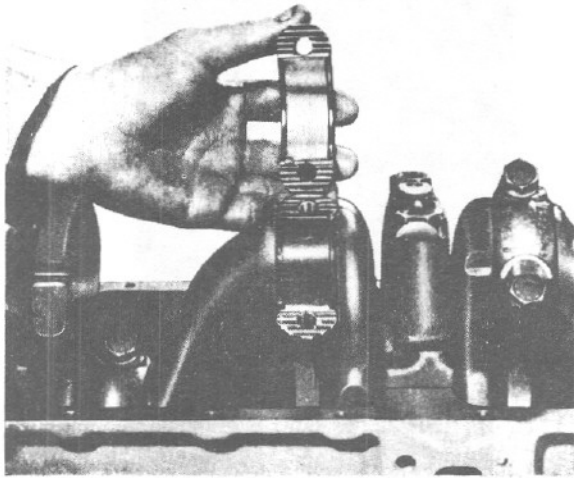
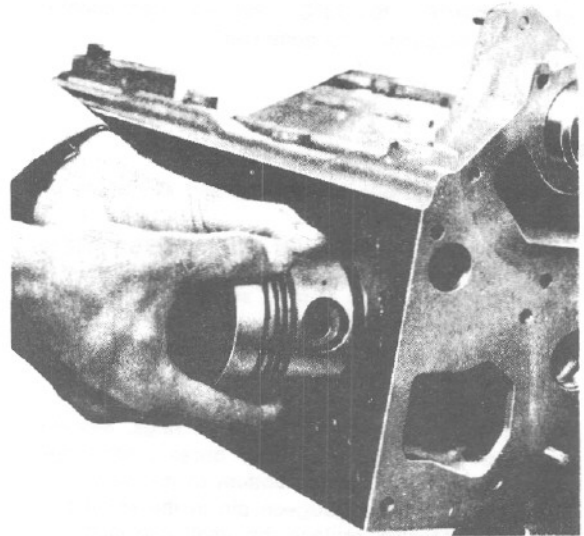


SECTION F

Pistons and Connecting Rods



F1



F2

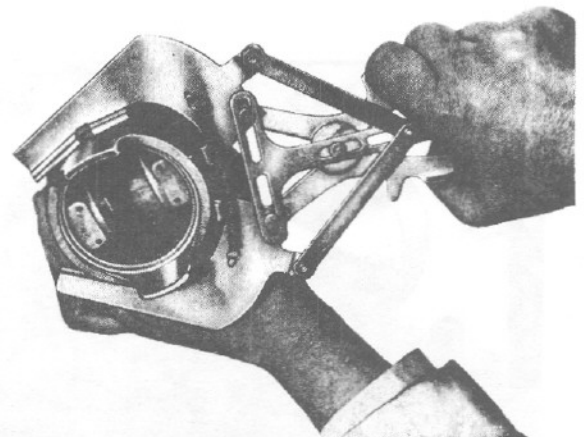
To Remove Pistons and Connecting Rods

1. Remove the cylinder head assembly. (Refer to Page E.1).
2. Remove the oil sump. (Refer to Page M.1).
NOTE: Any ridges or carbon deposits around the top of the cylinder bores should be removed with a suitable scraper before piston removal is attempted.
3. Rotate the crankshaft until one pair of big ends are at bottom dead centre, then remove their respective connecting rod cap securing bolts.
4. Remove the connecting rod caps and bearing shells. (Refer to Fig. F.1).
NOTE: If the bearing shells are serviceable, they should be suitably marked to identify them to their original locations.
5. Push the pistons and connecting rods carefully out through the top of the block and remove as shown in Fig. F.2.
6. Rotate the crankshaft through 180° to bring the remaining pair of big ends to bottom dead centre and repeat removal operations.
When piston removal has been carried out keep each piston and rod assembly separate, each to each as marked. Mark the pistons on the crown (before removing the gudgeon pin) to indicate the 'FRONT' in relation to the 'FRONT' marking cast on the connecting rods.

suitable piston ring tool, such a tool is shown in Fig. F.3.

NOTE: The laminated segments or spring loaded rings fitted in the fourth ring groove should be removed by hand.

With 4.108 pistons there is a steel insert rolled into the top ring groove during piston manufacture. It should be regarded as an integral part of the piston and no attempt should be made to remove



F3

To Remove Pistons and Rings from the Connecting Rods

1. Remove the piston rings from each piston, using a

PISTONS AND CONNECTING RODS—F.2

it from its location.

2. Remove the circlip retaining the gudgeon pin and push out the gudgeon pin to release the connecting rod.

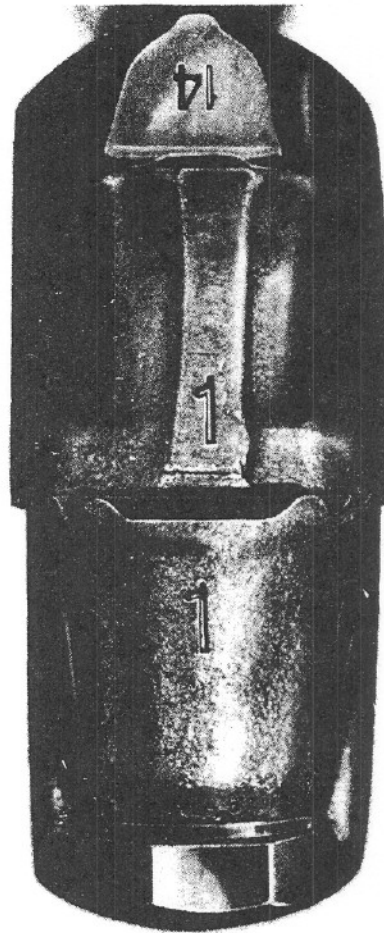
NOTE: Should difficulty be experienced in removing the gudgeon pin, warm the piston in a suitable clean liquid (usually water) to a temperature of 100—120°F, (40—50°C), this will then enable the pin to be pushed out quite easily.

Inspection

1. Examine the pistons for scoring and any signs of groove damage.
2. Check the clearance of the piston rings in their respective grooves by placing the ring outer face into the groove and a suitable sized feeler between the ring and groove face.
NOTE: All ring gaps, ring groove clearances etc., are given in the Technical Data Section on Pages A.5 and A.6.
3. Check the fitted gaps of the piston rings, bearing in mind that in worn cylinder bores these gaps should be checked at the **bottom** of the bore.
4. Check the fit of the gudgeon pin in the small end bush, if excessive, replace the small end bush.
5. To renew the small end bush, remove the old one by means of a suitable press and 'dolly'. Press in the new bush, ensuring that the oil holes coincide when fitted. Ream out the new bush to suit the gudgeon pin, then check the rod for parallelism and twist. (Refer to Page A.7).
6. Examine the big end bearing shells for any signs of wear or pitting.

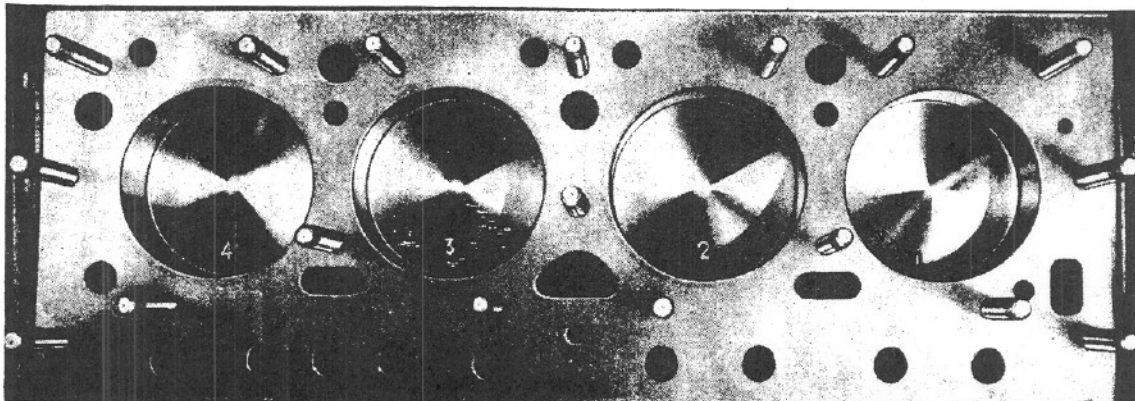
To Refit the Pistons to the Connecting Rods

If the original pistons are to be refitted they must be re-assembled to the same connecting rods, i.e. No. 1 piston to No. 1 connecting rod assembly. Refer to Figs. F.4 and F.5 for location of piston and rod numbering. Any new components fitted should be numbered the same as those which they replace.



F4

1. Warm the piston in a suitable clean liquid to a temperature of 100 — 120°F (40 — 50°C) which will enable the gudgeon pin to be easily pushed into the piston bore when the piston and rod have been correctly aligned.
2. Place No. 1 piston onto its head, noting the position of the mark previously made to indicate the "FRONT".



F5

3. Hold No. 1 connecting rod with the small end between the gudgeon pin bores so that the word "FRONT" cast on the rod is towards the same side.
4. Push the gudgeon pin into the piston thus locating the connecting rod in position.
5. Fit the two retaining circlips ensuring that they locate correctly in their recesses. (Refer to Fig. F.6).
NOTE: If the engine has been in service for some considerable time it is advisable to fit new circlips, even if the old ones do not appear to be strained or damaged.
6. Repeat this procedure for the three remaining pistons and connecting rods.

Fitting the Piston Rings

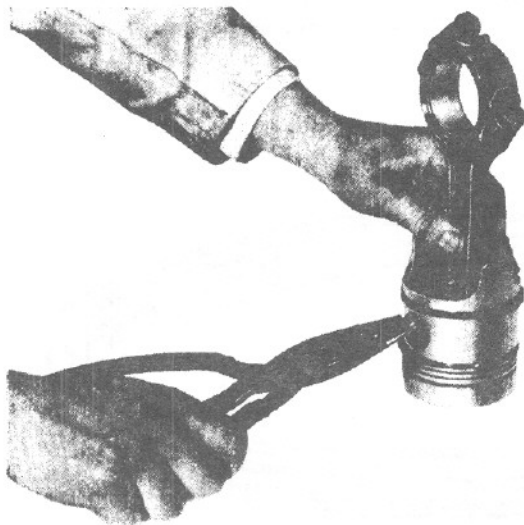
Fit piston rings to the piston. Rings vary according to engine type and application as follows: reading from the top of the piston.

4.108 Engines

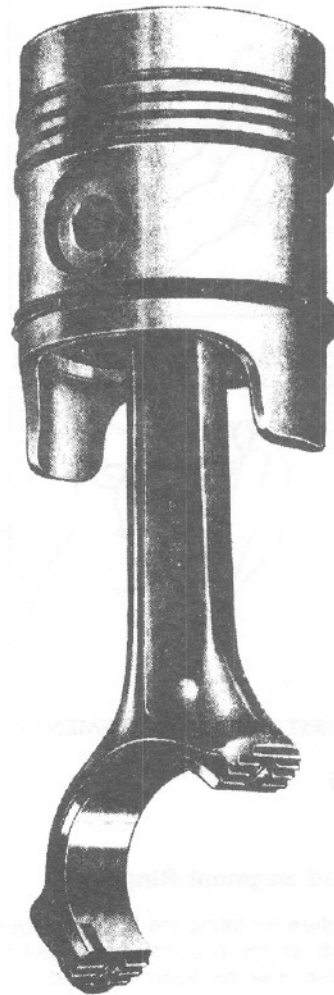
1. Plain parallel faced compression.
2. Internally stepped compression.
3. Internally stepped compression.
4. Laminated segment oil control.
5. Slotted scraper.

4.99 Vehicle Engines

1. Chrome parallel faced compression.
2. Internally stepped compression.
3. Internally stepped compression.
4. Slotted scraper.
5. Slotted scraper.



F6



F7

4.107 and 4.99 Agricultural and Industrial Engines

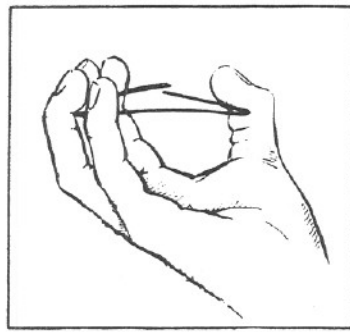
1. Plain parallel faced compression.
2. Internally stepped compression.*
3. Internally stepped compression.*
4. Chrome spring loaded scraper.
5. Slotted scraper.

*4.99 agricultural engines have taper faced cast iron compression rings fitted in the 2nd and 3rd ring grooves.

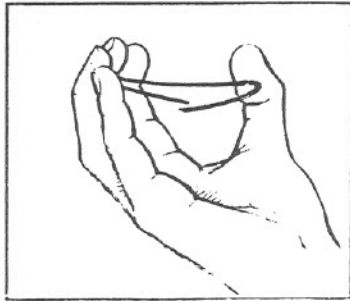
After an appropriate period of service, when indications of piston ring and/or cylinder bore wear may become apparent, a replacement ring pack has been made available for fitting exclusively to 4.99 service engines and includes a taper faced ring for fitting in the top ring groove.

NOTE: All the rings quoted above except the laminated and spring loaded type may be fitted by means of an expanding tool of the type shown in Fig. F.3. These rings, being made of cast iron are therefore comparatively brittle, so when fitting care should be taken not to expand any ring more than is necessary to just clear the piston.

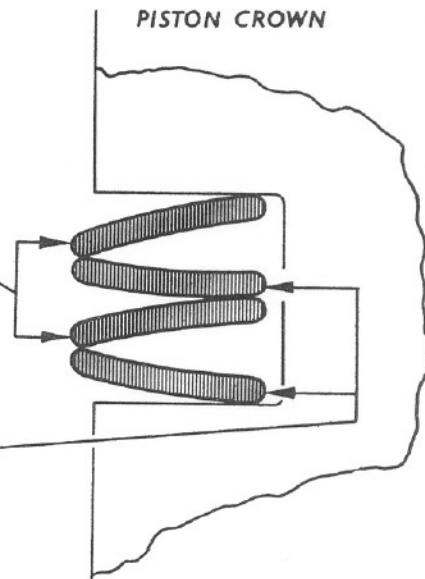
PISTONS AND CONNECTING RODS—F.4



SECOND AND FOURTH SEGMENTS



FIRST AND THIRD SEGMENTS



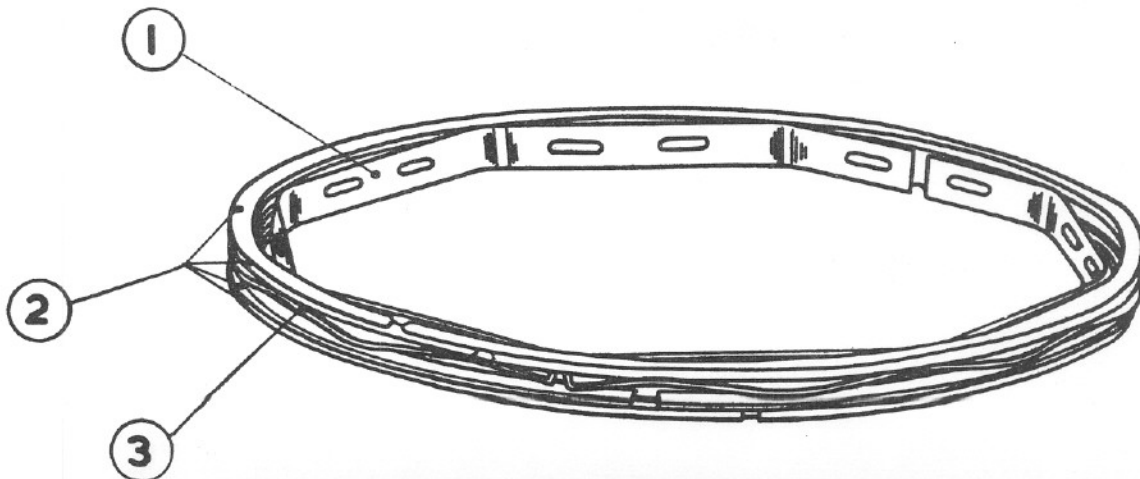
F8

Laminated Segment Rings

The procedure for fitting the laminated type is different, in as much as the ring comprises four separate segments, these may be fitted by hand in the following sequence with the piston crown uppermost:—

1. Fit the first segment to the piston so that when held horizontally between the thumb and fingers and radially compressed the ring ends point downwards (see Fig. F.8). Place this ring on the bottom face of the fourth ring groove with the gap over the gudgeon pin bore.

2. Fit the second segment on top of the first, so that when compressed as described above the ends point upwards. Position the gap at 180° to that of the first segment.
3. Fit the third segment as in (1) above with the gap immediately above the gap of the first segment.
4. Fit the fourth segment as in (2) above with the gap immediately above the gap of the second segment. If all the segments have been fitted correctly then they will be positioned as shown above.



F9

The gaps of the remaining rings should be staggered alternately along the gudgeon pin axis. Liberally lubricate the rings in their grooves and see that they can move freely in their locations. This does not apply to the laminated type in the fourth groove, which if correctly fitted should not move freely due to the outward pressure of the top and bottom segments on the ring groove walls. When all the rings have been fitted, they should be as shown in Fig. F.8.

Always ensure that internally stepped or taper faced rings are correctly fitted. They are marked TOP or BTM (bottom) to ensure correct replacement. The top compression and slotted oil control rings may be fitted either way up.

Spring Loaded Scraper Ring

When fitting the chrome plated spring loaded scraper ring, (see Fig. F.9), the following procedure should be adopted:—

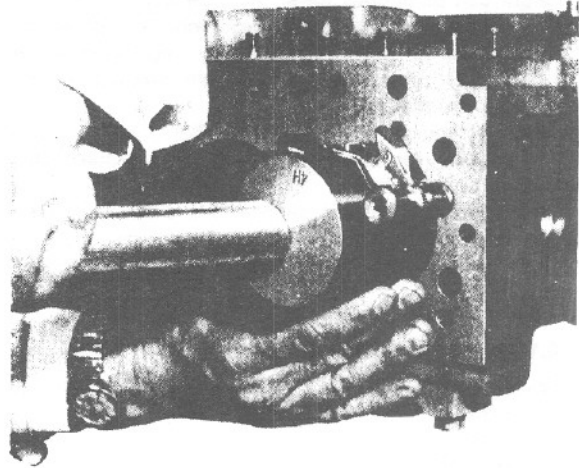
1. Fit internal expander (1).
2. Fit two rail rings (2) at the bottom of the groove.
3. Fit spiral ring (3).
4. Fit two top rail rings (2).

When fitting rail rings, the gaps should be staggered.

To Fit Piston and Connecting Rod Assemblies

Before fitting the piston and connecting rod assemblies to their respective cylinder bores, thoroughly clean and liberally coat each bore with clean engine oil.

1. Turn the engine until the crankpins of numbers 1 and 4 cylinders are at bottom dead centre.
2. Using a suitable ring clamp of the type shown in Fig. F.10, carefully compress the rings of No. 1 piston and hold in this position.
3. With the word 'FRONT' on the connecting rod facing the front of the engine, insert the rod carefully into No. 1 cylinder bore.
NOTE: The cylinders are numbered 1, 2, 3, 4 starting from the front (water pump) end of the engine. It is extremely important that these components (marked as shown in Figs. F.4 and F.5), are returned to their original locations.
4. The piston head may be gently tapped with the shaft of a hammer as shown in Fig. F.10 until all the rings have entered the cylinder bore.
5. Draw the rod towards the crankpin, place the top half bearing shell in position locating the tag in the machined slot and liberally oil, draw the rod onto the crankpin.
6. Fit the lower half bearing shell to the connecting rod cap, locating the tag in the machined slot, liberally oil and fit the cap to the crankpin, ensuring that the numbers on the rod and cap coincide as shown in Fig. F.4.



F10

7. Fit the two connecting rod securing setscrews and tighten evenly to the torque quoted on Page B.2.
NOTE: Locking tabs are not fitted to these setscrews.
8. Repeat this procedure for No. 4 piston and connecting rod assembly.
9. Rotate the crankshaft to bring numbers 2 and 3 crankpins to bottom dead centre.
10. Repeat procedures 2 — 7 to fit the two remaining assemblies.
11. Refit the lubricating oil sump. (Refer Page M.4).
12. Refit the cylinder head assembly. (Refer Page E.7).

Fitting New Pistons

With new 4.108 and 4.107 pistons a machining allowance is provided on the crown of the piston to enable the necessary material to be removed by means of a lathe so that when fitted the piston height above the cylinder block top face will be within the limits quoted on Page B.3.

To determine the exact amount to be removed from the piston crown, the piston, connecting rod and bearing assembly will have to be fitted to its respective cylinder bore as previously described, and the piston height above the cylinder block top face measured with the particular piston at top dead centre. This piston height can be measured by means of a piston height gauge of the type shown in Fig. F.11. Repeat for each new piston to be fitted and mark each piston with the number of the cylinder bore it will belong to, (not on the top as any marking here will be removed by the machining). When each piston has been skimmed it should be checked again when finally refitted to ensure that any new piston fitted is now within the limits quoted. Once the piston height is correct mark any such piston on the crown with the number of its respective bore. (Refer to Fig. F.5).
Pretopped pistons are available for fitting to 4.108 vehicle engines and all 4.99 engines and are available in three grades (see separate tables). For identification purposes, the grade letter is stamped on the piston crown.

PISTONS AND CONNECTING RODS—F.6

Where pretopped pistons are used, then the piston height can be slightly lower than the limits given.

It is important to note that where vehicle engines have to conform to the smoke density regulation B.S.AU 141a: 1971, then the piston height production limits must be maintained.

It will of course be appreciated that grade F pistons are suitable for topping to give other grades where these are not to hand.

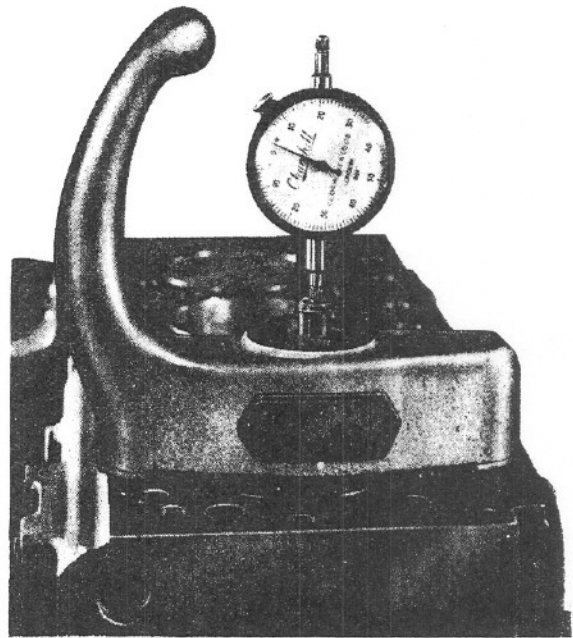
After fitting pre-topped pistons, the distance between the cylinder block face and piston crowns should be checked to ensure the limit is as already quoted (See Fig. F.11).

4.108 Vehicle Engines

Production Grade	Equivalent Service Grade
A to F	F
G to L	L
M to P	P

4.99 Engines

Production Grade	Equivalent Service Grade
B, D, & F	F
H, J & L	L
N & P	P



F11