Service Instruction Manual

Fourth Issue

STANDARD VANGUARD

SERIES I AND II
and
TRIUMPH "RENOWN" MODELS

REAR AXLE

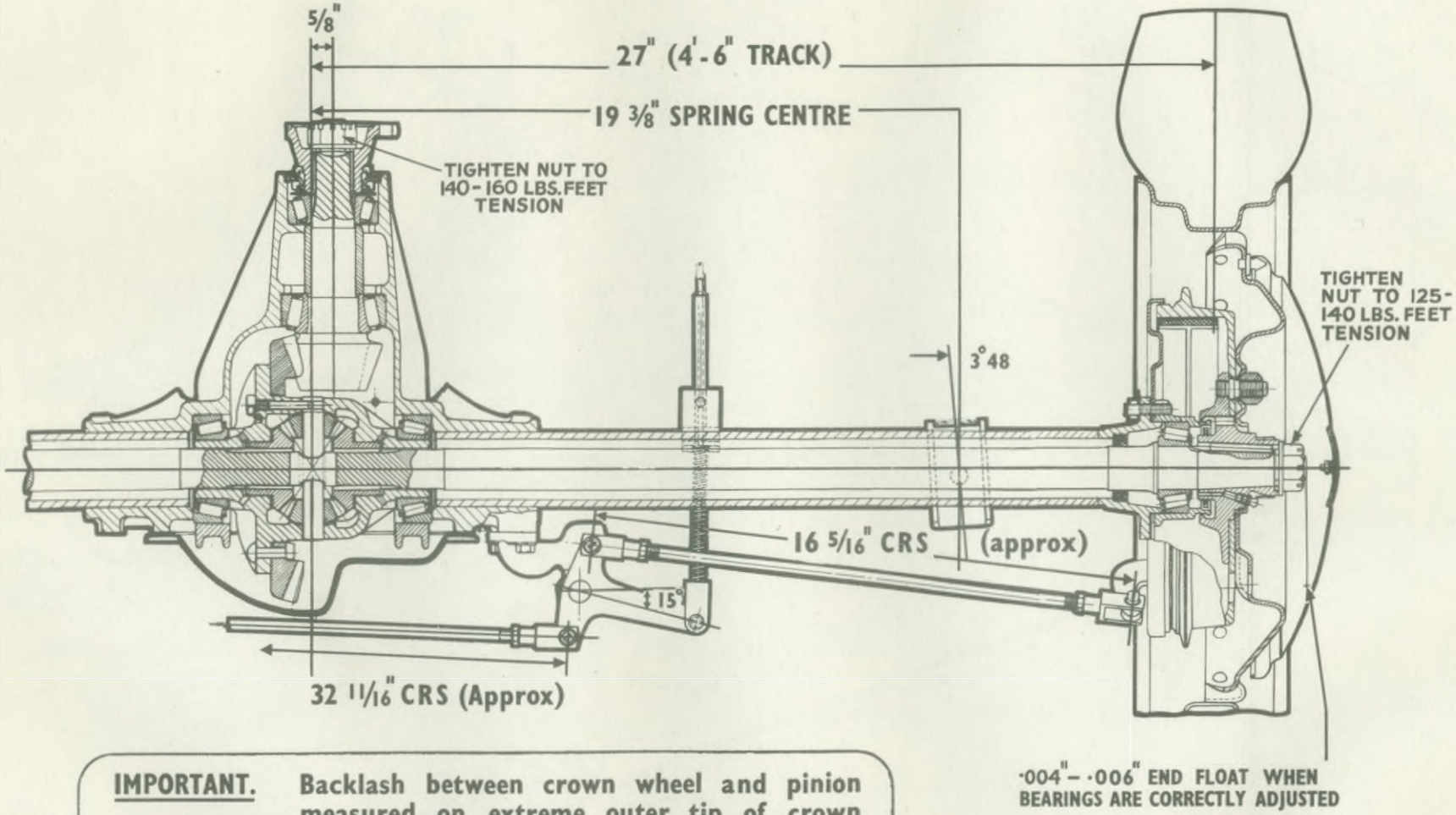
SECTION F

THE STANDARD MOTOR COMPANY LTD., COVENTRY

REAR AXLE

INDEX

ILLUSTRATIONS



IMPORTANT. Backlash between crown wheel and pinion measured on extreme outer tip of crown wheel tooth to be from ·005 inch to ·007 inch.

Pinion bearings to be preloaded to give from 8 to 10 inch pounds torque (not including oil seal).

Differential bearings to be preloaded by addition of ·006 shim.

Fig. 1. Longitudinal section of rear axle

REAR AXLE

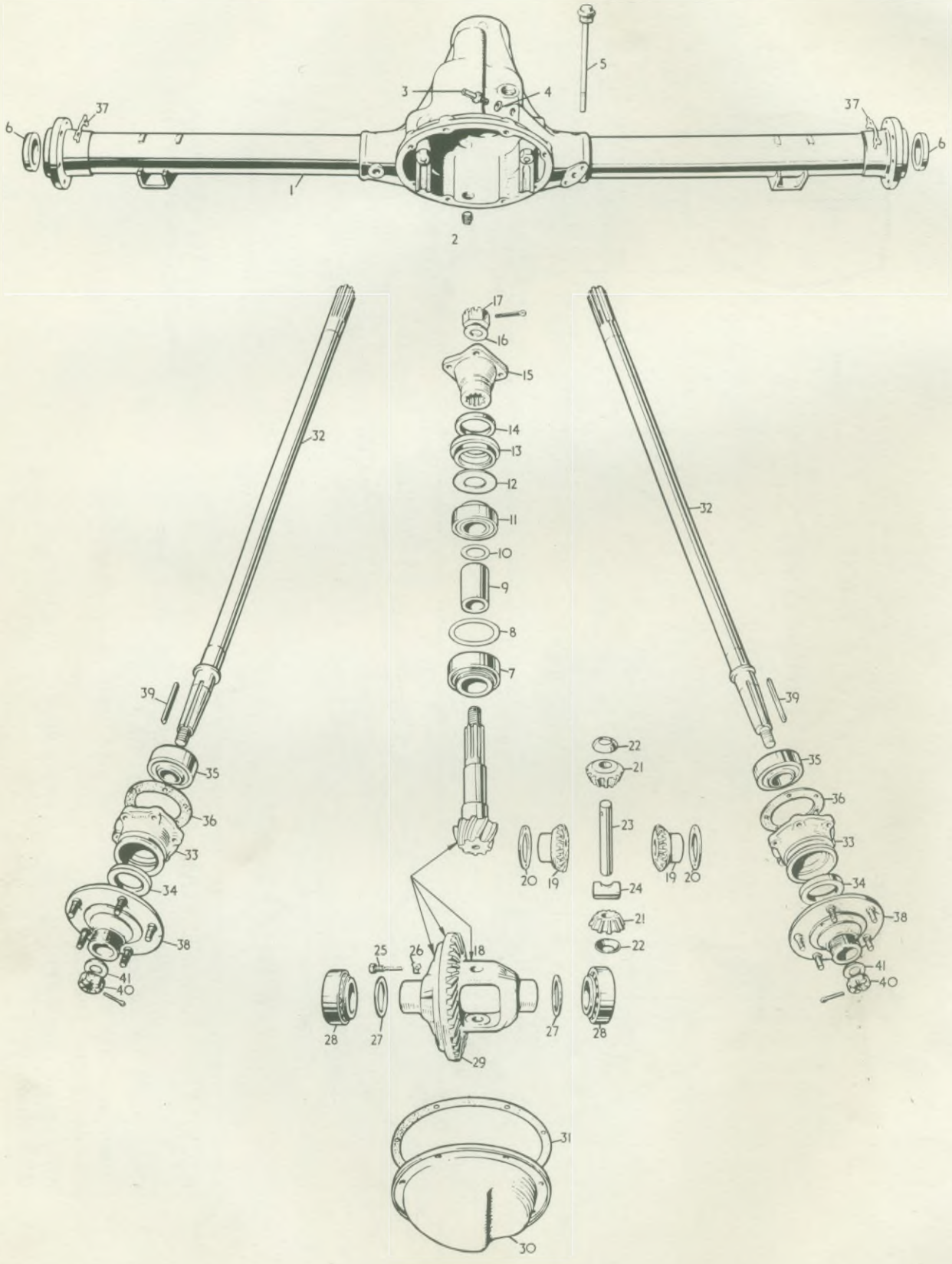


Fig. 2. Exploded view of rear axle details.

DIMENSIONS AND TOLERANCES

Rear axle.

Axle Shaft End Float ... ... .004"—.006"
Crown Wheel Run Out Not more than .003"
Backlash between Crown Wheel and Pinion ... . .005"—.007"
Distance from ground thrust face on Bevel Pinion to centre of Crown Wheel Bearings ... 4.0625" ± .000"
Depth from Centre line of Crown Wheel Bearings to Pinion Head Bearing abutment ... 5.25" ± .005"
Distance from Centre line of Crown Wheel Bearings to machined face of Centre Casing 1.875" ± .001"
Diameter of Differential Bearing Housing ... ... 3.266 / 3.265

NOTATION FOR FIG. 2

No.	*Detail*	*Item*	*No.*	*Detail*	*Item*
1	57241	Pinion Housing and Tube Assembly with Bearing Caps, Studs, Nuts and Washers.	20	56789	Thrust Washer for Sun Wheel.
			21	57699	Diff. Pinion 10T. (Com. V1-V1264).
2	57216	Drain Plug.		60693	Diff. Pinion 10T. (Com. V1265 & Future).
3	56894	Breather.			
4	56895	Washer for Breather.	22	56793	Thrust Washer for Planet Wheel.
5	56932	Dipstick Assembly.	23	56799	Cross Pin for Diff. Pinion.
6	58800	Oil Seal, Inner.	24	56792	Thrust Button.
7	58823	Taper Roller Bearing, Pinion Head.	25	56788	Locking Pin $\frac{5}{16}$" × 24 N.F.
			26	57702	Tab Washer for Locking Pin.
8	57861	Shim .010" for Pinion Head Bearing.	27	56917	Shim .010" for Diff. Bearings.
				56916	Shim .005" for Diff. Bearing.
	57860	Shim .005" for Pinion Head Bearing.		56915	Shim .003" for Diff. Bearing.
			28	58821	Taper Roller Bearing for Diff.
	57859	Shim .003" for Pinion Head Bearing.	29	60210	Crown Wheel, Pinion (sold only as a pair.
9	57866	Distance Collar.	30	58777	Rear Cover (secured by eight setscrews $\frac{5}{16}$" × 18 N.C. × $\frac{5}{8}$" long).
10	57864	Shim .010" for Distance Collar.			
	57863	Shim .005" for Distance Collar.			
	57862	Shim .003" for Distance Collar.	31	58776	Packing for Rear Cover.
11	58824	Taper Roller Bearing, Pinion Tail.	32	58757	Axle Shaft.
			33	58773	Bearing Housing.
12	57865	Oil Thrower (fitted on Pinion).	34	58801	Oil Seal, Outer.
13	58091	Oil Super Seal.	35	58822	Taper Roller Bearing (Wheel).
14	58092	Thrower Ring (fitted on Pinion Flange).	36	36581	Shim $\frac{1}{32}$".
				36582	Shim $\frac{1}{64}$".
15	57867	Pinion Flange.		38264	Shim .008".
16	WP. 0024	Washer.		36583	Shim .006".
17	57868	Slotted Nut $\frac{3}{4}$" × 16 N.F.	37	36567	Tab Washer (used with $\frac{5}{16}$" Bolt × 24 N.F. × 1").
18	57961	Differential Casing.			
19	57700	Diff. Wheel 16T. (Com. V1-V1264).	38	58346	Rear Hub Assembly.
			39	58785	Woodruff Key for Rear Hub.
	60694	Diff. Wheel 16T. (Com. V1265 & Future).	40	58784	Slotted Nut.
			41	WP. 0026	Washer.

DESCRIPTION (Figs. 1 and 2)

The rear axle is of the hypoid, semi-floating type with shim adjustment for the differential unit bearings and for the engagement between the crown wheel and pinion.

The axle sleeves are pressed into the centre casing and are located by welding. The outer extremities of these sleeves are provided with flanged and spigotted faces to accommodate the brake back plates and wheel bearing housings—shims being fitted between the axle sleeves and back plates to provide adjustment for the wheel bearings.

The axle shafts are splined at their inner ends to fit into the sun gears. The outer extremities of these shafts being tapered and provided with a key for transferring the drive to each rear hub. The inner member of each rear hub's roller bearing is mounted on a parallel portion of the axle shaft, against a flange on this, and the outer ring being accommodated in, and located endwise by, the bearing housing.

Side thrust from the road wheels is transferred from one shaft to the other by a ground faced thrust block which surrounds the differential cross pin.

The centre casing is a casting which accommodates the differential cage and the attached crown wheel, together with the hypoid pinion. A detachable pressed steel cover, at the rear of the centre casing, allows access to the differential unit and crown wheel, and the removal of which permits the withdrawal of the various components contained by the centre casing when dismantling the rear axle.

One of the special hypoid oils recommended should be used in the axle, and under no circumstances should the various brands recommended be mixed. Where doubt exists as to the brand originally employed, the axle should be drained when warm, flushed out with flushing oil (paraffin should not be used) and refilled with one of the recommended hypoid lubricants which may be available.

The differential gear is contained in a housing, to a flange of which is riveted the crown wheel.

The differential consists of two bevel sun gears, which engage with a pair of planet pinions, one at either end of a cross pin, which is mounted in the casing, the pin itself being located endwise in the housing by a tab-washered setscrew.

End thrust from the sun gears and planet pinions is taken on suitably shaped thrust washers interposed between the gears themselves and the differential casing.

The differential casing is provided with an extension on both sides, on each of which is mounted a taper roller bearing, the outer ring of which is accommodated in a housing in the centre casing. Shims are fitted between the inner ring of these bearings and the differential casing, and by varying the thickness and disposition of these it is possible to control bearing pre-loading and crown wheel and pinion backlash.

To remove and dismantle axle shaft wheel bearings and oil seals.

1. Remove castellated nut from end of axle shaft, after withdrawal of split pin ($1\frac{1}{4}$" A/F spanner required).
2. Withdraw brake drum after removal of two grubscrews.
3. Remove rear hub with extractor as shown in Fig. 3. Extraction of the rear hub provides access to the outer oil seal when it is necessary to replace this.

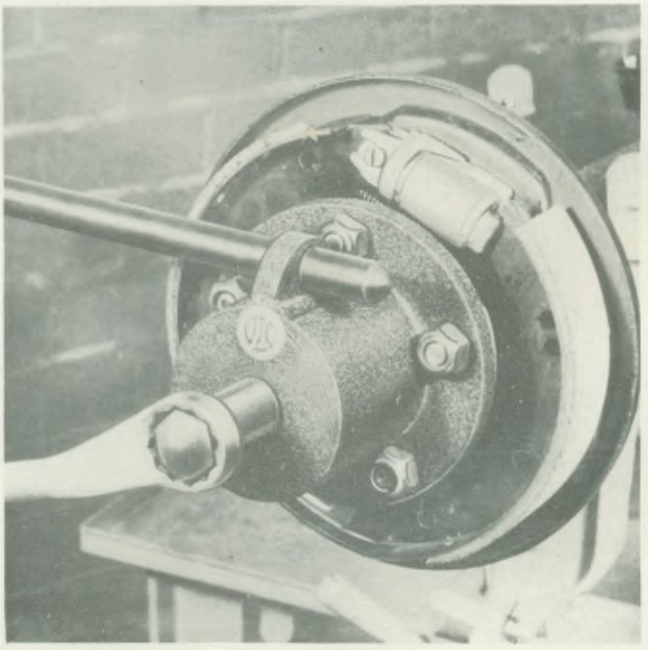


Fig. 3. Extraction of rear hub—Tool No. 20S-86

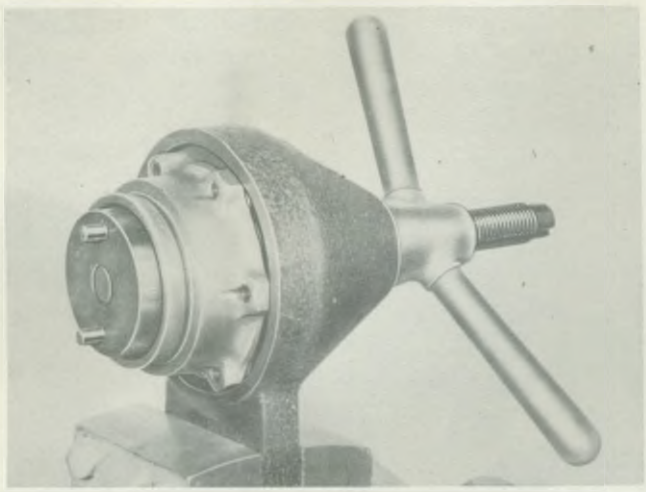


Fig. 4. Showing extraction of outer ring of wheel bearing from housing—Tool No. 20S-93

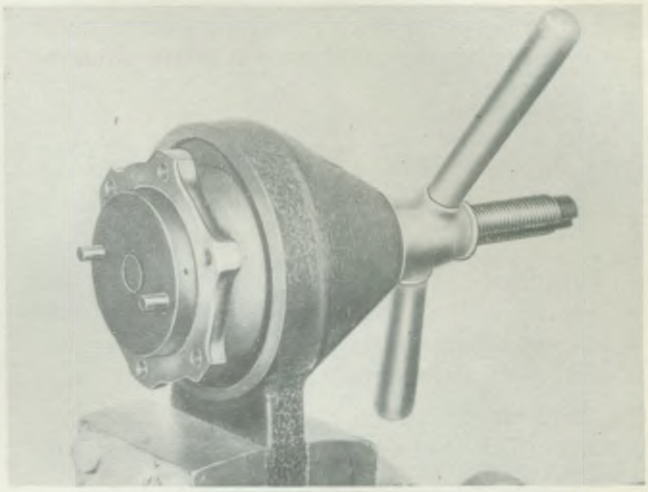


Fig. 7. Installing outer ring of wheel bearing in housing—Tool No. 20S-93

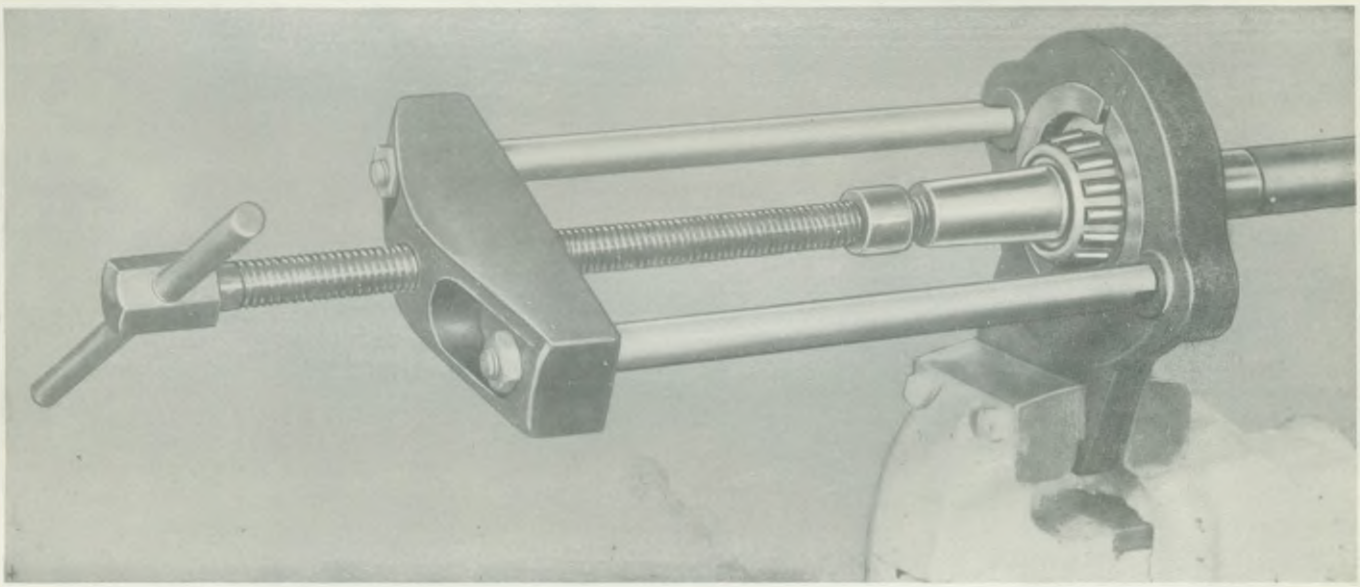


Fig. 5. Extraction of rear hub bearing inner ring—Tool No. 20SM-4615

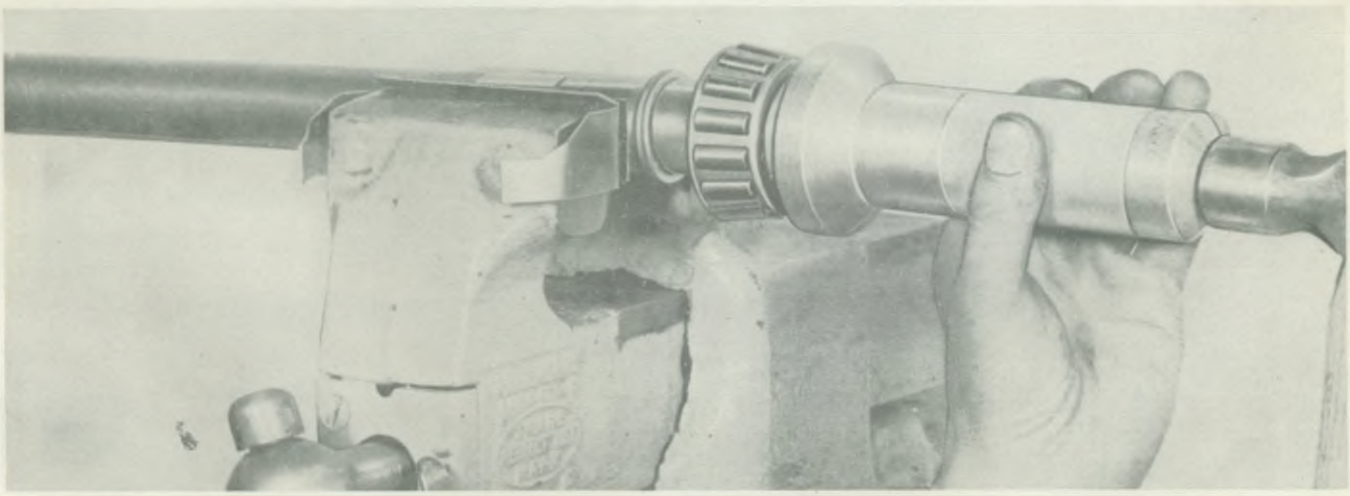


Fig. 6. Fitting wheel bearing inner ring on axle shaft—Tool No. 20S-92

4. Remove the bearing housing with outer ring bearing after withdrawal of six securing setscrews.
5. Extract outer ring of bearing from housing as shown in Fig. 4, after first tapping out oil seal, which should be subsequently replaced.
6. Withdraw axle shaft with inner ring of bearing. The inner ring of the bearing may be withdrawn with the extractor as shown in Fig. 5, after first removing the key.

To reassemble axle shaft, wheel bearings and oil seals.

1. Fit inner ring of hub bearing on axle shaft employing special installing tool as shown in Fig. 6.
2. Fit outer ring of bearing in housing as shown in Fig. 7. Refit key.
3. Install oil seal utilizing fitting sleeve as shown in Fig. 8.

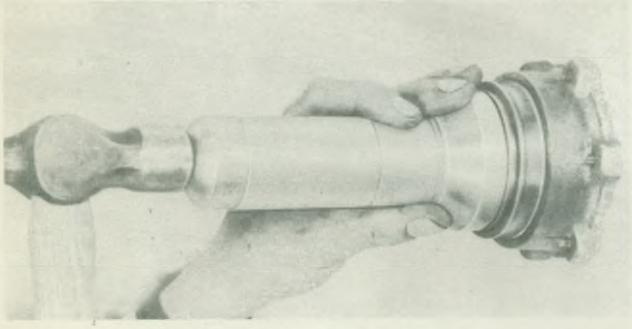


Fig. 8. Fitting oil seal into bearing housing—Tool No. 20S-92

4. Thread bearing housing with oil seal and outer ring on to shaft avoiding damage to fabric face of seal. Refit hub.
5. Examine inner oil seal, replacing if necessary, employing installing tool as shown in Fig. 9. where the necessity for its renewal arises. (This is recommended in all cases of an axle overhaul.)
6. Where a new bearing has been installed, or when, for any reason, the original thickness of shims fitted between the brake backing plate and axle sleeve is unknown, it will be necessary to check the end float of one axle shaft by pushing and pulling this against a dial indicator mounted on the backing plate as shown in Fig. 10. The correct axle shaft end float, when the bearings are correctly adjusted, should be between .004″—.006″ and can be increased or decreased respec-

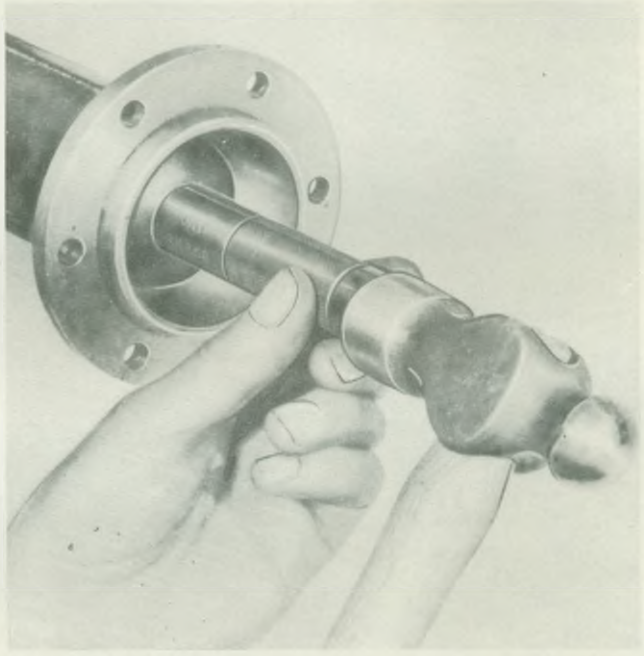


Fig. 9. Fitting oil seal in axle sleeve—Tool No. 20S-73

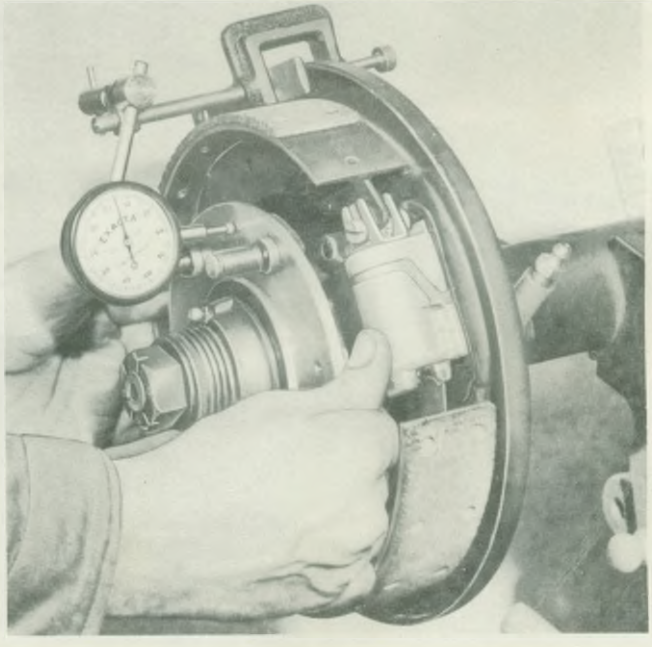


Fig. 10. Checking axle shaft end float.

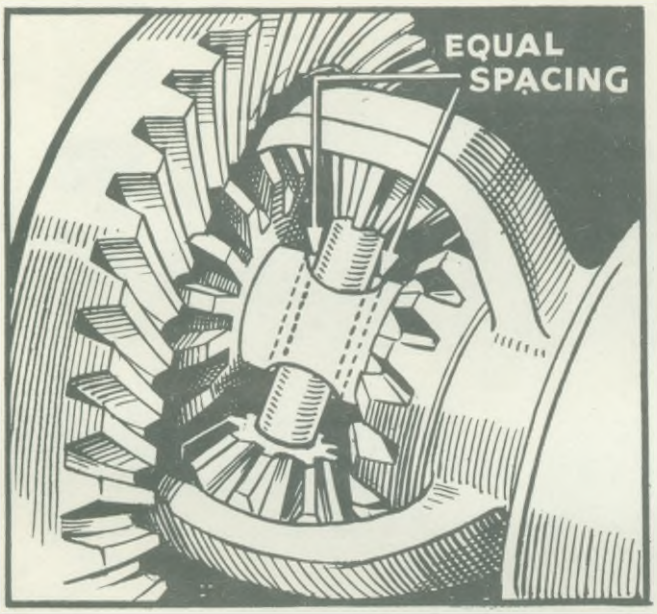


Fig. 11. Showing position of differential cross-pin in relation to thrust block

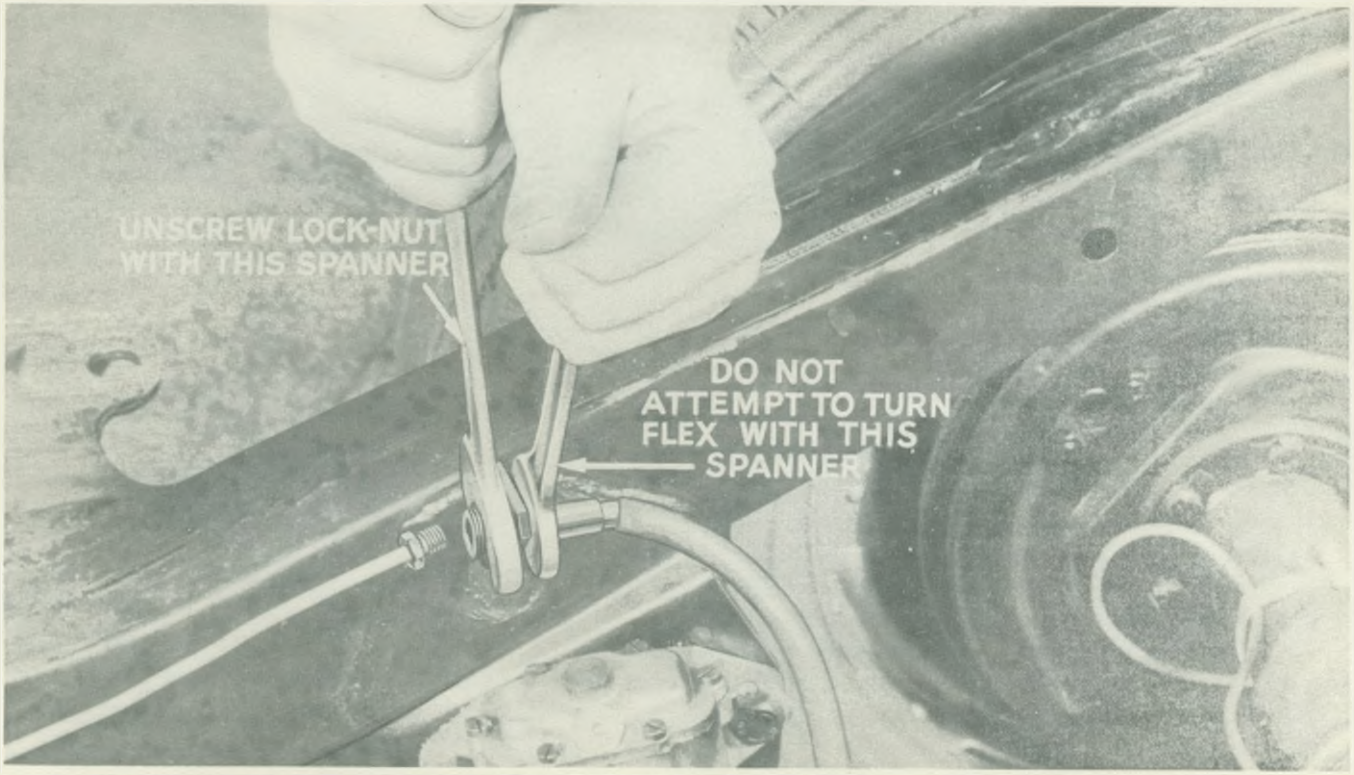
tively by adding or subtracting shims. In addition to the existence of the specified end float, it is important that the thrust block, which separates the inner extremities of the two shafts, should have a clearance on the cross pin, upon which are mounted the differential planet gears, as shown in Fig. 11, and this will obviously depend on the allocation of the shims between each backing plate and axle flange.

Removal of rear axle from chassis.

To remove the rear axle from chassis, the following procedure is recommended :—

1. Jack up rear of car, at a position on each of the chassis side members, just in front of the rear spring front shackle pin.
2. Detach propeller shaft flange from that fitted on the pinion shaft, by withdrawing the four bolts and Simmonds nuts which secure these.
3. Remove road wheels.
4. Disconnect hydraulic pipe line at junction on right-hand side member, just forward of the rear axle, by unscrewing the lock nut shown in Fig. 12. UNDER NO CIRCUMSTANCES SHOULD AN ATTEMPT BE MADE TO UNSCREW THE FLEXIBLE OIL PIPE AS THIS MAY CAUSE IRREPAIRABLE DAMAGE.

Fig. 12. Disconnecting flexible brake pipe-line from abutment bracket on chassis



5. Pipe line should be plugged to prevent loss of fluid and similarly the pipe line fixed to the rear axle should be drained off into a clean receptacle.
6. Detach hand brake cable from abutment bracket on axle and remove its clevis pin, taking care not to lose anti-rattle spring.
7. Remove spring " U " bolts and leave spring plates attached to shock absorber links.
8. Lift out axle assembly.

To dismantle rear axle.

1. Drain axle of oil.
2. Proceed to dismantle axle shafts, wheel bearings, etc., as directed under operations 1-6 on Pages 4 and 6.
3. Remove brake shoe assemblies with backing plates, dismantling shoes if necessary as directed in the section on " Brakes."

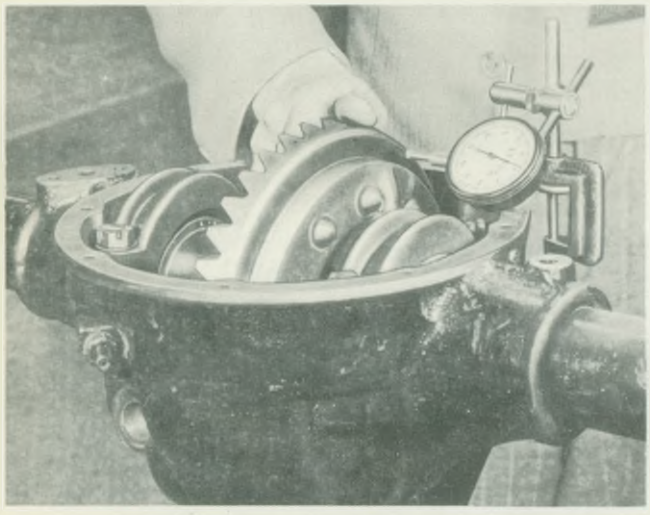


Fig. 13. Checking crown wheel for run-out prior to dismantling

4. Remove inner oil seals if these require renewing. It is a wise precaution when overhauling an axle to make such replacements as a matter of routine.
5. Detach centre casing cover by removal of eight setscrews and spring washers ($\frac{1}{2}$" A/F spanner).
6. Clean out differential gear and bearings with paraffin, petrol or other solvent, and check crown wheel for run out with a dial gauge as shown in Fig. 13. Run out in excess of .003" indicates either loose or defective differential bearings, or possibly a distorted differential housing, and should be dealt with accordingly.

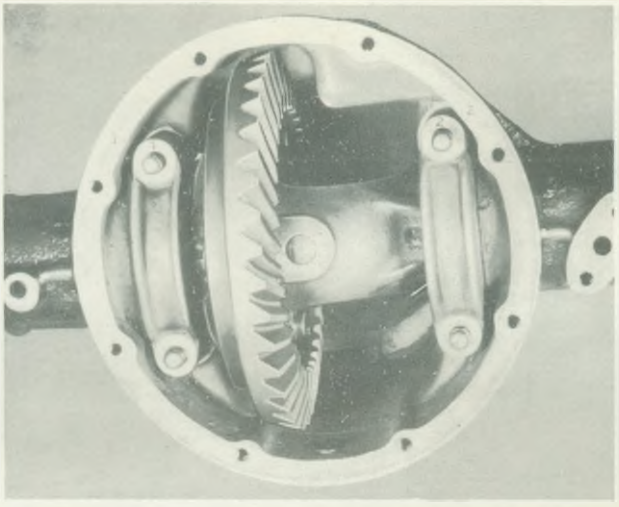


Fig. 14. Showing differential housing and bearing cap markings

7. Remove the two bearing caps, which clamp the differential bearings in position after the withdrawal of the two pairs of securing nuts ($\frac{11}{16}$" A/F spanner required). Take note of the markings on the caps and their respective housings in the centre casing, which are illustrated in Fig. 14. The correct inter-relation of the housings and bearing caps must be maintained.
8. Fit the casing spreader as shown in Fig. 15 and spread casing just sufficiently to over-

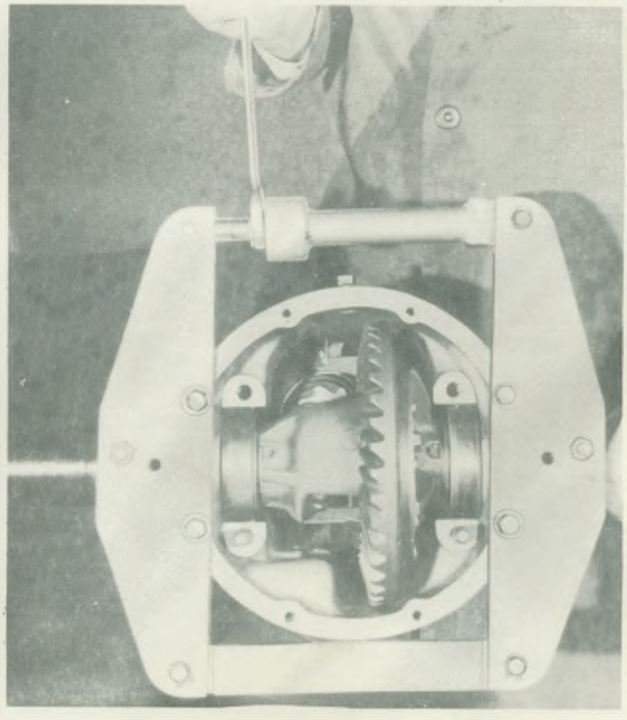


Fig. 15. Using casing spreader—Tool No. 20SM-4220

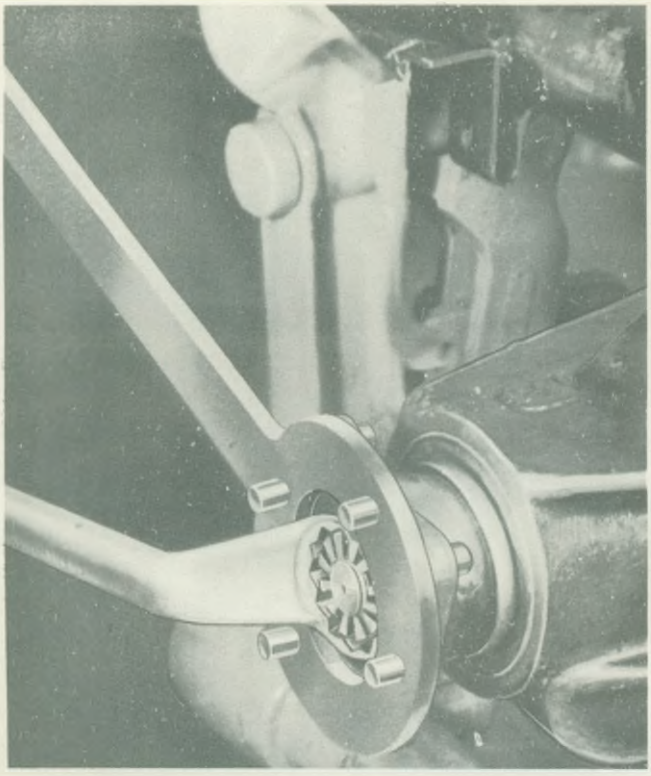
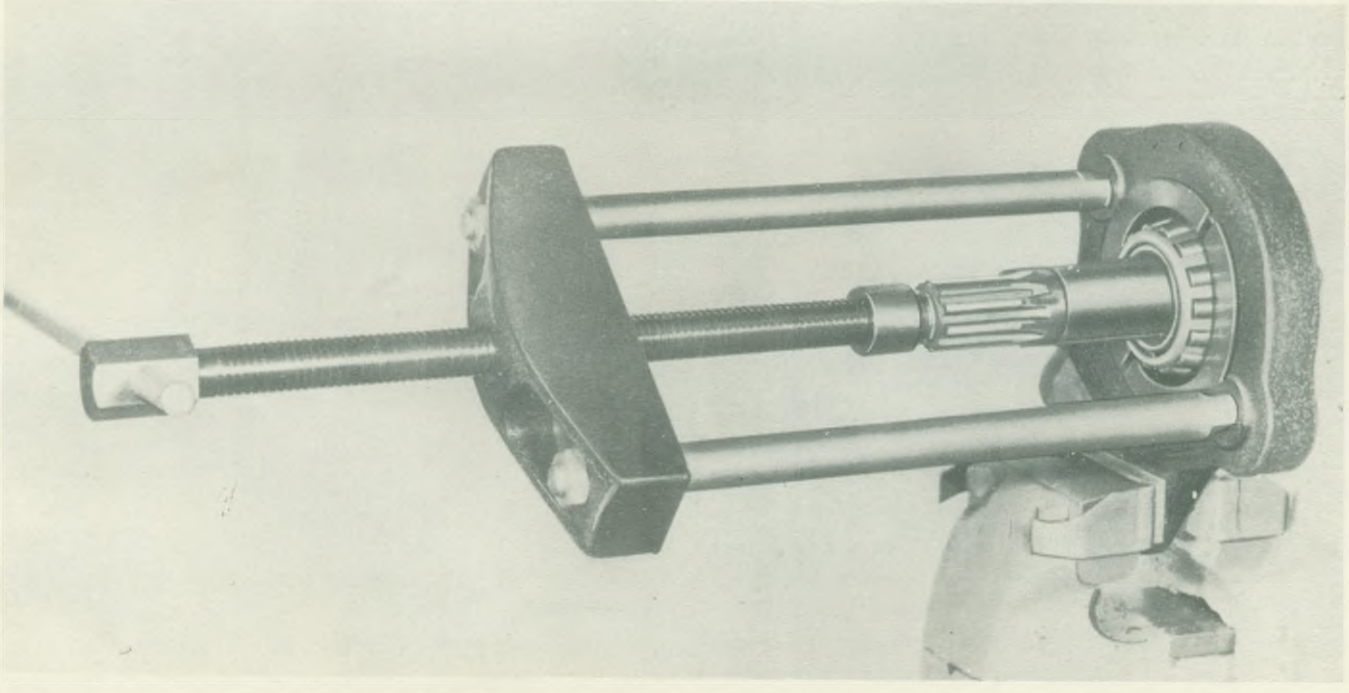


Fig. 16. Removal of pinion driving flange securing nut

Fig. 17. Extraction of pinion head bearing inner ring

come any bearing preload which exists and lift out differential unit. Overspreading of the casing should be avoided.

9. Remove driving flange securing nut from pinion shaft, utilizing a $1\frac{1}{4}$" A/F spanner and pronged holding tool as shown in Fig. 16.
10. Drive the pinion shaft out into the interior of the centre casing using a brass drift, or soft-faced hammer, on the forward end of this shaft, releasing this from its tail bearing and leaving the inner ring of the head bearing in position against the pinion. The pinion can now be pulled out of the axle casing with the inner ring of the head bearing, the distance collar and shims. The shims should be kept together for refitting, but if new pinion bearings are to be installed, the thickness of these may have to be varied to give the correct amount of pre-loading, the provision for which is explained later in these instructions.
11. Extract pinion head bearing inner ring as shown in Fig. 17.
12. Drive out pinion tail bearing with oil seal, employing special tool as shown in Fig. 18. (The illustration shows the oil seal already removed the better to show the operation of this tool.)
13. Drive out outer ring of pinion head bearing with shims, employing tool used for Operation 12. Place aside shims against the



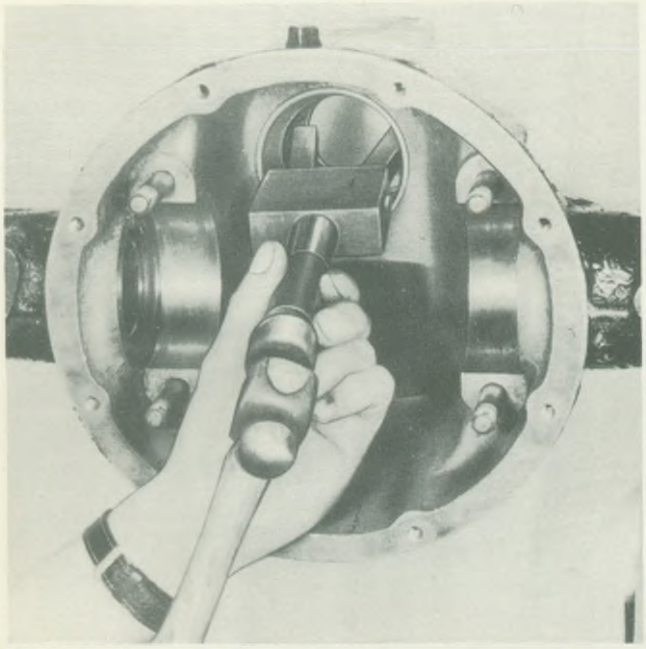


Fig. 18. Driving out pinion bearing outer ring

possibility of the same pinion head bearing being employed when reassembling.

14. Dismantle the differential gear by releasing tab washer on cross pin locating setscrew and screwing this out of the housing and driving the cross pin out of the casing, keeping the flat on the pin parallel with and adjacent to the relieved tooth on the ring gear. The sun and planet wheels with their respective thrust washers can now be withdrawn, completing the dismantling of the rear axle.

To reassemble rear axle.

For Home Agents it has been decided to supply replacement axle units less axle shafts, hubs, brake shoes, backing plates, etc., on an exchange basis.

Where the facilities exist for carrying out the work, the procedure indicated for Overseas Agents may, of course, be adopted.

For Overseas Agents, owing to the shipping difficulties, paired crown wheels and pinions will be supplied with the necessary rivets. Separate instructions with regard to the riveting of the crown wheel to the differential casing for the benefit of Overseas Agents are given later in this Section, on page 14.

In the procedure for assembly of the rear axle, instructions are based on the assumption that a new crown wheel and pinion is required together with new bearings. Naturally, in a number of cases, all such replacements may not be required.

The procedure we recommend is as follows :—

1. Reassemble differential gear, replacing damaged or worn gears and thrust washers. Fit and secure cross pin locating setscrew with tab washer, noting position of flat on this pin adjacent and parallel to relieved tooth on crown wheel (where a crown wheel has to be riveted to the casing the work will be carried out before assembling this, as explained later in this Section).
2. Examine the machined portions of the differential casing for burrs and remove any such excrescences. Clean the assembly, particularly the contacting faces.
3. Drive on inner rings of differential bearings employing the special driver as shown in Fig. 19, but without yet fitting shims. Fit outer rings after carefully cleaning coned faces.

Fig. 19. Fitting inner ring of differential side bearing

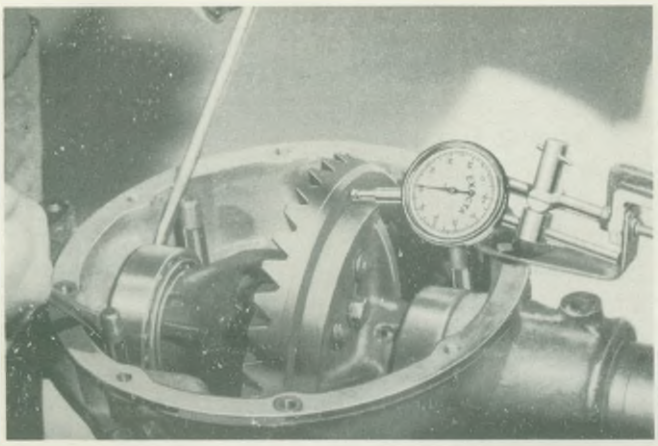


Fig. 20. Checking differential assembly end float

4. Fit differential assembly with crown wheel and bearings into casing, after ensuring that the housings are scrupulously clean.

5. Check total end float in differential assembly as shown in Fig. 20. Note the end float, adding .006″ for pre-loading, the total figure, which will probably approximate to .050″, will give the thickness of shims required. Do not yet fit these shims. Now remove differential assembly and crown wheel from centre casing.

6. Apply pinion shim estimating fixture, placing the taper roller bearing, which abuts against the ground thrust face of the pinion head, beneath the anvil of this fixture as shown in Fig. 21. Utilize a feeler gauge to check the clearance between the upper side of this bearing and the adjacent ground face of the

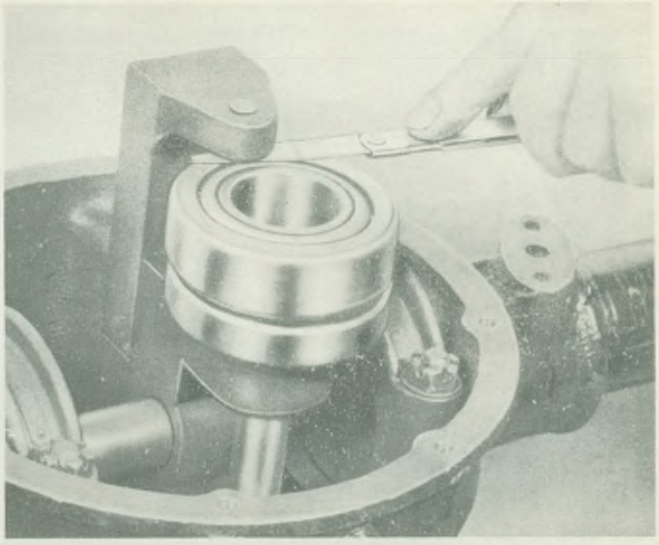


Fig. 21. Employing special fixture to enable estimation of "shimming" required

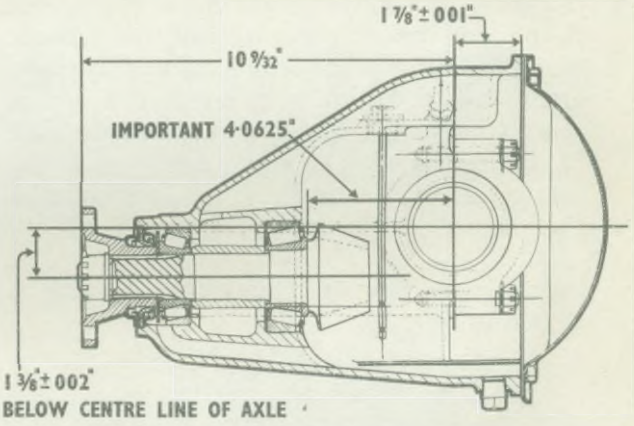


Fig. 22. Dimensional details for pinions & bearings

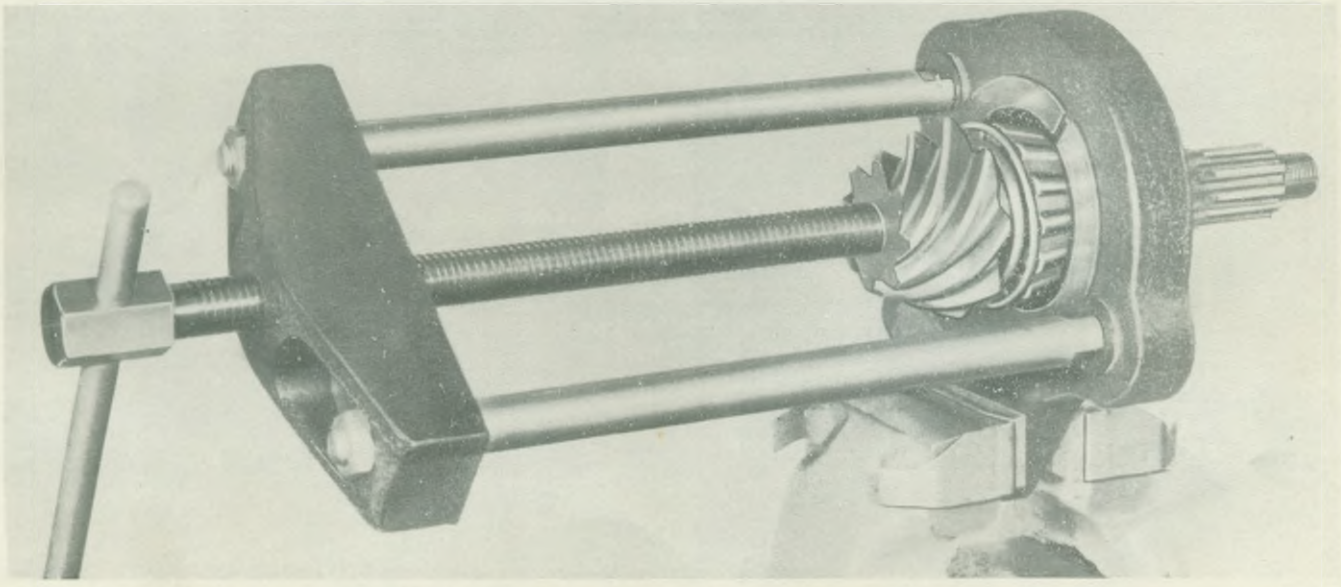


Fig. 23. Fitting pinion head bearing inner ring —Tool No. 20SM-4615

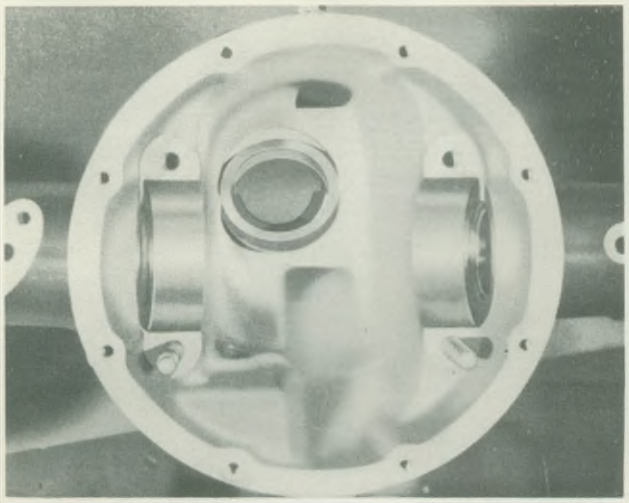


Fig. 24. Showing position of pinion head bearing shims on abutment face

fixture, this clearance should represent the thickness of shims required between the casing and bearing outer ring, to provide correct pinion and crown wheel engagement. (The datum position of the pinion should be such that the ground thrust face of pinion is 4.0625″ ± .000″ from the centre line of the crown wheel, as shown in Fig. 22.)

7. Install inner ring of pinion head bearing as shown in Fig. 23.

8. Having made the first check for pinion head bearing shimming, install the calculated thickness of shims placed on the head bearing abutment face, as shown in Fig. 24 (these shims should be measured with a micrometer) and pull in outer ring of pinion tail and head bearings with special tool, as shown in Fig. 25 (both outer rings are installed together).

9. Fit pinion into position, subsequently fitting distance collar, original shims removed on dismantling inner portion of tail bearing, oil thrower and driving flange, tightening this into position with securing nut employing 1¼″ A/F tension spanner and flange holding tool as shown in Fig. 26. Tighten nut to 140-160 lbs. feet tension. For the next test DO NOT fit the oil seal.

10. Having carried out the previous operation, there should be no end play in the pinion shaft and there should be sufficient pre-loading to impose a slight drag and resistance to the turning of the driving flange. The pre-loading of the oiled bearings should be such as to require a torque of 8-10 inch lbs. to revolve flange which can be accurately gauged by the employment of the fixture shown in Fig. 27.

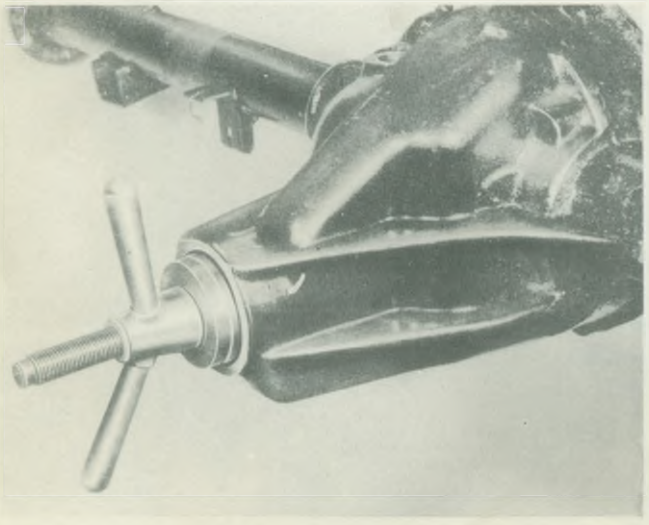


Fig. 25. Fitting pinion bearing outer rings

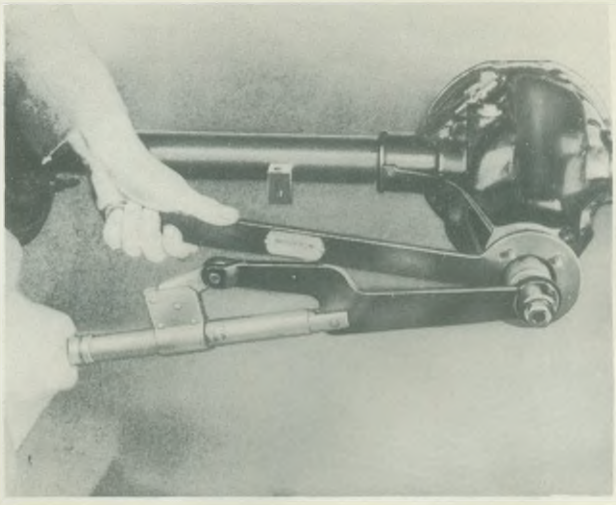


Fig. 26. Tightening driving flange holding nut with Churchill torsion wrench.

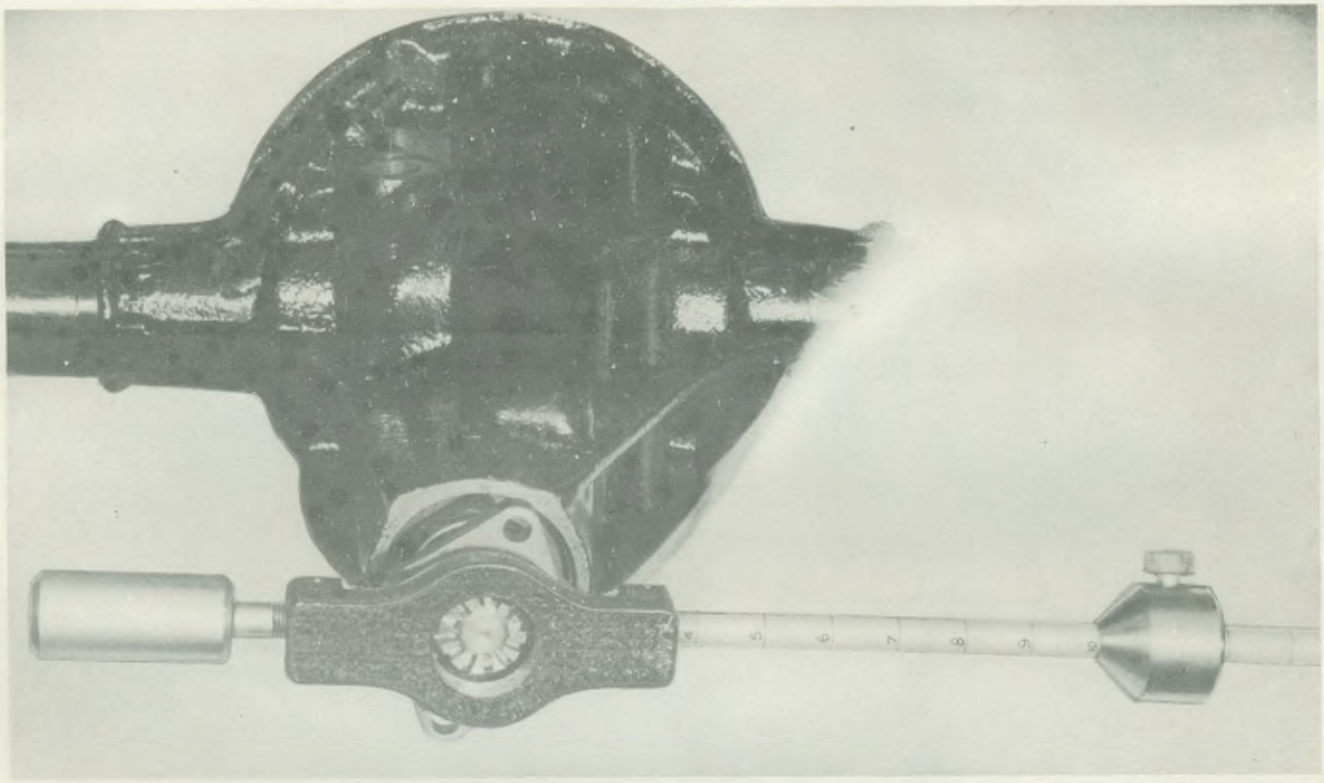


Fig. 27. Checking pinion bearing preloading with special fixture. Graduations give torque in inch-pounds

11. Taking steps to ensure the scrupulous cleanliness of the differential bearing cones and cups and of their respective housings, again install the assembly in position, still without shims between the housing and bearings.

12. Install a dial indicator, with its plunger against the back of the crown wheel, and by prising the outer ring of the differential housing bearing with two large screwdrivers or other suitable levers, the crown wheel hard into the pinion. After setting the dial indicator to zero force the differential assembly in the opposite direction as shown in Fig. 28, until the opposite bearing cup is hard against the housing. The reading of the dial gauge now registered (less .006" for crown wheel and pinion backlash) represents the thickness of shims required between the bearing on the crown wheel side and the differential casing. By subtracting this latter dimension from the total shims, the thickness calculated in Operation 5, obviously gives the shim thickness for the other differential bearing. Extract side bearings, employing extractor as shown in Fig. 29, and fit shims, as calculated above, afterwards re-installing assembly and securing bearing caps, regarding their correct inter-relation indicated by markings. (Spreader shown in Fig. 15 will facilitate installation of differential unit.)

13. As a final check on crown wheel and pinion backlash, install a dial indicator, as shown in Fig. 30, with the plunger resting on the flank of a crown wheel tooth. Use up backlash by rocking the crown wheel to and fro by hand and note the reading on the gauge. If backlash does not fall between the prescribed limits of .005" — .007", shims should be moved from crown wheel side to the side remote from this to increase, or the reverse procedure adopted to decrease, lost movement.

14. Having set the backlash to the limits specified above, paint 10 or 12 teeth of the crown wheel with red lead or other marking material, and move the painted teeth over the pinion until clear tooth markings are obtained and compare these with the markings given in Fig. 31. Refer below to note on " Tooth Markings."

15. Remove the driving flange as previously described and fit oil seal with installing tool as shown in Fig. 32. Re-install driving flange, fit axle shafts, wheel bearings, etc., as

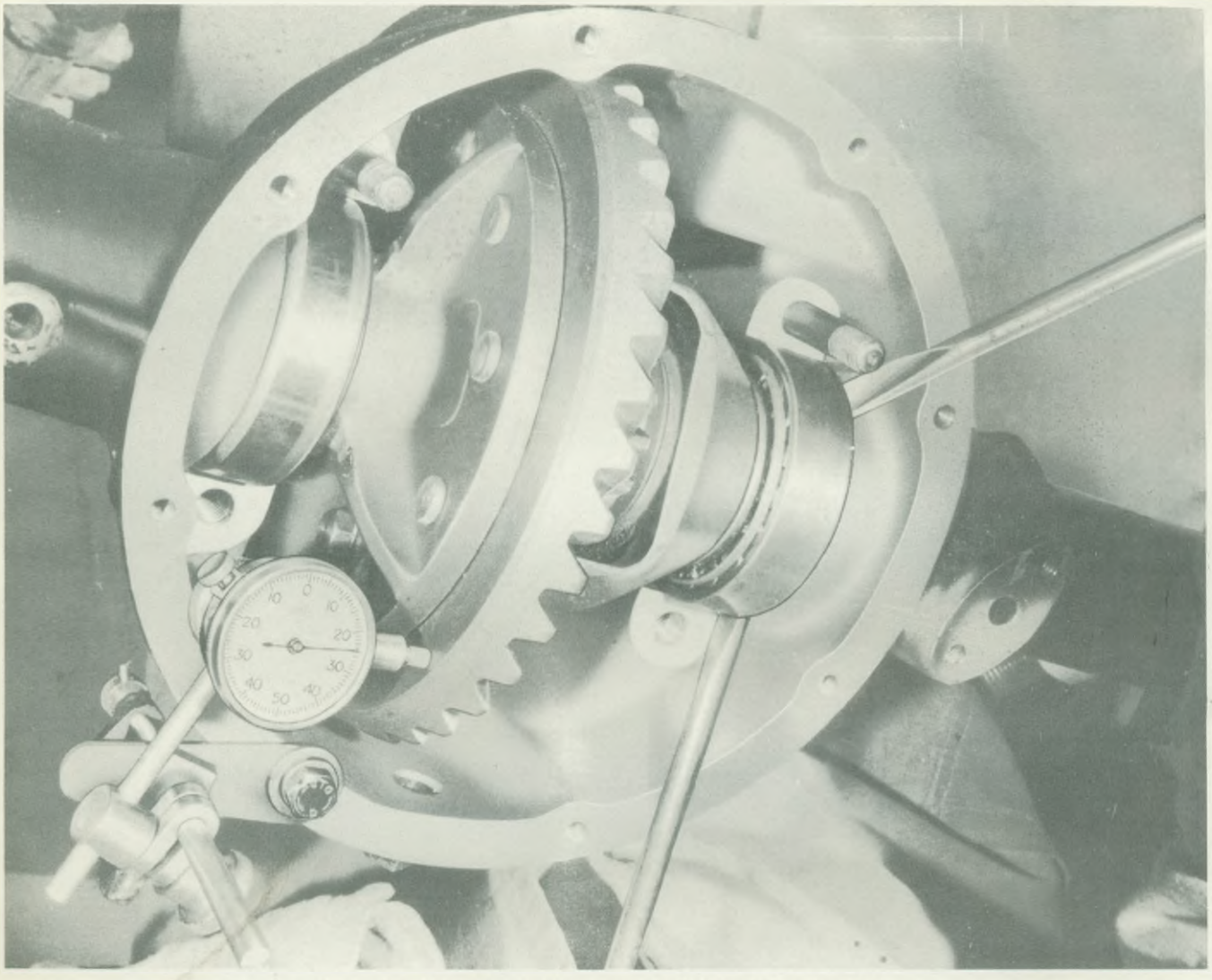


Fig. 28. Checking side float of differential assembly in relation to hypoid pinion

described on page 6, and after renewing centre casing cover packing and fill to level with correct grade of hypoid oil selected from the list of recommendations given in General Data Section.

Note—Tooth Markings.

Owing to the fact that, after the crown wheel and pinion have been lapped together at the correct centres of 4.0625", these gears are subjected to a proprietary process known as "Parco-lubrizing" which consists in depositing lubricating media on the tooth faces, tooth markings may be sometimes misleading and should on that account, be treated as of secondary importance to the correct cone centres and backlash. The correct mounting distance of 4.0625", which is maintained during lapping, must be respected during assembly, and all adjusted to give a backlash of .005" — .007" and the bearings preloaded to give the necessary rigidity to minimize deflection. Providing these precautions are observed during assembly, the markings shown in Fig. 31 will be produced within very close limits.

Riveting crown wheel to differential housing.

The crown wheel is riveted to the differential housing, and in the factory this riveting is carried out with the Holder-Hunt electrical heating and hot closing machine. This machine is a fairly expensive one and may not always be available in our agents' repair shops.

To meet the need of repairers, where suitable hot-riveting facilities are not available, we have investigated the application of cold

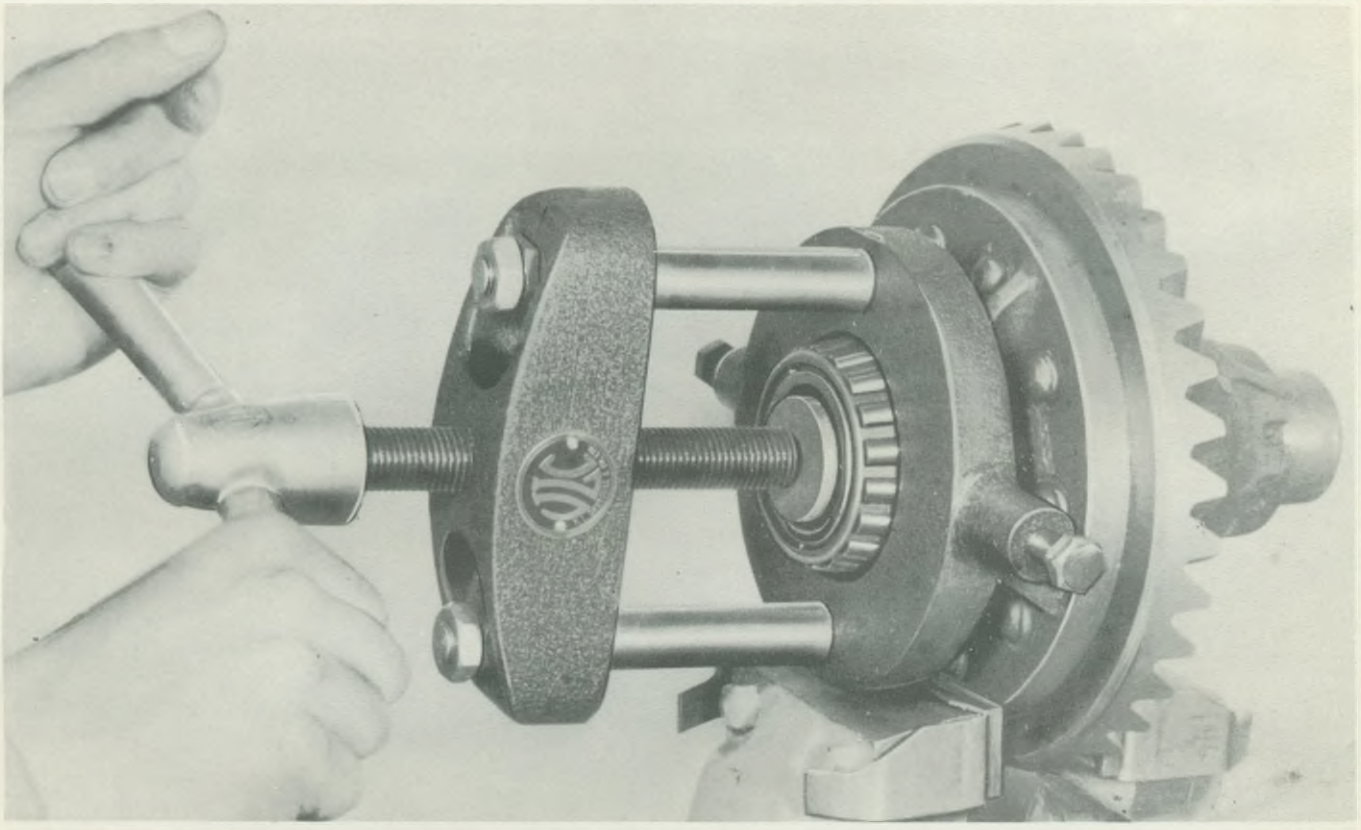


Fig. 29. Removal of differential bearing inner ring with approved extractor.
(*Remove cross-pin set-screw before using extractor*)

riveting and find that this can be adopted quite satisfactorily, providing certain precautions are observed.

Specially shortened rivets should be used as those used for hot riveting cannot be dealt with properly by a cold process. When carrying out this work it is important that an adequate load is employed and that suitable equipment is used. Our Engineering Department used a Churchill riveting fixture which had been specially designed for this purpose and this proved quite satisfactory for the work. Arising out of these investigations the following recommendations are made:—

1. A hardened steel punch should be used having a concave depression $\frac{1}{2}$" in diameter with $\frac{3}{8}$" radius.

2. Rivet lengths should be $1\frac{1}{4}$" under the head. Such a rivet has been specified for servicing purposes. (Detail 61884.)

3. The riveting load should be 8-12 tons.

4. A hardened steel dolly should be used which should support at least to $\frac{1}{32}$" from the edge of the rivet head.

5. Adequate means of holding the punch, crown wheel and dolly, are necessary so that no tip or digging in of the dolly is experienced.

All the above requirements are satisfied by the equipment manufactured by Messrs. V. L. Churchill & Co. Ltd. Fig. Nos. 33, 34 and 35 illustrate the equipment in use and the individual items of which it is composed.

Alternative method of estimating the thickness of shims for differential bearings.

In our Reconditioning Department, we employ a pair of Vernier Rings for estimating the shim thickness required, to give the necessary backlash between the crown wheel and pinion and to provide the desired degree of preloading to minimize bearing deflection.

These Vernier Rings are somewhat expensive and their use can only, therefore, be justified where a large number of axles are likely to be handled.

The Vernier Rings are positioned on the differential casing trunions, as shown in Fig. 37,

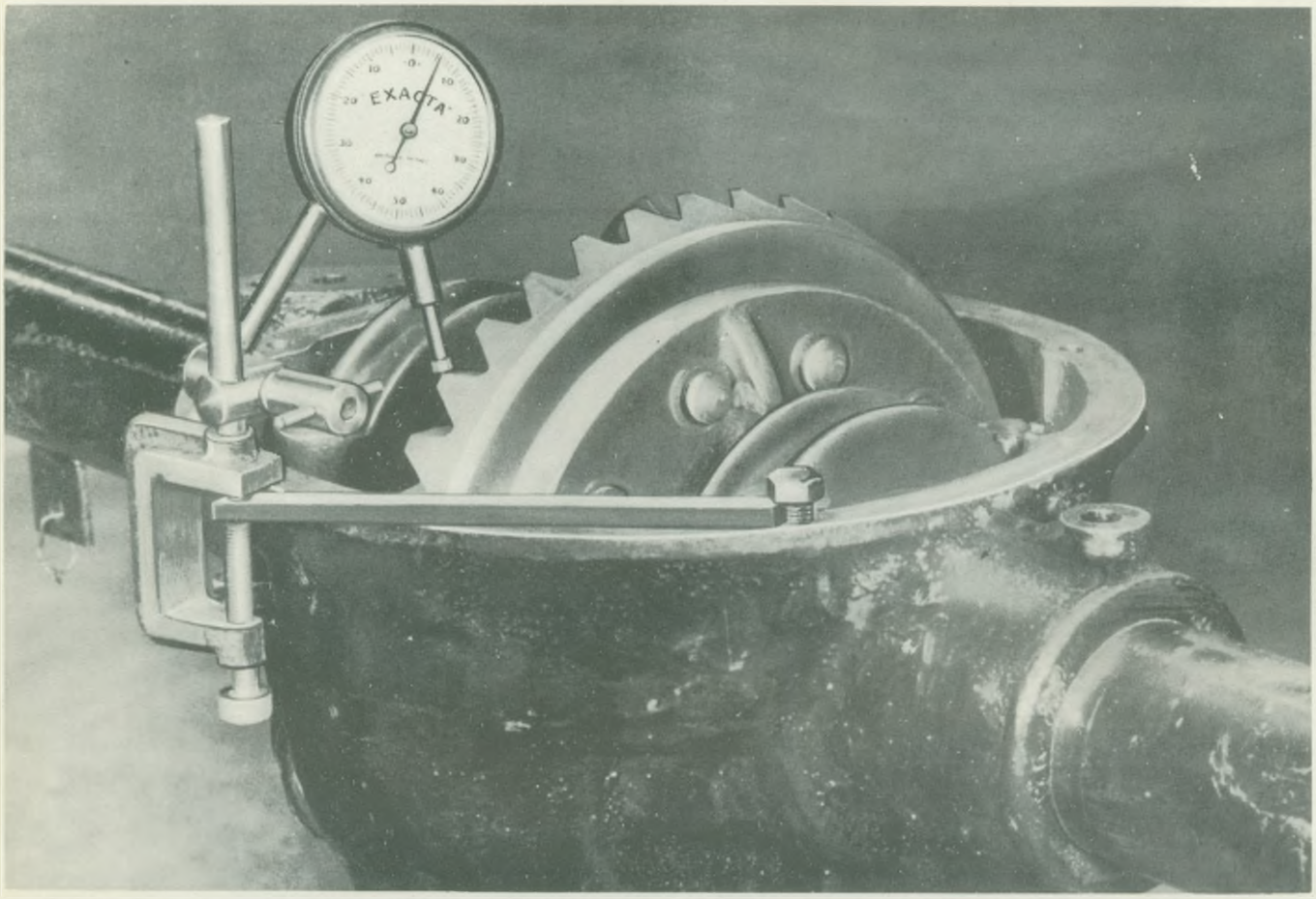


Fig. 30. Checking backlash between crown wheel and pinion

and after the assembly has been inserted in the casing, as shown in Fig. 36, the rings are adjusted so as to take up all side float and to provide a backlash of .005″ — .007″ between the crown wheel and pinion.

The Vernier Rings are both provided with a right-hand thread. Reading the graduation aligned with square edge at A and B, the thickness of shims required (less allowance for bearing's departure from nominal thickness, as explained below), will be respectively .031″ and .038″. Allowance is made in the design of the fixtures for the provision of preloading for the bearings.

In view of the fact that the thickness of the differential bearings may vary, within the limits of their tolerances, and that the Vernier Rings are designed to read from the nominal thickness, after making the necessary deduction to each to provide the required degree of preloading, in order to get accurate results, allowance must be made for these variations in thickness. To compare the thickness of the bearings to be used with the nominal thickness, a dial indicator and a setting piece should be used.

A dial indicator is "zeroed" with the plunger resting on a setting piece, the nominal thickness of the bearings themselves, *i.e.*, $1\frac{1}{16}$″. The bearings to be fitted are then placed under the dial gauge and the variation from the standard thickness can be measured and subtracted from the respective vernier readings. (The variation in every case will be in a positive direction.) When measuring these bearings always place the inner portion of the race downwards on the surface plate, thus working off the ground portions of the rollers.

Fig. 38 shows the indicator being set to zero, and Fig. 39 a bearing being measured.

These Vernier Rings can be made to special order by Messrs. V. L. Churchill & Co. Ltd., 27/34, Walnut Tree Walk, Kennington, London, S.E.11. Cost and delivery will be dependent upon the material position at the time the order is received.

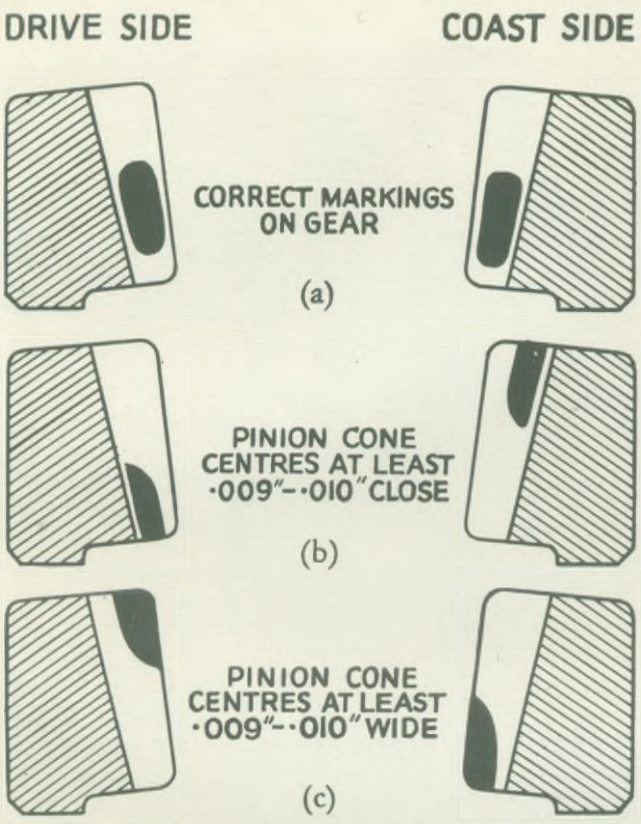


Fig. 31. Hypoid pinion tooth markings

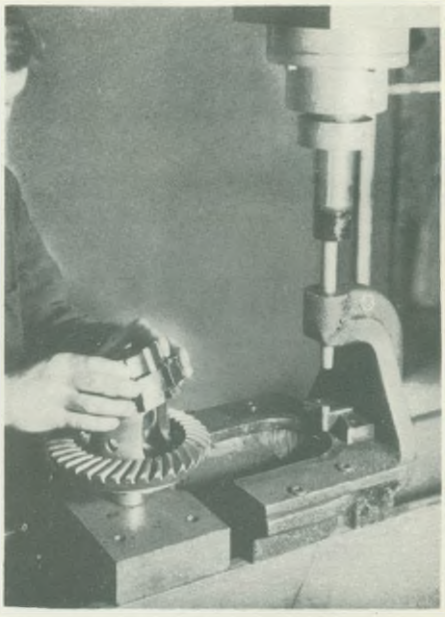


Fig. 33. Applying carrying fixture to crown wheel and differential housing assembly

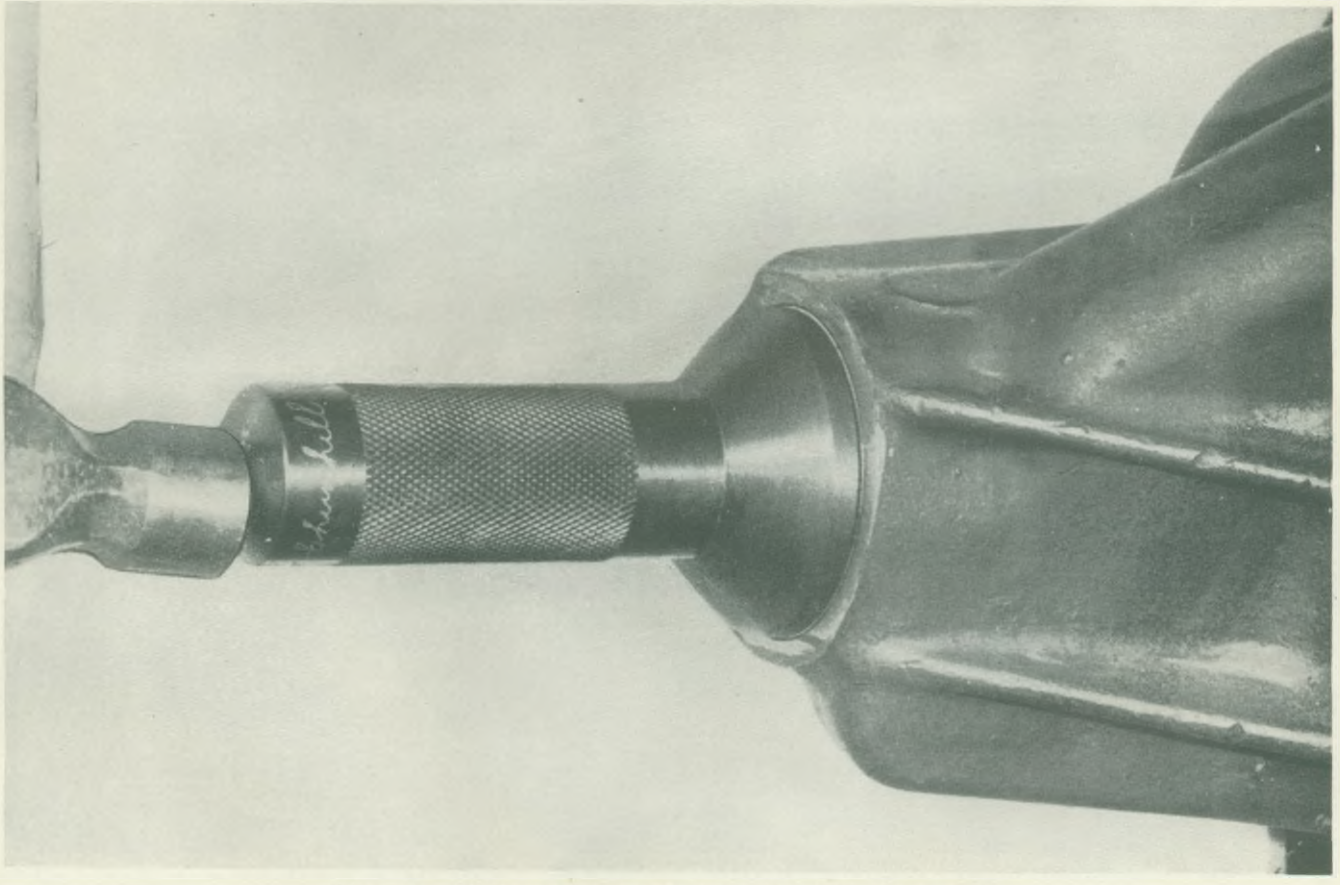


Fig. 32. Fitting pinion oil seal with installing tool

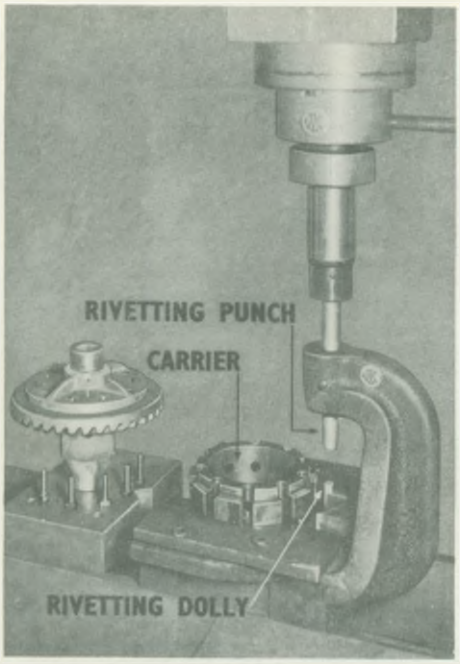


Fig. 34. Showing carrying fixture in position under press

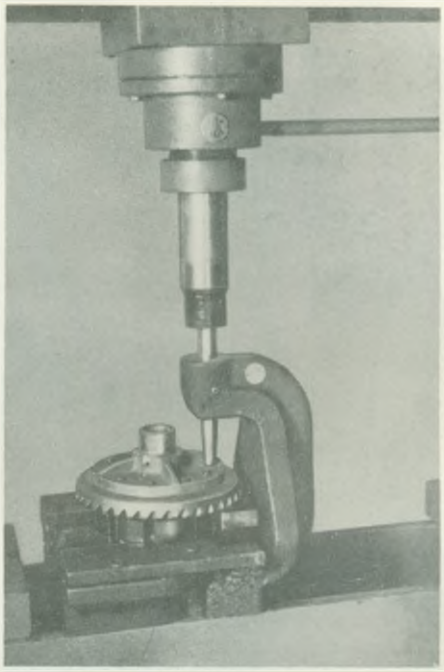


Fig. 35. Riveting operation being performed

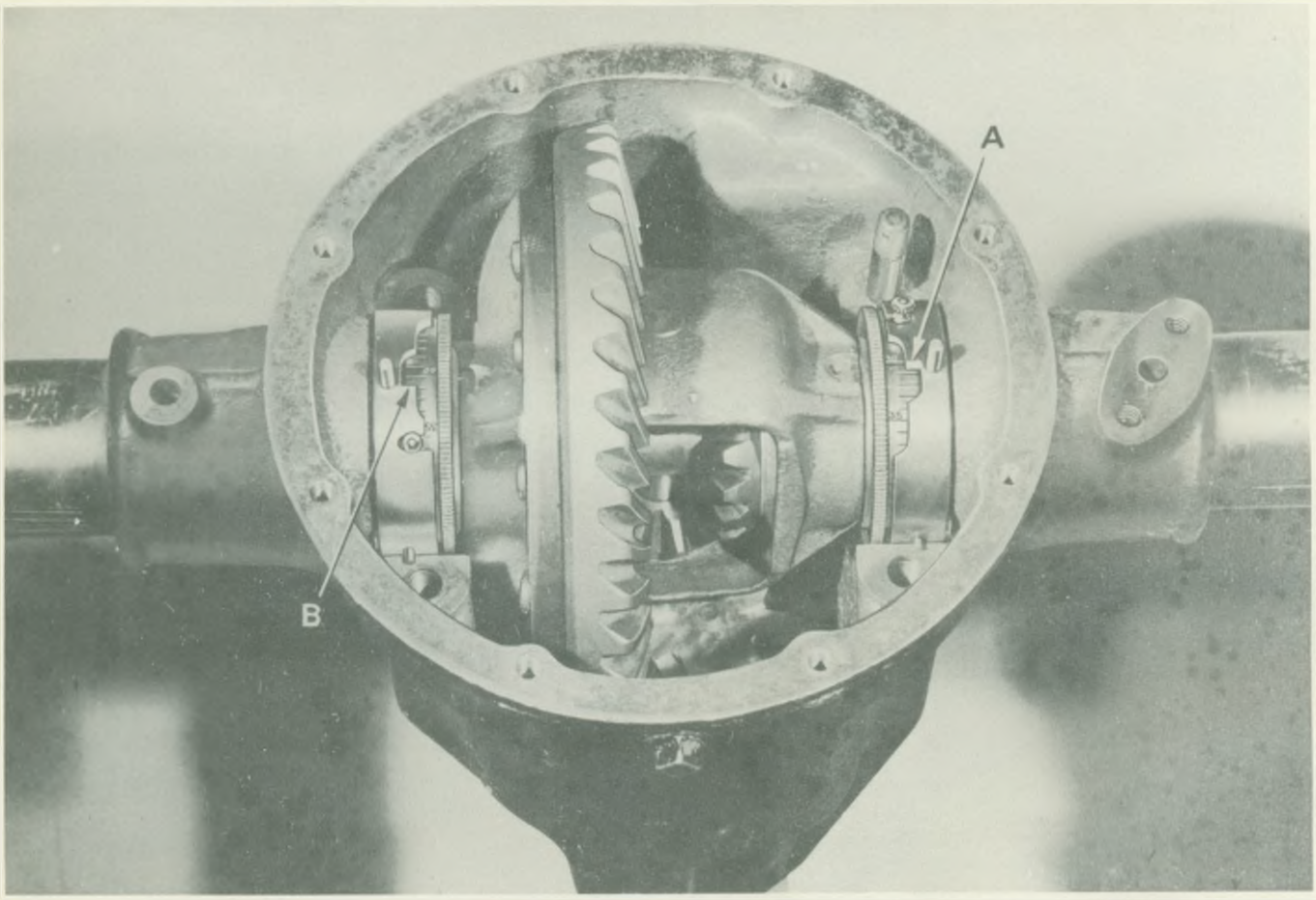


Fig. 36. Showing the employment of special vernier rings to assess thickness of shim.

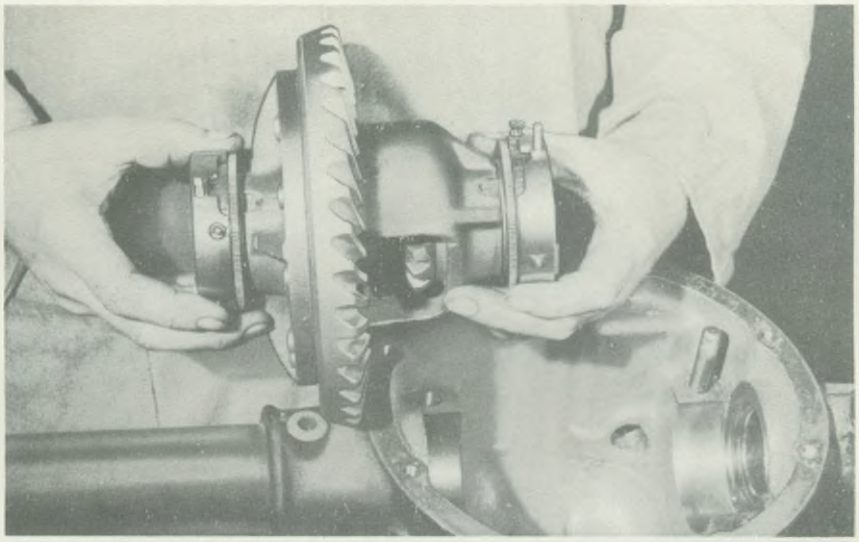


Fig. 37. Showing application of shim estimating vernier rings.

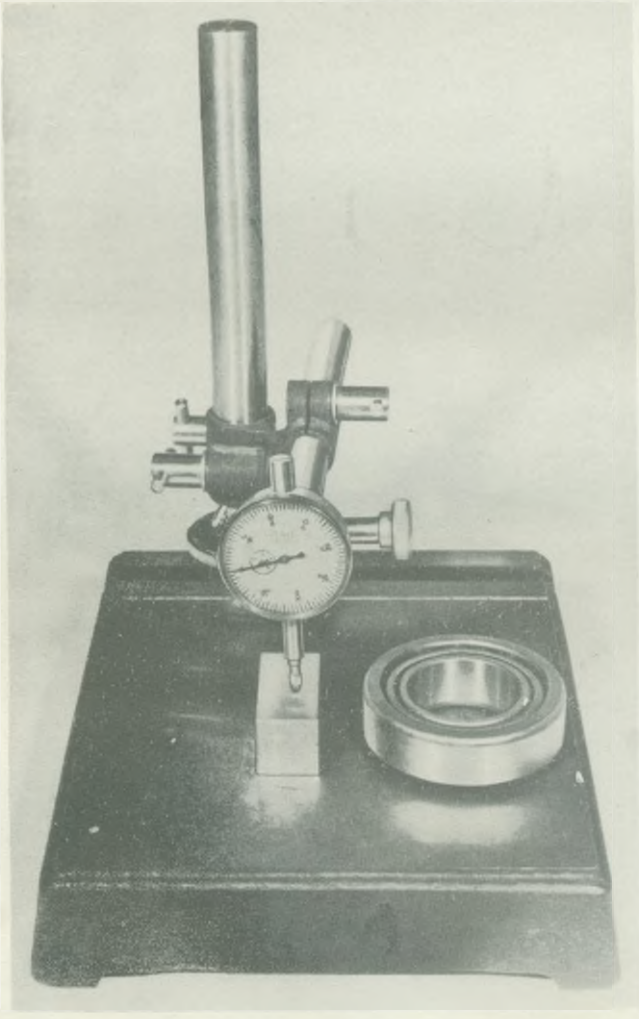


Fig. 38. Setting dial gauge to zero preparatory to measuring differential bearing.

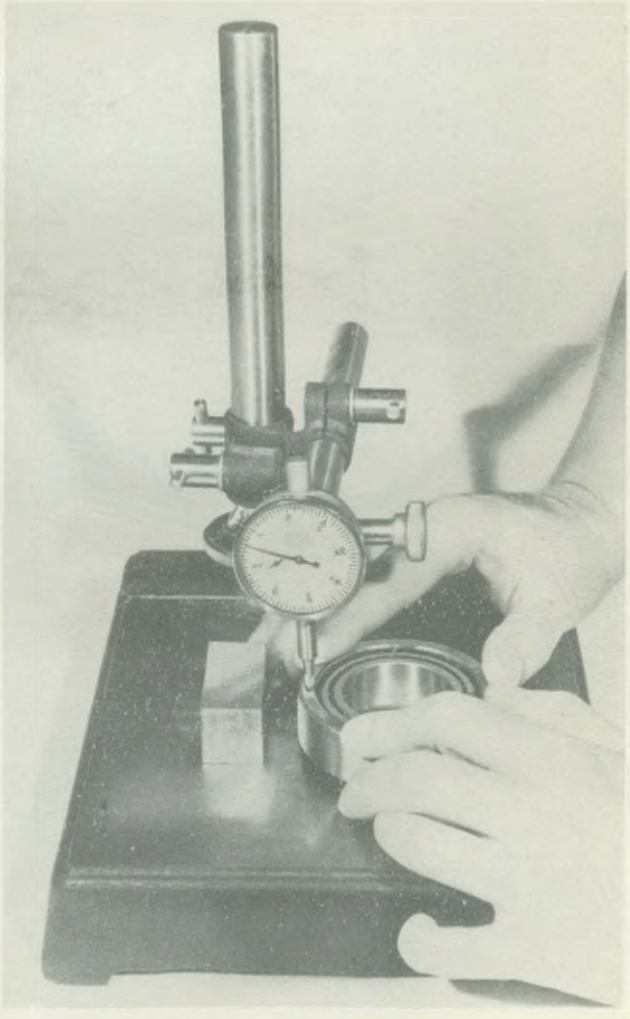


Fig. 39. Comparing bearing depth with nominal dimension