SERVICE MANUAL

for

SALISBURY

HYPOID AXLES

FOR PASSENGER CARS
LIGHT COMMERCIAL VEHICLES
DUMPERS ETC.

Price 3/-

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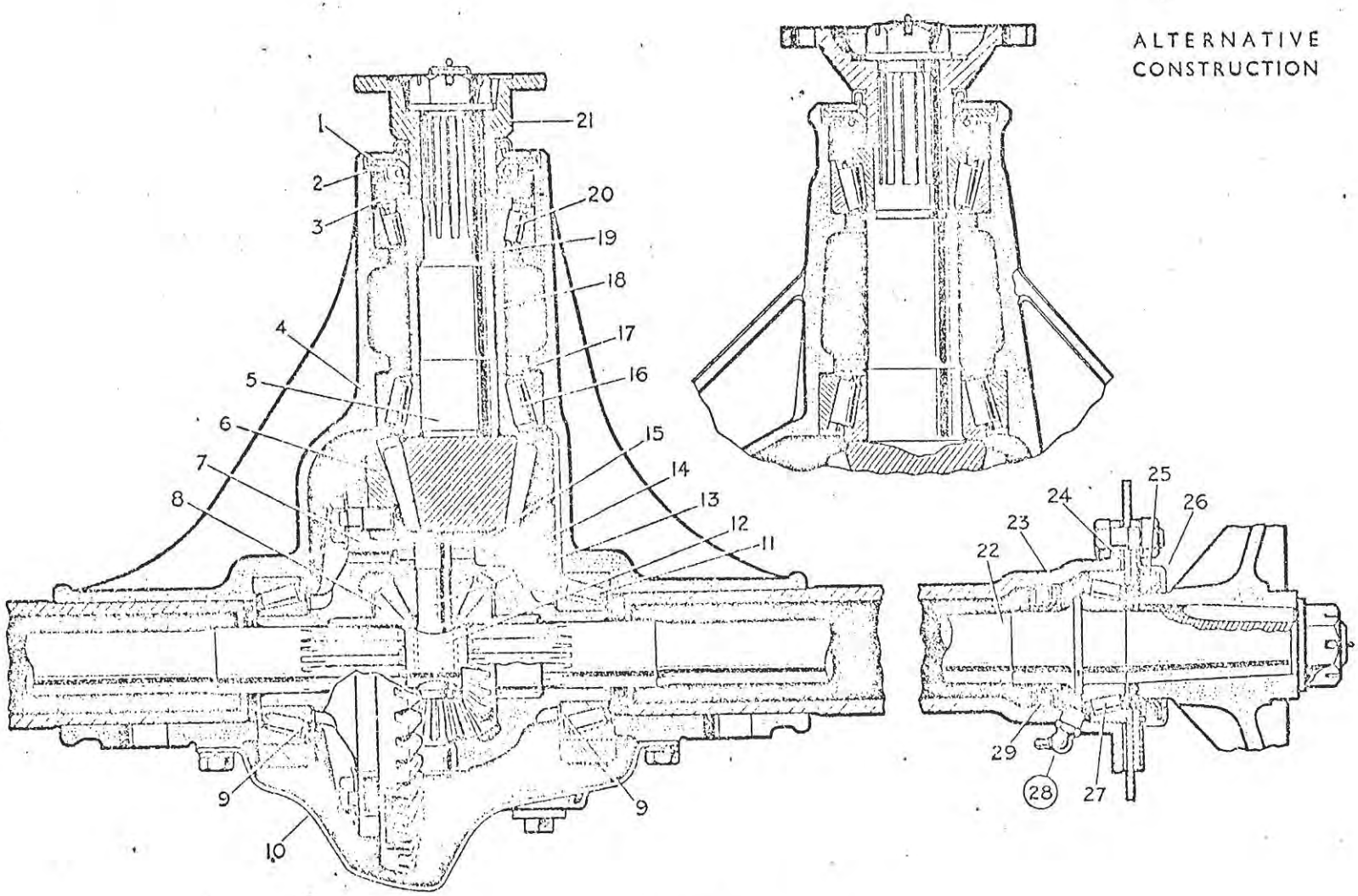
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FIGURE 1

SERVICE MANUAL FOR SALISBURY HYPOID REAR AXLES

FACTORY SERVICE AVAILABLE

Factory reconditioned complete axle assemblies are in most cases available through the vehicle manufacturers fitting SALISBURY axles to their cars, dumpers, etc. Provided it is properly lubricated and not subjected to gross overload or misuse, the life of the axle is likely to equal or exceed that of any other major component, and should require no major adjustments of any kind. In the unlikely event of trouble through any cause, wherever possible it is strongly recommended that use should be made of the factory reconditioning service, rather than that the somewhat difficult and intricate processes described in this manual should be undertaken. It should be clearly understood that the adjustment of a hypoid bevel axle is more complex than that necessary for the satisfactory performance of the spiral bevel-type axle.

When advantage cannot be taken of the factory reconditioning service, the instructions given in the following pages should be very carefully followed.

The service methods described assume the availability of certain special tools which are separately listed on Page 25 and shown in the various illustrations. In extreme emergency it may be necessary to carry out repairs without these special tools and alternative methods have been described which give the minimum risk of serious damage to the unit if considerable care is taken. The use of emergency methods is not recommended for normal service requirements.

STANDARD PARTS NAMES

Reference numbers identify components indicated in Fig. 1

Ref. No.	*Part Name*
1.	Drive Pinion Oil Seal
2.	Drive Pinion Oil Seal Gasket
3.	Drive Pinion Oil Slinger
—	Drive Pinion Dust Saield
—	Drive Pinion Cotter
—	Drive Pinion Nut
—	Drive Pinion Washer
4.	Gear Carrier
5.	Hypoid Drive Pinion } Matched
6.	Hypoid Drive Gear } Assembly
—	Drive Gear Bolt

Ref. No.	*Part Name*
—	Drive Gear Lock Strap
7.	Differential Case
8.	Differential Side Gear
—	Differential Side Gear Thrust Washer
9.	Differential Bearing Shim
10.	Gear Carrier Cover
—	Gear Carrier Cover Gasket
—	Gear Carrier Cover Screw
—	Gear Carrier Cover Lock Washer
—	Filler and Drain Plug

Ref. No.	*Part Name*
11.	Differential Bearing
—	Differential Bearing Cap Bolt
—	Differential Bearing Cap Washer
12.	Axle Shaft Spacer
13.	Pinion Mate Shaft
14.	Differential Bevel Pinion Mate
—	Pinion Mate Thrust Washer
15.	Pinion Mate Shaft Lock Pin
16.	Drive Pinion Bearing (Inner)
17.	Drive Pinion Bearing Shim (Inner)
18.	Drive Pinion Bearing Spacer

Ref. No.	*Part Name*
19.	Drive Pinion Bearing Shim (Outer)
20.	Drive Pinion Bearing (Outer)
21.	Universal Joint Flange
—	Axle Shaft Cotter
—	Axle Shaft Nut
—	Axle Shaft Washer
—	Axle Shaft Key
22.	Axle Shaft
23.	Axle Tube
24.	Hub Bearing Shim
—	Hub Bearing Retainer Plate

Ref. No.	*Part Name*
—	Hub Bearing Retainer Plate Gasket
25.	Hub Oil Seal
26.	Hub Oil Seal Container
27.	Hub Bearing
28.	Grease Nipple—*Note location and do not omit to grease*
29.	Axle Shaft Oil Seal
—	Brake Back Plate Bolt
—	Brake Back Plate Nut
—	Brake Back Plate Washer

GENERAL DESCRIPTION OF THE SALISBURY AXLE

The axle assembly shown in Figure 1 is of the semi-floating type with shim adjustment for all bearings and meshing of the hypoid drive gear and pinion matched assembly. The axle shafts are splined at the inner ends, which engage splines in the differential side gears, while the outer ends have tapers and keys to fit the wheel hubs. The hubs are supported by taper roller bearings pressed on to the axle shafts and located in the ends of the axle tubes. Outward thrust on either wheel is taken by the adjacent hub bearing, whilst inward thrust is transmitted through the axle shafts and slotted axle shaft spacer to the opposite bearing. Thus each hub bearing takes thrust in one direction only.

A cover on the rear of the gear carrier housing permits the inspection and flushing of the differential assembly without dismantling the axle.

The gear ratio is stamped on a tag attached to the axle by one of the gear carrier cover screws, and the axle serial number is stamped on the gear carrier housing and should always be referred to when corresponding with reference to any particular unit.

NOTES ON LUBRICATION

LUBRICATION OF HYPOID GEARS

Hypoid gears need special Hypoid Lubricants. It is absolutely essential to use an Extreme Pressure HYPOID Lubricant of approved type in the SAE.90 classification and conforming to the requirements of U.S. Specification MIL-L-2105 (formerly 2-105B).

The oils listed on Page 24, Table 1, have been approved for use in SALISBURY axles and meet the above specification requirements. It cannot be too strongly emphasised that the use of wrong oils will result in very rapid failure of the gears, since ordinary axle lubricants suited to the earlier type spiral bevel gears will not sustain the higher loading and increased sliding velocity of the hypoid tooth action. Beware of oils described as "Extreme Pressure" as many such oils were designed for use in ordinary spiral bevel axles only, and do not suit the requirements outlined above.

The recommended oils, whilst individually conforming to the correct specification, should not be mixed one with another, and if in doubt the axle should be drained and flushed with a little of the new hypoid oil it is proposed to use before filling up with the new lubricant. It is better not to use flushing oils for this purpose as unless draining is carefully carried out, a dangerous dilution of the new oil might result.

Salisbury Transmission Ltd. do not approve the addition of any proprietary compounds to the oils recommended, as all these oils have been individually compounded from specified base oils and additives in definite proportions, and any addition to these lubricants could result in dangerous dilution, or gear failure.

LUBRICATION OF HUB BEARINGS

The wheel hub bearings are each lubricated by a grease nipple located in the axle tube housing, behind the brake back plate and visible from underneath the vehicle. **There is no other source of lubrication,** since the hub bearing housing is separated from the remainder of the axle casing by an oil seal which prevents the hypoid oil reaching the hub bearing.

Where a vent hole is provided, the greasing operation should be continued until grease is forced out of this hole, indicating that the chamber is full, and providing a seal against the ingress of dirt.

ROUTINE MAINTENANCE OF OILING AND GREASING

OIL CHANGING AND TOPPING-UP

The first drain of the oil should be at 500 miles, and then the axle should be drained and refilled every 10,000 miles or at least every six months. The axle should preferably be drained after the vehicle has been run, and the warm oil will then flow more freely. The drain plug is situated on the underside of the gear carrier housing and the filler plug is in the rear cover.

Check the oil level and top up if required every 1,500 miles or at least monthly.

HUB BEARING GREASING

Greasing should be carried out at 500 miles, and thereafter at every 1,500 miles, or at least monthly, using a recommended grease as listed on Page 24, Table 2.

GENERAL SERVICE INSTRUCTIONS

For Service Tool List refer to Page 25, Table 5.

Drawings have been prepared detailing the various tools listed. Customers wishing to make these tools may obtain prints of the drawings on application to Salisbury Transmission Ltd. Such requests for prints must be made by a principal of the company concerned.

Complete sets of the tools are available from Messrs. V. L. Churchill & Co. Ltd., Great South West Road, Bedfont, Middlesex. Any requests for such tools should be made direct to them as should any request for detailed information regarding same.

TO REMOVE AXLE COMPLETE FROM VEHICLE

First remove the axle from the vehicle using the procedure described in the vehicle manufacturer's service manual. Next, thoroughly clean the exterior of the unit, thereby rendering subsequent work easier and more pleasant, in addition to ensuring that the inside of the axle shall be kept clean. Carry out all stripping and reassembly under clean conditions, since inclusion of foreign matter in the axle could easily lead to failure of the gears and bearings. It is not essential to remove the unit from the vehicle if the work is limited to removal and replacement of an axle shaft or shafts.

AXLE SHAFTS, TO REMOVE AND REFIT

TO REMOVE AXLE SHAFTS AND HUBS

To remove an axle shaft the following procedure should be carried out:—

(1) Remove the road wheel, brake drum and hub. The hub should be withdrawn with a suitable extractor (for information about this extractor refer to the vehicle manufacturer, not Salisbury Transmission Ltd.), after removing the axle shaft nut, washer and split pin.

(2) Check the end-float of the axle shaft with the dial indicator assembly, SE.101 in the Service Tool List, as shown in Figure 2. The correct tolerance for axle shaft end-float is shown on Page 25, Table 6.

(3) Remove the brake back plate retaining bolts, the outer oil seal assembly, the hub bearing retainer plate (if fitted), and the brake back plate, taking care not to lose or damage any of the hub bearing adjusting shims which control the shaft end-float.

(4) Remove the axle shaft with its taper roller bearing, using Tool No. SL.13A (SE.102) in the Service Tool List.

(4a) To remove a broken axle shaft, make a loop at one end of a length of stiff wire, slide the loop down the axle tube and over the broken end of the shaft for a sufficient distance so that on pulling the loop will bind on the shaft and withdraw it from the differential side gear.

(5) Examine the shaft oil seal which is pressed inside the axle tube, and if necessary withdraw same and replace with a new seal.

(6) Examine the hub bearing, and if replacement is necessary, the cone may be withdrawn from the shaft by means of the extractor Tool No. SL.14 with suitable adaptor.

(7) Fit the replacement bearing (if required) making sure that the cone is pressed squarely on the bearing diameter until it firmly abuts against the shoulder provided. If the bearing is not pressed home it will creep in service, resulting in excessive shaft end-float, which will damage the surfaces due to hammering.

Where an abutment shoulder is not provided for the bearing, as in the case of certain of the HA and 3HA models, the bearing has a taper bore and should be pressed on with the specified steady load of two tons.

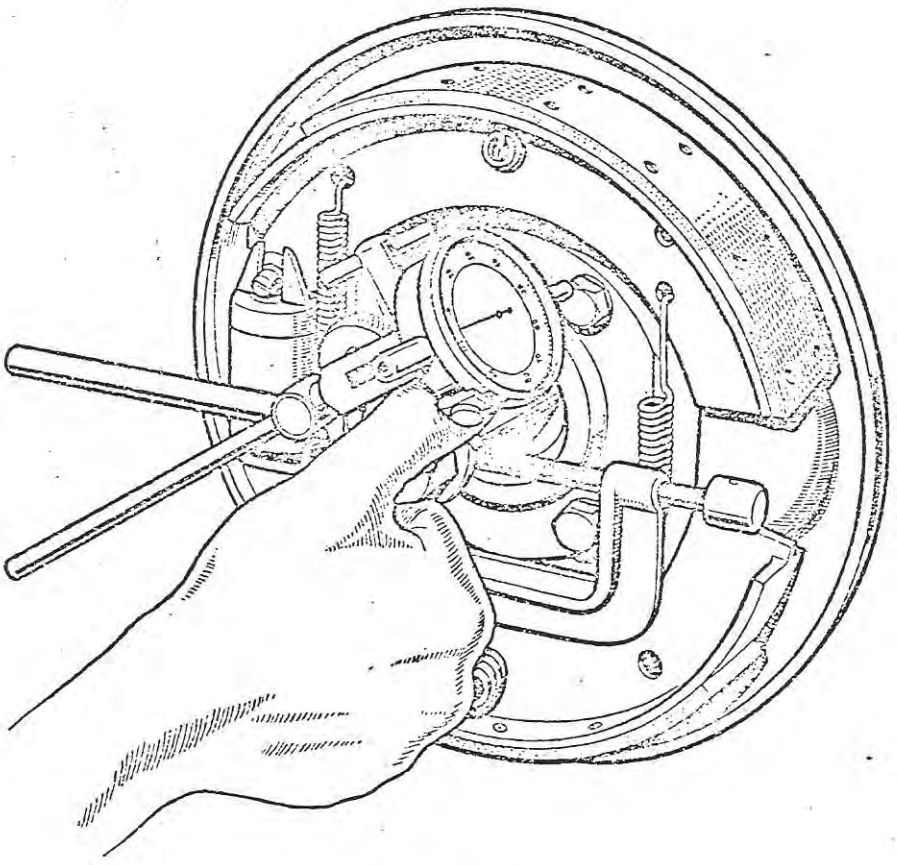

FIGURE 2

TO REPLACE AXLE SHAFT

(1) Wash the hub bearing so that the axle shaft end-float may be determined accurately.

(2) Install the shaft with the taper roller bearing cone, taking care not to damage the shaft oil seal.

(3) Assemble the bearing cup whilst making absolutely sure that the cup enters the housing squarely.

(4) Add or subtract adjusting shims (available in thicknesses of .003", .005", .010" and .030") until the correct axle shaft end-float as stated in Table 6 on Page 25 is obtained. This should be just perceptible by hand. Adding shims increases end-float, subtracting shims decreases end-float. Remove or install approximately an equal thickness of shims at each end of the axle, in order to retain the shaft spacer in a central position.

(5) Examine the hub oil seal assembly and relace if necessary.

(6) Fit the brake back plate and centralise the hub oil seal assembly. When re-installing, fit new paper gaskets on either side of the hub bearing retaining plate, or, if a retaining plate is not fitted, between the brake back plate and the hub oil seal assembly, to prevent grease leaking into the brake drum.

(7) Check the axle shaft end-float as in Figure 2 with a dial indicator assembly, after gently tapping with a rawhide mallet on each axle shaft to ensure that the bearing cups are butting against the brake back plates or retaining plates, according to the design of the particular unit.

(8) FINALLY, IT IS ESSENTIAL TO GREASE HUB BEARINGS, as already described.

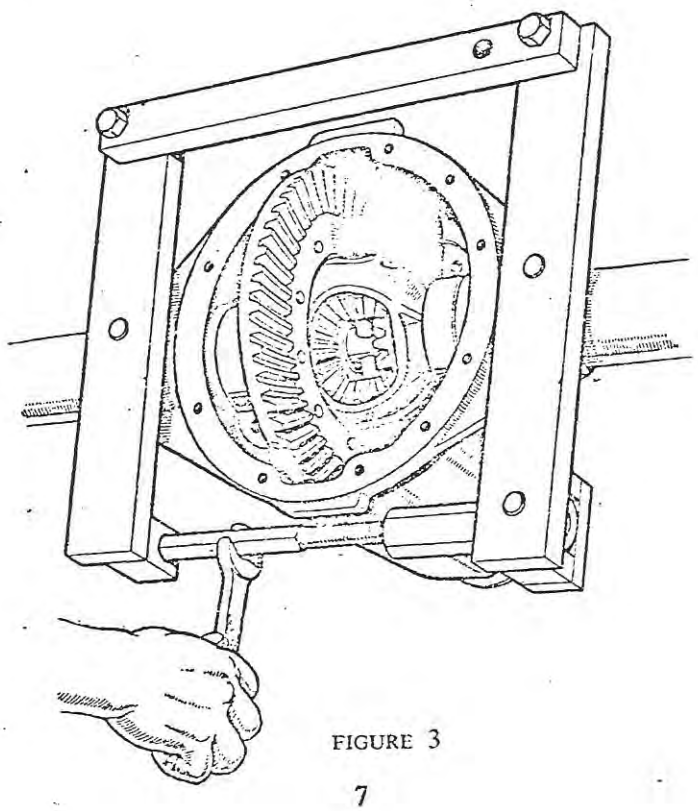

FIGURE 3

DIFFERENTIAL AND PINION ASSEMBLIES, TO REMOVE, ADJUST AND REFIT

TO DISMANTLE DIFFERENTIAL UNIT WITH SERVICE TOOLS

First drain the lubricant from the gear carrier housing and then remove the gear carrier rear cover. Flush out the unit thoroughly, so that the parts can be carefully inspected. Remove the axle shafts as previously detailed.

To remove the differential, proceed as follows:—

(1) Withdraw the four bolts securing the two differential bearing caps and remove the two caps.

(2) Before attempting to remove the differential assembly, fit the stretching fixture, Tool No. SL.1 (SE.104) in the Service Tool List, as shown in Figure 3. The fixture should be adjusted to suit the model being serviced, a series of holes being provided in the member opposite the turnbuckle for this purpose. Open the fixture by means of the turnbuckle until it is hand tight, then spread the casing by using a spanner. DO NOT OVER-SPREAD, OR THE CASING WILL BE DAMAGED BEYOND REPAIR. The correct spread does not exceed a half turn on the turnbuckle, and this figure should not be exceeded even if the differential is still stiff to move.

(3) The differential assembly may now be prised out by means of two levers, one on each side of the differential case opening. During this operation use suitable packing between the levers and the gear carrier.

To dismantle Differential Unit Emergency Method

First drain the lubricant from the gear carrier housing and then remove the gear carrier rear cover. Flush out the unit thoroughly so that parts can be carefully inspected. Remove the axle shafts as previously detailed.

To remove the differential proceed as follows:—

(1) Withdraw the four bolts securing the two differential bearing caps and remove the two caps.

(2) The differential assembly should now be prised out by means of two levers, one on each side of the differential case opening, taking care not to tilt the assembly and so wedge it more tightly than it is already held by the preload. During this operation use suitable protective packing between the levers and the gear carrier.

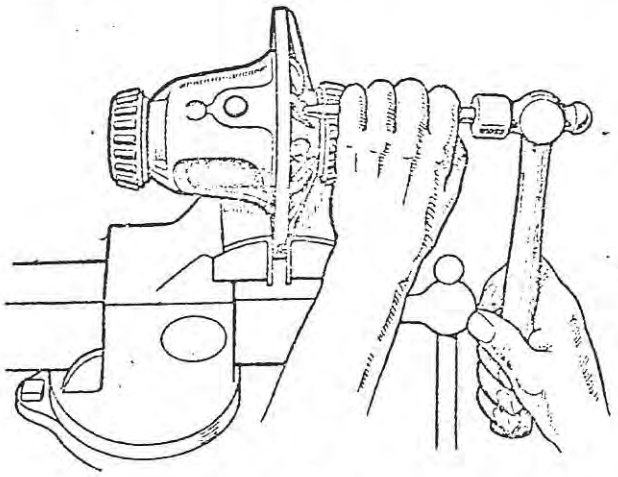

FIGURE 4

Differential Assemblies can be of two types (a) TWO PINION TYPE (b) FOUR PINION TYPE. Below are detailed instructions for stripping and reassembly of both types.

STRIPPING DIFFERENTIAL ASSEMBLY (2 PINION TYPE)

(1) Bend down the tabs of the drive gear screw locking straps and remove the drive gear screws.

(2) Remove the drive gear from the differential case by tapping with a rawhide mallet.

(3) Using a small punch drive out the pinion mate shaft locking pin, which is secured in place by peening the case, and remove the pinion mate shaft. Figure 4 indicates the direction in which the locking pin is removed; it is not possible to drift the pin in the opposite direction.

(4) Remove the shaft spacer.

(5) Rotate the side gears by hand until the pinions are opposite the openings in the differential case, then remove the differential gears taking care not to lose the thrust washers fitted behind them.

(6) If the drive gear setting is to be altered it will be necessary to withdraw the differential bearings, using the extractor, Tool No. SL.14 (SE.103) with appropriate adaptors, to gain access to the shims located between the bearing and the abutment face on the differential case.

STRIPPING DIFFERENTIAL ASSEMBLY (4 PINION TYPE)

(1) Bend down the tabs of the drive gear screw locking straps and remove the drive gear screws.

(2) Remove the drive gear from the differential case by tapping with a rawhide mallet.

(3) Remove the eight Socket Head Screws holding the two halves of the differential case together and lift off the top half.

(4) Remove the top side gear and then ease out the crosspin and pinion mates together with the two halves of the shaft spacer from the lower half of the differential case, taking care not to lose the thrust washers fitted behind all the gears.

(5) Remove the lower side gear from the bottom half of the differential case, once again taking care not to lose the thrust washer.

(6) If the drive gear setting is to be altered it will be necessary to withdraw the differential bearings, using the extractor, Tool No. SL.14 (SE.103) with appropriate adaptors, to gain access to the shims located between the bearing and the abutment face on the differential case.

REASSEMBLY OF DIFFERENTIAL (2 PINION TYPE)

(1) Assemble the side gears with the thrust washers in position.

(2) Insert the differential pinions, through the openings in the differential case, and mesh with the side gears. Hold the pinion thrust washers on the spherical thrust faces of the pinions, whilst rotating the differential gear assembly into its operating position by hand.

(3) Line up the pinions and thrust washers and then install the pinion mate shaft with the axle shaft spacer in position.

(4) Line up the crosspin hole in the shaft with the hole in the differential case, and then fit the pinion mate shaft lockpin.

(5) Using a punch, peen some of the metal of the differential case over the end of the lockpin to prevent its working loose and thereby causing extensive damage to the axle assembly.

(6) Clean the drive gear and differential case contacting surfaces and carefully examine for burrs.

(7) Align the drive gear attaching bolt holes with those of the flange of the case, and gently tap the drive gear home on the case with a hide or lead hammer.

(8) Insert the drive gear bolts with NEW Lockstraps and tighten them uniformly, preferably with a torque spanner to the reading listed in Table 6 on Page 25. Then bend the locking tabs round the bolt heads to prevent their working loose.

REASSEMBLY OF DIFFERENTIAL (4 PINION TYPE)

(1) Take up the bottom half of the differential case and fit the bottom side gear not forgetting the thrust washer on the back face.

(2) Fit half of the split shaft spacer in the side gear spline with the small diameter facing upwards.

(3) Refit the crosspin with the pinion mates and thrust washers into the lower half of the differential case.

(4) Fit the remaining half of the shaft spacer into the recess in the centre of the crosspin with the larger diameter facing upwards.

(5) Place the second side gear on top of the split spacer allowing the larger diameter to enter the splined bore.

(6) Place the second side gear thrust washer on top of the side gear.

(7) Replace the top half of the differential case ensuring that the identification marks stamped on both halves are opposite to one another. This ensures that the differential case is correctly aligned.

NOTE:—It is not permissible to assemble two halves from different differential cases as several of the machining operations are carried out after assembly of the two halves of the case.

(8) Refit the socket head screws and tighten to the torque figure shown in Table 6, Page 25, according to the size of the bolts and type of axle. The tightening should be carried out by tightening single screws at opposite sides of the differential case to ensure that pressure is uniform, and NOT by following round the diameter of the differential case.

(9) With a small punch carefully peen over the differential case adjacent to the screw head bores in order to prevent the loosening of the bolts in service.

(10) Clean the drive gear and differential case contacting surfaces and carefully examine for burrs.

(11) Align the drive gear attaching bolt holes with those in the flange of the differential case and gently tap the drive gear home on the case with a hide or lead hammer.

(12) Insert the drive gear bolts with NEW lockstraps and tighten them uniformly, preferably with a torque spanner to the reading listed in Table 6 on Page 25. Then bend the locking tabs round the bolt heads to prevent them working loose.

The procedure for fitting the differential case assembly into the gear carrier is given below under the heading "Differential Bearing Adjustment".

REMOVING PINION

(1) Remove the pinion split pin (where fitted), nut and washer.

(2) Withdraw the universal joint companion flange with a puller.

(3) Press the pinion out of the outer bearing. It is important that the pinion should be pressed and NOT driven out, to prevent damage to the outer bearing. The pinion, having been pressed from its outer bearing, may now be removed from the gear carrier housing.

NOTE:—Keep all shims intact.

(4) Remove the pinion oil seal together with the oil slinger and outer bearing cone.

(5) Examine the outer bearing for wear, and if replacement is required, extract the bearing cup, using Tool SL.12 (SE.105) with appropriate adaptor. The Tool SE.105 is shown in Figure 5. The extractor plate should be installed behind the bearing cup and then the drawbar may be fitted together with the extractor bar which seats on the nose of the gear carrier. The bearing cup may then be withdrawn by tightening the nut on the drawbar.

(5a) **If either tool is not available and the old bearing cup is to be scrapped, it is possible to drive out the cup, the shoulder locating the bearing being recessed to facilitate this operation.**

(6) Remove the inner pinion bearing cup as shown in Figure 5, using either Tool SL.12 or SE.105 as available, if the bearing needs replacement or adjustment of the pinion cone setting is to be undertaken. Take care of the shims fitted between the bearing cup and the housing abutment face.

(6a) **If the inner bearing is to be replaced it may be driven out, but the correct Service Tool should be used when the bearing is removed in order to carry out the pinion setting adjustment.**

NOTE:—On certain of the latest model axles a .048" washer has been fitted next to the abutment shoulder under the outer bearing, and care must be taken when refitting that this washer is fitted next to the shoulder with the packing shims between the washer and the bearing. Since this washer can be fitted to all models it would be advantageous to fit one in all cases of reassembly as it eliminates the risk of damage to the shim pack, and also reduces the amount of shimming required by .048".

DIFFERENTIAL BEARING ADJUSTMENT

The thickness of shims required in the installation of the differential bearings is determined as follows:—

(1) Fit the differential bearings, without shims, on the differential case, making sure that the bearing cones and cups and the housing itself are perfectly clean.

(2) Place the differential assembly with the bearing cups in their housing within the gear carrier, the pinion not being assembled.

(3) Install the dial indicator set, Tool SE.101 in the Service Tool List, on the gear carrier, with the button against the back face of the drive gear.

(4) Inserting two levers between the housing and the bearing cup, move the differential assembly to one side of the carrier, as shown in Figure 6.

(5) Set the dial indicator to zero.

(6) Move the assembly to the other side and record the indicator reading, which gives the total clearance between the bearings as now assembled and the abutment faces of the carrier housing.

Add the amount of preload shown in Table 6, Page 25 for the particular type of axle concerned, to the clearance reading, to ensure correct pre-loading. The total of the first indicator reading plus the correct preload gives the amount of shims to be used in the installation of the differential bearings, the shims being divided to give the gear position with correct backlash as detailed later under "Drive Gear Adjustment".

——— o O o ———

(7) Remove the differential from the gear carrier.

(8) Re-install the pinion outer bearing cup with Tool No. SL.12 or SE.106 as available.

(9) Re-install the pinion bearing inner cup with the original adjusting shims positioning same.

(10) Press the inner bearing cone on the pinion, using an arbor press and a length of tubing, contacting the inner race only and **not the roller retainer.**

PINION ADJUSTMENT

The hypoid drive pinion should be correctly adjusted before attempting further assembly, the greatest care being taken to ensure accuracy.

The correct pinion setting is marked on the ground end of the pinion as shown in Figure 7. The matched assembly serial number at the top is also marked on the drive gear, and care should be taken to keep similarly marked gears and pinions in their matched sets, as each pair is lapped together before despatch from the factory. The letter on the left is a production code letter and has no significance relative to the assembly or servicing of an axle. The letter and figure on the right refer to the tolerance on offset or pinion drop, dimension "A" in Figure 8, which is stamped on the cover facing of the gear carrier housing. When ordering spares, specify the offset required if the best performance is to be obtained. Thus, an L.1 carrier requires L.1 gears, or an H.2 carrier requires H.2 gears.

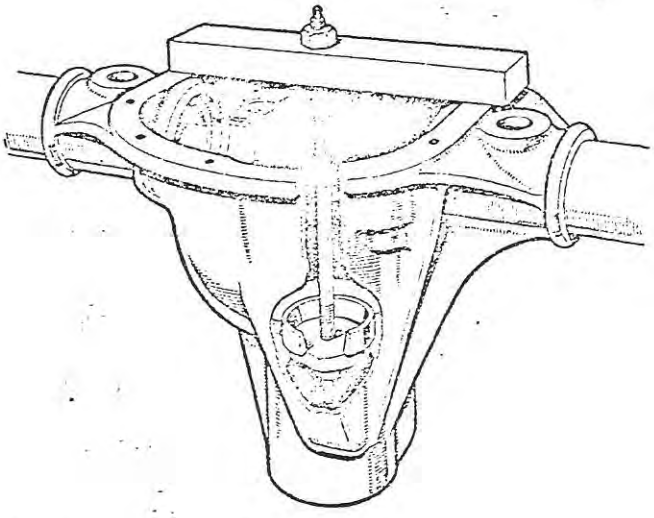

FIGURE 5

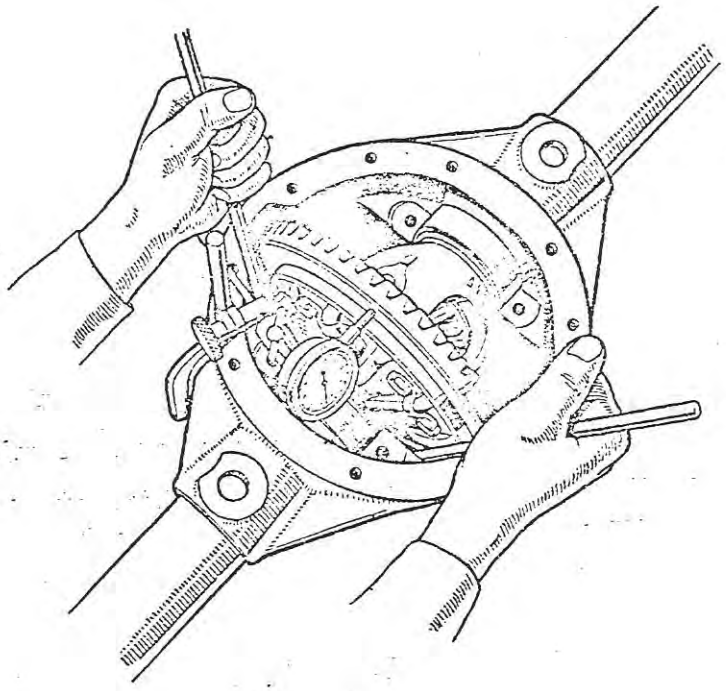

FIGURE 6

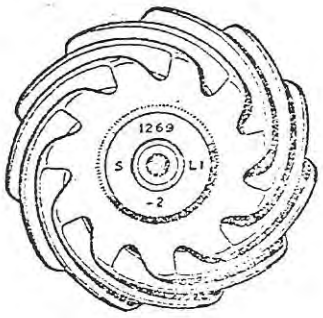

FIGURE 7

The number at the bottom gives the cone setting distance of the pinion and may be Zero (0), Plus (+) or Minus (−). When correctly adjusted, a pinion marked Zero will be at the zero cone setting distance, dimension "B" in Figure 8, from the centre line of the gear to the face on the small end of the pinion; a pinion marked Plus Two (+2) should be adjusted to the nominal (or Zero) cone setting plus .002", and a pinion marked Minus Two (−2) to the cone setting distance minus .002".

The Zero Cone Setting Distances for the various SALISBURY axles are as follows:—

MODEL	6HA	... ...	2.000"
	HA	... ...	2.125"
	7HA	... ...	2.219"
	3HA & 3HU	...	2.250"
	4HA & 4HU	...	2.625"
	2HA	... ...	2.750"
	5HA	... ...	2.968"

The various dimensions shown in Figure 8 are tabulated on Page 25, Table 6.

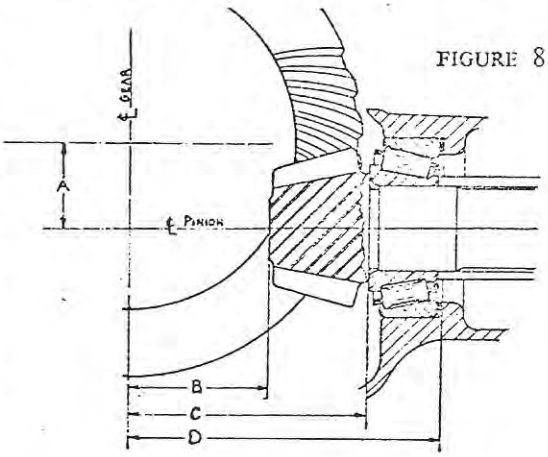

FIGURE 8

Thus, for a model 3HA pinion marked Minus Two (−2) the distance from the centre of the drive gear to the face of the pinion should be 2.248" (i.e. 2.250"—.002") and for a pinion marked Plus Three (+3) the cone setting distance should be 2.253".

When the pinion bearing cups have been installed in the gear carrier, with the original pinion inner bearing adjusting shims, as described in items 7 to 10 in the section entitled "Differential Bearing Adjustment", proceed with pinion adjustment as follows:—

(1) Place the pinion, with the inner bearing cone assembled, in the gear carrier.

(2) Turn the carrier over and support the pinion with a suitable block of wood for convenience before attempting further assembly.

(3) Install the pinion bearing spacer if fitted on the unit under repair (see Figure 1 for alternative construction).

(4) Install the original outer bearing shims on the pinion shank (or if fitting the abutment washer referred to in the note at the end of the section on "Removing Pinion", the original shims, less .048") so that they seat on the spacer or a shoulder on the pinion shank, according to the construction of the unit.

(5) Fit pinion outer bearing cone, companion flange, washer and nut only, omitting the oil slinger and oil seal assembly, and tighten the nut.

(6) Check the pinion cone setting distance by means of the gauge Tool No. SL.3P (SE.107), see Figure 9. The procedure for using the gauge SE.107 is:—

(a) Adjust the bracket carrying the dial indicator to suit the model being serviced, then set the dial indicator to zero with the setting block.

(*b*) Place the dial indicator assembly on the fixed spindle of the gauge body.

(*c*) Fit the fixed spindle of the gauge body into the centre in the pinion head, slide the movable spindle into position, locating in the centre in the pinion shank with the gauge body underneath the gear carrier, and lock the spindle with the screw provided.

(*d*) Check the pinion cone setting by taking a dial indicator reading on the differential bearing bore with the bracket assembly seated on the ground face at the end of the pinion. The correct reading will be the minimum obtained, i.e. when the indicator spindle is at the bottom of the bore. Slight movement of the assembly will enable the correct reading to be ascertained easily. The dial indicator shows the deviation of the pinion setting from the zero cone setting, and it is important to note the direction of any such deviation as well as the magnitude.

NOTE:—When using the Churchill Tool SL.3P there is merely an indicator assembly on a magnetic base which operates from the ground face of the pinion in exactly the same manner, there being no gauge body outside the carrier.

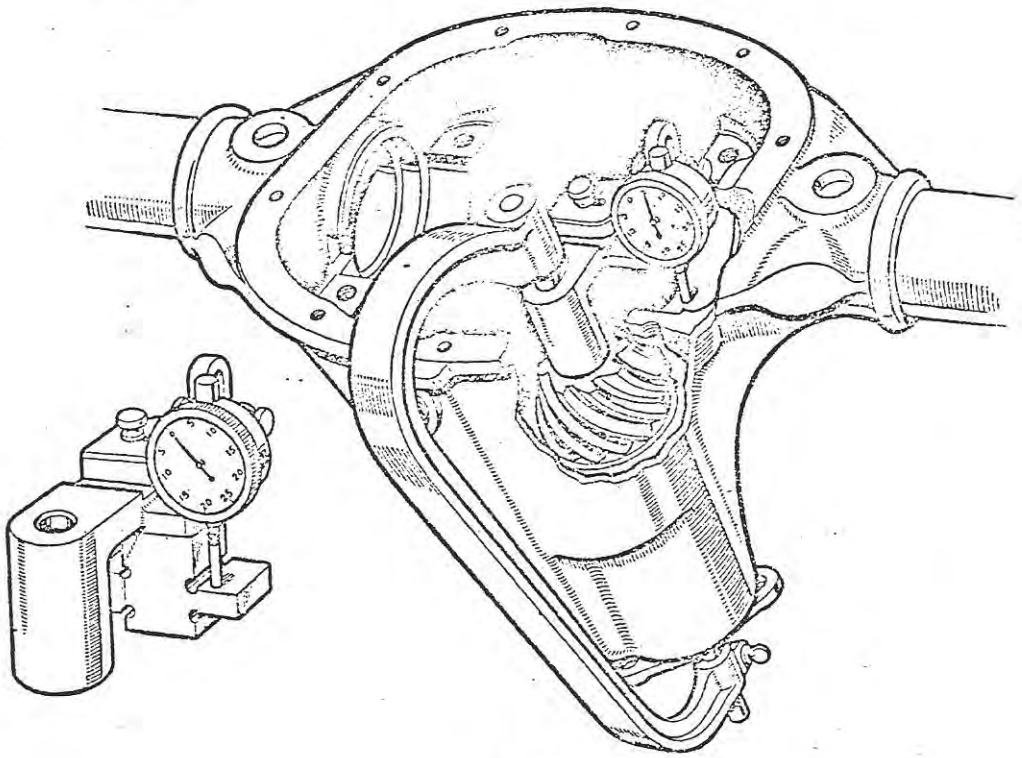

FIGURE 9

(7) If the pinion setting is incorrect it is necessary to dismantle the pinion assembly, and remove the pinion inner bearing cup using Tool No. SL.12 (SE.105) in the Service Tool List. Add or remove shims as required from the pack locating the bearing cup and re-install the shim pack and the bearing cup. The adjusting shims are available in thicknesses of .003″, .005″, .010″.
Then carry out operations (1) to (6) detailed above.

(8) When the correct pinion setting has been obtained, check the pinion bearing preload, which should afford a slight drag or resistance to turning, there being no end play of the pinion. The correct preload for the pinion bearings gives a torque figure as listed in Table 6 on Page 25. Less than the correct range will result in excessive deflection of the pinion under load, whilst too much preload will lead to pitting and failure of the bearings.

To rectify the preload adjust the shim pack between the outer bearing cone and the pinion shank or spacer, but do not touch the shims behind the inner bearing cup, which control the position of the pinion. Remove shims to increase preload and add shims to decrease preload.

Installation of the Pinion Oil Seal assembly and oil slinger is usually effected after fitting differential assembly, see operations (1), (2) and (3) under "Final Assembly", Page 18.

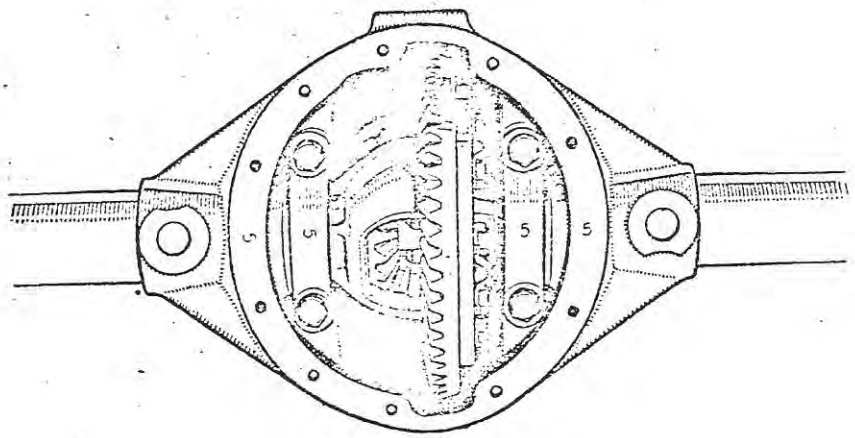

FIGURE 10

DRIVE GEAR ADJUSTMENT

(1) Place the differential assembly with bearing cups, and less shims, into the housing, being sure that the bearing cones, cups and housing are perfectly clean.

(2) Install a dial indicator on the housing with the button on the back face of the drive gear as shown in Figure 6.

(3) Inserting two small levers between the housing and the bearing cup, move the differential case and drive gear assembly away from the pinion until the opposite bearing cup is seated against the housing.

(4) Set the dial indicator to zero, then move the differential assembly towards the pinion until the drive gear is in metal to metal contact deeply in mesh with the pinion.

The indicator reading now obtained (clearance between drive gear and pinion) minus the backlash allowance as etched on the drive gear (e.g. B/L .007) denotes the thickness of shims to be placed between the differential case and the bearing cone on the drive gear side of the differential.

(5) Install the thickness of shims determined in operation (4), on the drive gear side of the differential, taking the shims from the pack determined previously, (see "Differential Bearing Adjustment").

(6) Install the balance of the total shims required on the opposite side of the differential case.

As an example of differential and drive gear adjustment, assume that the total indicator reading obtained, as described under "Differential Bearing Adjustment", is .083". This figure plus the differential preload shim allowance given in Table 6, Page 25, will give the total thickness of shims to be used, say .088". Also assuming the clearance between drive gear and pinion to be .042" determined as in operations (1) to (4) above, subtract the backlash as etched on the gear, say .007" from the .042" clearance. The .035" difference denotes the thickness of shims to be placed between the differential case and bearing cone on the drive gear side of the differential. Then subtract the thickness of shims inserted on the drive gear side, i.e. .035" from .088", and the .053" difference denotes the thickness of shims to be installed on the opposite side of the case.

(7) To facilitate installation of the differential assembly, fit the stretching fixture SL.1 (SE.104) whichever is available, as shown in Figure 3 (Ref. operation (2) in "To Dismantle Differential Unit with Service Tool"). Stretch the gear carrier, being sure not to exceed the half turn specified on the tunbuckle, or the axle casing will be damaged beyond repair.

(8) Lower the differential assembly into position, lightly tapping the bearings home with a hide hammer, whilst ensuring that the gear teeth are led into mesh with those of the pinion. Careless handling at this stage may result in bruising the gear teeth, and removal of the consequent damage can only be partially successful and result in inferior performance.

(9) When refitting the bearing caps, be sure that the position of the numerals marked on the gear carrier housing face and the caps correspond, as indicated in Figure 10. Tighten the caps lightly, remove the stretching fixture, then finally tighten the bolts securing the bearing caps. Then continue with operation (10).

Emergency Operation (7a) **In an emergency it is possible to install the differential assembly by slightly tilting the bearing cups and tapping same lightly into position with a hide hammer. Naturally this method increases the difficulty of avoiding damage to the gear teeth, and extreme care is necessary to prevent damage to the differential bearings. This procedure is not recommended and should be strictly reserved for emergencies.**

(8a) **Install the differential bearing caps as indicated in operation (9) above and shown in Figure 10. Finally tighten the bolts securing the bearing caps.**

(10) Mount a dial indicator on the gear carrier housing with the button against the back face in a similar manner to that employed for differential bearing adjustment as shown in Figure 6. Turn the pinion by hand and check the runout on the back face which should not exceed .005". If there is excessive runout strip the assembly and rectify by cleaning the surfaces locating the drive gear. Any burrs on these surfaces should be removed.

(11) Remount the dial indicator on the gear carrier housing with the button against one of the drive gear teeth, as nearly in line with the direction of tooth travel as possible, see Figure 11. Move the drive gear to check the backlash which should be as etched on the gear. If the backlash is not in accordance with the specification, transfer the necessary shims from one side of the differential case to the other to obtain the desired setting. To increase backlash, remove shims from the drive gear side and install on the opposite side. Backlash is decreased by transferring shims to the drive gear side from the opposite side of the differential case.

(12) After setting the backlash to the required figure, use a small brush to paint eight or ten of the drive gear teeth with a stiff mixture of marking raddle, used sparingly, or engineer's blue may be used if preferred. Move the painted gear teeth into mesh with the pinion until a good impression of the tooth contact is obtained. The resulting impression should be similar to figure A in Table 7. Refer to the section on Tooth Contact and to Table 7 for instructions on correction of tooth contact if the impression obtained is not satisfactory.

FINAL ASSEMBLY

To complete the rebuilding of the unit:—

(1) Remove the drive pinion nut, washer and companion flange.

(2) Install the oil slinger and then fit the pinion oil seal assembly using Tool No. SL.4PB or 5PB (SE.108) as shown in Figure 12. Place the oil seal with the dust excluder flange uppermost (not omitting the oil seal gasket used with the metal case-type seal, fit the tool, and then tighten down the pinion nut and washer to drive the assembly home. Remove the tool.

(3) Fit the companion flange with dust excluder washer and pinion nut, tighten, and where a self-locking nut is not used secure with a cotter pin.

(4) Fit the rear cover gasket, renewing it if required, and the rear cover, securing same with set bolts and lock washers, and not omitting the ratio tag which is attached by one of the set bolts.

(5) Re-install the axle shafts and hub bearings, etc., as described on Page 7 under "To Replace Axle Shafts".

(6) Check that the drain plug is securely tightened, then fill with the appropriate quantity of one of the Hypoid Lubricants listed in Table 1, Page 24.

(7) Replace the filler plug and check that the cover set bolts are tight.

(8) Check for oil leaks at the cover, pinion oil seal and where the differential cap bolt holes break through the carrier.

(9) Finally grease the hub bearings.

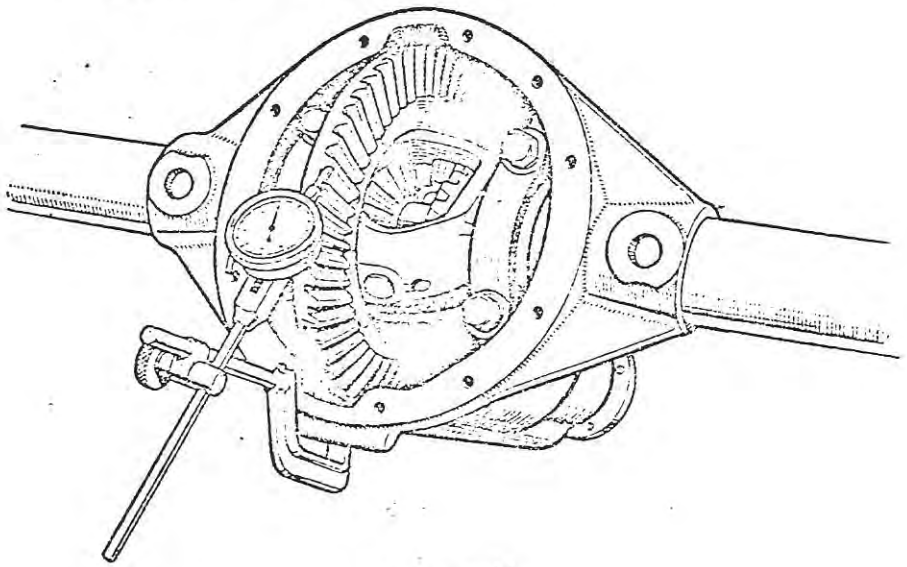

FIGURE 11

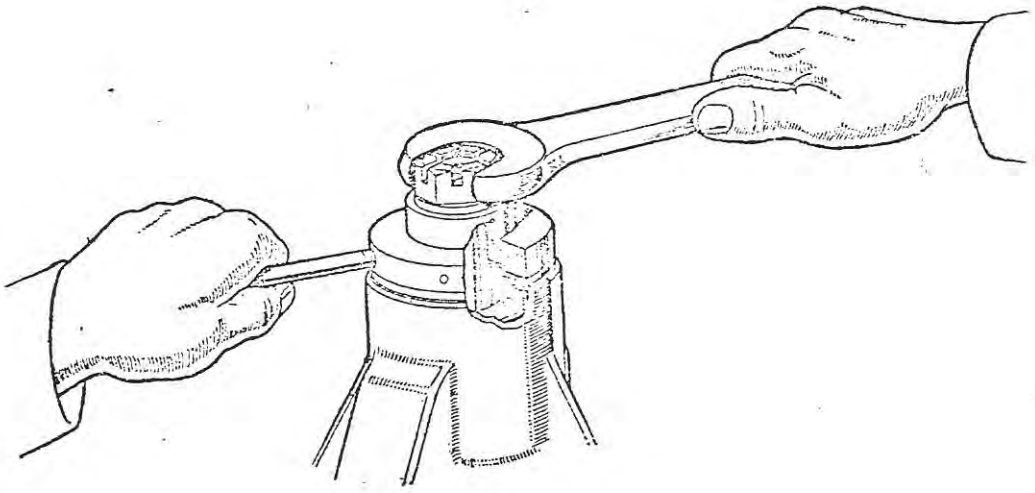

FIGURE 12

INDEPENDENT DRIVE UNITS—4HU & 3HU TYPE

The same factory service is available as for beam axles and the same remarks apply as on Page 3. Basically, apart from the drive shafts, the same general principles apply. The hypoid drive gear and pinion matched assembly is supported by taper roller bearings which are adjusted by means of shims to give the correct running position for the gears and suitable preload on the bearings. The whole assembly is housed in a malleable cast iron carrier incorporating oil circulation channels and suitable support flange to permit installation in the vehicle.

Output shafts carried in twin tapered roller bearings are fitted in the larger type, i.e. 4HU, but in the smaller type, 3HU, a single ball journal bearing is used. The inner ends of the splined shafts engage the bevel side gears in the differential, which on the 4HU is of the two pin type, but on the 3HU may be either 2 pinion or 4 pinion type.

A cover on the rear of the gear carrier housing is fitted with a combined filler and oil level plug. Also a breather tube for venting the unit. Inspection of the assembly and flushing may be carried out by removal of this cover. The drain plug is sited on the underside of the unit.

The final drive ratio is stamped on a tag attached to one of the cover screws and since most of the units built are to some extent special, it is important to note that the unit serial number is stamped on the housing and should always be quoted in any correspondence regarding a particular unit.

LUBRICATION—OILING

As for Beam Axles—see Page 4.

No greasing is necessary.

GENERAL SERVICE INSTRUCTIONS

For Service Tool List refer to Page 25, Table 5. Since there are no stretching holes in the carrier 2 adaptors SE.109 will also be required.

TO REMOVE UNIT COMPLETE FROM VEHICLE

Proceed as for normal beam axle—see Page 5.

OUTPUT SHAFTS—TO REMOVE AND REFIT 4HU TYPE

TO REMOVE OUTPUT SHAFTS

(1) Remove the nuts securing the universal joint flange to the shaft and detach the joint flange.

(2) Put the distance piece (where fitted) in a safe place where it will not be damaged since any burrs on this component could cause runout of the joint.

(3) Remove the set bolts which retain the shaft oil seal container assembly and retainer plate. Access to these bolts is facilitated by the cutaways in the shaft flange which should be rotated into suitable positions during this operation.

(4) Withdraw shaft assembly and secure shim pack.

(5) Withdraw inner bearing cup only if replacement of this bearing is necessary, and this operation is more easily performed after the differential has been removed. It is advisable that this course be adopted when the unit is being completely stripped.

The shaft assembly should not be stripped further unless it is necessary to replace bearings or oil seal.

(6) Prise up the locking tabs on the shaft nut washer and remove both nut and washer.

(7) Remove bearing cones and cup of outer bearing together with retainer plate and oil seal assembly.

TO REFIT OUTPUT SHAFTS

Commence at operation (9) if the shaft assembly has not been dismantled.

(1) Place the oil seal assembly on the shaft with the seal lip away from the flange, taking care not to damage the lip during installation.

(2) Fit the paper gasket adjacent to the container.

(3) Install the retainer plate.

(4) Place the outer bearing cup next to the retainer and fit the bearing cone on the shaft bearing diameter with the small end of the cone abutting against the shoulder of the shaft (identical bearings are used on both inner and outer locations).

(5) Press the inner bearing cone on to the shaft with the large end of the cone locating against the larger end of the outer bearing cone, i.e. bearings mounted back to back so that the outer bearing supports the shaft against the outward thrust and the inner bearing acting in like manner supports the inward thrust loads.

(6) Place the abutment washer on the shaft next to the inner bearing cone and install the tab washer with its internal tag located in the groove provided in the shaft and projecting under the abutment washer.

(7) Fit and fully tighten the nut.

(8) Secure the nut by carefully bending over one or more tabs of the washer, ensuring that they lie on the flat of the nut as closely as possible. Careless handling here could result in the nut being only partially locked.

(9) Ensure that the bearings are completely free of grease so that shaft end float may be determined accurately.

*(10) Determine the shim pack as follows — (if the shaft assembly has not been dismantled the original shim pack may be refitted) -- measure the width across the two bearing cups and subtract from this dimension the depth of the shaft bearing bore. The resultant value plus .002″ gives the thickness of shims required. Select suitable shims and check the thickness of the total pack with a micrometer.

(11) Install the inner bearing cup and ensure that it is firmly located against the abutment shoulder in the housing.

(12) Fit the shaft assembly with the selected shims located between the retainer plate and the machined face of the housing.

(13) After lining up the holes the set bolts should be fitted and tightened up.

(14) Check by means of a dial indicator that the end float is .001″ to .003″. If it is not remove assembly and refit after adjusting shim pack as necessary. To reduce end float remove shims and conversely to increase add shims.

(15) When the shafts have been installed satisfactorily lock the set bolts by wiring in pairs.

(16) Replace the distance piece on the shaft flange, ensuring that both the distance piece and the flange face is free from burrs.

* An alternative method of assessing the shims required is to install the shaft assembly as detailed above, but without fitting shims. Then check the clearance between the retainer plate and the face of the housing, using feeler gauges. Then install the thickness of shims ascertained plus .002″.

OUTPUT SHAFTS TO REMOVE AND REFIT 3HU TYPE

TO REMOVE OUTPUT SHAFTS

(1) As 4HU—operation (1) (Page 20).

(2) Remove brake drums.

(3) As 4HU—operation (3) (Page 20).

(4) As 4HU but remove brakes and ensure that dowels remain in position (Page 20).

(5) Remove circlip and abutment washer.

(6) Press bearing off shaft enabling oil seal housing, bearing retainer plate gaskets and oil catcher where fitted to be removed.

TO REFIT OUTPUT SHAFTS

(1) As 4HU but refit oil catcher (Page 20).

(2) Press bearing on shaft.

(3) Fit abutment washer and new circlip.

(4) Fit original shim pack.

(5) As 4HU—operation (12) (Page 21), but shims are between the bearing retainer plate and the brake backplate and the outlet hole must be lined up with the mating recess in the grease catcher.

(6) As 4HU operation (13) (Page 21).

(7) As 4HU operation (15) (Page 21).

DIFFERENTIAL & PINION ASSEMBLIES TO REMOVE, ADJUST & REFIT

TO DISMANTLE DIFFERENTIAL UNIT WITH SERVICE TOOLS	As for beam axle—see Page 8, but before fitting stretching fixture secure stretching adaptors SE.109 to case by means of bolts each side. Since case has no stretching holes, adaptors are required.
STRIPPING DIFFERENTIAL ASSEMBLY	As for beam axle—see Page 9, but it must be remembered that no shaft spacer is fitted.
REASSEMBLY OF DIFFERENTIAL	As for beam axle—see Page 10, but no shaft spacer fitted.
REMOVAL OF PINION	As for beam axle—see Page 11.
DIFFERENTIAL BEARING AJUSTMENT	As for beam axle—see Pages 11, 12.
PINION ADJUSTMENT	As for beam axle—see Pages 12, 14, 15.
DRIVE GEAR ADJUSTMENT	As for beam axle—see Pages 16 and 17.
FINAL ASSEMBLY	As for beam axle—see Page 18, omit operation (9).

The information given below and on Page 23 of the manual is general and applies equally to both beam axles and independent units.

TOOTH CONTACT OF HYPOID GEARS

The illustrations referred to in this section are those shown in Table 7 which indicate the tooth bearing impression as seen on the drive gear.

The HEEL is the large or outer end of the tooth.

The TOE is the small or inner end of the tooth.

The FACE, top or addendum is the upper portion of the tooth profile.

The FLANK or dedendum is the lower portion of the tooth profile.

The DRIVE side of the drive gear tooth is CONVEX.

The COAST side of the drive gear tooth is CONCAVE.

(A) Ideal Contact Figure A shows the ideal tooth bearing impression on the drive and coast sides of the gear teeth. The area of contact is evenly distributed over the working depth of the tooth profile, and is located nearer to the toe (small end) than the heel (large end). This type of contact permits the tooth bearing to spread towards the heel under operating conditions when allowance must be made for deflection.

(B) High Tooth Contact In Figure B it will be observed that the tooth contact is heavy on the drive gear face or addendum, i.e. High Tooth Contact. To rectify this condition move the pinion deeper into mesh, i.e. reduce the pinion cone setting distance, by adding shims between the pinion inner bearing cup and the housing and adding the same thickness of preload shims between the pinion bearing spacer, or the shoulder of the pinion shank and the outer bearing cone. This correction has a tendency to move the tooth bearing towards the toe on drive and heel on coast, and it may therefore be necessary after making this change to adjust the drive gear as described in section (D) and (E) below.

(C) **Low Tooth Contact** In Figure C it will be observed that the tooth contact is heavy on the drive gear flank or dedendum, i.e. Low Tooth Contact. This is the opposite condition from that shown in B and is therefore corrected by moving the pinion out of mesh. i.e. increase the pinion cone setting distance by removing shims from between the pinion inner bearing cup and housing, and removing the same thickness of preload shims from between the pinion bearing spacer or the shoulder of the pinion shank and the outer bearing cone. This correction has a tendency to move the tooth bearing towards the heel on drive, and toe on coast. and it may therefore be necessary after making this change to adjust the drive gear as described in sections D and E.

(D) **Toe Contact** Figure D shows an example of toe contact which occurs when the bearing is concentrated at the small end of the tooth. To rectify this condition, move the drive gear out of mesh, i.e. increase backlash, by transferring shims from the drive side of the differential to the opposite side.

(E) **Heel Contact** Figure E shows an example of heel contact which is indicated by the concentration of the bearing at the large end of the tooth. To rectify this condition, move the drive gear closer into mesh, i.e. reduce backlash, by adding shims to the drive gear side of the differential and removing an equal thickness of shims from the opposite side.

NOTE:—It is most important to remember when making this adustment to correct a heel bearing, that sufficient backlash for satisfactory operation must be maintained. If there is insufficient backlash the gears will at least be noisy and have a greatly reduced life, whilst scoring of the tooth profile and breakage may result. Therefore, always maintain a minimum backlash requirement of .004".

BACKLASH When adjusting backlash always move the drive gear as adjustment of this member has more direct influence on backlash, it being necessary to move the pinion considerably to alter the backlash a small amount. (.005" movement on pinion will generally alter backlash .001").

GEAR AND PINION MOVEMENT Moving the Gear Out of mesh moves the tooth contact towards the heel and raises it slightly towards the top of the tooth.

Moving the Pinion Out of mesh raises the tooth contact on the face of the tooth and slightly towards the heel on drive, and toe on coast.

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SALISBURY HYPOID AXLES TECHNICAL DATA

TABLE 1. LUBRICANTS APPROVED FOR USE IN SALISBURY HYPOID AXLES

This list gives oils for use under normal conitions, in temperate climates. For extreme operating conditions, refer to the vehicle manufacturer, who will advise any special recommendation approved for such conditions.

SUPPLIER	*LUBRICANT*
H. G. Allcard & Co. Ltd	CYLDOL Hypoid Gear Oil SAE.90
Esso Petroleum Co. Ltd.	Esso Expee Compound 90
Edward Joy & Sons Ltd.	Hypoid "Filtrate" Gear Oil SAE.90
Germ Lubricants Ltd.	Germ NEO ASTRA Oil
Gulf Oil (Gt. Britain) Ltd.	Gulf Multipurpose Gear Lubricant 90
Mobil Oil Co. Ltd.	Mobilube GX.90
Oiline Refining Co. Ltd.	"Oiline" HA Compound Hypoid Gear Lub. 90
Ragosine Oil Co. Ltd.	Ragosine Nimrod Hyp. (SAE.90)
Regent Oil Co. Ltd.	Caltex Universal Thuban 90
Shell Companies	Shell Spirax 90 EP
B.P. Companies	Energol EP. SAE. 90
Snowdon Sons & Co. Ltd. ...	Royal Snowdrift Gear Oil H.G.90
Vigzol Oil Co. Ltd.	Vigzol E.P. 90
C. C. Wakefield & Co. Ltd. ...	Castrol Hypoy

Use only the grades of oil listed above.

TABLE 2. GREASES SUITABLE FOR HUB BEARING LUBRICATION

SUPPLIER	*GREASE*
British Oil & Turpentine Co. Ltd. ...	Speedwell L.R. Grease
A. Duckham & Co. Ltd.	Duckhams H.B.B. Grease
Esso Petroleum Co. Ltd.	Esso Grease
Forward Oil Co. Ltd.	Forward Pure Oil Grease
Hill & Jackson Ltd.	A.H.82 Grease
Maxima Lubricants Ltd.	Maxima R.B. Grease
Mobil Oil Co. Ltd.	Greaserex K.2 *
Mobil Oil Co. Ltd.	Mobilgrease B.B.
Oiline Refining Co. Ltd.	Oiline J.A.F. Grease
B.P. Companies	Energrease L.2 * *or* C.3
Regent Oil Co. Ltd.	Caltex R.B. Grease
Shell Companies	Retinax A. *
Shell Companies	Retinax A *or* Retinax R.B.
Solvolene Lubricants Ltd.	Solvolene R.B. Grease
C. C. Wakefield & Co. Ltd. ...	Castrolease I.M. Grease *

* NOTE: For rear hub bearings Jaguar Cars Ltd. recommend these greases, of higher melting point, for the special conditions under which axles operate in these cars. In this case the lighter greases should not be used.

TABLE 3. ROUTINE MAINTENANCE

After first 500 miles	Monthly or every 1,500 miles	Twice yearly at seasonal change of oil or every 10,000 miles
Drain and refill oil	Check oil and top up if required	Drain and refill oil
Grease hub bearings	Grease hub bearings	Grease hub bearings

TABLE 4. OIL CAPACITY OF SALISBURY HYPOID AXLES

Model	*Oil Capacity*		
6HA	1¾ pints	2 U.S. pints	1.0 litre
HA	2 pints	2¼ U.S. pints	1.1 litres
7HA	2 pints	2¼ U.S. pints	1.1 litres
3HA & 3HU	2¼ pints	2½ U.S. pints	1.2 litres
4HA & 4HU	2½ pints	3 U.S. pints	1.4 litres
2HA	2½ pints	3 U.S. pints	1.4 litres
5HA	3 pints	3½ U.S. pints	1.7 litres

TABLE 5. SERVICE TOOL LIST

Salisbury Tool No.	*Churchill Tool No.*	*Description*
SE.101	—	Universal Dial Test Indicator, Catalogue No. 160, obtainable from J. E. Baty & Co. Ltd., 39 Victoria Street, London, S.W.1.
SE.102	SL.13.A.	Axle Shaft Extractor
SE.103	SL.11.PD/AB	Pinion and Differential Bearing Cone Puller (with SL.14)
SE.104	SL.1.	Gear Carrier Stretching Fixture
SE.105	SL.12.	Pinion Bearing Cup Extractor
SE.106	SL.12.	Bearing Cup Installation Tool
SE.107	SL.3.P.C.S.	Pinion Cone Setting Gauge
SE.108	SL.4.P.B. & SL.5.P/B	Pinion Oil Seal Installation Collar
SE.109	—	Gear Carrier Stretcher Adaptors (for 3HU or 4HU)
—	SL.14.	Multi-Purpose Hand Press.

Complete sets of the above tools are available from Messrs. V. L. Churchill & Co. Ltd., Great South West Road, Belfont, Middlesex, to whom all enquiries should be sent. When ordering it is advisable to state the tool required, and also the axle model for which it is required, since the tools are universal and specific adaptors have to be supplied. As mentioned earlier, the SALISBURY tool numbers are merely prints from which these tools can be manufactured.

TABLE 6. SERVICE DATA

For key to dimensions in Section *(a)* refer to Figure 8, Page 14.

	Model	6HA	HA	7HA	3HA 3HU	4HA 4HU	2HA	5HA
(a)	Pinion Drop "A" ...	1.000"	1.250"	1.000"	1.375"	1.500"	1.750"	1.750"
	Zero Cone Setting "B" ...	2.000"	2.125"	2.219"	2.250"	2.625"	2.750"	2.968"
	Mounting Distance "C"	3.375"	3.625"	3.562"	3.937"	4.312"	4.625"	4.906"
	C/L to Brg. Housing "D"	4.193"	4.848"	4.753"	5.130"	5.505"	5.818"	6.131"
		4.183"	4.838"	4.743"	5.120"	5.495"	5.808"	6.121"
(b)	Axle Shaft End Float ...	.006" to .008" unless Disc Brakes fitted, then .003" to .005"						
	Torque Spanner Setting ...	40-50	40-50	⅜" 50-60	¾" 50-60	⅝" 50-60	40-50	70-80
	Drive Gear Bolts lbs.ft. ...				7/16" 70-80	7/16" 70-80		
	Diff. Preload Shim Alice.	.005" on All Models						
	Backlash	As etched on Drive Gear (Minimum .004")						
	Pinion Bearing Preload ...	8-12lbs. in. on All Models						
	Spanner Setting for Diff.				½" 15-20			25-30
	Case Securing Screws lbs. ft.				5/16" 25-30			
(c)	Torque Spanner Setting; Drive Pinion Nut ft. lbs.	6HA & 7HA 95-105			HA, 3HA, 3HU, 5HA, 2HA, 4HA, 3HU 120-130			

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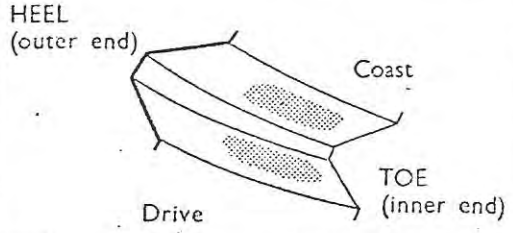
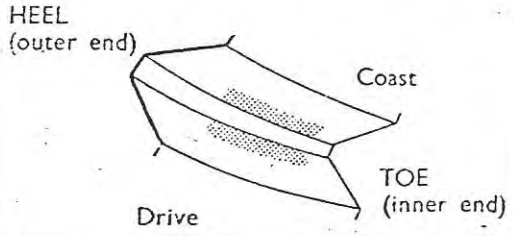
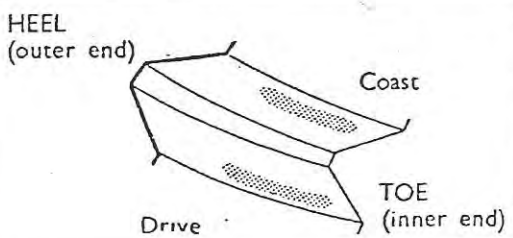
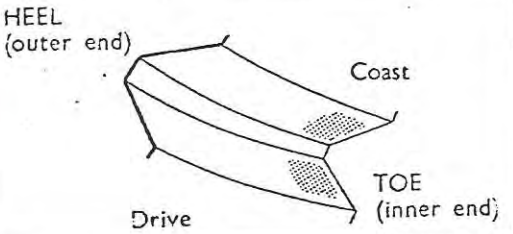
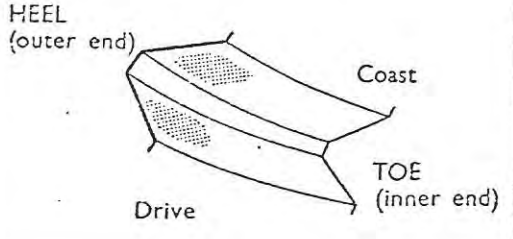
TABLE 7. TOOTH CONTACT CHART

Diagrams show contact on drive gear tooth.

	TOOTH CONTACT	CONDITION	REMEDY
A		IDEAL TOOTH CONTACT evenly spread over profile. nearer toe than heel.	o / o
B		HIGH TOOTH CONTACT heavy on the top of the drive gear tooth profile.	Move the Drive PINION DEEPER into MESH, *i.e.* Reduce the pinion cone setting.
C		LOW TOOTH CONTACT heavy in the root of the drive gear tooth profile.	Move the Drive PINION OUT of MESH, *i.e.* Increase the pinion cone setting.
D		TOE CONTACT hard on the small end of the drive gear tooth.	Move the Drive GEAR OUT of MESH, *i.e.* INCREASE BACKLASH.
E		HEEL CONTACT hard on the large end of the drive gear tooth.	Move the Drive GEAR INTO MESH, *i.e.* DECREASE BACKLASH *BUT* MAINTAIN MINIMUM BACKLASH as given in Table 6.

NOTES

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