STANDARD TRIUMPH

DIFFERENTIAL UNIT

HERALD RANGE
SPITFIRE
VITESSE

SERVICE TRAINING NOTES

TO BE USED WITH FILMSTRIP

No. 2116

AMENDMENTS

Page 8, Frame 6

3. Turn the nut.....

Page 32, Frame 23

"In increments of 0.002" (0.05 mm.)."

Page 34, Frame 24

".....as shown. Peen over end of casing to secure locating pin".

Page 38 and 39, Frame 27

"4.11 : 1 Crown wheel ratio 40–45 lb./ft. (5.5 – 6.2 Kg/m.)."

Introduction

This booklet and its accompanying filmstrip shows the main features of the differential unit as fitted to the Herald Range, Spitfire and Vitesse models.

There are three main sections :-

Part 1. Removal of sub-assembly.

Part 2. Inner half-shaft assembly.

Part 3. Overhauling differential unit.

It is intended that the filmstrip should form the backbone of a lecture. The subject matter can be elaborated or abbreviated to suit the standard of the audience.

The booklet by itself provides a handy pocket manual for ready reference.

FRAME 3

CASE IDENTIFICATION

TRIUMPH HERALD SALOON. G.

948 c.c. engine, 4 cylinder, single carburettor
Differential Ratio 4.875 : 1
Crown Wheel 39 teeth Pinion 8 teeth.

TRIUMPH HERALD COUPE, CONVERTIBLE AND TWIN CARB. SALOON. Y.

948 c.c. engine, 4 cylinder, twin carburettors
Differential Ratio 4.55:1
Crown Wheel 41 teeth Pinion 9 teeth.

HERALD 1200 RANGE. GA.

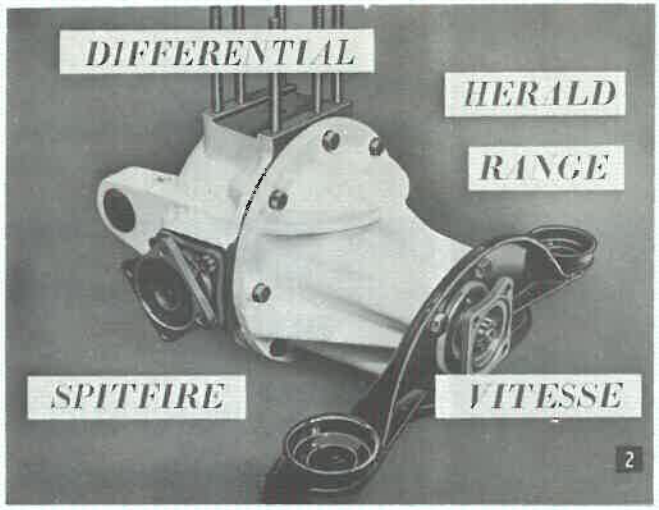
1147 c.c. engine, 4 cylinder, single carburettor
Differential Ratio 4.11 : 1
Crown Wheel 37 teeth Pinion 9 teeth.

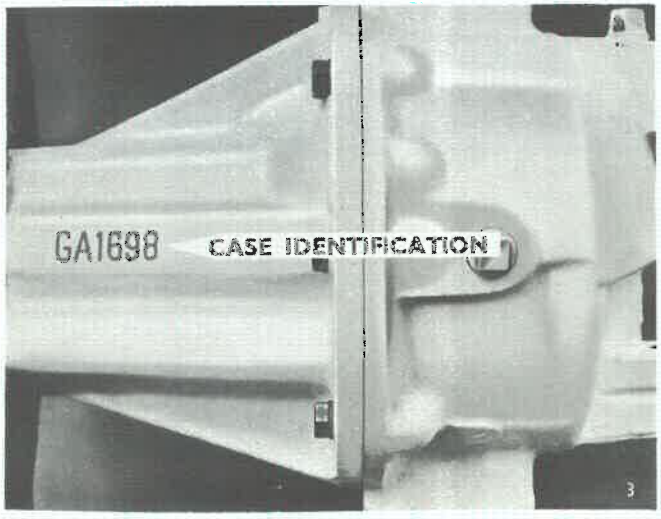
HERALD MARK II. GA 80000 AND SPITFIRE 4 FC.

1147 c.c. engine, 4 cylinder, single carburettor
Differential Ratio 4.11 : 1
Crown Wheel 37 teeth Pinion 9 teeth.

VITESSE HB.

1596 c.c. engine, 6 cylinder, twin carburettors
Differential Ratio. 4.11:1
Crown Wheel 37 teeth Pinion 9 teeth
Large Inner Half Shaft Flange and Bolt Holes.





FRAME 4

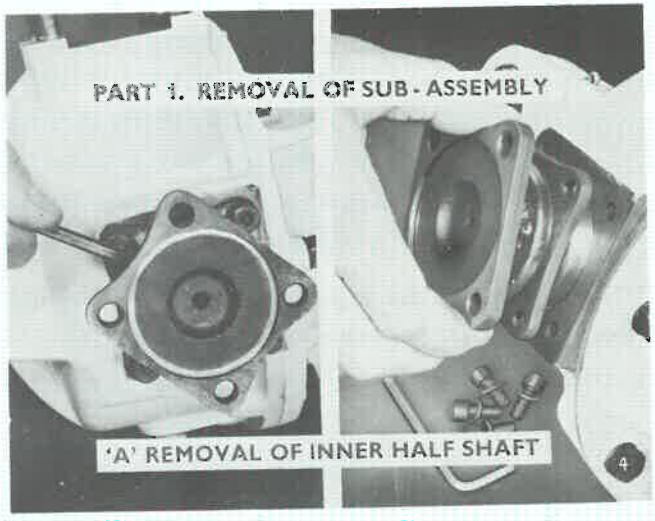
PART 1 - REMOVAL OF SUB-ASSEMBLIES FROM DIFFERENTIAL UNIT

A. Removal of Inner Half Shaft

The inner half shaft must be withdrawn before the "Hypoid Housing" can be removed from the "Axle Case".

The left hand picture shows the 3/16 ins. (4.763 mm) Allen key in position for removing the four Allen screws.

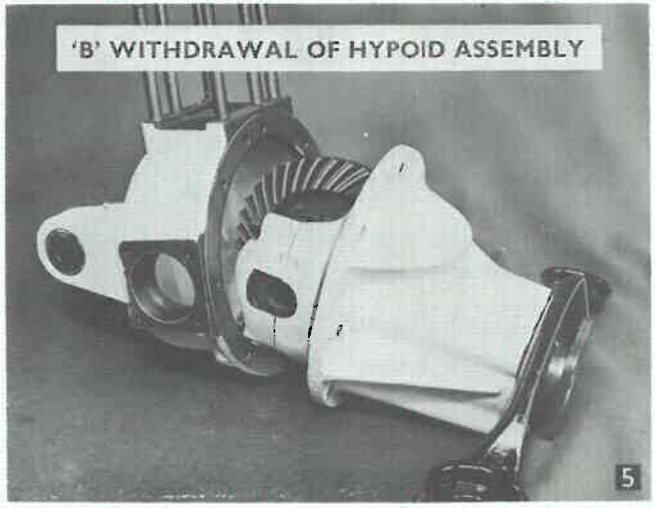
The right hand picture shows the "Inner Half Shaft" being withdrawn.



FRAME 5

B. Withdrawal of "Hypoid Assembly" from "Axle Housing"

Having removed the eight locating bolts and spring washers the Hypoid Assembly can be withdrawn.



FRAME 6

C. Removal of "Differential Assembly" from "Hypoid Housing"

Before the differential assembly can be removed it is necessary to expand the hypoid housing. It is essential to use the spreader tool No. S.101.

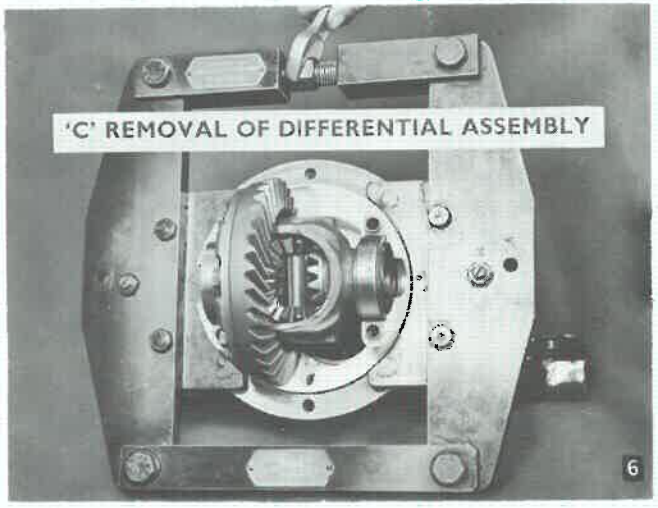
The following procedure is MOST IMPORTANT when using the spreader:

1. Locate the six pegs into the hypoid housing flange bolt holes.

2. Tighten the expander nut as tightly as possible with fingers.

3. Turn the nut with the aid of a spanner, but not more than three flats.

NOTE: Excessive spreading of the Hypoid Housing beyond the elastic limit of the material will result in PERMANENT DAMAGE and a new Hypoid Housing will be necessary.



FRAME 7

D. Removing Pinion Assembly from Hypoid Housing

To remove the pinion from the hypoid housing the following procedure should be carried out.

1. Remove the splitpin from the castellated nut.

2. Remove the castellated nut. With the aid of a special tool 20 SM 90 the drive flange can be held while removing the nut.

3. Remove drive flange and withdraw pinion.

FRAME 8

E. Removing Pinion Bearing Outer Cups from Hypoid Housing

To remove the pinion bearing outer cups a special drift is desirable, Tool No. S.123A.

Start by removing the tail bearing cup as shown, then turn the Hypoid Housing over and remove the larger bearing cup.

'D' REMOVAL OF PINION ASSEMBLY

7

'E' REMOVAL OF PINION BEARING OUTER CUPS

8

FRAME 9

PART II - INNER HALF SHAFT ASSEMBLY

The inner half shaft assembly consists of the following components :–

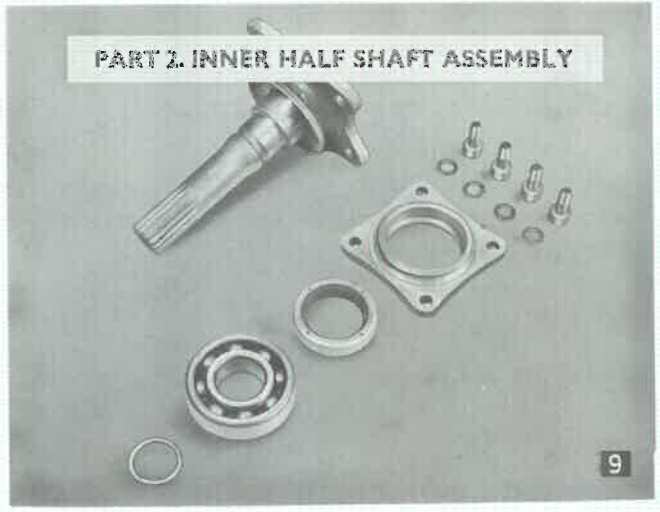
Circlip (circular section), Ball race, Oil seal, Oil seal flange housing, four Allen screws with washers and inner half shaft.

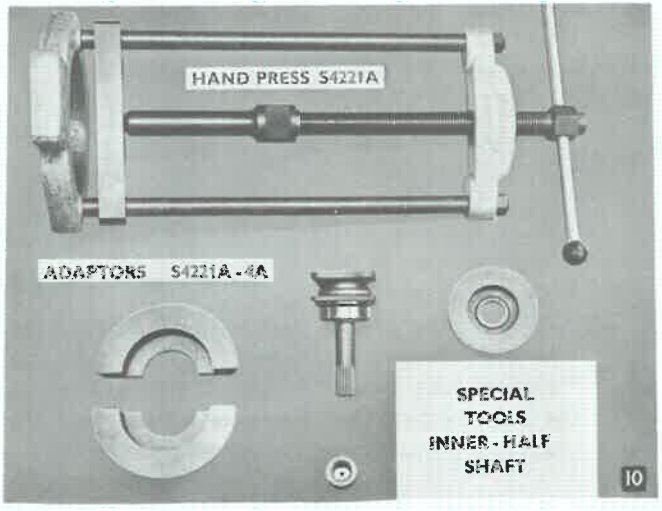
NOTE: Previous to Rear Axle No. GA.35604 Y.31501 the circlip was square in section, also a flat washer was fitted between circlip and ball race.

FRAME 10

The following special tools are recommended for dismantling and re-assembling of the inner half shaft':–

Multi-purpose Hand Press	S-4221A
with	
Cones and Adaptors	S-4221A-7





FRAME 11

PART III - OVERHAULING DIFFERENTIAL UNIT

When a differential unit needs overhauling it usually requires the adjustment or replacement of one or all of the following parts :–

a) Crown Wheel and Pinion

b) Sun and Planet Gears

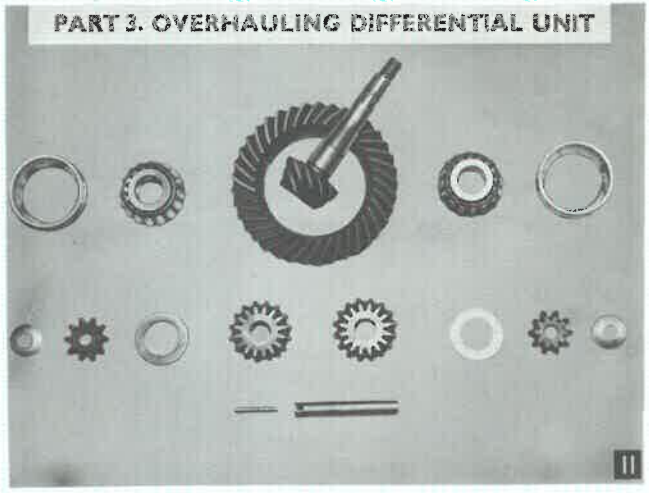
c) Bearings

If the Crown Wheel or Pinion needs replacing a new pair must be fitted. It is important they both have the same stamp number. During manufacturing the Crown Wheel and Pinion are lapped together in a jig to perfect smooth and silent action.

FRAME 12

To obtain accurate results it is important to keep to the sequence shown in the following frames:

1. When fitting pinion bearing outer races into hypoid housing, it is essential to use the special tool shown, S.124. It fits both races simultaneously and guarantees that they are seating properly.



FRAME 13

2. Special tools are desirable for removing the head race from the pinion. The tools shown are :–

Multi-purpose Hand Press S.4221A

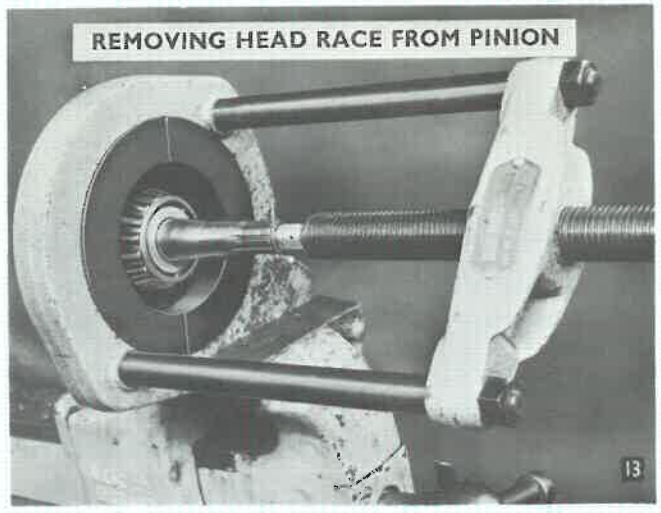
and

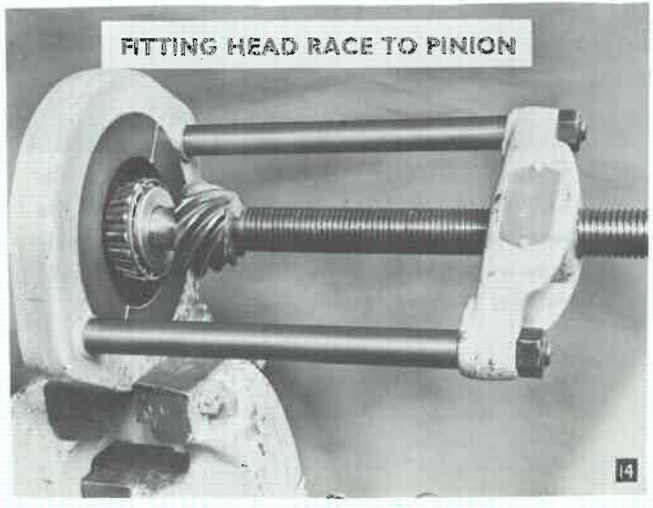
Pinion Bearing Cone Adaptors
(fitted for removing race) S.4221A-4A

FRAME 14

3. The same tools are being used as were shown in the last frame, the difference being that in addition a centre adaptor is used for fitting the head race to the pinion.

NOTE: These tools will be used again, after the pinion height has been caiculated, to remove the head race so that the shimpack may be fitted between pinion head and head race.





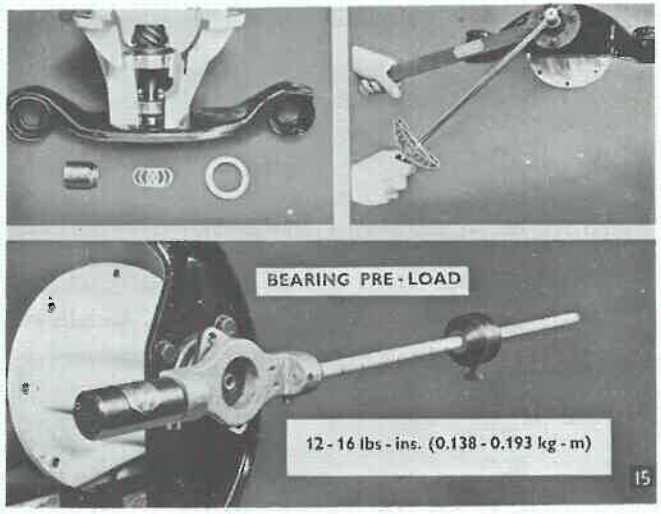
FRAME 15

4. a) Place the pinion into the hypoid housing leaving out spacer, shims and oil seal.

b) Tighten the pinion locating nut to a bearing pre-load of 16 lbs/ins. (0.193 kg/m) if new bearings are being fitted, and 12 lbs/ins (0.138 kg/m) if original bearings are being refitted.

NOTE: While tightening the nut rotate pinion at intervals to enable the rollers to settle in their natural position.

c) Check pre-load of bearings with "Pre-load Gauge" 20.SM.98. With the beam in the horizontal position move weight until the beam just drops of its own accord and take note of reading. If necessary re-adjust until correct reading is obtained.



FRAME 16

5. Zero "Pinion Bearing Setting Gauge" S.108 for checking pinion height.

   a) With the ground thrust button supplied with the gauge press the plunger upwards until the thrust button contacts the bottom of the gauge.

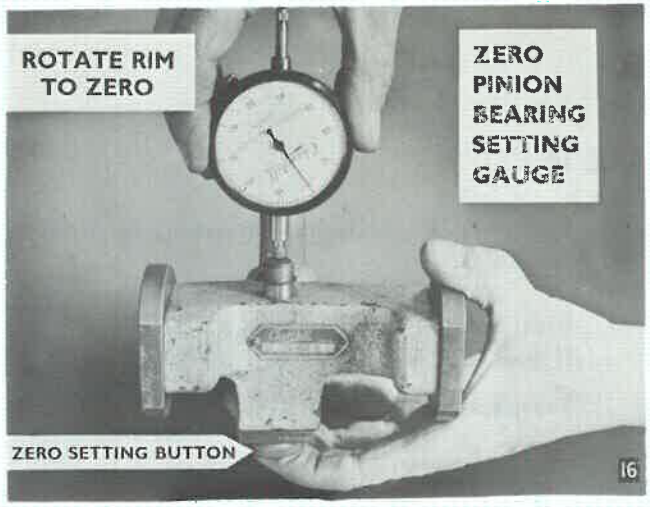
   b) Zero the dial indicator by rotating the rim of the clock.

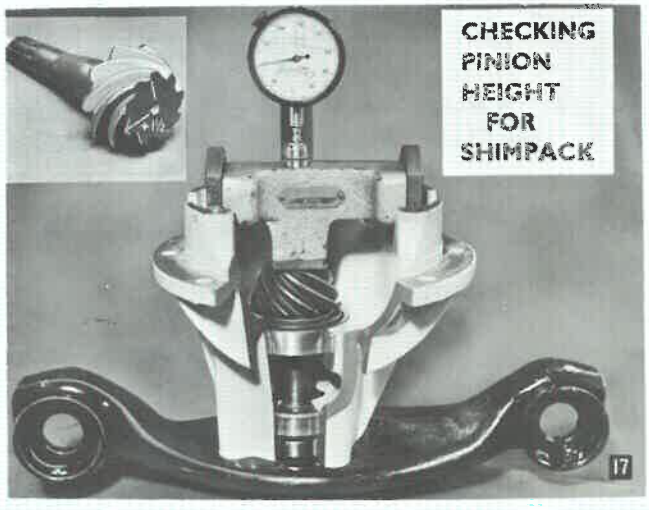
   c) The gauge is now set ready for adjusting.

FRAME 17

6. Place the "Bearing Setting Gauge" in position making sure all contact surfaces are clean and take note of the reading on the clock.

   Before the shimpack can be calculated a note must also be made of the figure preceded by a + or a – on the pinion head. If the marking is "N" the clock reading is all that is required.





FRAME 18

7. Examples of calculating shimpack, for pinion height.

		ins	mm
a)	With a pinion head marked +2	0.002	0.050
	If the Clock Reading is	0.018	0.457
	Shimpack required will be	0.020	0.507
b)	With a pinion head marked N	Nominal	Nominal
	If the Clock Reading is	.020	0.508
	Shimpack required will be	.020	0.508
c)	With a pinion head marked – 3	.003	0.076
	If the Clock Reading is	.023	0.584
	Shimpack required will be	.020	0.508

CALCULATING SHIMPACKS.

		ins.	mm.
a)	With a pinion head marked +2	0.002	0.050
	If the Clock Reading is	0.018	0.457
	Shimpack required will be	0.020	0.507
b)	With a pinion head marked N	Nominal	Nominal
	If the Clock Reading is	0.020	0.508
	Shimpack required will be	0.020	0.508
c)	With a pinion head marked – 3	0.003	0.076
	If the Clock Reading is	0.023	0.584
	Shimpack required will be	0.020	0.508

18

FRAME 19

8. a) Remove pinion head bearing.

b) Fit shimpack to pinion head (previously calculated).

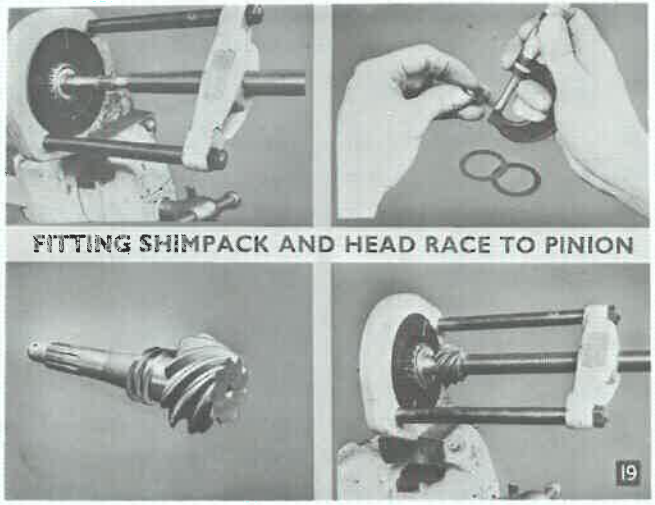
NOTE : Pinion head and tail bearing shims are made in three sizes.

0.003 ins. (0.076 mm) 0.005 ins (0.127 mm)
0.010 ins (0.254 mm)

IMPORTANT : When checking shim thickness with a micrometer make sure all shims are free from burrs.

c) Re-fit pinion head bearing.

NOTE : It is advisable to use special tools as described in frames 13 and 14.



FITTING SHIMPACK AND HEAD RACE TO PINION

FRAME 20

9. a) Place pinion into hypoid housing with spacer and original shimpack for initial trial but leave out oil seal.

   b) Fit tail bearing, drive flange and tighten flange nut to a torque of 70–85 lbs/ft. (9.678–11.75 kg/m).

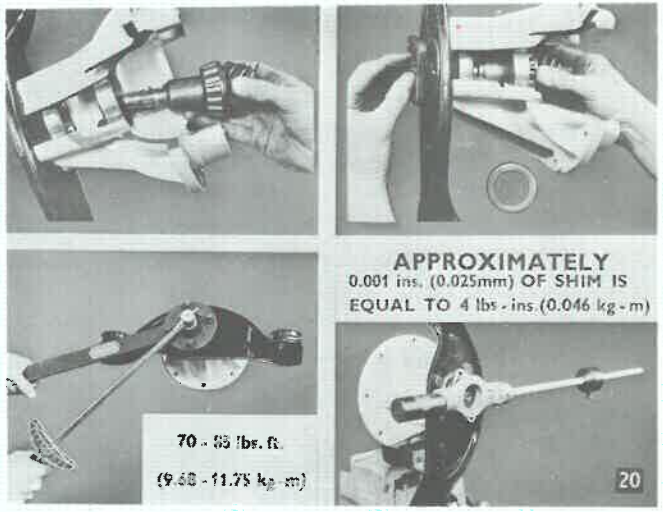
   c) Check bearing pre-load with "Pre-load Gauge" 20 SM 98.

NOTE: Remember the tolerances of 12-16 lbs/ins. (0.138-0.193 kg/m) as described in frame 15.

To reduce pre-load add shims.

To increase pre-load subtract shims.

0.001 ins (0.025 mm) of shim alters pinion pre-load approximately 4 lbs/ins. (0.046 kg/m).



FRAME 21

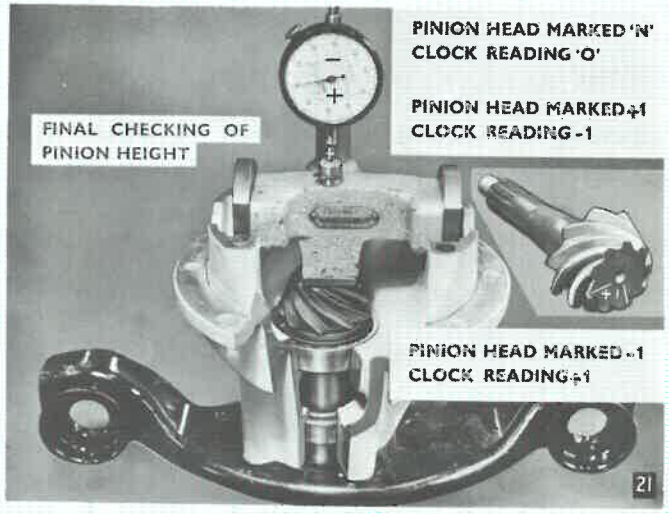
10. a) At this stage with the bearing pre-load correct, take a final check of pinion height.

NOTE : If pinion is marked with a letter N, clock reading should be zero. (As shown).

If pinion is marked +1 clock reading should be −1

If pinion is marked −1 clock reading should be +1

b) If pinion height check is satisfactory remove drive flange, fit oil seal; refit drive flange, tighten flange nut to the same torque that produced correct pre-load in frame 21 and fit split pin.

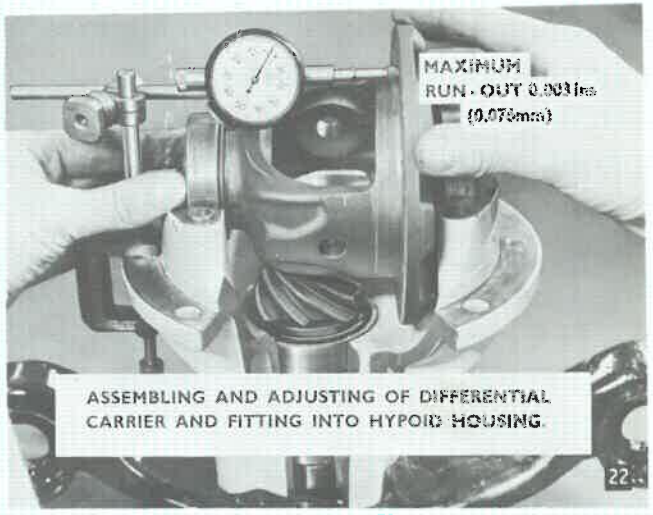


FRAME 22

ASSEMBLING AND ADJUSTING OF DIFFERENTIAL CARRIER AND FITTING INTO HYPOID HOUSING

1. When building the differential assembly it is IMPORTANT to check the Crown Wheel locating flange for "run out" which MUST NOT exceed 0.003 ins. (0.076 mm).

   Before checking make sure all "high spots" and burrs around flange bolt holes have been removed.



FRAME 23

2. When assembling the Sun and Planet Gears, the following procedure must be adopted.

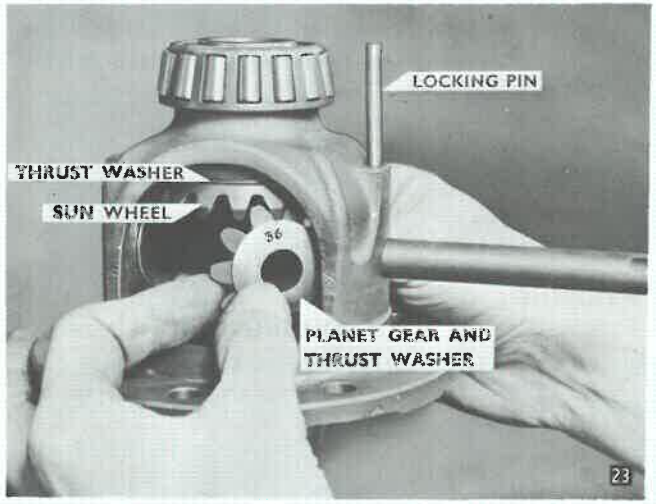
   a) Fit a thrust washer onto each sun wheel and position into differential carrier.

   b) Slide the two planet gears into position opposite each other

   c) Select a pair of thrust washers for the planet gears that give minimum backlash and smooth gear action.

NOTE: The thrust washers vary in size from 0.036 ins. (0.914 mm) to 0.056 ins. (1.422 mm) in increments of .004 ins. (0.1016 mm). The size is stamped on the domed side of the washer.

   d) Fit cross shaft and check that all gears have a smooth action.



FRAME 24

3. Finally check smoothness of gear action and if satisfactory secure cross shaft by fitting locating pin as shown.

FRAME 25

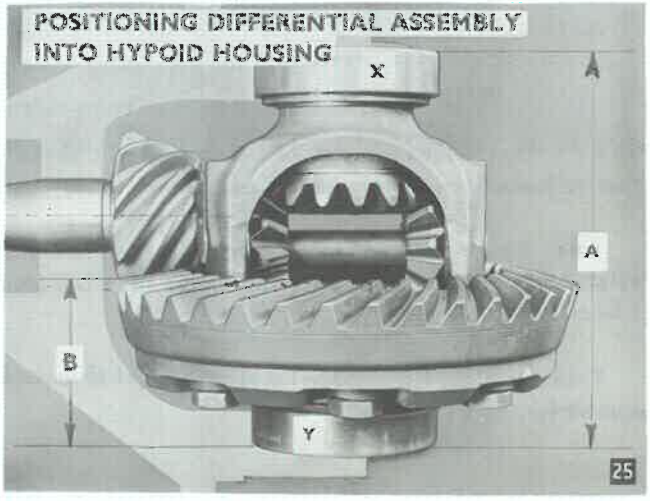
POSITIONING DIFFERENTIAL ASSEMBLY INTO HYPOID HOUSING

This frame is to give an insight into the problem of obtaining correct pinion to crown-wheel meshing.

A. To find out total endfloat of differential assembly in hypoid housing.

B. To find out endfloat IN AND OUT of mesh, (shimpack for bearing Y.)

C. To find out shimpack for bearing X. (By calculation).



FRAME 26

4. A. 1) Place the differential into the hypoid housing as shown.

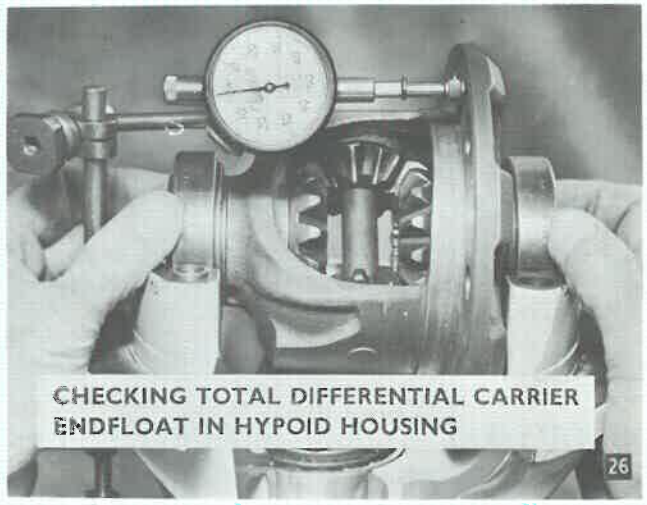
2) Before taking reading exert pressure with both hands using finger and thumb pressing firmly against outer races, (as shown) at the same time rotating them to allow the rollers to settle. When this has been carried out satisfactorily, continue to hold outer cups firmly onto their races then push the assembly to the right and zero the clock.

3) Push the assembly to the left and observe the reading on the clock.

NOTE: This sequence should be carried out several times to make sure the reading is consistent.

This figure is the total amount of differential carrier float. To this must be added 0.003 ins (0.076mm) for bearing pre-load.

Total endflaot + pre-load = Total amount of shimpack required for the assembly.



CHECKING TOTAL DIFFERENTIAL CARRIER ENDFLOAT IN HYPOID HOUSING

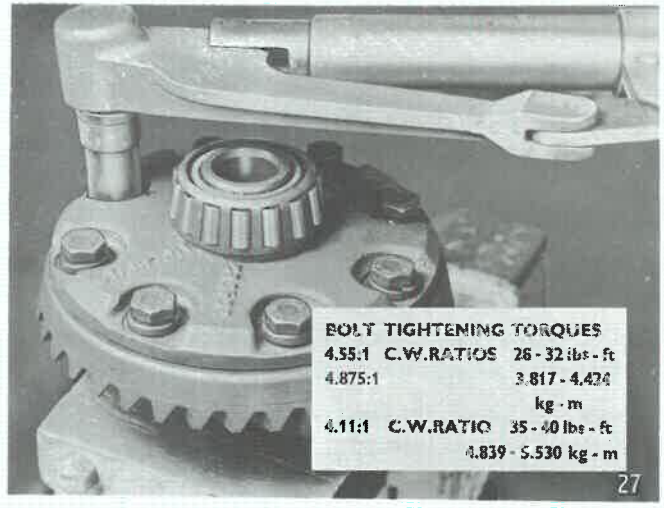
FRAME 27

5. Before we can obtain any more figures to decide how the total shimpack should be divided between the two bearings, we must fit the crown wheel to the carrier.

   The six locating bolts should be lubricated and tightened to their correct torque figure.

   4.55 : 1)
)
   4.875 : 1) Crown Wheel Ratios 28-32lbs/ft. (3.817-4.424 kg/m)

   4.11 : 1 Crown Wheel Ratios 35-40 lbs/ft. (4.839-5.530 kg/m)



FRAME 28

6. B. 1) Place the differential assembly back into the hypoid housing.

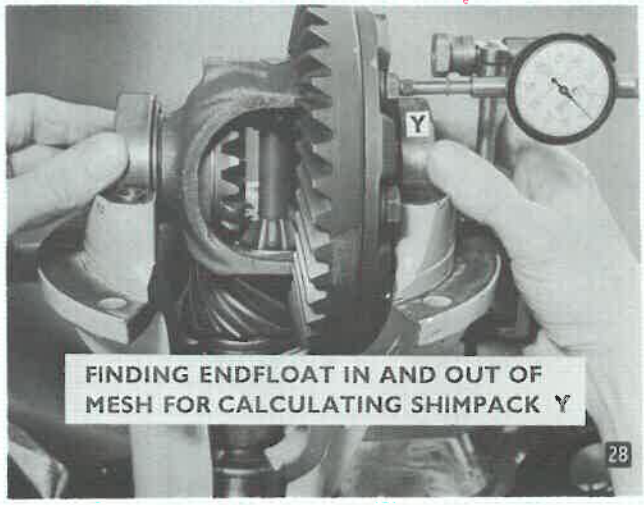
2) Push the assembly towards the clock making sure the bearings are correctly positioned as in frame 26 and zero the dial.

3) Push crown wheel fully into mesh and observe the reading on the clock.

NOTE: Check several times to make sure the reading is consistent.

From the figure obtained subtract 0.005 ins. (0.127 mm) to allow for backlash.

The result is the shimpack required between bearing Y in hypoid housing.

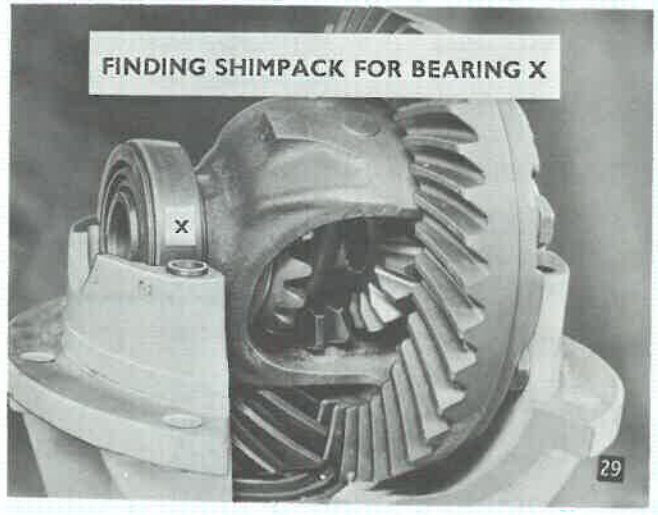


FINDING ENDFLOAT IN AND OUT OF MESH FOR CALCULATING SHIMPACK Y

FRAME 29

7. C. To find out the number of shims required for bearing X a simple calculation must be made.

Subtract shimpack Y from the total number of shims required, i.e. (total end float + pre-load) – Y = X.



FRAME 30

This example is to show you how to lay your figures out in order to calculate the shimpacks which locate the differential assembly into the hypoid housing.

	ins.	mm.
FRAME 26A		
Total endfloat	0.062	1.575
Bearing pre-load add	0.003	0.076
Total number of shims	0.065	1.651
FRAME 28B		
Endfloat IN AND OUT of mesh (Crown Wheel to Pinion)	0.045	1.143
Allowance for backlash subtract	0.005	0.127
Shimpack for bearing Y	0.040	1.016
FRAME 29C		
Total number of shims	0.065	1.651
Subtract shimpack for bearing Y	0.040	1.016
Shimpack for bearing X	0.025	0.635

CALCULATING SHIMPACKS.

FRAME 26.A

	ins.	mm.
Total endfloat	0.062	1.575
Bearing preload add	0.003	0.076
Total number of shims	0.065	1.651

FRAME 28.B

	ins.	mm.
Endfloat IN AND OUT of mesh (Crown wheel fitted)		
(Crownwheel to Pinion)	0.045	1.143
Allowance for backlash subtract	0.005	0.127
Shimpack for bearing Y	0.040	1.016

FRAME 29.C

	ins.	mm.
Total number of shims	0.065	1.651
Subtract shimpack for bearing Y	0.040	1.016
Shimpack for bearing X	0.025	0.635

30

FRAME 31

8. a) With the aid of a micrometer make up shimpacks X & Y to conform to your calculations.

NOTE: Differential carrier bearing shims are made in the following sizes:

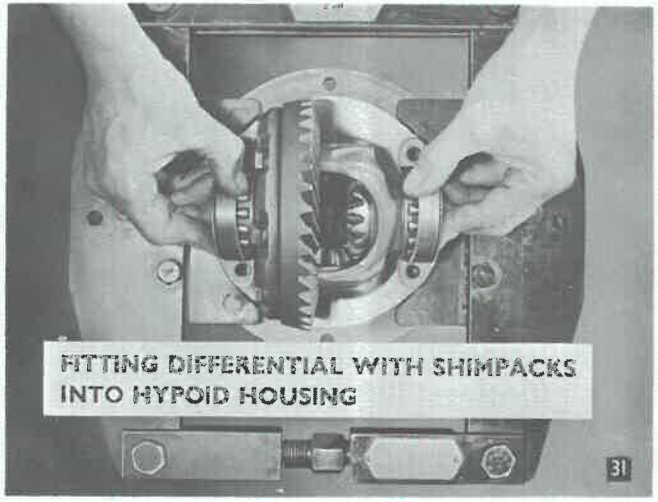
0.009 ins. (0.228 mm) 0.013 ins. (0.330 mm)
0.014 ins. (0.356 mm) 0.016 ins. (0.406 mm)
0.020 ins. (0.508 mm)

b) Fix the "Differential Case Spreader", S.101 on the hypoid housing and turn adjusting nut until it is finger tight.

c) With a spanner on the adjusting nut spread the case by NOT more than 3 FLATS.

(Beyond this there is danger of permanent case distortion).

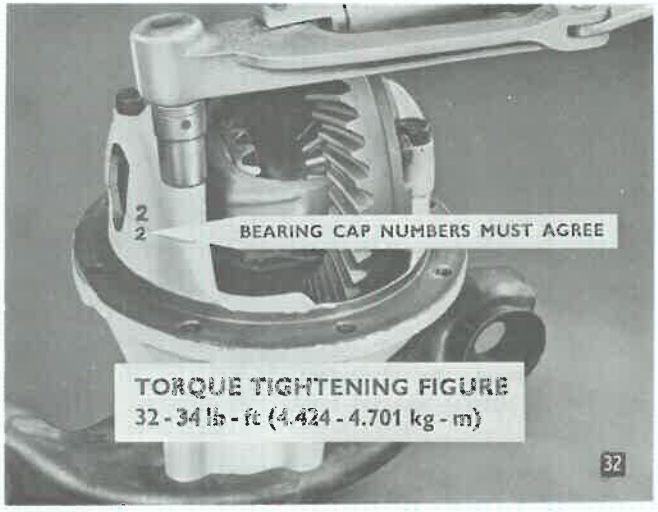
d) Fit Differential Assembly into hypoid housing with the appropriate shimpacks.



FRAME 32

9. When refitting the bearing caps make sure they are put back in their original positions with the same numbers adjacent to each other.

   The bolts should be tightened evenly and finally to a torque figure of 32-34 lbs/ft. (4.424 – 4.701 kg/m).



FRAME 33

FINAL CHECK OF GEAR MESHING

1. With the assembly completed the backlash can now be checked.

   Mount a clock making sure the dial plunger is as near as possible in line with tooth travel.

   Move the crown wheel by hand. The backlash should be between 0.004 – 0.006 ins. (0.1016 – 0.1524 mm).

   Repeat this check at several positions around the crown wheel.

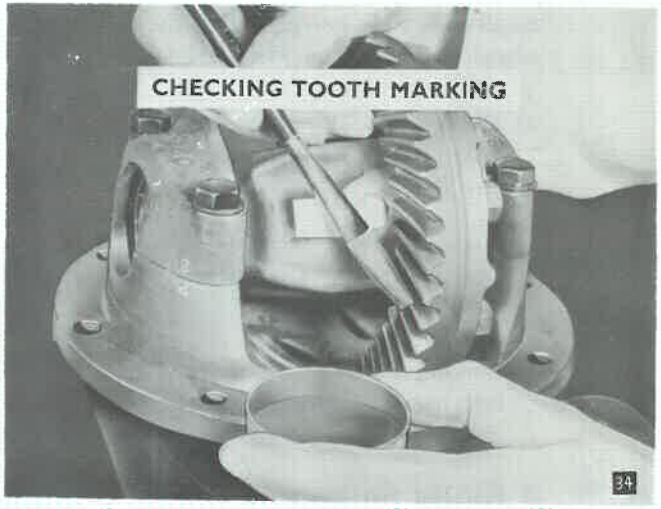
   If adjustment is necessary remove differential assembly and "re-arrange" bearing shimpacks.

NOTE: The total thickness of shimpack MUST remain constant.

FRAME 34

2. As a final check of correct meshing, paint a number of crown wheel teeth with engineer's marking blue.

   Rotate the pinion at the same time holding back on the crown wheel against rotation to produce a good impression.



FRAME 35

3. These impressions are examples of various conditions of correct and incorrect crown wheel and pinion marking:

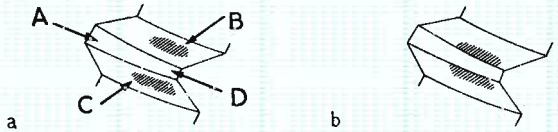
   a) **Marking is correct.** Area of contact is evenly positioned and slightly towards the toe D.

   b) **Marking high.** Caused by pinion too far out of mesh. Correct by adding shims under pinion head.

   c) **Marking low.** Caused by pinion too far into mesh. Correct by reducing number of shims under pinion head.

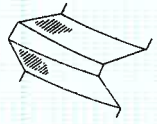
   d) **Marking too far towards toe.** Caused by insufficient backlash. Correct by removing shims from bearing pack Y and adding to bearing pack X.

   e) **Marking too far towards head.** Caused by excessive backlash. Correct by removing shims from bearing pack X and transferring to bearing pack Y.



EXAMPLES OF PINION TO CROWN

WHEEL TOOTH MARKINGS



35

FRAME 36

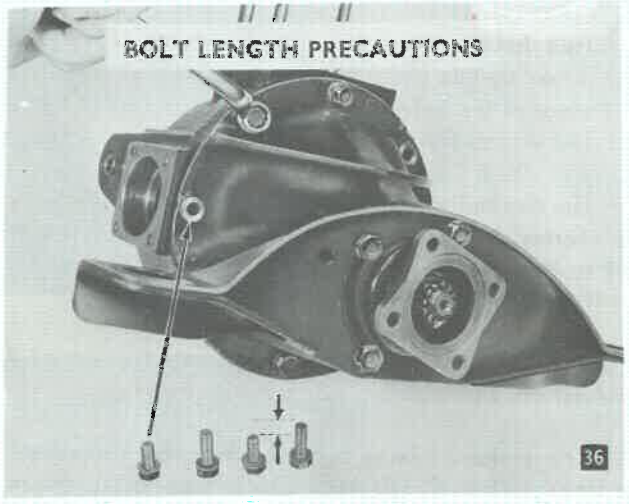
This frame shows the hypoid housing being bolted back into the axle housing.

The unit shown is an early type.

The two bolts opposite the inner half shaft aperture are shorter than the other six to prevent damage to the ball races.

All present day bolt hole bosses adjacent to the half shaft aperture are thicker so that 8 bolts of the same length with locking washers can be used.

NOTE: Before finally tightening the axle housing fit the inner half shaft ensuring they are correctly aligned. Then tighten axle housing.



FRAME 37

The left hand picture in this frame shows the original type of breather hole. The right hand picture shows the self cleansing type which was introduced in June 1961 at Commission No. GA.16653 Y.30142.

The hole is kept clean by a loosely fitting split pin which shakes about as the car moves along keeping dirt clear of the hole.

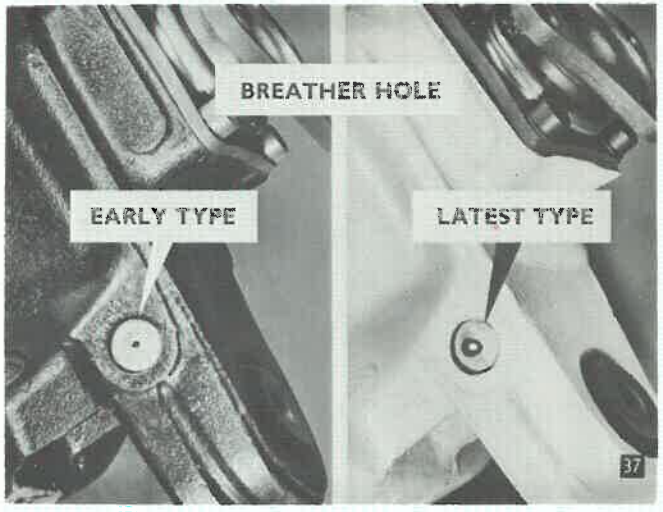
NOTE: With the early type, if the breather hole became blocked a pressure build up occurred in the unit and forced oil past one of the oil seals. The first check before changing oil seals was to make sure the breather hole was open.

FRAME 38

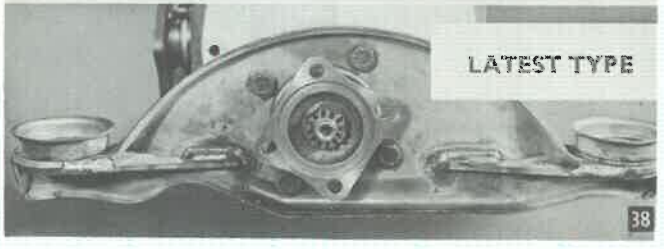
The pinion housing bearing plate was increased in thickness from 0.128 ins. (3.25 mm) to 0.160 ins. (4.06 mm) at Commission No. G.65719.SP. and GA. 14733.

At the same time the Wedgelock setscrews were modified by lengthening the taper for the increased thickness of plate. The part number for the modified setscrew is Pt. No. 132856 and it should be tightened to a torque of 34 – 36 lbs/ft. (4.701 – 4.98 kg/m).

NOTE: It is **NOT** advisable to refit setscrews which have worked loose.



FRONT MOUNTING PLATE



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