-

To obviate the necessity of holding large stocks of pistons for which past experience has proved that there is a limited demand, it has been decided to rationalize the oversize available to the following sizes:- 0.015", 0.025", 0.035", 0.045"

It is recommended that liners be fitted when further re-boring becomes necessary, thereby restoring the cylinder bores to their original sizes.

PISTON RINGS:

A. Although the early four ring split skirt type pistons, originally fitted to all $3\frac{1}{2}$ litre Bentley engines prior to the first chassis in 'E' series, are obsolete, it is believed that there are still a limited number of vehicles operating with this type of assembly fitted, and replacement rings for use with existing old type pistons are available from this Service Depot.

When indenting for these, however, the chassis number should be given, and the size of piston fitted, stated.

B. Rings supplied through this Service Depot, whether separately, or in conjunction with their respective pistons, are not "gapped" to the recommended clearance limits prior to delivery.

These should be "gapped" during the actual assembly of the engine, the tightest portion of the respective cylinder bores being chosen for this purpose.

GUDGEON PINS:

It should be noted that the fitting of gudgeon pins is facilitated if the piston is warmed slightly.

BORING:

The cylinder should be bored to the oversize stated. The necessary clearance is provided for in the piston dimensions.

DETAILED INFORMATION.

Detailed part numbers and recommended piston ring gaps for both the $3\frac{1}{2}$ litre and $4\frac{1}{4}$ litre Bentley engine, are contained in the following pages.

Further assistance is provided by the inclusion of diagrams illustrating the correct assembly of the rings.

SERVICE INSTRUCTION LEAFLET

ISSUED BY
BENTLEY MOTORS (1931) LTD.



BM/E6.

SB/GF.6/SF.

Subject : Pistons and Rings
for
Bentley 3½ Litre (¾" Bore) Engines.

Date
of
Issue 15th June, 1948.

All Bentley 3½ litre engines prior to the first chassis in 'E' series, i.e. Chassis No: B-2-EF, were originally fitted with four ring split skirt type pistons of Rolls-Royce manufacture. These, however, are obsolete, having been superseded by the present range of three ring Aerolite pistons quoted below.

The additional ring sizes are included to cover those cases where suitable replacement rings are required for use with existing oversize piston assemblies fitted prior to the current system of rationalization.

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FOR ALL BENTLEY 3½ LITRE CHASSIS.

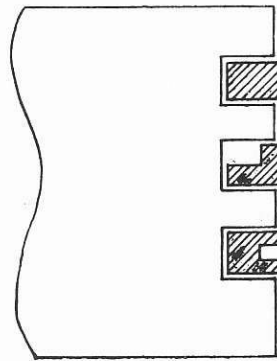
Size	Piston	A		B		C	
		Top Ring	Inter Ring	Bottom Ring	1	Off	1
Std.	EB.2441	EB.2377	EB.3077	EB.2686			
.005 O/S	-	EB.3078	EB.3088	EB.3450			
.010 "	-	EB.3079	EB.3089	EB.3451			
.015	EB.2441	EB.3080	EB.3090	EB.3452			
.020 "	-	EB.3081	EB.3091	EB.3453			
.025 "	EB.2551	EB.3082	EB.3092	EB.3454			
.030 "	-	EB.3083	EB.3093	EB.3455			
.035 "	EB.2441	EB.3084	EB.3094	EB.3456			
.040 "	-	EB.3085	EB.3095	EB.3457			
.045 "	EB.2441	EB.3086	EB.3096	EB.3458			
.050 "	-	EB.3087	EB.3097	EB.3459			

All quantities are expressed in terms of one piston.

- NOTES:**
- (1) The same part numbers apply to all the replacement pistons, but the oversize required must also be stated at time of indenting.
 - (2) All Bentley pistons are supplied complete with rings and gudgeon pins.
 - (3) Gudgeon pins are NOT supplied separately.
 - (4) Replacement rings ARE obtainable separately.

Ring Assembly:

The following diagram illustrates the correct ring assembly:-



- A Rectangular
- B "L" Section
- C Channelled.

Ring Gaps:

Top Ring	.010" to .014" }	No stops fitted.
Inter and Bottom Rings.	.006" to .008" }	

SERVICE INSTRUCTION LEAFLET

ISSUED BY

BENTLEY MOTORS (1931) LTD.



BM/E6.

SB/GF.7/SF.

Subject : Pistons and Rings
for
Bentley $\frac{1}{4}$ Litre ($3\frac{1}{2}$ " Bore) Engines.

Date
of 15th June, 1948.
Issue

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All early Bentley $\frac{1}{4}$ litre engines were fitted with parallel skirt three ring Aerolite pistons in conjunction with connecting rods which were drilled solely for the purpose of small end lubrication.

At Chassis No: B-1-KU, however, an oil hole was added to improve cylinder lubrication, and this coincided with the introduction of the tapered skirt three ring Aerolite piston with its closer limits of clearance.

It is essential, therefore, that these two types of piston are fitted in conjunction with their appropriate connecting rods, for, should parallel skirt pistons be used with connecting rods having oil squirt holes, excessive cylinder lubrication may occur. Conversely, taper skirted pistons fitted to connecting rods without squirt holes may result in piston seizures.

For recognition purposes, it will be found that a tapered skirt piston has a continuous slot behind the scraper ring, and the parallel skirt piston has a series of holes behind this ring, with a narrow slot just beneath it.

The replacement Aerolite pistons and rings suitable for both the early and later types of engines will be found quoted in the following schedules, the additional ring sizes being included to cover those cases where suitable replacement rings are required for use with existing over-size piston assemblies fitted prior to the current system of rationalization.

FOR ALL BENTLEY CHASSIS UP TO B-200-KT incl.

Size.	Piston	A		B		C	
		Top Ring	1 Off	Inter Ring	1 Off	Bottom Ring	1 Off
Std.	EB.2844	E.60820		E.61123		E.60821	
.005 O/S	-	E.61152		E.61184		E.61162	
.010 "	-	E.61153		E.61185		E.61163	
.015 "	EB.2844	E.61154		E.61186		E.61164	
.020 "	-	E.61155		E.61187		E.61165	
.025 "	EB.2844	E.61156		E.61188		E.61166	
.030 "	-	E.61157		E.61189		E.61167	
.035 "	EB.2844	E.61158		E.61190		E.61168	
.040 "	-	E.61159		E.61191		E.61169	
.045 "	EB.2844	E.61160		E.61192		E.61170	
.050 "	-	E.61161		E.61193		E.61171	

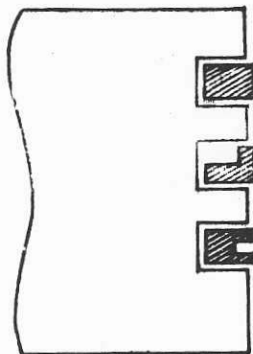
FOR ALL BENTLEY CHASSIS BETWEEN B-1-KU AND B-203-MX INCL.

	Piston	A Top Ring	B Inter Ring	C Bottom Ring
		1 Off	1 Off	1 Off
Std.	EB,3916	E.60820	E.61123	EB.3122
.005 O/S	-	E.61152	E.61184	EB.3353
.010 "	-	E.61153	E.61185	EB.3354
.015 "	EB.3365	E.61154	E.61186	EB.3355
.020 "	-	E.61155	E.61187	EB.3356
.025 "	EB.3367	E.61156	E.61188	EB.3357
.030 "	-	E.61157	E.61189	EB.3358
.035 "	EB.3369	E.61158	E.61190	EB.3359
.040 "	-	E.61159	E.61191	EB.3360
.045 "	EB.3371	E.61160	E.61192	EB.3361
.050 "	-	E.61161	E.61193	EB.3362

- NOTES: (1) Pistons are supplied only complete with rings and gudgeon pins.
 (2) Gudgeon pins are not supplied separately.
 (3) Replacement rings are obtainable separately.

Ring Assembly:

The following diagram illustrates the correct ring assembly for both types of piston:-



- A Rectangular.
 B "L" Section.
 C Channelled.

Ring Gaps:

Top Ring	} No stops fitted.
Inter and Bottom Rings	

.010" to .014"
 .006" to .008"

SERVICE INSTRUCTION LEAFLET

ISSUED BY
BENTLEY MOTORS (1931) LTD.



BM/E7.

SB/GF.1/SF.

Subject : THE OVERHAUL AND ADJUSTMENT
OF
BENTLEY CRANKSHAFT VIBRATION DAMPERS.

Date of Issue 9th November, 1948.

The information contained in this leaflet is intended to provide the necessary assistance in connection with the overhaul and adjustment of the Low Inertia Spring Drive crankshaft vibration dampers fitted to Bentley engines.

DESCRIPTION.

Before proceeding with further technical detail, it is thought desirable for the following brief description of the general construction to be given.

LOW INERTIA SPRING DRIVE.

Incorporated in the following Bentley cars.

3½ litre. All chassis.
4¼ litre. All chassis.

As its name implies, this design has been developed to reduce, as far as possible, the inertia of the parts rigidly attached to the crankshaft so as to increase the natural frequency of oscillation, and to reduce the amplitude of movement. Thus, the only part directly attached to the crankshaft is the central driving hub of the spring drive which carries a light friction disc. The so-called flywheel is attached rigidly to the crankshaft pinion and is driven through the medium of the radial driving springs. Between these two components is interposed the damping device.

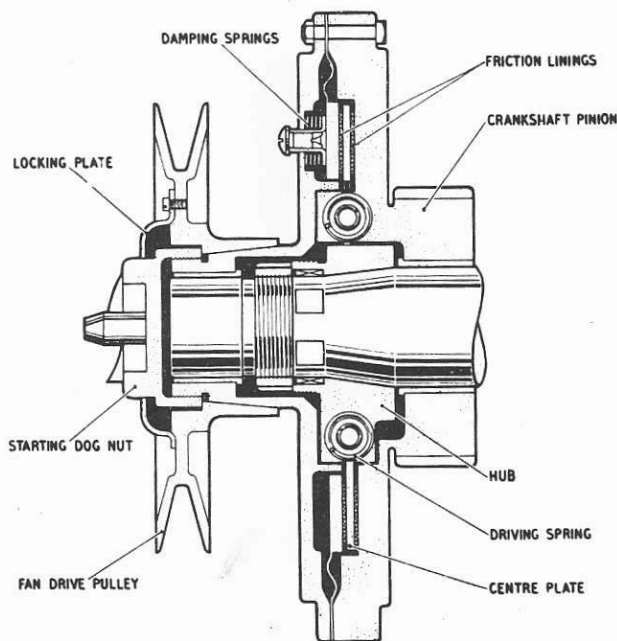


Fig. 1.

DERANGEMENT OF THE DAMPER - REASON AND SYMPTOMS.

Apart from such mechanical reasons as structural breakages, inefficiency of the damper will, in the main, be found attributable to an alteration in the pre-determined slipper drive poundage.

Lengthy periods of idleness, such as car storage, may result in the cotton duck washers adhering to the damper friction plates, thus preventing the movement between the friction faces so necessary for the absorption of the minute variations in crankshaft angular movement.

This tendency for the cotton duck washers to adhere to the friction plates during a period of idleness, makes it essential, should some considerable time elapse between assembly and actual fitting to the engine, for all assembled dampers to undergo a final poundage test.

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Loss of movement between the damper friction faces results in the accentuation, rather than the absorption of the minute variations in crankshaft angular movement, thus leading to the introduction of engine vibration periods.

Vibration periods solely resulting from a deranged crankshaft damper will generally be first experienced at 1750 r.p.m. in third gear, and will tend to increase in intensity until reaching a climax at approximately 2,500 r.p.m. in the same gear, after which they will continue to be experienced at intermittent intervals.

A distinct rattle will also frequently be heard in the timing gears at the same time when picking up from slow speeds, but this should not be confused with the fast clicking sound associated with a faulty cam balance assembly.

SPECIAL TOOL SCHEDULE FOR REMOVAL.

The removal and dismantling of these dampers for overhauling necessitates the use of special tools. These are obtainable from this Service Station, and are as follows:-

<u>Model.</u>	<u>Chassis Series.</u>	<u>Spanner for Damper Retaining Nut.</u>	<u>Damper Extractor.</u>
3 1/2 litre) 4 1/4 litre)	All chassis.	R-2883.	R-2879.

PROCEDURE FOR THE REMOVAL AND DISMANTLING OF DAMPERS.

1. Remove the radiator.
2. Remove the locking plate from in front of the fan pulley and draw off the pulley by unscrewing the large hexagonal nut in the centre.
NOTE: Do NOT remove the serrated locking ring which will be seen located round this nut.
3. Remove the timing gear cover.
4. Bend back the tab washers, remove the four 1/4" B.S.F. nuts in the centre of the spring drive, together with the twelve 2-BA. nuts round the outer circumference of the damper flywheels and pull off the front damper plate, spring plate and first cotton duck washer.
5. Bend back the lock washer and remove the serrated retaining nut securing the rear damper plate to the crankshaft.
6. Bring the engine up to TDC. on No. 1 cylinder by means of the flywheel, position the extractor (R-2879) and draw off the rear damper plate. (It is recommended that the mating teeth between the crankshaft and camshaft pinions be suitably marked prior to the complete removal of the damper).
7. Remove the driving springs, centre plate and second cotton duck washer. (These driving springs are retained in position at one end only and require to be compressed before they are free for extraction. To effect this, the blade of a suitable screwdriver should be inserted into the spring at the end adjacent to the driving dog on the hub side, and the spring compressed until this end is clear of the retaining lip or dowel, after which it can be prized out quite easily).

Continued:

After the damper has been completely dismantled, the following procedure should be carried out:-

1. Examine all the friction faces for scoring, and regrind if necessary.
2. Discard all used cotton duck washers.

SAFE LIMITS OF GRINDING.

Friction Faces:

The diagrammatic sketches appended below, illustrate the limits to which the various friction faces may be safely ground:-

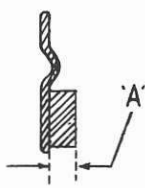


FIG. 2.

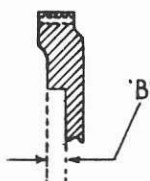


FIG. 3.

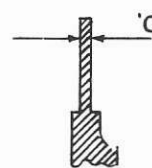


FIG. 4.

Minimum Permissible
Working Thickness for
Presser Plate.
(See Fig. 2 Dimension 'A')

Depth to which the Rear
Damper Friction Face
may be ground.
(See Fig. 3 Dimension 'B')

$3\frac{1}{2}$ litre }
 $4\frac{1}{4}$ litre }

0.107" or 2.72 mm.

0.388" or 9.86 mm.

NOTE: The Presser Plate is the friction ring which is riveted to the corrugated spring plate located between the front damper wheel and the centre friction drum.

The centre friction flange must not be ground below a working thickness of:- 0.062" or 1.57 mm. (See Fig. 4 Dimension 'C').

FRUCTION LININGS.

In view of the fact that friction represents the main principle used for the absorption of torsional oscillation, and that this friction is dependent upon the friction linings themselves, it is obvious that the efficient functioning of the damper will be governed by the condition of these linings.

The tendency for these to become hard, ingrained with carbon and superficially glazed, thus losing their original properties, makes it essential for all existing linings to be replaced by new ones at each overhaul period.

Before assembly, all replacement friction linings must be reduced to a state approximating to that in which they will operate when actually assembled, and, as this entails a reduction in material thickness, care should be taken to ensure uniformity in all-round working thickness, particularly at the scarf joint. This is of the utmost importance, as the fitting of unevenly ironed friction linings will only result in the rapid deterioration in damper efficiency.

Continued:

FM/E7

In order to prepare these friction linings for assembly, the following procedure should be carried out:-

1. Soak in oil for approximately 24 hours.
2. Lay the linings between their respective damper flywheel faces and bolt up both flywheels tightly. The damping springs carried by the front damper plate should be retained in position.
3. Fit the assembly on to an appropriate mandrel, secure this in a vice, and oscillate the damper flywheels, using the testing bar as a means of leverage, until the linings have been reduced to a uniform working thickness all round. This is of particular importance and cannot be over-emphasised, as any appreciable difference or local variations in the working thickness of the friction linings will result in the rapid deterioration of the damper efficiency.
4. Carefully trim off all superfluous fringes from round the scarf joints and test for fit relative to the hub. Each lining should lie perfectly flat upon its respective friction surface, at the same time being free to rotate.

NOTE: The springs comprising the spring drive section MUST always be omitted for operation No: 3.

RECOMMENDED SLIPPER POUNDAGES.

Each crankshaft damper has a recommended slipper spring pre-loading for operational purposes.

These figures quoted below, represent the force required to overcome the frictional drag between the damper flywheels and centre friction drum, and have been found by experience to produce the correct amount of damping in normal circumstances.

Although these figures represent sufficiently accurate limits to ensure normally efficient damping, variations are permissible to suit individual cases, e.g. in the event of a vibration period developing at low engine speeds, reduction of the recommended spring poundage is permissible as a counteracting measure, and conversely an increase in the recommended spring poundage is permissible should the period be experienced at high engine speeds. At no time, however, should these variations be in excess of 1-lb. (0.45 Kilo), above or below the recommended pre-loading figures quoted below:-

3½ litre) & 4¼ litre)	All chassis	11/12-lbs. or	4 99/5.44 Kilos.
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SPECIAL TOOL SCHEDULE FOR ASSEMBLY AND TESTING.

These are obtainable from this Service Station and are as quoted below:-

<u>Tool Piece No:</u>	<u>Description:</u>	<u>To Which Applicable:</u>
R-2986	Mandrel)	All chassis in both series.
R-3138	Poundage Bar)	

SLIPPER POUNDAGE TEST.

The effort required to overcome the frictional drag which is exerted by the damping springs is measured on a spring balance and is obtained in the manner detailed below:- (See Fig.5).

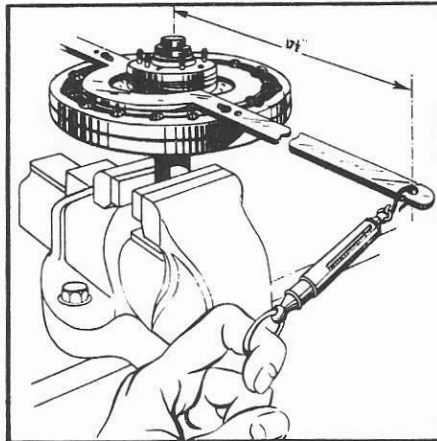


Fig. 5.

1. Fit the damper assembly on to an appropriate mandrel and secure in a vice.
2. Attach the testing bar to the damper flywheel in the manner shown in Fig. 5.
3. Secure the spring balance to the bar at a radial distance of $17\frac{1}{2}$ " (44.45 cms), and pull on the free end of the balance.

If the effort required to move the two flywheels relative to the centre hub after the original inertia has been overcome, is greater than the maximum recommended pre-loading figure, further

ironing of the friction linings should be carried out. Should this not be sufficient, reduction in the spring loading can be effected by the removal of damper springs in pairs, i.e. those diametrically opposite to each other, but at no time should more than two pairs, i.e. four springs be so removed.

NOTE: All driving springs MUST be omitted for this poundage test.

PROCEDURE FOR THE RE-ASSEMBLY OF THE DAMPER.

1. Fit the replacement friction lining to the rear damper plate, ensuring that it lies perfectly flat upon the friction face and is free to rotate, and also that its scarf joint is in line with the assembly mark 'O' which will be seen etched on the face of the damper plate.
2. Line up the assembly mark 'O' on the centre friction drum with that seen on one of the centre pins and then refit.
3. Fit the second friction lining, ensuring that its scarf joint is diametrically opposite to that of the first lining, and that it is both perfectly flat upon the friction face and free to rotate.
4. Fit the spring plate, ensuring that the assembly mark 'O' is coincident with those already assembled.

Continued:

BM /E7

5. Fit the packing plate, again ensuring that its assembly mark is lined-up, and after removing all packing washers from behind the damping springs, replace these springs and fit the front damper plate to the rear plate in the normal manner. Carry out the slipper spring poundage test in the manner described above.
6. Upon the recommended spring loading being obtained, remove the front damper plate, packing plate, spring plate and second friction lining, and re-insert the driving springs. This latter operation may be simplified by leaving the rear damper plate on the mandrel, and after locating the springs alternately, compressing these by means of the testing bar, thus widening the remaining spaces sufficiently for the easy insertion of the remainder of the springs.
7. Having re-positioned the driving springs, remove the rear damper plate from the mandrel and refit to the crankshaft nose, ensuring that the marks already etched on the mating teeth of the crankshaft and camshaft pinions are coincident.
8. Thread on the lockwasher and tighten up the serrated locking nut, using the special box spanner for the purpose.
9. Replace the second friction lining, spring plate, packing plate and front damper plate and secure in position.
10. Check the engine timing. (When carrying this out, the engine should always be turned by means of its flywheel and NOT by the starting handle).

SERVICE INSTRUCTION LEAFLET

ISSUED BY
BENTLEY MOTORS (1931) LTD.



BM/E7A.

SE/GF.1/SF.

Subject: ADDENDUM TO SERVICE INSTRUCTION LEAFLET BM/E7.

Date of Issue
6th December, 1948.

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Subsequent to the publication of BM/E7, it is felt that a certain degree of amplification is necessary in order to ensure that no uncertainty arises regarding the overhaul and dismantling of the Bentley crankshaft damper.

With this in mind, it has been decided that an addendum be issued, containing such additional information as is considered necessary, and to be used in conjunction with the existing leaflet.

Commencing with the second page, it will be noticed that the removal of the timing gear cover is shown as the second operation following that of the radiator. In actual practice however, certain other items require to be dismantled prior to the removal of the timing cover, these items and the order of their removal being as follows:-

- a) Remove the engine undershield, support the engine at its forward end upon a suitable trestle and then remove the engine front suspension cross-member.
- b) Remove the fan bracket, complete with the fan and fan belt.
- c) Disconnect the external oil pipe leading from the oil pump to the top of the timing cover and remove same.
- d) Remove the dynamo drive brake blocks if fitted. These will be located in the front end cover, being situated in an extension on top of and directly underneath the drive itself. (Certain of the early $3\frac{1}{2}$ litre chassis will be found not to have these brake blocks fitted, although provision for their fitting has been made in the design of the front end cover).
- e) Draw off the fan pulley in the manner already described in BM/E7.
- f) Disconnect all leads between the ignition coils and the distributor head, unscrew the front cover securing nuts and remove the timing cover.

The remainder of the dismantling can then be carried out in the manner set down.

The procedure laid down on Page 3 for the examination of the damper components should also include the following:-

"Check for any signs of movement between the centre friction plate and its hub. This is of the utmost importance, as any movement between these parts indicates that the rivets securing this plate to the hub have worked loose, and if this is not rectified, will result in the rapid deterioration in the damper efficiency with possibly a structural breakage occurring at the point of riveting.

In all cases of loose rivets, the assembly must be re-riveted, using replacement rivets for the purpose, but before this is done, it is recommended

"that the friction plate is examined, and if the rivet holes in its webs are unduly elongated, or the webs cracked, then a replacement plate must also be fitted".

In conclusion, an important feature in the re-assembly of the timing cover is to ensure that the radial clearance between the oil thrower and the timing cover is not closer than 0.004", (0.10 m/m), this representing the minimum recommended limit of clearance necessary to prevent any contact between the oil thrower and the timing cover under normal conditions.

In view of the fact that it is impossible for the clearance to be accurately measured with the oil thrower in position, it is suggested that a special sleeve or bush of the identical external and internal measurements of the existing oil thrower is locally produced, and is used as a gauge in the assembly of the timing cover relative to the oil thrower. In this way, the radial clearance can be accurately checked and the timing cover correctly assembled to ensure the concentricity of the oil thrower relative to the bore of the hole through which it passes.

In the event however, of the machining of such a sleeve proving to be impracticable, a process of trial and error will be necessary, using "Prussian Blue" on the barrel of the oil thrower to determine whether a definite radial clearance between the oil thrower and the timing cover exists or not. As an accurate measurement of the actual clearance is unobtainable, however, it may be necessary to relocate the timing cover one way or the other several times before a satisfactory setting relative to the oil thrower is obtained.

SERVICE INSTRUCTION LEAFLET

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BM/E8

SB/VA.4/PR

Subject : Duaflex Piston Rings
for
Bentley $3\frac{1}{2}$ & $4\frac{1}{4}$ litre Models.

Date
of 14th May, 1956.
Issue

It has been the practice of the London Service Station for sometime now to fit Wellworthy Duaflex Oil Control Rings to engines where heavy oil consumption has been reported.

As this type of ring has proved very satisfactory, it has now been decided to discontinue the use of the Standard Slotted Oil Control Ring, and all oversize pistons will now be supplied with a Duaflex Oil Control Ring.

A complete list of the Duaflex Rings, which are to supersede the original scraper ring, is given below.

It will be noted that one size Duaflex Ring is suitable for a small range of oversize bores. The actual size is as follows :-

Standard ring is suitable for:- Standard to .019" o/size bores.
.020" o/size ring is suitable for:- .020" o/size to .039" o/size bores.
.040" o/size ring is suitable for:- .040" o/size to .059" o/size bores.

The sizes quoted above are those to which the respective rings are capable of expanding i.e. .019" in each case.

The ring gaps are pre-sized and must therefore not be altered.

TO ASSEMBLE TO A PISTON

NOTE: On existing pistons all grooves and oil drain holes must be thoroughly clean and free from carbon.

- (i) Place the expander in the groove first, and then SPIRAL the rails on one by one, taking care to arrange the gaps all round the piston. The top rail will need a little pressure to enter the groove, as the assembled ring is slightly wider than the groove.
- (ii) Check that the assembled ring, lightly oiled, can be moved round in the groove.
- (iii) Oil with light oil and install with fitting clamp.

NOTE: The three side rails are identical and may therefore be installed either way round. The assembled order on a piston is:-

Expander, two side rails uppermost, centre spring and one side rail at bottom.

<u>MODEL.</u>	<u>PART NO. OF ORIGINAL OIL CONTROL RING.</u>	<u>SIZE.</u>	<u>SUPERSEDED BY.</u>
Bentley $3\frac{1}{2}$ litre $3\frac{1}{4}$ " bore.	EB.2686.	Std.	R.5264.
	EB.3450.	.005 o/s.	R.5264.
	EB.3451.	.010 o/s.	R.5264.
	EB.3452.	.015 o/s.	R.5264.
	EB.3453.	.020 o/s.	R.5382.
	EB.3454.	.025 o/s.	R.5382.
	EB.3455.	.030 o/s.	R.5382.
	EB.3456.	.035 o/s.	R.5382.

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EM/E8

<u>MODEL.</u>	<u>PART NO. OF ORIGINAL OIL CONTROL RING.</u>	<u>SIZE.</u>	<u>SUPERSEDED BY.</u>
Bentley $3\frac{1}{2}$ litre $3\frac{1}{4}$ " bore. Contd.	EB.3457.	.040 o/s.	R.5398.
	EB.3458.	.045 o/s.	R.5398.
	EB.3459.	.050 o/s.	R.5398.
Bentley $4\frac{1}{4}$ litre $3\frac{1}{2}$ " bore.	EB.3122.	Std.	RE.21327.
	EB.3353.	.005 o/s.	RE.21327.
	EB.3354.	.010 o/s.	RE.21327.
	EB.3355.	.015 o/s.	RE.21327.
	EB.3356.	.020 o/s.	RE.21329.
	EB.3357.	.025 o/s.	RE.21329.
	EB.3358.	.030 o/s.	RE.21329.
	EB.3359.	.035 o/s.	RE.21329.
	EB.3360.	.040 o/s.	RE.22039.
	EB.3361.	.045 o/s.	RE.22039.
	EB.3362.	.050 o/s.	RE.22039.