

A close-up photograph of a motorcycle's internal gear assembly, showing several interlocking brass and steel gears. The lighting is dramatic, highlighting the metallic textures and the complex mechanical structure.

Ural (Урал) - Dnepr (Днепр) Russian Motorcycle Part 4: Gears and Gear Ratios

(Also See Part 1: Overall Drive Chain, Part 2: One-Wheel Drive (1WD), Part 3: Two-Wheel Drive (2WD), Part 5: Disassembly of Drive Chain, Part 6: Drive Train Components, Part 7: Drive Train Maintenance, and Part 8: Chapter 7 of Bill Glaser's "Unofficial" URAL 750cc Motorcycle Service Manual)

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Gears and Gear Ratios: Agenda

- ***History of Ural / Dnepr Gear Ratios***
- ***Final Drive Gear Ratios***
- ***List of Components***
 - ***Multiple Gear Suppliers***
 - ***Especially for Sidecar (8/37/ Ratio) and Solo (9/35 Ratio) Versions***
 - ***Large Variations in Listed Prices (2013 dollars, euros or rubles)***

History of Ural / Dnepr Gear Ratios on Russian Motorcycles with Sidecars

- **Final Gear Ratio Is Relationship between Turns of the Propeller Shaft Relative to the Wheel**
 - Gear Ratio Determined by the Number of Teeth on Crown Gear Set (Pinion Gears)
 - Example: Crown Ring Gear (35 teeth) / Small Pinion Gear (9 teeth) = 3.89:1
- **In 1938, Original Ratio German BMW Offered with the R-71 Was 9/35 Ratio (3.89:1)**
- **In 1944, Final Drive Gear Ratio of 4.625 Introduced to Russian M-72**
 - 9/35 (3.89:1) Ratio Too Optimistic for Russian Roads When Copying Design in 1941
 - Quickly Switched to 8/37 (4.625:1) Ratio to Cope with Muddy Roads
- **In 1994, Ural Began Selling 650cc Motorcycles with Sidecar in the United States, Using the Old 9/35 Ratio (3.89:1) to Take Advantage of Paved Roads in the U.S.**
 - Soon Ural Regretted the Switch as Bikes Equipped with 9/35 (3.89:1) Ratio Started Breaking Crankshafts
- **Ural Quickly Re-introduced 8/37 (4.625:1) Ratio**
 - Later Acknowledged That 9/35 Ratio Good with 18" Wheels at Elevations near Sea Level
 - Urals with 19" Wheels or Those Sold above 3,000 ft Elevation Came with 8/37 Ratio
 - When Ural Started Selling 750cc, They Designed a Much Stronger Crankshaft Which Could Easily Cope with the 9/35 Ratio
 - But That Ratio Had Gotten Such a Bad Reputation that Ural Switched 3rd and 4th Gear Ratios
 - The New Ratios Pretty Much Made the 8/37 "look" like a 9/35
 - Didn't Matter If You Had 18" or 19" Wheels or Lived at Sea Level, Your 750cc Ural Got the 8/37 (and the new 3rd & 4th Gear Ratios)
 - 9/35 (3.89:1) Ratio Fine with a 650cc Ural with Sidecar on Flat Terrain with 18" Wheels
 - Not Good for a 750cc Ural with Sidecar
 - Good for Solo
 - Both 9/37 (4.10:1) and 10/36 (3.60:1) Ratios Offered on e-bay
 - Both are Russian "aftermarket" ratios, built by folks who may or may not have any idea of how to machine the proper helix, ramp, undercut, etc.
 - 10/35 (3.50:1) Ratio Is Unrealistic
 - Perhaps a Supercharged 750cc Could Pull That Steep a Ratio
- **All Ural and Dnepr Motorcycles with Sidecars Have 8/37 (4.625) for Rear Gear Ratio**

Final Drive Gear Ratios

- ***Original German BMW R71 (father of Russian M-72)***
 - ***Solo: 3.6:1 (10/36 pinion teeth / ring teeth)***
 - ***Sidecar: 3.89:1 (9/35 pinion teeth / ring teeth)***
- ***Standard Ural / Dnepr***
 - ***Solo: 3.89:1 (9/35 pinion teeth / ring teeth)***
 - ***Sidecar: 4.625:1 (8/37 pinion teeth / ring teeth)***
- ***Aftermarket Ratios of 3.4:1 (10/34), 3.5:1 (10/35) and 4.11:1 (9/37)***
 - ***Available via Internet***
 - ***Generally Expensive and Speedometer Gears Aren't Readily Available***
- ***Simple Test to Determine Rear Wheel Ratio:***
 - ***Vance Blosser, www.crawfordsales.info***
 - ***Put Bike Up on Center Stand***
 - ***Put It in Neutral***
 - ***Turn Back Wheel until Tire Valve Is at Top***
 - ***Turn Wheel 1 Full Rotation until Valve Is Back to Top***
 - ***Count Number of Turns of the Flexible Coupling (Driveshaft Flange)***
 - ***If It Turns Just under 4 Complete Turns, You Have Solo Gearing: 3.89:1***
 - ***If It Turns Just over 4 Complete Turns You Have Sidecar Gearing: 4.625:1***
 - ***It Could Be Another Ratio, But Unlikely***

Ural / Dnepr produced two types of cone beveled paired gears: the so-called "eight" (the number of teeth on the small pinion), which has 4.625 gear ratio and is used on motorcycles with sidecars, and "nine", with a ratio of 3.89, used on solo motorcycles.

2012 Gear-Up Gear Ratio Test (sovietsteeds.com)

- **2012 Ural Gear-Up's Transmission Ratios Are on the Tall Side, Making It Difficult to Haul the 866.5-lb. Rig Up to Speed with Any Urgency**
 - 4.625:1 (8/37 pinion teeth / ring teeth) Rear Drive
- **Test Unit Went from 0-to-60 mph in 15.97 sec.**
 - 1.19 4th Gear & 4.625:1 Rear Drive Cause Engine to Rev at 4850 rpm at 65 mph, Making Sustained Interstate Motoring an Impractical Strain on the Engine
 - Bit Gutless Up Hills and in Head Winds
- **Other Gear Ratios**
 - 9/35 (3.91:1) Found on Solos and Some Retros
 - 10/35 (3.50:1) Insufficient Torque and Horsepower
- **People Used 3.89 Gears with 19" wheels on a 750cc, but with Limited Success**
 - Motor Doesn't Have the HP to Pull 4th Gear Up-Hill or into Any Wind
 - Retro Is Most Road-Friendly Ural
- **Urals Come in Two Gear Ratios: 3.89:1 (Solo) and 4.625:1 (with Sidecar)**
 - Years Ago You Could Get Either but They Found the 3.89 Was Breaking Crankshafts in the 650's Due to Lugging, So Now You Only See 3.89 in Solo's
 - Motorcycles with 18" Wheels, such as Retro's, Deco's and B.C.'s, can Go with 3.89:1 Gears
 - Installed 18" Wheels on My '99 Patrol and Really Like Them
- **Ideally IMZ Eventually Will Become Solvent Enough to Fund R&D to Develop a New Transmission with a Lower 1st and 2nd Gear and Even Add a 5th OD Gear**

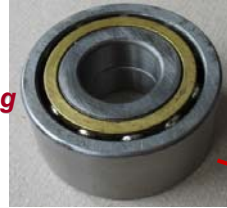
A lower gear ratio (higher numerically) yields a little more grunt (torque) at the low-end, sacrificing at the top-end. A higher ratio (numerically lower) will boost your top-end speed a little bit sacrificing low-end grunt.

Rear Drive Reduction Gears, 1WD

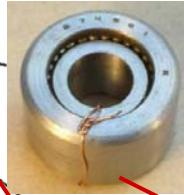
Pinion Gears



**Pinion Double-Row Bearing
3086304L**



**Pinion Gear Needle Bearing
874901**



**Final Drive Nut
75005223**



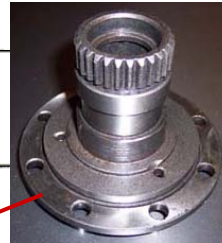
**Shim 37x46x0.20 mm
7205242**

**Pinion Shaft-Adjustment Shim
(Various Thickness)
7205318**

**Bearing
207**



**Rear Drive Hub
7205229**



**Hub Adjustment Shim
(Various Thickness)
7205241/7205242/7205243**



**Hub Internal Bush
w/Felt Seal Ring
7205246 + 7204142**



**Hub Bolt
201473**



**Double Washer for Crown Wheel Bolts
7205248**



Pinion gears are stocked as a mated pair, typically purchased as a pair held together with a small wire.

Bevel Gears (Driver Gear / Driven Gear): 8/37

(4.625:1 Ratio; for use on sidecar, not solo bike)



**Final Drive Gear and Pinion, 8x37
gear (8/37) IMZ
15505210/7205028
List Price: 990 rub.
Pinion, Leading 7205202-01 1 pc.
Pinion, Driven 7205227 1 pc.
(mazepper.ru)**

**Final Drive Gear and Pinion, 8x37
Part #: 7205202 + 7205227
Vendor ID: 1233
List Price: €77.88
(moto-boxer.com)**

**Final Drive Gear and Pinion, 8x37
Part #: 7205202 + 7205227
Vendor ID: 187
List Price: €52.00
(www.ural-hamburg.de)**

**Final Drive Gear and Pinion, 8x37
Vendor ID: S605
List Price: €59.99
(www.ural-zentrale.de)**

**Final Drive Gear and Pinion, 8x37
Vendor ID: 290421997329
List Price: \$69.99
(www.ebay.com)**

**Final Drive Gear and Pinion, 8x37, Black Oxide
Part #: 7205202 + 7205227
Vendor ID: 1800
List Price: €65.96
(moto-boxer.com)**

**Final Drive Gear and Pinion, 8x37
Vendor ID: 41
List price: \$75.00
(www.russianguarage.com)**

**Final Drive Gear and Pinion, 8x37
(M-72, K-750)
Vendor ID: 190446945171
List price: €29.90
(www.ebay.de)**

The gear ratio is stated as the number of teeth in the small pinion gear divided by the number of teeth in the large rim gear.

Bevel Gears (Driver Gear / Driven Gear): 9/35

(3.889:1 Ratio; for use on solo bike, not sidecar)



Final Drive Gear and Pinion 9x35

CMH-8.15505210-07

IMZ-8.123-05015

(Ural; M-61, M-62, M-63, M-66, M-67, M-67.36, IMZ-8.103-10, IMZ-8.103-30, IMZ-8.103-40 "Tourist", IMZ-8.103-50, MZ-8.107, IMZ-8.123, Dnepr; MT-11 (CMH-8.155), MT-16 (CMH-8.922), MT-10.36)

Leading pinion Z = 9, D = 46.0 mm.

Driven Z = 35, D = 142.5 mm. d = 82.0 mm

List Price: 2500 rubles

(mazepper.ru)

Final Drive Gear and Pinion 9x35

Vendor ID: 451 List Price: €55.00

(www.ural-hamburg.de)

Final Drive Gear and Pinion 9x35

(K-750, M-72, Dnepr MT)

Vendor ID: 200867525726

List Price: €39.00

(www.ebay.co.uk)

Final Drive Gear and Pinion 9x35

(MT-11, MT-16)

Part #: 7205202/7205227

List Price: \$60

(www.dnepr-kiev.com)

Final Drive Gear and Pinion 9x35

List Price: €97.00

(www.henriksson.ee)

Final Drive Gear and Pinion 9x35

Vendor ID: S604-9

List Price: €62.50

(www.ural-zentrale.de)

Final Drive Gear and Pinion 9x35

Vendor ID: 1234

List Price: €63.72

(moto-boxer.com)

Final Drive Gear and Pinion 9x35

(MT-11, MT-16)

Vendor ID: 260828566629

List Price: \$89.00

(www.ebay.com)

Final Drive Gear and Pinion 9x35

List Price: \$55.99

(www.ebay.com)

Final Drive Gear and Pinion 9x35

Item #: 300414691334

List price: \$79.99

(www.ebay.com)

Final Drive Gear and Pinion 9x35

List price: \$90.00

(www.russiagarage.com)

New Final Drive Gear ratio 9/35

(MT-11, MT-16)

Vendor ID: 260828566629

List Price: \$59.00

(www.ebay.com)

Final Drive Gear and Pinion 9x35

(M-72, K-750)

Vendor ID: 190443404647

List Price: €42.90

(www.ebay.de)

The paired bevel gears are typically referred to as a Crown Wheel Set.

Bevel Gears (Driver Gear / Driven Gear): 9/38



Final Drive Gear and Pinion, 9x38
Part #: 7205202-b + 7205227-b
List Price: €59
(www.henriksson.ee)

Final Drive Gear and Pinion, 9x38
(M-72, K-750)
Part #: 7205227-B/7205202-B
Vendor ID: 000.867
List Price: €250.00
(www.oldtimergarage.eu)

Final Drive Gear and Pinion, 9x38
(MB-750, MT-16)
Part #: MB750M48101-A + 7205202-A
List Price: €105
(www.henriksson.ee)

38 teeth divided by 9 teeth yields a gear ratio of 4.22.

Bevel Gears (Driver Gear / Driven Gear): 10/34



***Final Drive Gear and Pinion, 10x34
(M-72/K-750)
Part: 7205227-B/7205202-B
Vendor ID: 003.492
List Price: €250.00
(www.oldtimergarage.eu)***

34 teeth divided by 10 teeth yields a gear ratio of 3.40.

Bevel Gears (Driver Gear / Driven Gear): 10/35



Final Drive Gear and Pinion, 10x35
Vendor ID: 290422002941
List price: \$89.99
(www.ebay.com)

Final Drive Gear and Pinion, 10x35
Mfgr in KMZ (not China!)
(MT-16)
List Price: \$110.00
(www.ebay.com)

Final Drive Gear and Pinion, 10x35
List Price: \$180.00
(www.russiangularage.com)

Final Drive Gear and Pinion, 10x35
(MT-11 1WD)
Vendor ID: 160833965598
List Price: \$62.00
(www.ebay.com)

Final Drive Gear and Pinion, 10x35
(M-72, K-750)
Vendor ID: 190766017353
List Price: €35.00
(www.ebay.de)

Final Drive Gear and Pinion, 10x35
(M-72, K-750)
Vendor ID: 190530553197
List Price: €43.00
(www.ebay.de)

Final Drive Gear and Pinion, 10x35
(Dnepr, Ural, K-750)
Vendor ID: 200867094140
List Price: €45.00
(www.ebay.co.uk)

Final Drive Gear and Pinion, 10x35
Vendor ID: S604-10
List Price: €79.99
(www.ural-zentrale.de)

Final Drive Gear and Pinion, 10x35
Vendor ID: 1235
List Price: €84.96
(moto-boxer.com)

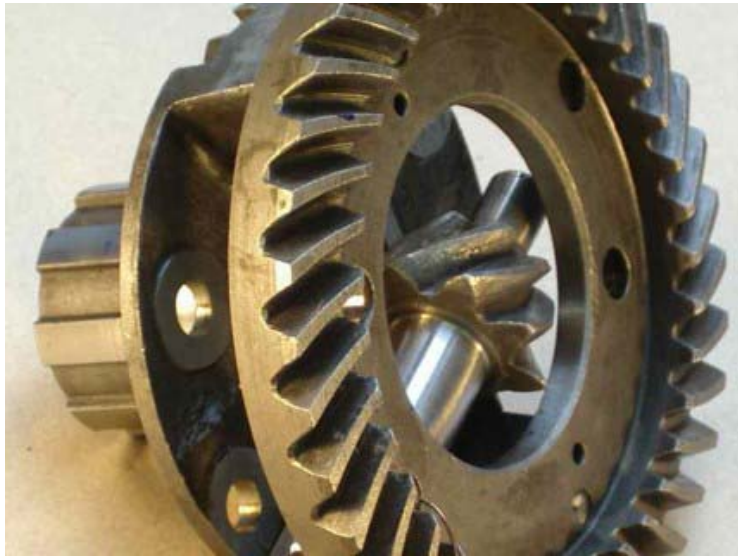
Final Drive Gear and Pinion, 10x35
(M-72, K-750)
Vendor ID: 1168
List Price: €65.00
(www.ural-hamburg.de)

Final Drive Gear and Pinion, 10x35
(MT-11, MT-16)
Part #: 7205202/7205227
List Price: \$60
(www.dnepr-kiev.com)



35 teeth divided by 10 teeth yields a gear ratio of 3.50.

Pinion Gear Assemblies: Differential Housings



Satellite Housing with Ring and Pinion, Lock-Ready
(MB-750, MB-650, MT-16)
Vendor ID: 000.833
List Price: €200.00
(www.oldtimergarage.eu)



Sidecar Drive Differential Half w/Pinion and Gear
Part #: MW750M48101 + 7205202 + WP48121
Vendor ID: 1231
List Price: €199.42
(moto-boxer.com)



**Rear Drive
Satellite Housing with Ring and Pinion**
(Dnepr)
Vendor ID: 002.808
List Price: €120.98
(www.oldtimergarage.eu)



Final Drive Gear with Flange
(MT-16)
Vendor ID: 2250
List Price: €155.00
(www.ural-hamburg.de)

Differential Planetary Gears: Satellite and Idle



Differential Gears
(MT-16)
Vendor ID: 1345
List Price: €49.00
(www.ural-hamburg.de)



Differential Gears
(MT-16, MB-650, MB-750)
Vendor ID: 2589
List Price: €80.00
(www.ural-hamburg.de)



Satellite Gear, 8 teeth
(MT-16)
Vendor ID: 2249
List Price: €13.00
(www.ural-hamburg.de)



Final Drive Gear, 12 teeth
(MT-16)
Vendor ID: 2247
List Price: €13.00
(www.ural-hamburg.de)



Idler Gear Assy
(Ural/Dnepr)
Vendor ID: 290558936198
List Price: \$9.99
(www.ebay.com)



Sidecar drive satellite gear
Part #: БП48014
Vendor #: 2048
List Price: €18.88
(moto-boxer.com)

Satellite Gear, 8 teeth
Part #: BL48014
List Price: €16.50
(www.henriksson.ee)

Differential Planetary Gears: Satellite and Idle (cont.)



Satellite Gears
(Ural)
(www.mc78.ru)



Sidecar Drive Satellite & Idle Gear Axle
Part #: ВП48806 / WP48806
Vendor #: 1641
List Price: €5.66
(moto-boxer.com)

Axle, Planet Gear
(MB-750, MT-16)
Part #: ВП48806 / WP48806
Vendor ID: 000.646
List Price: €11.59
(www.oldtimergarage.eu)



Differential Drive
(MT-16, MB-650, MB-750)
Vendor ID: 200867094164
List Price: €71.00
(www.ebay.co.uk)



Planet Gear
(MB-750, MT-16)
Part #: ВП48015
Vendor ID: 000.651
List Price: €18.15
(www.oldtimergarage.eu)

Sidecar Drive Idle Gear
Part #: ВП48015
Vendor ID: 2047
List Price: €18.88
(moto-boxer.com)

Output Gear: Locking Differential



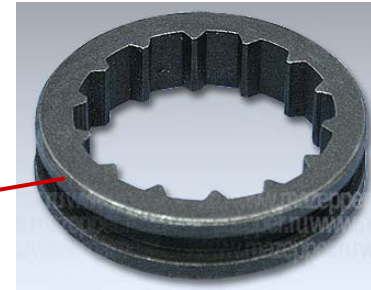
Sidecar Drive Differential Gear Set
(MT-16, MB-750, MB-650, MT-12)
Vendor ID: 190586412762
List Price: €289.00
(www.ebay.de)



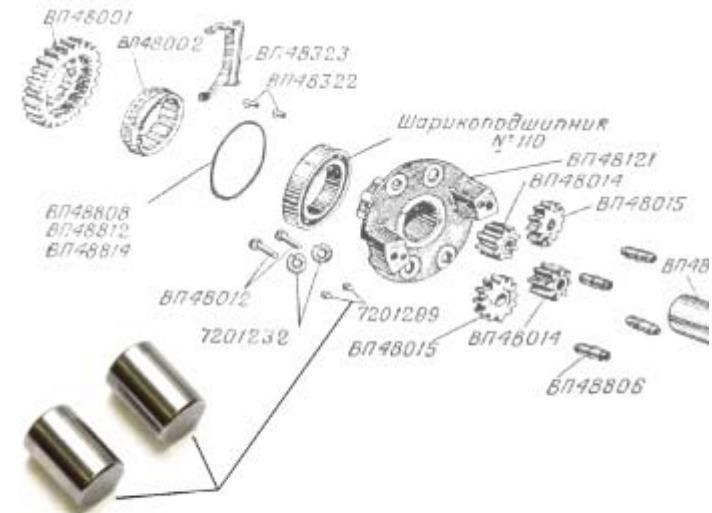
Output Gear, 24 teeth
(MT-16)
Vendor ID: 2249
List Price: €15.00
(www.ural-hamburg.de)



Output Gear Differential Drive
(MT-16)
Vendor ID: 200867947580
List Price: €15.00
(www.ebay.co.uk)



Coupling "Dnepr" Shift
Part #: MT804419
List Price: 190 rubles
(mazepper.ru)



Ural 650cc rear Drive Gear Wear Limits (2000 Ural Repair Manual)

- ***Tolerated Wear Limits and Clearances of Rear Drive Gears***
 - ***Parts Worn Beyond Recommended Limits Should Be Replaced***
 - ***Replace All Seals and Gaskets at the Same Time***

<i>Name of Parts and Mating Members</i>	<i>Maximum Tolerances</i>		<i>Measuring Point and Method</i>
	<i>Wear on Diameter</i>	<i>Diameter Clearance</i>	
<i>Ring Gear Hub Splines</i>	<i>Tooth Thickness 0.75 mm</i>	<i>-</i>	<i>On Working Surfaces of Journals</i>
<i>Propeller Shaft Cross Pins</i>	<i>0.05 mm</i>	<i>-</i>	
<i>Final Drive Gears</i>	<i>Tooth Thickness</i>	<i>-</i>	
<i>Ring Gear Hub Bearing</i>	<i>0.15 mm</i>	<i>0.12 mm</i>	

- ***Rear Drive Gear Backlash Should Be within 0.003 to 0.006" (0.07 to 0.16 mm)***
 - ***If Backlash Is Incorrect, Change Adjusting Shims on Ring Gear, Substituting Thicker or Thinner Shims to Achieve Backlash within Tolerance***
- ***Before Tightening Nut in Case Cover, Hub Gear Flange with Seal and Ball Bearing Should Be Installed***
 - ***Bronze Ring Should Be Positioned onto Hub Gear Neck Next After the Steel Ring***
- ***After Putting Main Drive Together, Check and Adjust Side-Play of Conical Gears by Tightening or Loosening Nut in Casing Cover***
 - ***When Side-Play of 0.004 to 0.012" (0.1 to 0.3 mm) Is Achieved, Stop Adjusting and Fix the Nut with the Retainer***

Final Drive Upgrades

- ***2003: New 750cc Ural Engine Replaced the 650 cc Engine***
 - ***Higher Output Ratio Gearing on 3rd & 4th Gears Allowing a Higher Cruising Speed of 65 mph for Standard 4.62 Final Drive (FD) Ratio***
 - ***New Drive Shaft with Course Splines to Reduce Chance of Stripping Out Drive Coupling***
- ***2006 Final Drive Changes & Improvements***
 - ***Use of Final Drive Lock-Nuts***
 - ***Knob Style Dipstick Removable by Hand***
 - ***Nylock Nuts to Secure Final Drive to Swing -Arm***
 - ***Labeled Final Drive Engagement Lever***
- ***2007 Final Drive Improvements***
 - ***Reversed Style Driveshaft with Larger Spline Surface Area***
 - ***Improved 2WD Engagement Rod with UNI Balls***
- ***2007 Urals Have Herzog Precision-Cut Timing Gears in Engine and in Gearbox***
- ***Unofficial Quality Improvements for 2008 Ural Models***
 - ***Precision German-Made "Herzog" Gears to Replace the Old, Cast Russian Gears***
 - ***CNC-Machined to Tight Tolerances, in Comparison to Old, Square-Cut Gears***
 - ***Herzog Final Drive Bevel Gears***
 - ***Stronger and Properly Heat -Treated for Prolonged Life***
 - ***Tighter Tolerances***
 - ***Cooler Running Temperatures***
 - ***Note: Earliest Availability Is Summer 2008***
 - ***Didn't Happen***
- ***Ural Makes Bevel Gears in Irbit***
 - ***Because Herzog Gears Are Expensive, Cost of Production Would Be Too Expensive***

<http://autos.groups.yahoo.com/group/thechangjiangexperience/message/372>

Hi Buddy,

Part 41 is shim that fits between the bearing and the "star" washer (see http://www.changjiang750sidecar.com/sipb/p046_cj12v.jpg) Maybe it's missing on your CJ. I couldn't find the required adjustment, but according to the parts manual, the shim is available in thicknesses from 0.4 to 1.15 mm in 0.15 mm steps (0.006 inch). Don't know what the required adjustment is though.

I found the following in the Ural 650 manual, but I'm not sure if the thickness of the CJ's shim adjusts the meshing of the pinion and the ring gear, so it may not apply:

If new gears or pinion bearings have been installed, gear tooth contact should also be checked:

1. Remove the ring gear and smear a coating of gear marking compound on several of the pinion teeth (lipstick can be used for this purpose).
2. Install the ring gear again. Pushing the ring gear towards the pinion, rotate the gears through several teeth to transfer the marking compound onto the other gear teeth.
3. Remove the ring gear and observe the pattern left on the teeth of the pinion.

The ideal wear pattern is with contact centered in the middle of the pinion tooth surface. If the contact pattern is towards the edges of the pinion tooth, the pinion shaft should be moved in or out of the case by changing the shim to a thicker or thinner shim.

When backlash and tooth pattern is acceptable, remove all traces of the gear marking compound and assemble the final drive.

