Ural (Урал) - Днепр (Днепр) Russian Motorcycle
Part XXXI: Drive Chain Evolution

(Also See Part XXXI-1: One-Wheel Drive (1WD),
Part XXXI-2: Two-Wheel Drive (2WD),
Part XXXI-3 Full-Time 2WD with Non-Locking Diff,
Part XXXI-4: Full-time 2WD with Locking Diff,
Part XXXI-5: Full-Time 1WD with Locking 2WD (non-diff),
Part XXXI-6: Gears and Gear Ratios,
Part XXXI-7: Drive Train Components,
and Part XXXI-8: Disassembly of Drive Chain)

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Parts to Overall Drive-Chain Study

• Part XXXI: Drive Chain Evolution: Overall Drive-Chain
  – Part XXXI-1: One-Wheel Drive (1WD)
  – Part XXXI-2: Two-Wheel Drive (2WD)

• Locking versus Non-Locking Differentials
  – Part XXXI-3: Full-Time Two-Wheel Drive (2WD) with Non-Locking Diff
  – Part XXXI-4: Full-Time Two-Wheel Drive (2WD) with Locking Differential
  – Part XXXI-5: Full-Time One-Wheel Drive (1WD) with Locking 2WD (non-Diff)

• Part XXXI-6: Gears and Gear Ratios
• Part XXXI-7: Drive Train Components
• Part XXXI-8: Disassembly of Drive Chain

We trace the evolution of the Russian motorcycle drive-train from the simple One-Wheel Drive (1WD) to the Two-Wheel Drive (2WD), with its differential (lockable and non-lockable) and non-differential rear drives.
Cardan and Rear Drive

• Final Drive (FD)
  – Consists of a Propeller Shaft (Cardan), Flexible Coupling (Flange), Elastic Disc (Doughnut) and Universal Joint (Cross)
  – Transmits Torque from Transmission to Rear Drive

• 1WD (One-Wheel Drive)
  – Rear Drive Has Pair of Bevel Gears with Spiral Teeth without a Sidecar Wheel Drive
  – Changes Direction of Torque at Right Angles to Power Rear Drive Wheel

• 2WD (Two-Wheel Drive, When Engaged)
  – Rear Drive Has Pair of Gears with Spiral Teeth, Semi-Detached with Cylindrical Gear to Drive Sidecar Wheel
  – Changes Direction of Torque at Right Angles to Power Drive Wheel and Sidecar Wheel
  – Changes Amount of Torque Transmitted by Propeller Shaft (Cardan)
  – Distribute Torque between Drive Wheel and Sidecar Drive Wheel in a Specific Ratio (19:11)

Example: Ural 1WD Drive Train
Ural and Dnepr Cardan Transmission

- Cardan Transmission Designed to Transfer Torque from Secondary Shaft of Gearbox to Drive Gear of Main Gear, with Different Angles between Them
- Suppress Vibrations and Shocks in the Transmission
- Cardan Consists of Cardan Shaft, Rigid Hinge and Elastic Coupling
- Gap between Disc Planes and Elastic Disk Is Importance
  - Value of Total Clearance from Both sides with a Horizontal Shaft Position Should Be within 3-6 mm
  - Clearance Adjusted by Changing the Locking Ring (13) in the Grooves of the Propeller Shaft (propshaft, 32)
  - Located on the Front on Ural's and to the Rear on Dneprs

The main transfer of the motorcycle "Dnepr":
1 - dipstick with breather; 2 - drain hole plug; 3 - final drive casing; 4 - needle roller; 5 - driven gear hub; 6 - gland cover; 7 - gland; 8 - drive pinion needle bearing; 9, 22 - adjusting washers; 10 - bearing nut; 11 - gland; 12 - wedge bolt; 13 - locking ring; 14 - leading fork of elastic coupling; 15 - elastic coupling collar; 16 - locking ring; 17 - gasket; 18 - driven gear; 19 - crankcase case; 20 - spacer ring; 21 - O-ring seal; 23 - crankcase cover; 24-ball bearing; 25 - leading gear wheel; 26 - angular contact ball bearing; 27 - adjusting washer; 28 - O-ring seal; 29 - universal joint cap (cardan cowl); 30 - rigid universal joint; 31 - protective sleeve; 32 - propeller shaft; 33 - elastic coupling; 34 - driven fork of elastic coupling
M-72 Final Drive (Главная передача)

- Cardan and Rear Drive Transmits Torque from Gear Box to the Main Gear
- Drive Shaft (5) Driven from Gearbox Secondary Shaft thru an Elastic Coupling (2), Consisting of Two Steel Discs (forks) and an Elastic Disc (4) with a bandage.
- One of These Discs Is Mounted on Secondary Shaft in the Gear Box, and Other Disc (3) Is Pressed Onto End of the Propeller Shaft
- Each Disc Has Two Fingers Entering the Holes of the Elastic Coupling
- At Other End of Cardan Shaft Is a Fork, Consisting of a Universal Cross (12) Mounted in the Sockets of Cardan Forks (9 and 10), Which Have Needle Bearings (8)
- Cardan Shaft Made of Special Alloy and Can Be Twisted Under Action of Increasing Loads
- When Unloading, Elastic Disc Returns to Original State
- Main Gear Consists of Leading (7) and Slave (11) Gears Placed in the Crankcase (6)
- Gears Rotate in Bearings and Transmit Torque to Drive Wheel thru Internal Gearing Formed by Hub of the Driven Rear Wheel Gear and Hub Connected to Driven Gear of the Main Gear
Focusing on the area to the right of the rear drive (non-U.K.), 1WD motorcycles don’t have a transverse driven shaft to power the sidecar wheel.
The driven disk (26) is found on the input to the cardan.
**Secondary Shaft (Вал вторичный)**

- **Leading Fork on the Engine-Side of the Elastic Coupler:** MT804577
- **Output of Gear Box**

<table>
<thead>
<tr>
<th>Part #</th>
<th>MT-11</th>
<th>MT-16</th>
<th>Description</th>
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<tr>
<td>KM3-8.15604400</td>
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<td>Shaft Assembly</td>
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<tr>
<td>MT804577</td>
<td></td>
<td>1</td>
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<tr>
<td>MT804573</td>
<td>1</td>
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<tr>
<td>MT804575</td>
<td>1</td>
<td>1</td>
<td>Gear</td>
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</table>

The leading disk mating to the elastic coupler (MT804577) is found on the output of the gear box.
Output from Gear Box = Input to Propeller Shaft, thru the Elastic Coupler
The leading disk of the elastic coupler (MT804577) is found on the output of the gearbox.
MT804 Gearbox Output Fork Flange
8x37 Ratio (MT804577)

The output flange in the gearbox is the driver flange fork for the drive chain elastic coupler.
The Final Drive (FD) consists of a rear drive, universal joint, drive shaft, flexible flange and an elastic coupler.
The German R-71 was the father to all heavy Russian sidecars, and was duplicated in the Russian M-72.
Four Types of Final Drives in Russian Sidecars

1. Full-Time, Straight Final Drive (1WD)
   – One-Wheel Drive (1WD)
   – Available in Various Ural / Dnepr Models

2. Full-Time, Two-Wheel Drive (2WD) with non-Locking Differential
   – Dnepr MT-12 (1977-1985)
   – Dnepr Rear Drive Casings Allow for Adding Locking Differential
     • Only True Differential for Ural
     • Pre-“Patrol” Model

3. Full-Time, Two-Wheel Drive (2WD) with Locking (Engageable) Differential
   – Dnepr MB-750 (1964-1973)
   – Dnepr MB-750M (1973-1977 Locking feature deleted after two years)

4. Full-Time, One-Wheel Drive (1WD) with Engageable Locking 2WD (non-Diff)
   – Available in Various Ural Models
     • Limited Editions with Engageable Sidecar Drive Shaft:
       – Derivatives of Patrol or Gear-Up
## Ural (Урал) / Днепр (Днепр) Drive Train and Rear Suspension

<table>
<thead>
<tr>
<th>Ural (Урал) Model</th>
<th>Production</th>
<th>Engine</th>
<th>Voltage</th>
<th>Drive Train</th>
<th>Rear Suspension</th>
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<tbody>
<tr>
<td>M-72</td>
<td>1941-1950</td>
<td>750cc SV</td>
<td>6-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
<td>Plunger</td>
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<td>M-72K</td>
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<td>M-72M</td>
<td>1956-1961</td>
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<td>M-61</td>
<td>1958-1961</td>
<td>650cc OHV</td>
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<td>M-62 (Ural-1)</td>
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<td>M-63 (Ural-2)</td>
<td>1965-1971</td>
<td>650cc OHV</td>
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<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>M-66 (Ural-3)</td>
<td>1971-1973</td>
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<td>6-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>M-67 (IMZ-8.101)</td>
<td>1974-1976</td>
<td>650cc OHV</td>
<td>12-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>M-67.36</td>
<td>1976-1984</td>
<td>650cc OHV</td>
<td>12-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>8.103 Series “650”</td>
<td>1984-2002</td>
<td>650cc OHV</td>
<td>12-Volt</td>
<td>Full-Time 1WD with Engageable 2WD (No Diff)</td>
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<td>“750”Series</td>
<td>2003-Present</td>
<td>750cc OHV</td>
<td>12-Volt</td>
<td>Full-Time 1WD with Engageable 2WD (No Diff)</td>
<td>Swing Arm</td>
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<tr>
<th>Днепр (Днепр) Model</th>
<th>Production</th>
<th>Engine</th>
<th>Voltage</th>
<th>Drive Chain</th>
<th>Rear Suspension</th>
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<tr>
<td>M-72</td>
<td>1951-1956</td>
<td>750cc SV</td>
<td>6-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>M-72N (H)</td>
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<td>750cc SV</td>
<td>6-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>K-750</td>
<td>1959-1963</td>
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<td>K-750M</td>
<td>1963-1977</td>
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<td>6-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>MT-12 (Dnepr-12)</td>
<td>1974-1982</td>
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<td>6-Volt</td>
<td>Full-Time 2WD with Non-Locking Differential **</td>
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<tr>
<td>MB-750</td>
<td>1964-1973</td>
<td>750cc SV</td>
<td>6-Volt</td>
<td>Full-Time 2WD with Locking (Engageable) Diff *</td>
<td>Swing Arm</td>
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<tr>
<td>MB-750M</td>
<td>1973-1977</td>
<td>750cc SV</td>
<td>6-Volt</td>
<td>Full-Time 2WD with Locking (Engageable) Diff *</td>
<td>Swing Arm</td>
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<td>K-650/MT-8</td>
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<td>6-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>K-650/MT-9</td>
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<tr>
<td>MB-650</td>
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<td>12-Volt</td>
<td>Full-Time 2WD with Locking Differential *</td>
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<tr>
<td>MB-650M</td>
<td>1985-1991</td>
<td>650cc OHV</td>
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<td>Full-Time 2WD with Non-Locking Differential **</td>
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<td>MT-10</td>
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<tr>
<td>MT-10.36</td>
<td>1976-1984</td>
<td>650cc OHV</td>
<td>12-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
<td>Swing Arm</td>
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<td>MT-11 (Dnepr-11)</td>
<td>1985-1995</td>
<td>650cc OHV</td>
<td>12-Volt</td>
<td>Full-Time, Straight Final Drive (1WD)</td>
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<td>MT-16 (Dnepr-16)</td>
<td>1986-1995</td>
<td>650cc OHV</td>
<td>12-Volt</td>
<td>Full-Time 2WD with Non-Locking Differential **</td>
<td>Swing Arm</td>
</tr>
</tbody>
</table>

* Locking Feature Deleted after Two Years of Production, ** Optional Kit Available to Add Locking Differential
KMZ’s (Dnepr factory) first production 2WD was the MB-750 (1964), with a rear drive modeled on the WW-II BMW R75. The first production Ural 2WD post-war was the short-lived Sportsman in the mid-1990's, to be followed by the non-diff Patrol and Gear-Up.
Focusing on the area to the right of the rear drive (non-U.K.), 1WD motorcycles don’t have a transverse driven shaft to power the sidecar wheel.
Standard One-Wheel Drive (1WD) Russian Sidecars

Dnepr MT-11, Dnepr MT-11, Dnepr MT-10.36, and 1995 Dnepr MT-11

Dnepr’s M-72, K-750, MT-10, MT-10.36, MT-11 and Ural’s M-72, M-61, M-62, M-63, M-66, M-67, and M-67.36 were all one-wheel drive (1WD).
Focusing on the area to the right of the rear drive, 1WD motorcycles don’t have a driven shaft to power the sidecar wheel.
Modern Urals offer an engageable, non-differential, only for off-road driving.
The Ural Patrol / Gear-Up version of the differential is not a diff but a live-axle lockup. This is fairly simple and relatively trouble free for the most part, but does not serve any purpose except to provide maximum traction to both pushers when engaged. Other than that it just free-wheels along all the time.
Ural “Limited Edition” Sidecars with Standard Full-Time 1WD and Engageable 2WD (non-Diff)

Modern Urals offer an engageable, non-differential, only for off-road driving, as an option for the Patrol and Gear-Up versions.
Two-Wheel Drive (2WD) with Differential

- Sidecar Wheel Creates a Resistance to Movement on Its Own Track
  - Tends to Turn Bike to the Right
- Effective Way to Improve Control Is to Transfer Torque to Sidecar Wheel
- Applied to Dnepr’s MB-750 / MB-650 in Limited Production
  - Basis for Dnepr-12 (MT-12) and Dnepr-16 (MT-16) with Increased Production
- Selected Skewness Differential Ratio: 19:11 (Number of Gear Teeth)
  - 63% of Torque Supplied to Main Gear & 37% to Sidecar Wheel Reducer
  - No Need to Set Camber and Toe Angles, as the Sidecar Is Not “Pulling“
    - Plane of Wheels Parallel to Each Other and Perpendicular to Road Surface
    - Reduces Rolling Resistance (Compared to Conventional Sidecar Rig)
      - Up to 25%
    - Increased Tire Mileage and Reduced Fuel Consumption
- Differential Operation
  - In Rear Drive Are Two Gear Shafts (Master and Slave) with a Pair of Cylindrical Gears
  - Slotted Hub-Driven Gear Protrudes from Gear Cover and Interfaces with Internal Splined Wheel Hub
  - Shock Absorber Connected to Welded Ear on Side of Differential
  - Transverse Propeller Shaft Passes under Sidecar Tub to Sidecar Reduction Gear
  - Reduction Gear Constructed with a Pendulum Wheel Suspension
    - Fixed to Sidecar Frame in Same Manner as Dnepr MT-10.36

Unlike automotive differentials, consisting of bevel gears to distribute torque to the wheels symmetrically, the mechanism of Dnepr’s MB-750 and MT-12 include a cylindrical gear transmission to the wheels, providing an uneven effort, where the sidecar wheel receives about 30 to 40% of the load and the bike wheel receives about 60 to 70%.
Dnepr MT-12 (2WD) with Full-Time Differential

Dnepr’s MT-12 has a full-time 2WD (true differential), and no locking activation lever.
Dnepr’s MT-16 has a full-time 2WD (true differential), and no locking activation lever.
If the MT-16 had a locking differential added, such as in the MB-750, it would have a shaft with an actuation arm at the location shown by the red arrow.
As Ural’s first and only full-time 2WD sidecar, the “Sportsman” does not need a lever on the rear drive. The Sportsman was produced from 1995 to 1998, morphing into today’s “Patrol,” which had an engageable 2WD (non-differential).
All 2WD Dneprs are full-time with true differentials, and some Dneprs have locking diff’s on top of that. All 2WD Urals, except for the Sportsman, cannot be used on hard surfaces when 2WD is manually engaged, because there is no real differential.
**Russian Powered Sidecar (2WD) Development**

- In 1943/4, M-73 (modified M-72) with Engageable Sidecar Drive and Sidecar Brake Developed
  - Never Put into Mass Production Due to Ready Availability of Jeeps
- In 1958/9, Swing-Arm Frame Introduced into Next-Generation K-750
  - K-750 Essentially Same Bike as M-72 with a Swing-Arm Frame Replacing Plunger Frame, to Cope with Rugged Russian Terrain
- In 1964, MB-750 (Military Version of K-750) Introduced with Differential Drive to Sidecar Wheel
  - Two-Wheel Drive (2WD) Brother of K-750
  - KMZ’s First Production 2WD
  - Swing-Arm Framed, Sidevalve (SV) 750 cc Engine
  - Differential Drive Modeled on the WW-II Zundapp System
  - Lockable Differential Seems to Have Only Been Used for a Few Years, Then Dropped
  - Rear Drive Castings Remained the Same, Allowing for Retro-Fit
  - Full-Time 2WD with Planetary Differential
  - Replaced by the Patrol with Engageable 2WD (non-differential) Drive

*Just as the one-wheel drive (1WD) sidecar can be traced back to the German R71, the split torque two-wheel drive (2WD) differential can be traced back to the BMW R75.*
Changes in Final Drive Chain

• Introduction of “Mother” of Russian Heavy Sidecar Motorcycles: M-72
  – Born 1941
  – Exact Copy of the 1938 BMW R-71 (except for larger gas tank and weaker metallurgy)
  – One-Wheel Drive (1WD) Standard

• Dnepr Differential Drive Sidecars:
    • MB-750 / MB-750M: Military Version of MT-12 with Full-Time 2WD and Engageable Locking Differential Added
    • Lockable Differential Seems to Have Only Been Used for a Few Years, Then Dropped
  – MT-12 and MT-16 Full-Time 2WD, Supplying Power to Pusher (73%) and Sidecar (37%)
    • Differential Lock Not Present (No Locking Lever)
    • MT-12 (1974-1982): Civilian Model with Full-Time 2WD and No Locking Differential

• Ural Differential Drive: “Sportsman”
  – True Differential
  – Pre-Patrol Model

• Ural Changed to Engageable Two-Wheel, Non-Differential Drive (2WD) Sidecars:
  – Engage Sidecar Drive Shaft Using Lever Near Rear Drive
  – Available in Various Models:

We have seen One-Wheel Drive (1WD), full-time Two-Wheel Drive (2WD), 2WD with locking differential and finally engageable 2WD, where the driver could manually put the sidecar wheel into place when the going got nasty.
One quickly notices that the 1WD rear drive does not have a transverse drive shaft to power the sidecar wheel.
1 - Driven Gear Fastening Bolt
2 - Driven Gear Rim
3 - Gasket
4 - Crankcase Bushing
5 - Needle Bearing Roller
6 - Casing Seal
7 - Seal Cover
8 - Rear Wheel Axle
9 - Seal Spring
10 - Distance Bushing
11 - Casing
12 - Driven Gear Hub
13 - Oil Drain Duct
14 - Needle Bearing
15 - Double-Row Ball Bearing
16 - Adjusting Washer (Shim)
17 - Universal Joint Fork Seal
18 - Protective Washer
19 - Universal Joint Splined Fork
20 - Lock Ring (Circlip)
21 - Universal Joint Cross
22 - Grease Cup
23 - Propeller Shaft
24 - Lock Ring
25 - Flexible Disk Band
26 - Flexible Disk (Doughnut)
27 - Flexible Joint Driven Disk (Flange)
28 - Packing Ring
29 - Needle Bearing
30 - Wedge Bolt
31 - Bearing Nut
32 - Gasket
33 - Driving Gear
34 - Casing Cover
35 - Adjusting Washer (Shim)
36 - Ball Bearing

Power from Gearbox (PTO)

Flexible Joint

Propeller Shaft

Universal Joint

Rear Drive

Rear Wheel Axle
Final Drive: Propeller Shaft and Final Drive (cont.)

- Power Delivered from Gearbox to Rear Wheel by Drive Shaft (propeller shaft) and Rear Drive with Bevel Gears
- Drive shaft Coupled to Gearbox via Flexible Rubber Collar (doughnut) and Universal joint
  - Flexible Joint (27) Is a Coupling Fitted with Plates and Pins
  - Splined Propeller Shaft (23) Fits into Coupling Disk (27)
  - Flexible Disk (26) Transitions to Transmission Gear Box
  - Flexible Coupling Helps Dampen Torque Impulses
  - Universal joint Allows suspension travel of the rear wheel
- Rear Drive is a Cast housing containing a helical bevel gear set
  - Bevel Gear Set
    - Contains Small Pinion Gear (Driver) and Ring Gear (Driven)
    - Turns the Rear Wheel Axle at a Lower Speed than the Propeller Shaft
    - Gear Backlash Adjusted via Washers or Shims (16) Installed between Side Portion of Casing Cover and Inner Race of Ball Bearing (15)
      - 0.004 to 0.012” / 0.1 to 0.3 mm Backlash Necessary between Gear Faces
- Rear Casing Serves as Backing Plate for Brake Shoes, Oil Reservoir and Support for Right-Hand End of Rear Wheel Axle
  - Oil Fill Hole Provided in Cover (34)
  - Casing (11) Has Oil Drain Hole at Bottom with a Plug
  - Cover (34) Attached to Casing Has a Slot and Two Studs Used to Fasten the Whole Drive to the Swinging Fork Arm of the Rear Suspension

The final drive transfers power from the transmission output, via flexible coupling, propeller shaft and flexible coupling, to the rear drive, where it is transferred to the rear wheel (pusher) and for 2WD, the sidecar wheel.
Sidecar Motorcycle Driveshaft Lengths

- K-650 (MT-8) Has a Longer Driveshaft to Reach the Old Gearbox
- MT-9 Onwards Had Shorter Shaft, Due to Thicker Gear Box (MT-804 Dneprglide)
- The Length of the Propshaft Depends on the Engine Design, the Gear Box, the Main Gear and the Motorcycle Frame
- Urals Has Three Lengths;
  - Plunger Framed Bikes (M-72, M-61, M-62)
  - M-63 thru M-66
  - M-67 and Later (20 mm longer)
  - All Shafts Are Interchangeable within One of Three Groups

<table>
<thead>
<tr>
<th>Motorcycle</th>
<th>Drive Shaft Part #</th>
<th>Length A</th>
<th>Length B</th>
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<td>57 mm</td>
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<td>MB-750 (CF-750)</td>
<td>75005301</td>
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<td>IMZ-8.101-05301</td>
<td>278 mm</td>
<td>191.4 mm</td>
<td>57 mm</td>
</tr>
<tr>
<td>MT-9 / MT-10 / MT-10.36 / MT-11 / MT-12 / MT-16</td>
<td>MT905301</td>
<td>288 mm</td>
<td>201.5 mm</td>
<td>57 mm</td>
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<tr>
<td>Ural M-62 / M-63 / M-66</td>
<td>IMZ-8.101-05301</td>
<td>278 mm</td>
<td>191.4 mm</td>
<td>57 mm</td>
</tr>
</tbody>
</table>
Elastic Coupling Assembly
(Муфта в сборе, 7205013)

- Rubber Puck (7205324-B) Uses Ring (7205329) That Slips into Middle of Band (7205328-A)
- Forms Assembly (7205013)

No Bushing or Outer Rim
Recent Quality Improvements in Ural Final Drive Chain

- **2003**: New 750cc Ural Engine Replaced the 650 cc Engine
  - New Drive Shaft with Course Splines to Reduce Chance of Stripping Out Drive Coupling
- **2006 Improvements**
  - Knob Style Dipstick Removable by Hand
  - Nylock Nuts Used to Secure Final Drive to Swing Arm
  - Engaged Austrian Design Office HC Concepts to Improve Ural Power Train
    - Redesigned Many Internal Gears, Bearings and Seals in Final Drive
    - Results Seen in the 2007 Ural
  - Use of final drive lock nuts
  - Labeled final drive engagement lever
- **2007 Improvements**
  - Redesigned Drive Shaft with Longer and Stronger Splines
  - Improved 2WD Engagement Rod with Uni-Balls
- **2008 Improvements**
  - Herzog Drive Bevel Gears Stronger and Heat-Treated for Prolonged Life, Tighter Tolerances, and Cooler Running Temperatures (earliest availability summer 2008)
- **2009 Improvements**
  - Standard Greaseable U-Joints for 2WD Shaft
- **2010 Improvements**
  - New U-Joint Polymers 40% Stronger
- **2011 Improvements**
  - Improved High-Strength Final Drive Ring Gear Bolts
- **2012 Improvements**
  - Castle Nut Replaced with Standard Self-Locking Nut on Flex Coupler
  - New Polymer Material Replaced Rubber for Flexible U-joint, 40% Stronger
  - Tourist, Patrol, Gear-Up, Patrol T: Sidecar Drive Shafts Powder-Coated on 2WD Models
  - Gear-Up: Sidecar Drive Distance Bushing Changed to Reduce Drive Bearing Failures
Dnepr’s MB-750 has a true differential 2WD, with a manual activation lever. A shift linkage on the final drive hub indicates that it is a selectable locking differential.
Handling Differences between the Ural Single-Wheel or One-Wheel Drive (1WD) and the Two-Wheel Drive (2WD) (myural.com)

Note: This does not include characteristics for the 1995-1998 Ural “Sportsman” model, or Dnepr’s MT-12, MT-16, MB-750, MB-750M, MB-650, MB-650M, all of which have a full-time differential drive.

- **Use of Ural 2WD (non-Differential) Is Strictly for Off-Road, Gravel, Snow, Ice or Wet Slippery Surfaces**
  - When 2WD Engaged, both Rear and Sidecar Wheel Locked Together and Turn at the Same Rate
  - No Differential
  - Left Turns Are Easier than Right Turns, as It Is Easier for the Sidecar to Turn Around the Motorcycle than Other Way Around
  - Using Power, the Motorcycle Can Be Slid Rapidly in a Left 180° Turn on Loose/Soft Ground
  - Right Turns Require a 10 ft to 15 ft Turning Radius, Depending on Surface Type
  - 2WD Meant for Extricating or Negotiating Through or Out of Low-Traction Environments
- **Avoid “Flying the Chair” While in 2WD**
  - Sidecar Wheel Contacting the Ground While Engaged in 2WD Can Damage the Axle Splines or Final Drive Engagement Gears
  - Pulling in the Clutch Disengages Power to the Drive Train, Which Will Lessen Any Chance of Damage When the Wheel Again Makes Contact with the Ground
- **Normal “Pulling” and “Drifting” Tendencies Are Reversed While in 2WD**
  - Normally in 1WD, Application of Throttle Causes Rig to “Pull” to Right Due to Drag of Sidecar Wheel
  - Letting Off Throttle Causes the Rig to “Drift” to the Left Due to Free-Wheeling of Sidecar Wheel
  - When 2WD Engaged, Power Is Split between Rear and Sidecar Wheels; Approximately 63% of Power Goes to Rear Wheel and 37% to Sidecar Wheel
  - Apply Throttle When There Is No Longer Drag, but Acceleration from the Sidecar Wheel Which Will "pull" (push) You to the Left
  - When You Let Off the Throttle, You Now Have More Drag Since the Sidecar Wheel Is Tied to the Transmission/Engine; and You Will "drift" to the Right
  - Just As You Can Use the Normal "pulling" and "drifting" Tendencies to Assist You thru Normal 1WD Turns, the Same Can Be Done While in 2WD
  - Remember the Tendencies Are Reversed and Somewhat Amplified While in 2WD

The dream sidecar is a bike with 2WD with a differential like the MT-16, but with the ability to lock-in straight drive for off-road situations.
With the tub removed, the sidecar drive shaft and gear reducer is clearly seen.
Rear Suspension on M-72, M-61 and M-62 (1WD)

• Plunger Rear Suspension Was the Original Rear Suspension Design: M-72
  – Plunger Was Used on M-72, Ural M-61 and M-62
  – M-61 and M-62 Plunger Frames Different from the M-72 Frames
  – Rear Suspension Connected to Rear Drive
• Next Generation Was the K-750
  – In 1958 Kiev Motorcycle Plant (KMZ) Replaced Plunger Framed M72-N with the Swingarm-Framed K-750
  – Essentially the Same Bike with a Swing-Arm Frame Instead of Plunger Frame
  – Swing-Arm Is an Improvement in Rear Suspension with Shocks
  – The K-750 was a Soviet improvement on plunger framed R-71/M-72 Design to Better Cope with Roads and Terrain Found throughout the USSR
  – Rear Swing-Arm on Inside of Frame unlike Later Ural Swing-Arm Located on the Outside of Frame
M-72 pioneered the plunger (coiled spring) suspension, which was replaced in the K-750. Ural’s M-61 and M-62 also used the plunger suspension system.
Later M-72 Cardan Shaft, Universal Joint and Elastic Coupling

<table>
<thead>
<tr>
<th>Part #</th>
<th>Name</th>
<th>Наименование</th>
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<tbody>
<tr>
<td>72053-1</td>
<td>Cardan shaft + universal joint spider assembly</td>
<td>Карданный вал и крестовина в сборе</td>
</tr>
<tr>
<td>7205304</td>
<td>Cowl</td>
<td>Колпак</td>
</tr>
<tr>
<td>7205308</td>
<td>Cardan shaft assembly</td>
<td>Карданный вал в сборе</td>
</tr>
<tr>
<td>7205324-B</td>
<td>Elastic coupling</td>
<td>Муфта резиновая</td>
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<tr>
<td>7205326-B</td>
<td>Bushing</td>
<td></td>
</tr>
<tr>
<td>7205328-A</td>
<td>Support ring</td>
<td>Обойма</td>
</tr>
</tbody>
</table>

7205301 Propeller Shaft

7205304 Cowl

7205307 Cardan Shaft Fork

7205324-B Elastic Coupler

7205326-B Bushing

7205328-A Support ring

7205329 Doughnut Wire Circlip

7205308 Cardan shaft assembly

7205304 Cowl

7205301 Propeller Shaft
**M-61 Drive Chain (Задняя передача)**

- 1 - elastic coupling
- 2 - clutch plate elastic hinge
- 3 - locking ring
- 4 - propeller shaft
- 5 - cardan shafts
- 6 - slotted plug universal joint
- 7 - driveshaft seal
- 8 - drive gear
- 9 - driven gear
- 10 - crankcase cover
- 11 - bearing idler
- 12 - crown wheel hub
- 13 - bronze bearing
- 14 - collar seal
- 15 - seal
- 16 - spacer
- 17 - wheel axle
- 18 - channel
- 19 - rear pinion bearing
- 20 - front pinion bearing
- 21 - nut bearing
- 22 - wedge bolt
- 23 - needle bearing

**Outer Ring of the Bearing Is Fixed in the Casing with a Special Left-Handed Nut**
- Between the Bearing and Nut Set Is a Shaped Spring Washer
- To Prevent Leakage of Oil Is a Nut with a Rubber Gasket

**Driven Gear Consists of a Rim and a Hub:**
- Crown Gear Fixed on the Hub Flange by Eight Bolts
- Driven Gear Rotates on Two Bearings:
  - Ball Bearing 207, Mounted on the Case
  - Bronze Bearing (13), Consisting of Two Half-Rings Installed on the Neck of the Hub and Working in a Steel Sleeve Pressed into the Back of the Transmission Casing

**Normal Backlash between Gear Teeth Should Be Set in the Range of 0.1 to 0.3 mm**
- Between the Inner Ring of the Ball Bearing and the Driven Gear and the Case Cover Shims
M-62 Final Drive and Rear Plunger Suspension
(www.ural-m62.com)
M-72 pioneered the plunger suspension system, but was replaced in the K-750. Ural’s M-61 and M-62 also used the plunger suspension system.
1WD versus 2WD Suspension of Rear Drive

• Swing-Arms Differ on the Drive Side
  – 1WD Swing-Arm Has a Simple Plate Which Bolts to Four Studs around the Axle Hole of the Rear Drive Casing
  – 2WD Swing-Arm Has a C-Shaped Fork Which Attaches to the Circumference Bolts on the Rear Drive Casing

Gearboxes are also distinguished by the appearance and method of fastening to an arm rear suspension.
Because Ural’s M-62 / M-63 / M-66 / M-67 do not offer 2WD, the swing-arm is not C-shaped on the open end.
Modern Ural 1WD versus 2WD Suspension

8. IMZ-8.107-09081 Rear Suspension Swing-Arm for 2WD

9. IMZ-8.103-09081 Rear Suspension Swing-Arm 1WD
(IMZ-8.103 is a 650cc Ural)

The swing-arm is different between the 1WD and 2WD modern Urals. The 2WD version uses a C-shaped support which allows the transverse shaft to drive the sidecar wheel.
Ural M-66 (1WD) Rear and Sidecar Wheel Suspension

1. Sidecar Wheel Axle
2. Guard Plate
3. Pendulum Wheel Axle Lever
4. Sidecar Wheel Shock Absorber
13. Motorcycle Frame
21. Rear Suspension Swing-Arm Fork
24. Sidecar Frame
25. Clamping Holder (cross-section)
26. Silent Block
27. Pin

Rear Drive Swing-Arm

Sidecar Wheel Swing-Arm
The M-63 was the first Ural to use a rear swing-arm suspension. Notice that unlike the KMZ/Dnepr bikes, the swing-arm is on the outside of the frame.
The Differential (Standard vs. Locked)

- Sometimes Called the “Pumpkin”, Where Rear Axle Intersects with Drive Shaft
- Consists of Set of Gears that Convert Rotating Motion of Driveshaft for 1WD, and Split Power to each Driving Axle Shafts (Pusher and Sidecar Wheels) for 2WD
- A True Differential Transmits Power to the Wheels, While Allowing Them to Rotate at Different Speeds, Thus the Term "differential"
  - Need for Wheels to Rotate at Different Speeds When Turning Corners
    - Inner Wheel Travels a Shorter Distance than the Outer Wheel in the Turn
    - If One Wheel Slips (for instance One Wheel Comes into Contact with Mud, Snow, or Ice, or If the Wheel Is Somehow Removed from Contact with the Road after Encountering an Obstacle or Area of Soft Ground) More Torque Is Sent to the Wheel That Slips
  - If That Slipping Wheel Completely Loses Traction, All Power Will Be Sent to That Slipping Wheel and You Have No Forward Momentum, at Which Point It Will Be Stuck
  - When Off-Road, This Is Where the 2WD Differential Fails to Remain Effective
  - When Off-Road There Are Many Situations Where a Wheel Will Spin Free
- A Locking Differential Solves This Problem by Delivering 100% of Available Torque to the Wheel with the Most Traction
  - Locking Differential or Locker Provides Increased Traction Compared to a Standard or "open" Differential by Disallowing Wheel Speed Differentiation between the Two Wheels
  - Locking Differential Essentially "locks" Both Wheels Together
  - Thus Difficult to Negotiate a Turn On-Road
  - Forces Both Wheels to Turn in Unison, Regardless of the Traction (or lack thereof) Available to Either Wheel Individually
2WD Dnepr uses a gear reduction box to match the transverse rotation speed to that of the sidecar wheel.
M-73: Prototype to M-72 (bcozz.multiply.com)

• First Soviet 2WD Was the IZH-1 (1929), but Never Achieved Large Production
• M-73 (1950s) was Prototype of M-72 incorporating Sidecar Wheel Drive
  – First production 2WD was Either the M-73 or TMZ-53 of 1942-43 Time frame
  • M-73 Featured Improved Off-Road Performance with Sidecar Wheel Drive
    – The M-73 was built from late 1942 to 1944 in Small Numbers
    – Had a Dog Clutch to Sidecar Drive, Otherwise a Normal M-72
• TMZ Was a 1000 cc Sidevalve (SV), Modeled on the BMW R75
  – Rigid rear and lockable differential drive with reverse.
• Both KMZ and IMZ built prototype 2WD plunger frame bikes in the 1950’s
  – KMZ’s (Dnepr’s) First Production 2WD was the MB-750 (1963)
    • Swingarm-Framed Sidevalve (SV)
    • Differential Drive Loosely Patterned on the WW-II Zundapp System
    • Locking Differential Added on the MB-750M (1973-77)
  – Production IMZ (Ural) 2WD Was the Sportsman in the late 1990’s
    • Full-Time Differential Drive
    • Replaced by Patrol with an Engagable, non-Differential Drive for Off-Road

Close-Up of the Three Gear Levers;
Neutral Finder/Gear-Change Lever,
Hi/Lo Ratio Lever and Sidecar Drive Lock Lever
Dnepr K-750M and Ural M-63 Propshaft (Propeller Shaft)

Propshaft Assembly:
1 - front driven disk (flange fork)
2 - elastic disc
3 - lock holders
4 - holder of the coupling
5 - rear fork flange (driven)
6 - drive shaft with leading fork
7 - needle bearing
8 - clip seal
9 - rubber ring
10 - driven fork
11 - universal cross
12 - cap
13 - O-ring

Main Gear:
1 - drive gear
2 - nut bearing
3 - bearing housing
4 - wheel hub bearing
5 - spacer
6 - large pole
7 - hub
8 - shim

6. Drive Shaft with Leading Fork
Ural Sportsman vs. Gear-Up, MB and MT-16 (www.russianiron.com)

- Ural Sportsman Had Full-Time, Two-Wheel Drive (2WD)
  - Driveshaft to Sidecar Wheel, Like a Gear-Up
  - No Torque Tube on Dnepr’s 2WD System
  - Torque Tube Is a Tube Enclosing a Drive Shaft That Is Used to Absorb the Resultant Torque from the Shaft
  - Final Drive (FD) Units Look Different from Ural’s Gear-Up and Dnepr’s MT-16
- Dnepr System Has a Sun-Gear Driving a Torque Tube Which Goes Straight Across to the Sidecar Hub
  - Dnepr’s Sun-Gears Are Dnepr’s Way of Allowing Lead on the Sidecar Wheel Without Having a Driveshaft Run at an Angle from the Differential Hub to the Driven Sidecar Wheel, As It Does on a Ural Sportsman and a Gear-Up
  - Hub Has Another Gear Which Drives a Gear Which Reverses the Output to the Driven Axle Shaft
  - Requires the Sidecar Frame to Have a Large Inner Loop to Allow Clearance for the Torque Tube Cross Shaft
  - Apparently Can Take a More of a Beating as Regards the FD, Due to Torque Tube Design
- The Ural Sportsman Differential (diff) Uses an Output Straight Off the Sun-Gear to a Splined Stub Axle
  - Axle Is Splined into Bushings Running in Bearings in the Sidecar Hub Swing-Arm, Which Is on a Slightly Longer Swing-Arm Which Moves the Axle Line Further Backwards Than Other Models, So the Cross Shaft Is at a Lesser Angle, But Still on an Angle
- Dnepr or Sportsman Diff Allow Zero Toe-In Alignment and Split the Power about 70/30 between the Bike and Sidecar Pusher Wheels
  - A Balanced Arrangement That Reduces Sidecar Lag and Yaw

KMZ (Dnepr) and IMZ (Ural) FDs are not interchangeable without replacement of almost everything they are connected to.
Ural Sportsman vs. Gear-Up, MB and MT-16: Drive from the Dneper MB (CF) without blocking - is found everywhere, but is more easily traversed by a free differential.