**SECTION A**

ENGINE
SERIES BN4

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Section A.1

GENERAL DESCRIPTION

The engine is a six cylinder unit with the borses cast integrally with the crankcase. Adequate cooling under the most arduous operating conditions is ensured by the provision of large area water circulating passages, and full length water jackets.

The detachable cylinder head is of cast iron and carries the overhead push rod operated valve gear.

Forged steel is used for the counter balanced crankshaft which is supported by four large diameter main bearings of the preformed "Thinwall" type. The same type of bearings are used for the connecting rod big end assemblies.

Particular attention has been paid to the design of the lubrication system to ensure that the moving parts of the engine are adequately supplied with oil at all times. The choice of oils is of great importance and those recommended on page Q1 have been tested under various running conditions and should be used in accordance with the schedule of regular attentions.

Section A.2

VISUAL INSPECTION

Examine the engine for any signs of oil leakage, with particular attention to the sump drain plug, the joint between the oil filter bowl and its head casting, and the rocker cover to cylinder head joint.

The connections to the distributor should be checked occasionally for tightness, and any perished or cracked high tension leads renewed.

Section A.3

ADJUSTMENTS IN THE VEHICLE

The purpose of the following adjustments is to maintain the performance of the engine at its maximum, and consists of a series of cleaning, inspecting and adjusting operations. A compression test of each cylinder should first be made to determine the general condition of the engine before proceeding with any adjustments. If a compression gauge is not available, a simple method to test the compression is to remove all the sparking plugs with the exception of the one in the cylinder being tested, and then rotate the engine with the starting handle through at least two complete revolutions. If the cylinder compression is satisfactory, proceed as detailed below.

(1) Clean the engine generally and lubricate as recommended.

(2) Adjust the fan belt tension in accordance with the instructions given in Section C.

(3) Remove the valve gear cover and test the cylinder head studs for tightness, using a torque spanner set to the figures quoted under "General Data".

(4) Check and adjust the valve and rocker clearances as outlined in Section A.11.

(5) Check for evidence of cracked valve springs or scored or worn stems.

(6) Replace the valve gear cover, using a new gasket if necessary.

(7) Disconnect the high-tension cables and remove the sparking plugs.

(8) Check to make sure that the correct type of sparking plug is being used.

(9) Clean the sparking plugs and examine the insulation for breaks or cracks.

(10) Adjust the sparking plug gaps as specified in Section B.

(11) Test the sparking plugs and renew any found to be unfit for further service.

(12) Refit the sparking plugs, using new copper washers.

(13) Check the high tension cables for wear and deterioration before refitting.

(14) Remove the distributor head cover and clean it inside and out. Examine it for cracks and burned contacts and renew if necessary.

(15) Inspect the contact breaker points to determine whether new points are needed. Follow the procedure given in Section B to clean and adjust the points.

(16) Check the distributor rotor arm, making sure the carbon brush makes contact. Check the capacitor terminal to make sure it is clean and tight.

(17) Check the ignition timing as outlined in Section B.

(18) Clean the air cleaners in accordance with the instructions in Section D.

(19) Make sure the fuel system is operating properly and clean all filters in the system as detailed in Section D.

(20) Check the carburettor flange gaskets for evidence of leakage.

(21) Adjust the carburetters if necessary, in accordance with the procedure given in Section D.

Section A.4

ENGINE ASSEMBLY

To remove (without gearbox)

(1) The battery master switch, which is situated inside the luggage compartment, should be turned to the "off" position.
(12) Release the oil pressure flexible pipe at its upper connection.

(13) Remove the starter motor as described in Section N.

(14) Withdraw the four setpins which secure each engine mounting bracket to the chassis frame. Detachment of the left-hand bracket is facilitated by a slit in the carburettor heat shield.

(15) Unscrew the six brass nuts securing the exhaust down pipe to the exhaust manifolds, and pull the down pipe away from the manifold studs.

(16) Remove the valve rocker as described in Section A.11 and secure two suitable lifting brackets.

(17) By means of lifting tackle, similar to that illustrated in Fig. A.2, support the engine so that the engine mounting brackets are just clear of their chassis mountings.

(18) Unscrew the four setpins securing the right-hand engine mounting bracket to the cylinder block and withdraw the mounting.

(19) Place a suitable support underneath the gearbox bell housing and unscrew the nuts, bolts and setpins securing the bell housing to the engine backplate.

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Fig. A.1. The engine left-hand front mounting bracket showing the four setpin holes at 1.

Fig. A.2. Showing the engine being removed at the correct lifting angle.
(12) Release the oil pressure flexible pipe at its upper connection.
(13) Remove the starter motor as described in Section N.
(14) Withdraw the four setpins which secure each engine mounting bracket to the chassis frame. Detachment of the left-hand bracket is facilitated by a slit in the carburettor heat shield.
(15) Unscrew the six brass nuts securing the exhaust down pipe to the exhaust manifolds, and pull the down pipe away from the manifold studs.
(16) Remove the valve rocker as described in Section A.11 and secure two suitable lifting brackets.
(17) By means of lifting tackle, similar to that illustrated in fig. A.2, support the engine so that the engine mounting brackets are just clear of their chassis mountings.
(18) Unscrew the four setpins securing the right-hand engine mounting bracket to the cylinder block and withdraw the mounting.
(19) Place a suitable support underneath the gearbox bell housing and unscrew the nuts, bolts and setpins securing the bell housing to the engine backplate.

Fig. A.1. The engine left-hand front mounting bracket showing the four setpin holes at 1.

[Image of engine with setpins and mounting bracket]

(2) Remove the radiator as described in Section C and detach the fan by unscrewing the four securing setpins.
(3) Disconnect the throttle linkage and choke control cable. The throttle linkage is freed by undamping the throttle control rod at its projection from the bulkhead.
(4) Unscrew the setpins securing the air cleaners to the carburettor inlets and remove the air cleaners.
(5) Disconnect the petrol feed pipe at its carburettor union.
(6) Remove the high tension cables from their connections at the coil and the sparking plugs.
(7) Release the dynamo, distributor and coil low tension cables, and place the complete harness to one side.
(8) Release the heater inlet and outlet rubber hoses from their connections at the rear of the cylinder head and the heater outlet pipe (when fitted).
(9) Remove the distributor as described in Section B.
(10) Remove the dynamo, complete with coil, as described in Section N.
(11) Remove the external oil filter as described in Section A.6.

Fig. A.2. Showing the engine being removed at the correct lifting angle.

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(12) Release the oil pressure flexible pipe at its upper connection.
(13) Remove the starter motor as described in Section N.
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(16) Remove the valve rocker as described in Section A.11 and secure two suitable lifting brackets.
(17) By means of lifting tackle, similar to that illustrated in fig. A.2, support the engine so that the engine mounting brackets are just clear of their chassis mountings.
(18) Unscrew the four setpins securing the right-hand engine mounting bracket to the cylinder block and withdraw the mounting.
(19) Place a suitable support underneath the gearbox bell housing and unscrew the nuts, bolts and setpins securing the bell housing to the engine backplate.

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(11) Remove the external oil filter as described in Section A.6.

Fig. A.2. Showing the engine being removed at the correct lifting angle.

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(20) Hoist the engine to give clearance between the crankshaft damper and the chassis cross member and pull the engine forward so that the clutch driven plate slides off the first motion shaft splines when the engine can be lifted through the bonnet opening and clear of the car.

To Replace
Replacing the engine is the reverse of the procedure “To Remove”

To Remove (with gearbox)
To avoid possible damage, either to individual components or to the car, removal of the generator, distributor and right-hand mounting bracket is advised.
1. Follow the instructions (1) to (10) and (12) to (18) as detailed in the engine removal less gearbox.
2. Inside the car remove the seat cushions and release the clips securing the padded arm rest to the central tunnel.

(3) Unclip and roll back the carpet over the short gearbox tunnel to expose the twelve screws securing the tunnel to the body of the car. Un-screw the setscrews and remove the tunnel and its carpeting.

(4) Unscrew the six setscrews, three either side, which secure the carpet covered bulkhead and remove the bulkhead.

(5) Using a suitable tool tap back the locking washers on the propeller shaft flange bolts and remove the bolts.

(6) Unscrew the four setpins from the gearbox mounting brackets (see fig. A.3), also unscrew the speedometer cable at its connection to the gearbox.

Fig. A.4. The gearbox lower securing points showing 1. Setpins; 2. Stabilizer Adjusting Nut; 3. Securing Pin.

Note.—When an overdrive gearbox is fitted it will also be necessary to unclip the cable to the gearbox switch and release it at its terminal on the switch.

(7) Working beneath the vehicle remove setpins (1) fig. A.4 and unscrew the nuts (2) and (3) to release the stabiliser bar.

(8) Detach the clutch slave cylinder from the gearbox bell housing by removing the two securing setpins. The slave cylinder push rod is released from the clutch operating lever by the removal of the securing clevis pin.

(9) Hoist the engine complete with gearbox through the bonnet opening as shown in fig. A.5, ascertain that no damage is done by the gearbox when manoeuvring it through the bulkhead aperture.

Fig. A.5. Showing the engine and gearbox being removed.
Section A.5

LUBRICATION

Description

The oil supply is carried in the sump below the cylinder block and the filler cap is fitted on the forward end of the rocker cover. The dipstick is on the right-hand side of the engine and is marked to indicate the maximum and minimum levels. The eccentric rotor type oil pump driven by the camshaft is mounted below the crankcase and is partially submerged in the oil reservoir.

Oil is drawn through a gauze strainer secured to the oil pump and passes through a drilling up the right-hand side of the crankcase to the oil filter, passing the non-adjustable pressure relief valve. After leaving the full flow filter the oil-way divides, one drilling passing up the right-hand side of the cylinder block through the cylinder head to a pipe feeding oil to No. 4 rocker shaft bracket. From here, oil passes through the hollow centre of the rocker shaft to lubricate all rocker bearings, and through drillings in the rockers, to lubricate the valve gear. Oil returning to the sump from the rockers lubricates the tappets. The second oil-way from the oil filter passes round No. 3 camshaft bearing, lubricating this bearing as it does so, to the oil gallery on the left-hand side of the engine. From the gallery, drillings in the cylinder block take oil to each main bearing and through the crankshaft to the big ends. Oil-ways from the main bearings also supply the camshaft bearings. The connecting rods have jet holes to deliver oil to the cylinder walls.

A vent pipe is attached to the rear tappet chamber cover and a breather in the valve rocker cover is connected to the rear air cleaner.

An oil pipe connects the rear end of the main oil gallery on the left-hand side of the engine with the oil gauge on the instrument panel.

Draining the Sump

The sump must be drained and filled with new oil at the recommended mileage.

The hexagon-headed sump drain plug is at the rear on the right-hand side.

The sump should be allowed to drain for at least ten minutes before the drain plug is replaced. The oil will flow more readily if it is drained while the engine is hot. When the sump has been drained, approximately 10½ pints (12-3 U.S. pints, 5-8 litres) of oil are required to fill it. The capacity of the filter is approximately 1½ pint (1-5 U.S. pints, 8 litres), giving a total of 11½ pints (13-8 U.S. pints, 6-5 litres). Do not forget to replace the sump drain plug.

Never use petrol or paraffin for flushing purposes. Such cleaning mediums are never completely dispersed from the engine lubrication system, and will remain to contaminate any fresh oil. This may cause premature bearing failure.

Refilling

When refilling the sump do not pour the oil in too quickly, as it may overflow from the filler orifice and
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mislead the operator as to the quantity of lubricant in
the engine.

Before testing the level of the oil, ensure that the
vehicle is as near level as possible. Always wipe the
dipstick clean with a non-fluffy cloth before taking the
reading. It should be remembered that time must be
allowed for new oil to reach the sump before reading the
dipstick. The dipstick location is shown in fig. A.7.

Oil Pressure

The pressure indicated by the gauge may rise to
60 lb. per sq. in. when the engine is started up from cold,
but after the oil has circulated and become warm, the
pressure will drop to approximately 55 lb. per sq. in.,
with a proportionately lower idling pressure, (about
25 lb. per sq. inch). If no oil pressure is registered by
the gauge, stop the engine at once and investigate the
cause.

NOTE: The automatic relief valve in the lubrication
system deals with any excessive oil pressure when
starting from cold.

Continuous running with unnecessary use of the
mixture control is often the cause of serious oil dilution
by petrol, and a consequent drop in pressure.

Check for Low Oil Pressure

Check the level of oil in the engine sump by means
of the dipstick and top up if necessary. Ascertain that
the gauge strainer in the sump is clean and not choked
with sludge, also that there is no air leakage at the
strainer union on the suction side of the pump.

In the unlikely event of the oil pump being defective,
remove the unit and rectify the fault, see Section A.8.

The oil relief valve should be examined, see Section A.9.

If the engine bearings are worn the oil pressure will
be reduced. A complete bearing overhaul and the
fitting of replacement parts is the only remedy, necessi-
tating the removal of the engine from the chassis.

Section A.6

OIL FILTER

The external filter is a full flow type thus ensuring
that all oil in the lubrication system passes through the
filter before reaching the bearings.

The element of the filter is of star formation in which
a special quality felt, selected for its filtering properties,
is used.

Oil is passed to the filter from the pump at a
pressure controlled at 50/55 lb. per sq. inch by the
engine oil relief valve. Some pressure is lost in passing
the oil through the filter element; this will only be a
pound or two per square inch with a new element, but
will increase as the element becomes progressively
contaminated by foreign matter removed from the oil.

Should the filter become completely choked due to
neglect, a balance valve is provided to ensure that oil
will still reach the bearings. This valve, set to open at a
pressure difference of 15/20 lbs. per square inch, is
non-adjustable and is located in the filter head casing.

When the valve is opened, unfiltered oil can by-pass the
filter element and reach the bearings.

To renew the filter element proceed as follows:

(1) Unscrew and remove the tachometer drive from
the distributor housing.

(2) Remove the two setpins securing the filter
bracket to the crankcase.

(3) Unscrew the centre fixing bolt, and the container
complete with element can be removed.

(4) Withdraw the contaminated element and carefully

(5) After ensuring that no fibres from the cleansing
operation have been left in the container, put in a
new element, prime the filter and refit to the head
casting, tightening the centre fixing bolt sufficiently
to make an oil-tight joint.

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Fig. A.8. Engine components.

1. Filter bowl.
2. Element.
3. Head casting.
4. Filter extension bracket.
5. Split pin.
6. Plain washer.
7. Spring washer.
8. Rocker bush.
10. Rocker.
11. Spacing washer.
12. Rocker shaft bracket.
13. Spacing spring.
15. Push rod.
17. Compression rings.
18. Oil control ring.
19. Piston.
20. Oil pump drive spindle.
21. Oil pump body.
22. Inner rotor.
23. Outer rotor.
24. Bottom cover.
25. Pick-up strainer.
26. Shell bearing big end.
27. Connecting rod.
28. Tapper.
29. Camshaft bearings.
30. Exhaust valve.
32. inlet valve.
33. inlet valve guide.
34. Inner valve spring.
35. Outer valve spring.
36. Spring cap.
37. Oil seal.
38. Collars.
39. Split pin.
40. Bush.
41. Oil seal.
42. Spindle housing.
43. Washers.
44. Tachometer spindle.
45. Rocker shaft.
46. Rocker shaft plug.
47. Camshaft gear.
49. Camshaft location plane.
50. Camshaft.
51. Plug.
52. Oil seal.
53. Tachometer gear.
54. Securing pin.
55. Distributor drive.
56. First motion shaft bush.
57. Drain pipe.
58. Relief valve assembly.
59. Big end cap.
60. Thrust washer.
61. Centre front main bearing.
62. Counter shaft.
63. Oil thrower.
64. Crankshaft pulley.
65. Vibration damper.
66. Starter dog.
67. Timing chain tensioner.

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Replace the filter and bracket complete by means
(6) of the two setpins.
(7) Refit the tachometer drive to the distributor
housing.
(8) Check the level of oil in the sump by means of
the dipstick.
It is recommended that the filter container should
not be disturbed other than for cleaning and the fitting
of a new element at the recommended mileages; to do so
invites the hazard of added contamination from accumu-
lated dirt on the outside of the filter entering the con-
tainer, and thus being carried into the bearings on
restarting the engine.

Section A.7
SUMP AND GAUZE STRAINER
Removing
(1) Drain off the oil into a suitable container then
extract the setscrews and washers, thus enabling the
sump to be removed.
(2) Detach the bottom of the strainer by removing
the nut, washer and distance piece. Take out
the three setpins holding the strainer to the pump,
so allowing the body of the gauze strainer to be
removed. The pump and strainer can be swilled
out with petrol or paraffin and thoroughly dried
with a non-fluffy rag.
(3) Inspect the two joint washers and renew if they
are damaged in any way.

Refitting the Sump
Clean out the sump by washing it in paraffin. Take
care to remove any traces of the paraffin before refitting
the sump to the engine. Pay particular attention to the
sump and crankcase joint faces, and remove any traces
of old jointing material. Examine the joint washer and
renew it if necessary. The old joint washer can be used
again if it is sound, but it is advisable to fit a new one.
Smear the faces of the joint with grease and fit the
joint washer. Lift the sump into position and insert the
setscrews into the flange tightening them up evenly.

Section A.8
OIL PUMP
Removing the Oil Pump
(1) Remove the sump and pick up strainer.
(2) Take off the nuts and spring washers from the
three studs which secure the oil pump assembly
to the crankcase, when the pump can be with-
drawn.
If the pump is removed with the engine still in
the car, the drive shaft will be free to disengage
from the camshaft, and care must be taken to
prevent it falling out. Note also the thrust washer
fitted on the drive shaft above the gear.

Dismantling the Oil Pump
Mark the flange and pump body to assist reassembly.
Separate the body from the bottom flange. The outer
rotor can then be lifted out of the body.

Replacing the Oil Pump
Insert the pump from below and push the shaft
right home until the driving gear is meshed with the gear
on the camshaft.

Section A.9
RELIEF VALVE
The non-adjustable oil pressure relief valve is
situated at the rear of the right-hand side of the cylinder
block below the oil filter and is held in position by a
hexagon nut sealed by a copper washer. The relief
valve spring retains a valve cup against a seating
machined in the block.

Section A.10
VALVE ROCKER SHAFT
The valve rocker shaft on the cylinder head is
hollow. It is supplied with oil by a pipe connection and
is drilled for lubrication to each rocker bearing.
This shaft is plugged at each end, one of these being
screwed in order that the shaft may be cleaned internally.

Fig. A.9. Valve adjustment.
1. Feeder gauge. 2. Rocker. 3. Lock nut. 4. Adjusting screw.
Section A.11
ADJUSTING VALVE CLEARANCE

Lift off the valve cover after removing the two flat and two dome cap nuts.

Between the rocker arm and the valve stem there must be a clearance of .012 in. (.30 mm.) for both inlet and exhaust, clearance being set with the engine cold.

(1) If adjustment is necessary, slacken the locknut whilst continuously applying sufficient pressure to the adjusting screw with a heavy screwdriver, and raise or lower the adjusting screw in the rocker arm. Check the clearance with a feeler gauge.

(2) Tighten the locknut when the adjustment is correct, but always check it again afterwards in case the adjustment has been disturbed during the locking process.

(3) When replacing the valve cover, take care that the joint washer (using a new one if necessary) is properly in place to ensure an oil tight joint.

Section A.12
ROCKER SHAFT ASSEMBLY

Removal
(1) Disconnect the breather pipes at their rocker cover terminals.

(2) Unscrew the two flat and two dome nuts securing the rocker cover to the cylinder head, taking care not to damage the cork gasket, and remove the rocker cover.

(3) Detach the oil feed pipe at the union on the cylinder head.

(4) Unscrew and remove the twelve nuts and spring washers which hold the rocker shaft brackets to the cylinder head.

(5) Remove the rocker assembly, complete with brackets, rockers and oil feed pipe.

Dissembling:
(1) Unscrew and remove the oil feed pipe banjo from its bracket noting its corresponding position on the shaft.

(2) Remove the split pins from the end of the rocker shaft to release thrust washers and double coil springs.

(3) Withdraw rocker, rocker shaft brackets, thrust washers and springs, retaining them in their original order for reassembly.

Reassembling
When reassembling the rocker gear, commence with No. 4 bracket and secure the oil feed pipe with the washers in position, ensuring that the dowel on the banjo bolt locates in the rocker shaft.

Fig. A.10. Valve timing diagram.
Exhaust closes at A, and opens at B, inlet opens at C and closes at D.

The brackets are fitted with the highest lug to the camshaft side of the engine, and the rocker shaft is fitted with the screwed in end plug to the front. The rear end tapered plug is a drive fit.
A thrust washer is fitted each side of each rocker shaft bracket, and all springs, and rockers, and the remaining brackets are interchangeable.

Section A.13
PUSH ROD REMOVAL

If the valve rocker assembly has already been removed all that remains is for the push rods to be lifted out. They may on the other hand be taken out without detaching the rocker assembly as described below —

(1) Remove the valve rocker cover as described in Section A.12 and slacken the valve adjustment screw to its full extent.

(2) With the aid of a screwdriver supported under the rocker shaft, depress the valve and slide the rocker sideways free of the push rod.

(3) Withdraw the push rod.

(4) In the case of the rocker at each end, it is necessary to take out the split pins at the end of the shaft.

(5) The above sequence should be reversed when replacing push rods and rockers.
Section A.14

ROCKER ARM BUSHES

(1) While the rocker gear is detached from the head, check for play between the rocker shaft and the rocker arm bushes. If this is excessive new bushes should be fitted. To do this dismantle the rocker assembly as described in Section A.12.

(2) The bush is best removed by using a drift and anvil (Service Tool No. 180 21). The anvil is recessed to retain the rocker in position while the bush is gently knocked out by the drift. File and drill out the rivet in the rocker arm oilway.

(3) The flange of the drift is also recessed to prevent the new split bush from opening when being driven into position with the joint immediately above the rocker arm oilway.

(4) Drill an oilway through the bush from the top of the rocker using a .0785 in. diameter drill. A second oilway must be drilled through the bush via the rocker arm using a .089 in. diameter drill.

(5) Plug the oilway in the rocker arm with a rivet and weld its head to the rocker boss. Ream the internal diameter of the bush to suit the shaft.

Section A.15

TAPPETS

Removal

(1) Remove the valve rocker shaft assembly as detailed in Section A.12.

(2) Disconnect the dynamo terminals and remove the set bolt securing the dynamo to the slotted link. Take out the bolts on which the dynamo pivots and remove the dynamo and coil.

(3) Release the front tappet chamber cover by removing the five securing bolts. The centre and rear tappet chamber covers give access to the valves for No. 3, 4, 5 and 6 cylinders when the single retaining bolts are removed.

(4) Withdraw the push rods, keeping them in their respective positions to ensure replacement onto the same tappets. Lift out the tappets, keeping them in the same respective locations. Inspect the tappet cam contacting surfaces for wear. New tappets should be fitted by selective assembly so that they just fall into their guides under their own weight when lubricated.

Replacement

Assembly is a reversal of the above procedure, but care should be taken to see that the tappet cover joints are oillight and that the rocker arms are adjusted to give the correct valve clearance.

Section A.16

RENEWING VALVE SPRING IN POSITION

(1) In an emergency a new valve spring(s) can be fitted without lifting the cylinder head, but it is advisable first to bring the piston to top dead centre, to ensure that the valve cannot fall into the cylinder during the process.

(2) Remove the sparking plug, and by means of a length of copper tubing or similar tool inserted through the plug hole, the valve can be held on its seat whilst the spring is compressed. The valve rocker shaft can be used as a fulcrum point, by an operator using two screwdrivers to bear on the valve spring cap each side of the valve stem, whilst the cotters are removed.

Section A.17

MANIFOLD

Removal and Replacement

(1) Detach the air cleaners from the carburetters by unscrewing the four setpins and releasing the breather pipe attached to the air cleaner.

(2) Disconnect the heat shield by removing the two securing nuts and washers.

(3) Unscrew and remove the six brass nuts and plain washers which secure the exhaust manifold to the down pipes.

(4) Disconnect the throttle and choke linkages to the carburetters, together with the vacuum control pipe and petrol feed pipe.

(5) Unscrew and remove the 14 nuts and washers which secure the exhaust manifold and carburetters to the cylinder head (four on the
carburettor flanges, ten on the exhaust manifold). This will automatically release the heater outlet pipe.
(6) The exhaust manifold and carburetters can then be drawn off their respective studs and lifted clear of the engine.
(7) Reassembly is the reverse of the above procedure; always use a new joint washer for the exhaust manifold to ensure an air tight joint.

Section A.18
CYLINDER HEAD

Removing
(1) Drain all water from the cooling system, if the water contains anti-freeze mixture, it should be run into a clean container and used again.
(2) Detach the top water hose from the cylinder head.
(3) Disconnect the high tension wires from the sparking plugs and remove the plugs.
(4) Detach the exhaust manifold, complete with carburetters, as detailed in Section A.17.
(5) Remove rocker cover and breather pipes as described in Section A.12.
(6) Release the suction advance pipe clip from its securing point on the cylinder head. Also slacken the retaining clip and detach the heater inlet hose.
(7) Remove the rocker assembly as described in Section A.12.
(8) Withdraw the push rods, keeping them in order of removal taking care not to pull the tappets out of their guides in the block.
(9) Remove the sixteen cylinder head nuts together with their flat washers and lift off the cylinder head.

Replacing
(1) Replace the cylinder head joint washer with the side marked “Top” uppermost, it is not necessary to use jointing compound or grease for the gasket.
(2) Having slipped the gasket over the studs, next lower the cylinder head into position and position the cylinder head stud nut washers. Ensure that a bronze washer is fitted below the steel washer on each stud which passes through the inlet manifold on the left-hand side of the head; also ensure that the suction advance pipe clip is replaced in its original position on the cylinder head.
(3) Fit the nuts finger tight and then tighten them a turn at a time, in the order given in fig. A.12, to the recommended torque spanner readings.
(4) Insert the push rods, ensuring that the ball ends are correctly located in the tappets.

(5) Replace the rocker gear and connect the oil feed pipe, as described in Section A.12.
(6) Reset the valve clearance, and replace the rocker cover using a new joint washer if the old one is damaged in any way.

Section A.19
REMOVING AND REFITTING VALVES

With the cylinder head removed, a valve lifting tool can be used to compress the springs (Service Tool No. 18G 106). Take away the circlip, split cotters, and valve stem cap, so releasing the springs and allowing the valve to be removed.
(1) When removing the valves, place them in a rack, thus enabling them to be paired up with their correct cylinders. The valve springs should be tested and their free length checked, the correct length being approx. 1-969 in. (50-93 mm.) for the inner spring and 2-047 in. (52 mm.) for the outer spring.
(2) Clean the carbon from the top and bottom of the valve heads, as well as any deposit that may have accumulated on the siames. The valve heads should, if necessary, be refaced at an angle of
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Section A.21

VALVE GUIDES

(1) The valve guides are of a one-piece design. They are pressed into the cylinder head to allow -0.875 to +0.00 in. (22.3 to 22.3 mm.) of the guide to protrude above the machined face when fitted.

(2) To position each valve spring on the cylinder head, a stepped pressed steel seating collar is fitted over the part of the guide protruding from the cylinder head.

(3) Valve guides should be tested for wear whenever valves are removed, and if excessive side play is present, a close check should be made of the valve stem and the guide. In the event of wear being noticeable, the defective components should be renewed. If a valve is at fault the wear will be evident on the stem. It should be borne in mind that the valve stem and guide should be a running fit to avoid the possibility of an air leak.

Section A.20

VALVE GRINDING

(1) For valve grinding a little grinding paste should be smeared evenly on the valve face, and the valve rotated backwards and forwards against its seat (using Service Tool No. 18G 29), advancing it a step at short intervals until a clean and unpitted seating is obtained. The cutting action is facilitated by allowing a light spring situated under the valve head, to periodically lift the valve from its seat. This allows the grinding compound to re-penetrate between the two faces after being squeezed out.

(2) On completion, all traces of compound must be removed from the valve and seating. It is essential that each valve is ground-in and refitted to its own seating.

(3) It is also desirable to clean the valve guides; this can be done by dipping the valve stem in petrol or paraffin, and moving it up and down in the guide until it is free.
(4) If renewal is necessary due to wear, the valve guide may be driven out after removal of the valve, as shown in fig. A.14.

(5) The drift is stepped from a \( \frac{1}{4} \) in. (12.7 mm.) diameter to a \( \frac{1}{16} \) in. (7.9 mm.) diameter locating spigot in order to obviate it slipping off the guide and damaging the port. Knock out the guide in the direction shown.

(6) A new guide should be driven into position in the same direction, that is, inserting it through the valve seating and driving towards the top of the cylinder head.

(7) The final position of the guide is shown in fig. A.13.

Section A.22

DECARBONISING

(1) Remove the cylinder head as described in Section A.18.

(2) Scrape off all carbon deposit from the cylinder head and ports. Clean the carbon from the piston crowns, care being taken not to damage the pistons, and not to allow dirt or carbon deposit to enter the cylinder barrels or push rod compartment.

When cleaning the top of the pistons do not scrape right to the edge as a little carbon left on the chamfer assists in keeping down oil consumption; with the pistons cleaned right to the edge or new pistons, oil consumption is often slightly though temporarily increased.

(3) Blow out the oil passages and swirl out the water passages using a water hose. The gasket contacting surfaces of the head should be checked for flatness with a straight-edge and the surfaces examined for scores. If the cylinder head is found to be badly out of true it should be renewed.

(4) Remove all carbon accumulation from the valves and thoroughly clean them. Inspect the valve bases and seats and if they are slightly pitted or rough, grind them in, as described in Section A.20.

If the valves and seats show signs of excessive pitting, or the faces are not flat, the valves and seats should be replaced.

(5) Examine the valve guides, as described in Section A.21.

(6) Broken or weak valve springs should be renewed. The other valve springs should be tested and the results compared with figures given under “General Data”.

(7) Clean the rocker shaft gear and blow out the oil passages as described in Section A.10.

(8) Inspect the rocker shaft, rockers and bushes for wear. Renew any worn rocker bushes as described in Section A.14.

(9) Reassemble and install the cylinder head assembly.

The following operations should be carried out with the engine removed, although in some cases it is possible to perform them with the engine in position.

Before removing or replacing any component it is important to ensure that all surrounding surfaces are perfectly clean, to prevent the entry of foreign matter into the engine. This can best be accomplished by the use of a paraffin bath and brush, and it is also important to note that fluffy rags should never be used, as there is danger of causing obstruction to small oil ways.

Section A.23

CONNECTING RODS AND BEARINGS

Removal

(1) Remove the cylinder head assembly as described in Section A.18.

(2) Drain and remove the sump (see Section A.3).

(3) Remove the self-locking nuts securing the caps and bearings to the connecting rods. Remove the caps and bearings.

(4) Withdraw the pistons and connecting rods upwards through the cylinder bores.

Fig. A.15. Showing the positions of connecting rod offsets.

(5) It may be necessary to remove the carbon or ridge from the top of the bores prior to pushing the pistons upwards, to avoid piston-ring fracture.

(6) Remove the pistons from the connecting rods by unscrewing the clamp bolt from the small end of the connecting rod and pushing the gudgeon pin out.

(7) Ensure that each connecting rod, cap and bearing is marked with the cylinder number from which it was removed.

(8) The big ends are offset, and rods in numbers 1, 3 and 5 cylinders are offset towards the front, with 2, 4 and 6 cylinders offset towards the rear.
The alignment of the connecting rods should be checked on an alignment fixture. On no account must the rods or caps be filed.

Examine the bearing shells for wear and pits. Renew the bearing shell if necessary. Bearings are pre-finished with the correct diametrical clearance and do not require bedding in.

Check the crankpins with a micrometer if they are worn oval or are scored, the crankshaft will have to be removed for regrinding, see Section A.29.

Replacing
Before installing the connecting rods and bearings it is assumed that the pistons and rings have been serviced, see Section A.24.

The pistons and connecting rods must be fitted in the same cylinder bores and the same way round as when removed.

Assemble the piston and the connecting rod to the gudgeon pin, so that the split in the piston skirt is adjacent to the split in the top of the connecting rod.

Refit the piston rings very carefully, make quite sure that the pistons and bores are perfectly clean and smear the bores with clean engine oil.

Use a piston ring clamp, service tool No. 18G 55A, when replacing the pistons from the top of the bore, and make sure that the split in the piston faces away from the camshaft.

Clean the crankpins and both sides of the shell bearings, locate the feathered ends in the connecting rod and its cap, and smear the crankpins with engine oil.

Before fitting the cap, check that the number stamped on the rod is the same as that on the cap. Note that the recesses in the cap and rod must be on the same side. Tighten the nuts. Turn the crankshaft after fitting each rod, to ensure that the bearing is not binding on the crankpin. Also check the side clearance of each rod, as given under “General Data”.

Refit the cylinder head assembly, see Section A.18.

Refit the sump and refill with recommended grade of oil, see Section Q.

Section A.24
PISTONS, RINGS AND GUDGEON PINS

Removal
The split-skirt pistons are of aluminium alloy material. Four rings are fitted above the gudgeon pin, the bottom ring being of the oil-control type. The pistons are fastened to the connecting rods by gudgeon pins which are clamped rigidly in the small ends of the connecting rods. Bushings are not needed in the gudgeon pin bosses of the pistons because the aluminium alloy material serves as a suitable bearing for the gudgeon pins, the bearing surfaces of which are lubricated by means of splash through the two holes drilled in each boss. To remove the pistons see Section A.23.

To view and overhaul
(1) Remove the rings over the tops of the pistons.

(2) Scrape all accumulation of carbon off the piston heads and, using a piston ring groove-cleaning tool or an old ring section, carefully scrape all carbon out of the ring grooves of the pistons. Clean the carbon out of the oil holes in the piston ring grooves.

(3) Thoroughly clean all the dismantled components in paraffin.

(4) Examine all parts for wear and damage, renew if necessary.

(5) If cylinder reconditioning is required (see Section A.30), determine the amount of material to be removed (refer to “General Data” concerning oversize pistons available).
(6) When fitting new or oversize pistons and rings to reconditioned cylinder bores, the clearances should be controlled within the limits given under “General Data”. The cylinder bore glazing should be removed before fitting new rings to a worn cylinder bore.

(7) Piston rings should have a gap clearance (see “General Data”) when installed in the cylinder bores. If new rings are being installed, each ring should be checked in the cylinder bore to determine whether its gap clearance is within the range specified. To do this, use the bottom of a piston to insert the ring part way into the bore. The ring will be squared up in the bore to measure the gap clearance as shown in fig. A.18. To check the ring clearance in the piston grooves, install the rings on the pistons and determine the clearances with a feeler gauge. If the piston ring grooves are worn excessively, as indicated when comparing the actual clearances with those given under “General Data”, renew the rings and pistons.

(8) Gudgeon pins should be a hand-push fit in the piston. The fit can be checked after the rod has been assembled by holding the piston with the connecting rod in an approximately horizontal position. The weight of the large end of the connecting rod should be just insufficient to turn the gudgeon pin in the piston. On no account must gudgeon pin piston bosses be reamed out as oversize gudgeon pins are not supplied or permitted.

Replacement
See Section A.23.
Section A.25

TIMING CHAIN AND WHEELS

Removal

1. Remove the radiator as described in Section C, if the removal is to be done with the engine in position.

2. Slacken the generator fixing bolts and take off the fan belt. Unscrew the starter dog nut using Service Tool No. 18G 391. Before doing this the tab washer must be knocked back.

3. In some cases it may now be possible to remove the crankshaft damper and pulley complete as one unit. If, however, the pulley is tight on the crankshaft, it will be necessary to undo the six nuts securing the damper, and with this component removed, draw off the pulley with Service Tool No. 18G 2.

4. Take out the five \( \frac{3}{4} \) in. and the seven \( \frac{1}{8} \) in. setpins from the timing cover flange, taking care to retrieve the special elongated washers fitted under the heads. The cover can now be removed and the joint washer separated, taking care to remove and retain the oil thrower.

5. Remove the automatic chain tensioner, see Section A.26.

6. Unlock and remove the camshaft chain wheel nut and remove the nut and lockwasher. Note that the locating tag on the lockwasher fits into the keyway of the camshaft chain wheel.

7. The camshaft and crankshaft chain wheels may now be removed, together with the timing chain, by easing each wheel forward a fraction at a time, with suitable small levers or Service Tool No. 18G 38. As the crankshaft gear wheel is withdrawn care must be taken not to lose the gear packing washers immediately behind it.

8. Clean and examine the joint faces of the timing cover and the front mounting plate.

9. Examine the felt oil seal for signs of wear, hardening or damage. If the slightest wear or damage is apparent the timing cover and seal must be renewed as an assembly.

10. Inspect chain wheels for worn or broken teeth.

11. Inspect the chain for excessive wear or stretch.

12. Examine the chain tensioner, see Section A.26.

Reassembling

The installation of the timing chain and wheels is the reversal of the removal procedure but for the following points:

1. Replace the same number of washers as was found when dismantling, unless new camshaft or crankshaft components have been fitted, which will disturb the alignment of the two gear wheels. To determine the thickness of washers required, place a straight-edge across the sides of the camshaft wheel teeth and measure with a feeler gauge the gap between the straight-edge and the crankshaft gear.

2. When replacing the timing chain and gears, set the crankshaft and camshaft with the keyways approximately at T.D.C. when seen from the front.
Double the timing chain, bringing both bright links together. This gives a long and short portion of the chain on either side of the bright links. With the shorter part of the chain on the Right, (the bright links facing the operator), and the longer on the Left, engage the marked camshaft sprocket tooth with the top bright link, and the crankshaft sprocket with the marked tooth coinciding with the other bright link.

Place the sprockets in their respective positions on the camshaft and crankshaft, complete with the chain, and push the assembly home. Carefully keep the sprockets in line with each other all the time to avoid straining the chain.

When replaced on the engine, the bright links and the marked teeth should take up the position shown in fig. A.21.

(3) Replace the camshaft chain wheel locking washer and nut.

(4) Apply engine oil to the timing chain and wheels before installing the cover.

(5) Replace the oil thrower, convex side towards the sprocket.

(6) When refitting the timing cover ensure that the seal is concentric with the crankshaft, using Service Tool 18G3. In the absence of the tool, lubricate the hub of the crankshaft pulley and push it into the seal, while turning it to avoid damaging the seal. Fill the annular groove between the lips of the rubber seal (later engines) with grease. Slide the pulley onto the crankshaft, aligning its keyway with the key on the shaft. Turn the cover to line up the setscrew holes with those in the crankcase, without straining the cover against the flexibility of the seal. A new joint washer should be fitted between the timing cover and the front mounting plate.

Section A.26

AUTOMATIC CHAIN TENSIONER

Description

The tensioner is secured to the engine front mounting plate by two bolts and a locking plate. When the engine is running, oil enters the spigot on the back face under pressure and lubricates the bearing surface through a hole in the tensioner slipper pad.

The tensioner consists of a cylinder with a helical slot which moves in a plunger by the action of a spring in the tensioner body. The helical slot has a recessed lower edge. Should the chain wear through use, the spring pushes the plunger and pad outwards against the chain. A limiting peg in the plunger, bearing on the upper edge of the helical slot, rotates the cylinder until the next recess in the lower edge engages it, and the plunger is prevented from returning to its original position and allowing the chain to become slack.

Fig. A.22. Crankshaft gear replacer tool No. 18G 16.

Fig. A.23. Timing chain tensioner.

1. Slipper head.
2. Spring.
3. Locating sleeve.
5. Setpin.
7. Plug.
8. Backplate.
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1. Generator pulley.
2. Generator fan.
3. Dipstick.
4. Tachometer housing.
5. Tachometer oil feed pipe.
6. Heater pipe.
7. Oil filter cap.
8. Rocker cover.
12. Inlet manifold joint.
13. Exhaust manifold joint.

Fig. A.24. Engine exploded
15. Deflector plate.
17. Oil gauge pipe connection.
18. Plug, oil filler feed hole.
20. Welch plug.
22. Tappet cover joint.
23. Engine front plate joint washer.
24. Tappet cover.
25. Generator mounting.
26. Generator mounting stud.
27. Generator swinging link.
29. Front cover.
30. Felt washer.
31. Engine front plate.
32. Seal for main bearing.
33. Front main bearing stud.
34. Front main bearing cap.
35. Sump joint washer.
36. Centre front main bearing cap.
37. Centre rear main bearing cap.
38. Rear main bearing cap.
39. Sump.
40. Engine mounting bracket.
41. Bracket carrying mounting rubber.
42. Bracket for mounting rubber.
43. Engine mounting rubber.

To Remove
(1) Unlock the tab washer fitted to the tensioner bottom plug and remove the plug from the body.
(2) Insert a ¾ in. (3 mm.) Allen key into the plug hole to engage the cylinder, and turn the key in a clockwise direction (viewed from the opposite end to the slipper), until the rubber slipper is completely free of spring pressure. Between a half and one full turn is necessary.
(3) Unlock and remove the bolts to release the chain tensioner assembly and back plate.

To Dismantle
(1) Withdraw the plunger and slipper assembly from the tensioner body and engage the lower end of the cylinder with the Allen key.
(2) Turn the key in an anti-clockwise direction, gripping the plunger and key securely, until the cylinder and spring are released from inside the plunger.

To Inspect
(1) Clean the components thoroughly in petrol.
(2) The oil hole in the spigot, and outlet oil hole in the slipper should be blown out by compressed air before reassembly.
(3) Check the tensioner spring and examine the slipper pad for wear. Renew as necessary. (See Section A.36).

To Reassemble
(1) Insert the spring in the plunger and place the cylinder on the other end of the spring.
(2) Compress the spring until the cylinder enters the plunger bore and engages with the peg in the bore.
(3) Hold the assembly compressed in this position and engage the Allen key. Turn the cylinder in a clockwise direction until the end of the cylinder is below the peg, thus fully compressing the spring and locking cylinder.
(4) Withdraw the key and insert the plunger assembly into the body.

To Replace
(1) Position the back plate and secure the assembly to the cylinder block.
(2) Move the timing chain into position and release the tensioner for operation by inserting the Allen key and turning it in an anti-clockwise direction as far as possible, assisting the slipper to rise initially with the finger.
(3) Secure the bolts into their locking plate, replace the bottom plug, and lock it with a tab washer.

Section A.27
CAMSHAFT AND BEARINGS

Removal
(1) Drain the sump and release it from the engine. Remove the oil pump, and then take off the rocker assembly, see Sections A.7, A.8 and A.12.
(2) Remove the push rods and take out the tappets, see Section A.13.
(3) Remove the timing cover, timing chain tensioner, chain and gears, see Sections A.24 and A.25.
(4) Remove the distributor and spindle drive, see Section B. Do not slacken the clamping plate bolt or the ignition timing setting will be lost.
(5) Take out the two setscrews which secure the camshaft locating plate to the cylinder block.
(6) Withdraw the camshaft forward rotating it slowly to assist the withdrawal.
(7) Inspect the camshaft bearing journals and caps for signs of scoring. If the journals are not within the required diameter limits (see under “General Data”), the camshaft should be renewed.
(8) Examine the camshaft bearings for scores, pits or evidence of failure. If the bearings have to be renewed it will necessitate the removal of the engine back plate as described in Section A.29. The old bearings can then be withdrawn and new ones installed, using Service Tools 18G 124A, 18G 124C, 18G 124D, 18G 124E, 18G 124F, 18G 124H, 18G 124L.


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Oil holes must be lined up carefully and all bearings reamed in line to give 0.001 to 0.002 in. (0.025 to 0.051 mm.) clearance in each, using Service Tools 18G 123A, 18G 123C, 18G 123D, 18G 123E, 18G 123F, 18G 123AB, 18G 123R, 18G 123T, 18G 123AA, 18G 123L.

(9) Inspect the tappet cam contacting surfaces for wear. New tappets should be installed wherever evidence of unusual wear is found.

(10) The installation of the camshaft and tappets is a reversal of the procedure "Removal". Lubricate the camshaft journals with engine oil.

Section A.28
FLYWHEEL AND ENGINE REAR PLATE

To Remove
The flywheel complete with starter ring is secured to the flange on the rear of the crankshaft by four set bolts, which are locked in position by three lockplates. The engine rear plate is secured to the crankcase by set bolts and lockwashers. To remove the flywheel and rear plate, after the engine is removed from the vehicle, proceed as follows:—

(1) Remove the gearbox from the engine (see Section F).
(2) Remove the clutch (see Section E).
(3) Knock back the tabs of the lockplates, unscrew the bolts and withdraw the flywheel.
(4) Unscrew the set bolts and withdraw the engine rear plate. Note the cork sealing strip behind the engine rear plate under the crankshaft flange.
(5) Examine the flywheel teeth and friction face for excessive wear. If the teeth on the starter ring are damaged or badly worn, a replacement flywheel and ring may be fitted.

NOTE: For instructions on fitting a flywheel starter ring only see Section A.31.
(6) Examine the engine rear plate for distortion and damage and clean the joint faces of the plate and crankcase and check for scores.

To Install
(1) Refit the engine rear plate to the crankcase, using a new joint washer. Tighten the securing bolts evenly and firmly.
(2) Place the flywheel over the flange and flange bolts of the crankshaft so that the timing mark "1" is at T.D.C. when the first throw of the crankshaft is at T.D.C. The joint faces should be perfectly clean. Fit the lockplates and nuts on the bolts and tighten them in diagonal sequence.

Section A.29
CRANKSHAFT AND MAIN BEARINGS

To Remove
The forged-steel crankshaft is statically and dynamically balanced and is supported in the crankcase by three renewable main bearings of the sintered copper and lead steel-backed type. Crankshaft end float is controlled by thrust washers fitted on both sides of the centre main bearing.

(1) Remove the engine from the vehicle (see Section A.4) and place it upside-down in a dismantling fixture.
(2) Remove the sump and oil strainer (see Section A.7).
(3) Remove the timing chain (see Section A.25).
(4) Remove the flywheel and engine rear plate (see Section A.28).
(5) Check the crankshaft end float to determine whether the renewal of the thrust washers is necessary.
(6) Remove the connecting rod bearing caps and shells, keeping the shells with their respective caps for correct replacement, and release the connecting rods from the crankshaft. Remove the sparking plugs from the cylinder head to facilitate the turning of the crankshaft.
(7) Withdraw the main bearing caps complete with bearing bottom shells. Caps and both bearing half-shells should be kept together. The use of Service Tool 18G 42 and adaptor 18G 42B will assist in the removal of the
bearing caps. Remove the screwed plug from the rear bearing cap oil return pipe and withdraw the pipe in order to use the extractor. Note that each main bearing is stamped with a common number, which is also stamped on the centre web of the crankcase near the main bearing. The bottom halves of the two thrust washers will be removed with the centre main bearing cap.

(8) Remove the crankshaft, the two remaining halves of the thrust washers and the top half-shells of the main bearings from the crankcase.

(9) Inspect the crankshaft main journals and crankpins for wear, scores, scratches and ovality. Necessary the crankshaft may be re-ground to the minimum limits shown under "General Data". Main bearings for re-ground crankshafts are available in sizes shown under "General Data".

(10) Clean the crankshaft thoroughly, ensuring that the connecting clearances between the journals and crankpins are perfectly clear. They can be cleaned out by applying a pressure gun containing petrol or paraffin. When clean, inject a thin oil in the same manner.

(11) Thoroughly clean the bearing shells, caps and housings above the crankshaft.

(12) Examine the bearing shells for wear and pitting, and look for evidence of breaking away or picking-up. Renew the shells if necessary.

(13) Bearings are pre-finished with the correct diametrical clearance, and do not require bedding in. New bearings should be marked to match up with the marking on the cap, and on no account should they be filed to take up wear or to reduce running clearance.

(14) Check the thrust washers for wear on their bearing surfaces, and renew if necessary to obtain the correct end float.

To Install
The installation of the crankshaft and main bearings is a reversal of the procedure "To Remove", noting the following points:

(1) Ensure that the thrust washers are replaced the correct way round and locate the bottom half tab in the slot in the bearing cap.

(2) The bearing shells are notched to fit the recesses machined in the housing and cap.

(3) In the case of the front and rear main bearing caps, install new cork or felt sealing strips.

(4) The rear main bearing cap horizontal joint surfaces should be thoroughly cleaned and lightly covered with Hylomar jointing compound before the cap is fitted to the cylinder block. This will ensure a perfect oil joint when the cap is bolted down to the block.

(5) Lubricate the bearings freely with engine oil.

(6) Tighten the main bearing nuts, see "General Data" for torque spanner settings.

Section A.30 CYLINDER BLOCK

To Remove and Dismantle

(1) Remove and dismantle the engine (see Section A.4).

(2) Remove all studs, unions and screwed plugs, etc., if necessary.

(3) If an expansion plug has blown, drill a hole in its centre and lever it out with a screwdriver.

To View and Overhaul

(1) Scrape as much sediment as possible from the water passages and thoroughly swill out with a water hose.

(2) Clean all gasket surfaces.

(3) Inspect for cracks and scores on gasket surfaces.

(4) It may be advisable to remove the ridge above the ring travel at the top of the cylinder bores before checking the fit of the pistons.

(5) Wipe the cylinder bores clean and examine them for scores, out-of-round and taper. If the cylinders are found to be out-of-round or excessively tapered when measured with a dial test indicator, they should be reconditioned.

(6) If cylinder reconditioning is required, determine accurately the amount of material to be removed (refer to "General Data" concerning oversize pistons available).

(7) Make sure that all traces of abrasives are cleaned from all parts of the cylinder block after the cylinder reconditioning operation is completed.

(8) Check the camshaft bearings (see Section A.27).

To Reassemble and Install

(1) Install all studs, unions and screwed plugs, etc.

(2) When installing new expansion plugs, coat the edge of the plug with a sealing compound and insert the plug with the "bulge" on the outside. A carefully aimed blow at the centre of the plug with a small hammer direct or with a blunt punch will expand the plug sufficiently to make a waters-tight joint. If too heavy a blow is used, the plug will be useless and must be replaced by another new one.

(3) Reassemble, install and test the engine (see Section A.4).
THE ENGINE

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>Liner Part No.</th>
<th>Machine Bores of Cylinder Block to this Dimension before Fitting Liner</th>
<th>Outside Diameter of Liner</th>
<th>Interference fit of Liner in Cylinder Block Bore</th>
<th>Machine Liner Bore to this Dimension after Fitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;C&quot;</td>
<td>AEC 607</td>
<td>3-301 to 3-303 in. 83/845 to 83/896 mm.</td>
<td>3-305 to 3-307 in. 83/947 to 83/997 mm.</td>
<td>-002 to -006 in. -051 to -132 mm.</td>
<td>3-124 to 3-126 in. 79.362 to 79.4 mm.</td>
</tr>
</tbody>
</table>

Fig. A.26
Cylinder bore and liner dimensions.

Section A.31
FITTING FLYWHEEL STARTER RINGS

To remove the old starter ring from the flywheel flange split the ring gear with a cold chisel taking care not to damage the flywheel. Make certain that the bore of the new ring and its mating surface on the flywheel are free from burrs and are perfectly clean.

To fit the new ring it must be heated to a temperature of 300° to 400°C, (575° to 752°F), indicated by a light blue surface colour. If this temperature is exceeded the temper of the teeth will be affected. The use of a thermostatically controlled furnace is recommended. Place the heated ring on the flywheel with the lead of the ring teeth next to the register on the flywheel. The expansion will allow the ring to be fitted without force by pressing or tapping it lightly until the ring is hard against its register.

This operation should be followed by natural cooling when the "shrink fit" will be permanently established and no further treatment required.

Section A.32
FITTING CYLINDER LINERS

Should the condition of the cylinder bores be such that they cannot be cleaned up to accept standard oversize pistons, dry cylinder liners can be fitted. This operation may be carried out by the use of specialized proprietary equipment, or with a power press using pilot adaptors to the dimensions shown in Fig. A.27. The press must be capable of 3 tons (3048 kg.) pressure to fit new liners and 5 to 8 tons (3080 to 8128 kg.) to remove old liners.

Remove the engine from the vehicle as detailed in Section A.4. Dismantle the engine and remove the cylinder head studs. If liners have not previously been fitted the bores must be machined and honed to the dimensions given in Fig. A.26.

To Remove Worn Liners

Place the cylinder block face downwards on suitable wooden supports on the bed of the press, making sure that there is sufficient space between the block and the bed of the press to allow the worn liner to pass down. Insert the pilot in the bottom of the liner and carefully press the liner from the bore.

To Press in New Liners

Thoroughly clean the inside of the bores and the outside of the liners. Stand the cylinder block upright on the bed of the press, insert the pilot guide in the top of the liner and position the liner with its chamfered end in the top of the bore. Make certain that the liner is square with the top of the block and that the ram or the press is over the centre of the pilot. Press the liner into the bore.

Each liner must be machined to the dimensions given in Fig. A.26 after pressing into position.

Section A.33
MODIFIED CONNECTING RODS

Connecting rods with fully floating gudgeon pins were fitted from Engine No. 40501. They are interchangeable only in sets of six. The dismantling procedure is as follows.

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Cylinder liner pilots should be made to the above dimensions from case hardening steel, and case hardened. The pilot extension should be made from 55 ton hardening and tempering steel and hardened in oil at a temperature of 550°F. (300°C).

Pressing-out Pilot
A. \( \frac{3}{4} \pm 0.005 \) in. (82.94\pm 0.127 mm).
B. 1, \pm 0.005 in. (79.04 \pm 0.00 mm).
C. \% in. (21.45 mm).
D. \% in. (19.05 mm).
E. \% in. B.S.W. Thread.

Pressing-in Pilot
F. \( \frac{3}{4} \) in. (93.66 mm).
G. \( \frac{3}{4} \) in. (84.91 mm).
H. \( \frac{3}{4} \) in. (78.61 \pm 0.00 mm).
I. 0.005 in.
J. \( \frac{3}{4} \) in. (81.75 mm).
K. \% in. (19.05 mm).
L. 0.005 in. (38 mm).

Pilot Extensions
M. \% in. (31.83 mm).
N. \% in. (22.22 mm).
O. \% in. (15.87 mm).
P. \% in. (15.87 mm).
Q. \% in. (12.74 mm), flat.
R. \% in. (27.34 mm).
S. \% in. (B.S.W. Thread).
T. \% in. (31.75 mm).

Remove the two circlips securing each gudgeon pin in its piston and press the gudgeon pin out. Mark the gudgeon pins and pistons for reassembly to their original positions and to their original connecting rods.

Check the gudgeon pin and the connecting rod little-end bearings for wear, with the dimension given in the General Data section. If the bush is worn it should be removed and a new bush fitted. A light press is most suitable for this operation.

When pressing in the new bush ensure that the oil hole in the bush is in line with the oil hole in the connecting rod.

Replacement bushes must be finish reamed to size after pressing into the connecting rod (see the General Data section for the correct dimensions). The piston gudgeon pin bosses must not be reamed as oversize gudgeon pins are not supplied.

Assemble the pistons to the connecting rods by inserting the gudgeon pins, which should be a hard hand-push fit at a room temperature of 20°C. (68°F). Secure each gudgeon pin in position with the two circlips, ensuring that they fit well into their grooves.

IMPORTANT.—When assembling the piston to the connecting rod make certain that the slot in the piston will be on the opposite side to the camshaft when the assembly is fitted to the cylinder block.

Section A.34

6 PORT CYLINDER HEAD

The Austin-Healey C-Series engine has been modified by the introduction of an entirely new cylinder head, together with a detachable induction manifold.

Two S.U. HD6 carburetters with 1\% inch throats replace the two S.U. H4 type used in the normal "C" type engine. Details of the new carburetters are given in Section D.12.

New features of the head include modified combustion chambers, larger inlet and exhaust valve head diameters and re-shaped inlet and exhaust ports to provide an even more efficient gas-flow.

The introduction of solid skirt, flat topped pistons has increased the compression ratio from 8.25:1 to 8.71:1.

Dimensional and power changes brought about by these modifications are given in the General Data.
Fig. A.28 View of induction manifold showing the six inlet ports.
Section A.35

6 PORT MANIFOLD

Removal and Replacement.

1. Detach each air cleaner from the carburetters by unscrewing the four setpins and releasing the breather pipe from the rear air cleaner.

2. Remove the carburetters as detailed in Section D.13.

3. Withdraw the heat shield off the induction manifold flange studs.

4. Unscrew the nine nuts securing the induction manifold to the cylinder head and remove the manifold.

5. Unscrew and remove the six brass nuts and plain washers which secure the exhaust manifold to the down pipes.

6. The remaining eight manifold securing nuts should now be removed and the exhaust manifold detached.

7. Reassembly is the reversal of the above procedure but always use a new joint washer for the manifolds to ensure an air tight joint.

Section A.36

TIMING CHAIN TENSIONER OVERHAUL

If the rubber slipper head of the timing chain tensioner is found to be badly worn, then either the complete adjuster, or the slipper head and cylinder assembly must be renewed.

Remove the tensioner and dismantle as described in Section A.26. Check the bore in the adjuster body for ovality. If the degree of ovality when measured on the diameters at the mouth of the bore is greater than .003 in. (.07 mm.) the complete adjuster assembly must be renewed. If the bore is within the acceptable limits, then fit a new slipper head and cylinder assembly in the existing body. Ensure that the bore of the body, and all components parts are scrupulously clean before re-assembling the adjuster (Refer to Section A.26).

Refit the adjuster to the engine (Section A.26) and check that the slipper head does not bind on the back plate when it is moved in the body.

Section A.37

THROTTLE CONTROL LINKAGE

To prevent the throttle linkage being strained and the throttle levers working loose, the linkage may be adjusted to allow the toe board to act as a positive
stop to the accelerator pedal when the throttles are fully open.

Slacken the pinch bolt on lever “A” (Fig. A.30). The illustration shows the linkage layout for L.H.D. cars. On R.H.D. cars lever “B” is on the right-hand side of the accelerator relay shaft. Place a wooden block “D” 2½ in. (63-5 mm.) thick between the pedal and the toe board. Push the pedal down to retain the block against the toe board. Adjust lever “A” in relation to the pedal cross-shaft to obtain a clearance of \( \frac{1}{8} \) in. (1.59 mm.) at point “X” between lever “C” and the body flange (Fig. A.30). Tighten the pinch bolt on lever “A”.

The carburettor control levers must then be set as follows.

Slacken the pinch bolt on levers “A” and “B” (see Fig. A.31).

Set lever “B” at approximately 45° as shown and tighten the pinch bolt, ensuring at the same time that the throttles are not being held open by the idling adjustment screws.

Adjust the length of rod “C” to bring lever “A” parallel with lever “B” (Fig. A.31).

With the pinch bolt of lever “A” still slack, press rod “D” downwards \( \frac{1}{4} \) in. (3.2 mm.) to tension the pedal return spring slightly, and then tighten the pinch bolt on lever “A”.

Depress the accelerator pedal fully and check the travel of lever “E”. This must be such that it is at least 20° short of the vertical position when full throttle is reached on the carburettors. Adjust rod “D” as necessary to achieve this position.

When the accelerator pedal is fully depressed check that the carburettor throttles are being fully opened.

NOTE.—After the linkage has been set it will be necessary to check, and adjust if necessary, the throttle switch operation on cars fitted with overdrive (see Section G.12, “Throttle switch adjustment”).
SECTION AA

ENGINE
SERIES BN6
Section No. AA1. Accelerator shaft bushes

NOTE
The engine of the BN6 is the same as that fitted to later BN4 cars, being fitted with the 6 port cylinder head. Reference should, therefore, be made to Section A and particular attention given to Sections A.35 and A.36.
Section AA.1

ACCELERATOR SHAFT BUSHES

When the felt bushes on the accelerator pedal shaft and the cross shaft have to be renewed, the following standard bushes are to be fitted:

- Part No. AHB8748 Bush, Nylon, accelerator pedal shaft—engine side.
- Part No. AHB8950 Bush, Compo, accelerator pedal shaft—pedal side.
- Part No. AHB8950 Bush, Compo, cross shaft.
SECTION AAA

ENGINE
Mk. I and II (SERIES BN7 and BT7)
AND Mk. II and III (Series BJ7 and BJ8)

Section No. AAA.1  Gear type oil pump
Section No. AAA.2  Fitting cylinder liners
Section No. AAA.3  Timing chain vibration damper

NOTE
The engine is the same as that fitted to Series BN6 cars
except for the information contained in the above
Sections.
Section AAA.1

GEAR TYPE OIL PUMP

The oil pump fitted to early engines is of the Hobourn Eaton rotary vane type, the service procedure for which is detailed in Section A.8. Later engines, however, are equipped with a gear type pump and instructions for servicing this type of pump are given below.

Dismantling the Oil Pump

(1) Mark the flange and pump body to assist reassembly and remove the four retaining bolts with their spring and plain washers.

(2) Separate the pick-up from the pump body, withdraw the drive gear and spindle and the driven gear from its fixed spindle. Thoroughly clean all parts in fuel or paraffin and dry off.

(3) Replace the gears and check for wear.
   (a) The radial clearance between the gears and the pump body should not exceed 0.0125 in. to 0.0025 in. (0.32 mm. to 0.63 mm.).
   (b) Check the clearance between the gears and the end cover by placing a straight edge across the pump body and checking with a feeler gauge. End float should be between 0.0005 in. and 0.002 in. (0.013 mm. and 0.051 mm.).

Renew worn parts as necessary. The pump driving gear is a press fit on its shaft and is keyed in position. The spindle should protrude 0.12 in. (7.94 mm.) from the gear face.

Replacing the Oil Pump

Care should be taken to see that the abutting faces of the cylinder block and the pump are clean before replacing and that the joint washers are in good condition. Insert the pump from below ascertaining that the driving gear is in mesh with the gear on the camshaft. Secure the pump with the three nuts and spring washers. Replace the pick-up strainer and sump.

Section AAA.2

FITTING CYLINDER LINERS

The dimensions required for the fitting of cylinder liners to the 2.9 litre "C" type engine are given below.

These dimensions should be used in conjunction with the removal and fitting instructions given in Section A.33.
AAA

THE ENGINE

Pressing out Pilot
A. $3.5\pm{}^\circ 05$ in. (87-31 + 127 mm).
B. $3.270\pm{}^\circ 000$ in. (83-056 + 000 mm).
C. $1.05$ in. (44-45 mm).
D. $1.95$ in. (49-05 mm).
E. $1.95$ in. R.S.W. Thread.

Pressing in Pilot
F. $3.5$ in. (98-43 mm).
G. $3.5$ in. (88-9 mm).
H. $3.270\pm{}^\circ 000$ in. (83-056 + 000 mm).
I. $1.05$ in. (44-45 mm).
J. $1.45$ in. (37-75 mm).
K. $1.95$ in. (49-05 mm).
L. $0.05$ in. (0-38 mm).

Pilot Extensions
M. $1.45$ in. (36-83 cm).
N. $0.05$ in. (0-22 cm).
P. $0.05$ in. (0-13 mm).
Q. $0.05$ in. (0-13 mm).
R. $0.05$ in. (0-13 mm). flats.
S. $1.45$ in. (37-75 mm).
T. $1.95$ in. (49-05 mm).

Cylinder bore and liner dimensions.

<table>
<thead>
<tr>
<th>Engine Type</th>
<th>Liner Part No.</th>
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<th>Outside Diameter of Liner</th>
<th>Interference fit of Liner in Cylinder Block Bore</th>
<th>Machine Liner Bore to this Dimension after fitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;C&quot;</td>
<td>AEC 879</td>
<td>3-457 to 3-459 in. 87-81 to 87-86 mm. 1-96 to 1-96 in. 0-76 to 0-127 mm.</td>
<td>3-461 to 3-463 in. 87-91 to 87-96 mm.</td>
<td>-002 to -006 in. 0-76 to 0-127 mm.</td>
<td>3-283 to 3-282 in. 83-22 to 83-26 mm.</td>
</tr>
</tbody>
</table>

Section AAA.3

TIMING CHAIN VIBRATION DAMPER

Coinciding with the introduction of the 3000 Mk. II power unit a timing chain vibration damper was fitted in addition to the automatic chain tensioner already in use (see Fig. AAA.3). The damper consists of an angled bracket bolted with a single set screw to the cylinder block and located on the engine front mounting plate by a dowel. An oil resistant rubber pad bonded to the bracket maintains light rubbing contact with the timing chain and damps chain vibration under light load running conditions.

This modification involved the introduction of a new cylinder block, front mounting plate and gasket.

Fig. AAA.2 Cylinder liner pilots should be made to the above dimensions from case hardening steel, and case hardened. The pilot extension should be made from 55-ton hardening and tempering steel and hardened in oil at a temperature of 550° C. (1020°F.).

Fig. AAA.3 The engine with the timing cover removed.
A. Vibration damper  B. Tensioner.

AAA.2

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