Ural (Урал) - Dnepr (Днепр) Russian Motorcycle Part 3B: Full-Time Two-Wheel Drive (2WD) with non-Locking Differential

(MT-12 / MT-16 / MB-650M / MB-650M1 / Ural "Sportsman")

(See Also Part 3A: Locking versus non-Locking Differential, Part 3C: Full-Time 2WD with Locking Differential and Part 3D: Full-Time 1WD with Locking non-Differential)

Ernie Franke eafranke@tampabay.rr.com 1 / 2013

Four Types of Final Drives in Russian Sidecars

- 1. Full-Time, Straight Final Drive (1WD) (Part 2)
 - -One-Wheel Drive (1WD)
 - -Available in Various Ural / Dnepr Models
- 2. Full-Time, Two-Wheel Drive (2WD) with non-Locking Differential (Part 3B)
 - -Dnepr MB-650M (1985-1991)
 - -Dnepr MT-12 (1977-1985)
 - -Dnepr MT-16 (1985-2005)
 - -Dnepr Rear Drive Casings Allow for Adding Locking Differential
 - -First Available in Ural: "Sportsman" IMZ 8.107 (1995-1998)
 - Only True Differential for Ural
 - Pre-"Patrol" Model
- 3. Full-Time, Two-Wheel Drive (2WD) with Locking (Engageable) Differential (Part 3C)
 - -Dnepr MB-750 (1964-1973)
 - -Dnepr MB-650 (1968-1984)
 - -Dnepr MB-750M (1973-1977)
- 4. Full-Time, 1WD with Engageable Locking 2WD (non-Diff) (Part 3D)
 - -Available in Various Ural Models
 - Production: Patrol (1998-Current), Gear-Up (2001-Current) and Patrol-T (2009-Current)
 - Limited Editions with Engageable Sidecar Drive Shaft:
 - -Derivatives of Patrol or Gear-Up
 - -Basic (2005), Raven (Vorona) (2006), Pustinja (2007), Wjuga (2008), Sahara (2009) and Taiga (2010)

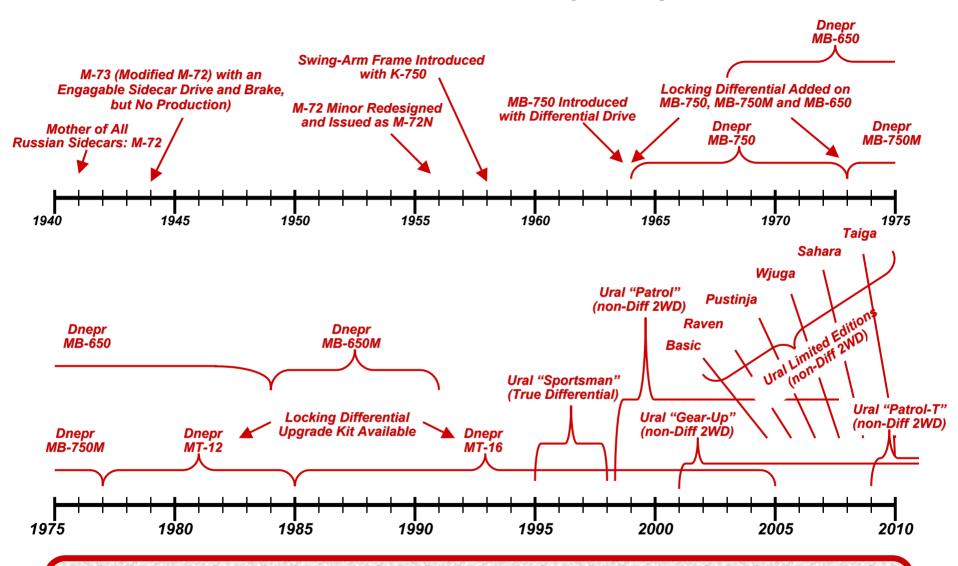
The order of presentation will be chronologically from Dnepr's MB-650M, MT-12, MT-16 and Ural's "Sportsman".

Ural (Урал) / Dnepr (Днепр) 2WD with Non-Locking Diff's

Ural (Урал) Model	Production	Engine	Voltage	Drive Train	Rear Suspension
M-72	1941-1950	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
M-72K	1952-1958	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
M-72M	1956-1961	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
M-61	1958-1961	650cc OHV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
M-62 (Ural-1)	1961-1965	650cc OHV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
M-63 (Ural-2)	1965-1971	650cc OHV	6-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
M-66 (Ural-3)	1971-1973	650cc OHV	6-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
M-67 (IMZ-8.101)	1974-1976	650cc OHV	12-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
M-67.36	1976-1984	650cc OHV	12-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
"Sportsman" IMZ 8.107	1995-1998	650cc OHV	12-Volt	Full-Time 2WD with Non-Locking Differential	Swing Arm
8.103 Series "650"	1984-2002	650cc OHV	12-Volt	Full-Time 1WD with Engageable 2WD (No Diff)	Swing Arm
"750"Series	2003-Present	750cc OHV	12-Volt	Full-Time 1WD with Engageable 2WD (No Diff)	Swing Arm
Dnepr (Днепр) Model	Production	Engine	Voltage	Drive Chain	Rear Suspension
M-72	1951-1956	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
M-72N (H)	1956-1960	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Plunger
K-750	1959-1963	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
K-750M	1963-1977	750cc SV	6-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
MT-12 (Dnepr-12)	1974-1982	750cc SV	6-Volt	Full-Time 2WD with Non-Locking Differential * *	Swing Arm
MB-750	1964-1973	750cc SV	6-Volt	Full-Time 2WD with Locking (Engageable) Diff *	Swing Arm
MB-750M	1973-1977	750cc SV	6-Volt	Full-Time 2WD with Locking (Engageable) Diff *	Swing Arm
K-650/MT-8	1967-1971	650cc OHV	6-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
K-650/MT-9	1971-1976	650cc OHV	6-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
MB-650	1968-1984	650cc OHV	12-Volt	Full-Time 2WD with Locking Differential *	Swing Arm
MB-650M	1985-1991	650cc OHV	12-Volt	Full-Time 2WD with Non-Locking Differential * *	Swing Arm
MT-10	1973-1976	650cc OHV	12-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
MT-10.36	1976-1984	650cc OHV	12-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
MT-11 (Dnepr-11)	1984-2005	650cc OHV	12-Volt	Full-Time, Straight Final Drive (1WD)	Swing Arm
MT-16 (Dnepr-16)	1985-2005	650cc OHV	12-Volt	Full-Time 2WD with Non-Locking Differential * *	Swing Arm

^{*} Locking Feature Deleted after Two Years of Production, * * Optional Kit Available to Add Locking Differential

Russian Two-Wheel Drive (2WD) Time-Line



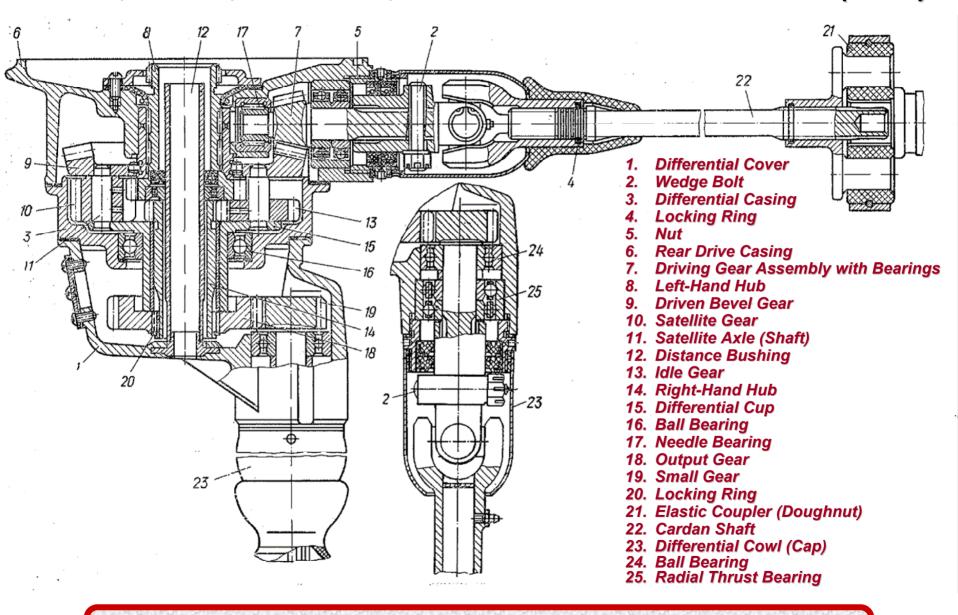
KMZ's (Dnepr factory) first production 2WD was the MB-750 (1964), with a rear drive modeled on the WW-II BMW's R75.

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.

Dnepr MB-650M (1973, eng.auto24.ee)



MT-12, MT-16, MB-650M, MB-650M1 Differential Drive (2WD)



The differential gear of the MT-12, MT-16, MB-650M, MB-650M1 is non-locking, with an asymmetric coefficient of 19:11.

MT-12, MT-16, MB-650M, MB-650M1 Differential Drive (2WD)

- Rear Drive and Differential Gear Mounted in Common Split-Housing
- Composed of Three Parts
 - -Differential Cover (1)
 - -Differential Casing (3)
 - -Rear Drive Casing (6)
- Rear Drive Consists of Spiral Bevel Gear (7 and 9)
- Differential Casing Consists of Four Parts:
 - -Two Hubs (8 and 14)
 - Left-Hand Hub (8) Mounted in Rear Drive Casing on Two Needle Bearings
 - · Right-Hand Hub (14) Mounted in the Differential Half
 - -Two Satellite Gears (10)
 - -Two Idle Gears (13)
 - -Differential Half (15)
 - Satellite and Idle Gears Installed on Axle (11), whose Tenons on one Side Enter Differential Cup (15), and on Other Side, Large Bevel Gear (9)
 - Differential Cup and Driven Gear Are Centered by Means of Two Roller and Tightened Together by Two Bolts, Secured by a Special Lock Washer
- Assembled Différential Supported by Two Bearings:
 - -Ball Bearing (16) Mounted in Differential Casing
 - -Roller (Compound) Bearing Mounted in Rear Drive Casing
- Force from the Differential Transmitted to Sidecar Wheel thru Pair of Gears (18 and 19)
 - -Output Gear (18) Mounted on Splines of Hub (14) and Fixed with Lock Ring (20)
 - -Nut (5) Has Left-Hand Thread at Both Ends
- Oil Poured into Main Casing thru Fill Hole, and into Differential Gear thru Side Port in Cover
- To Lubricate Universal Joint, Remove Rubber Seal and Unscrew Protective Cap
 - -Reduction Gear Cowl Has Right-Hand Thread

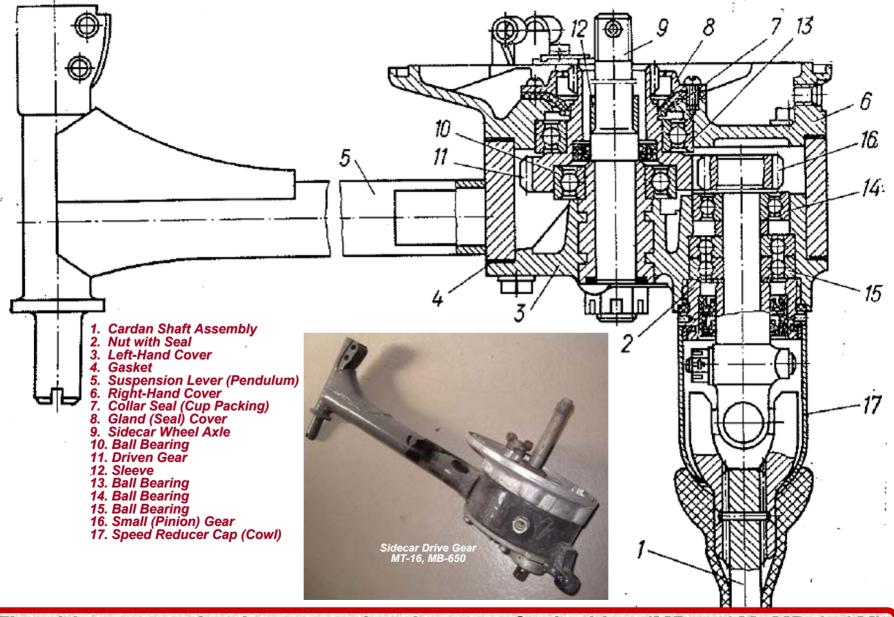


8. Left-Hand Hub



10. Right-Hand Hub

MT-12, MT-16, MB-650M, MB-650M1 Sidecar Wheel Speed Reducer (2WD)



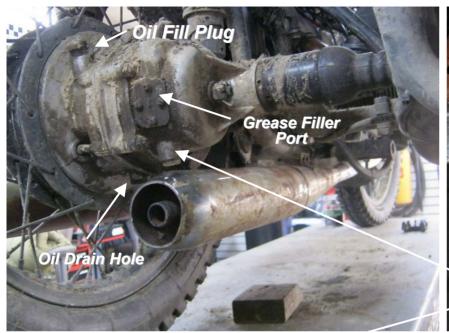
The sidecar speed reducer remains the same for locking (MB-750M, MB-650M) and non-locking differentials (MB-750, MB-650, MT-12 and MT-16).

MT-12, MT-16, MB-650M, MB-650M1 Sidecar Wheel Speed Reducer (2WD)

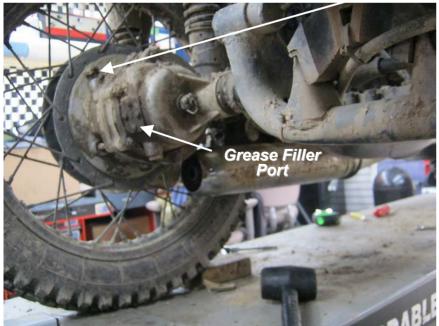
- Force from Differential Gear Transmitted via Transverse Torsion Cardan Shaft to Reduction Pinion Gear (16), which Is Meshed with Driven Gear (11)
- Transverse Cardan Shaft Designed to Cushion Impact Loading in Power Transmission to Sidecar Wheel Drive
- Pinion Gear (16) Interchangeable with Differential Gear (19) from Main Drive
- Driven Gear (11) Mounted on Two Ball Bearings (10 and 13)
- · Covers (3 and 6) Bolted to Casing
- Gaskets (4), Collar Gland (7) and Two Rubber Glands Press-Fitted in Nut (2) Provide Air-Tightness for Reduction Gear
- · Oil Is Poured into Reduction Gear Casing thru Filling Hole
- When Mounting the Reduction Gear, Ensure Proper Position of Joint Forks -Forks Press-Fitted on Cardan Shaft Splines Must Be Arranged in Same Plane
- To Lubricate Universal Joint, Remove Rubber Seal and Unscrew Protective Cap -Differential Cowl Has Left-Hand Thread

The sidecar wheel speed reducer has a gear ratio of 2.4:1 between the transverse drive shaft and the sidecar wheel.

Dnepr MT-12 (affordable-beemers.smugmug.com)









MT-12 Rear Drive: Before and After (www.wilku.szczecin.pl)









MT-12 Rear Drive: Before and After (www.wilku.szczecin.pl)



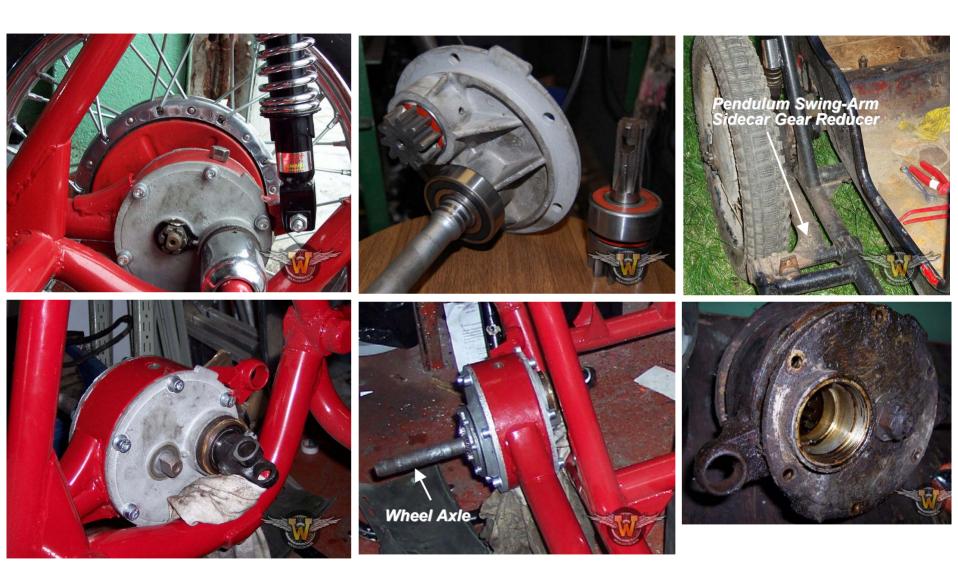






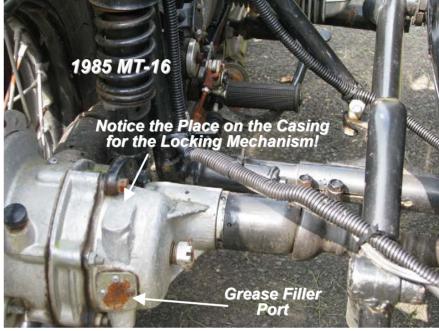
MT-12 Sidecar Gear Reducer: Before and After

(www.wilku.szczecin.pl)



Dnepr MT-16 (sovietsteeds.com)









Inside the MT-16 Rear Drive (moto.kiev.ua)







Notice Area of MT-16 Rear Drive Reserved for Differential Lock Engagement Lever

Grease Filler Port



The next few slides open up the MT-16 differential.

MT-16 in the Raw (http://oppozit.ru/post_73445.html)











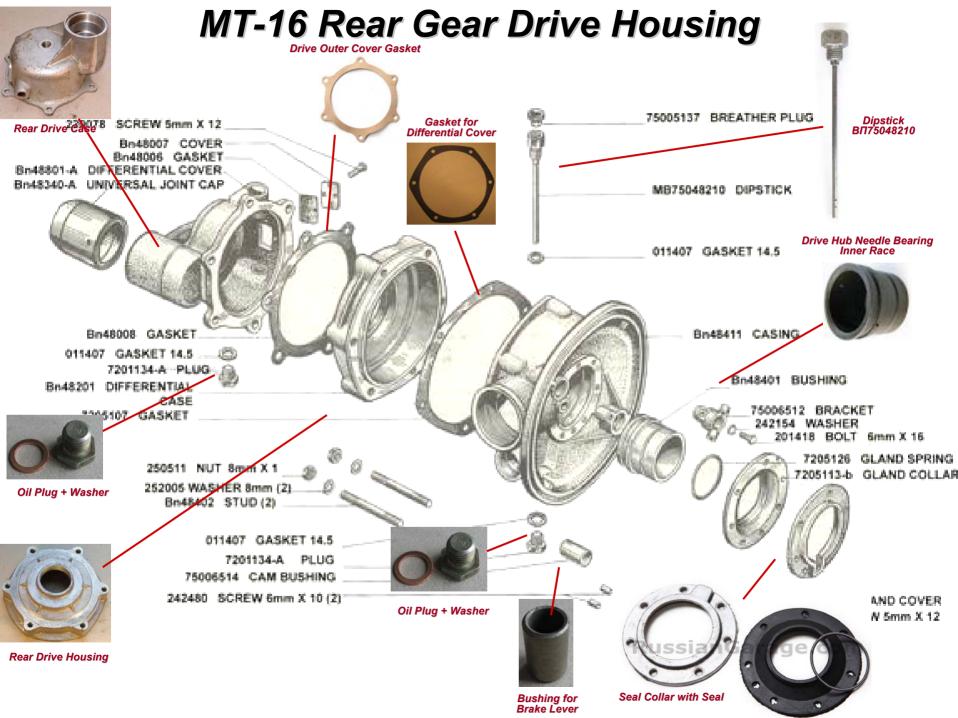
MT-16 Rear Drive and Sidecar Wheel Gear Reducer



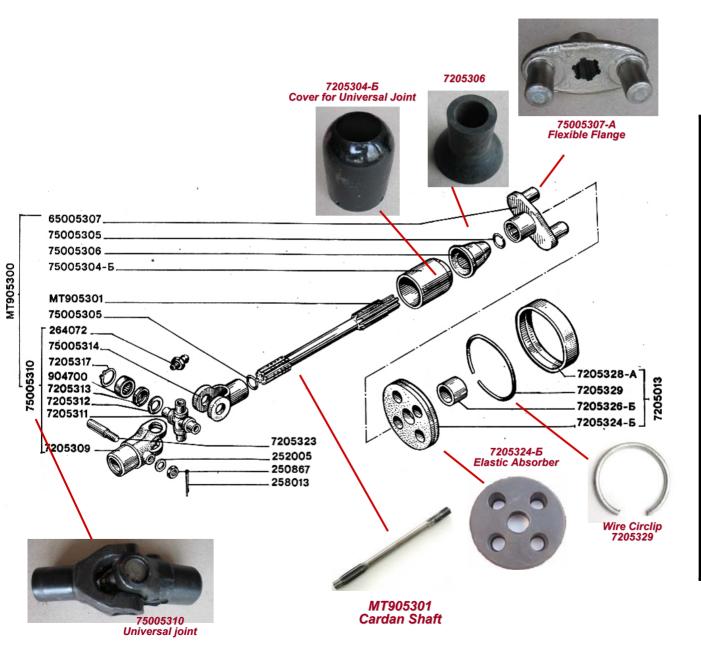






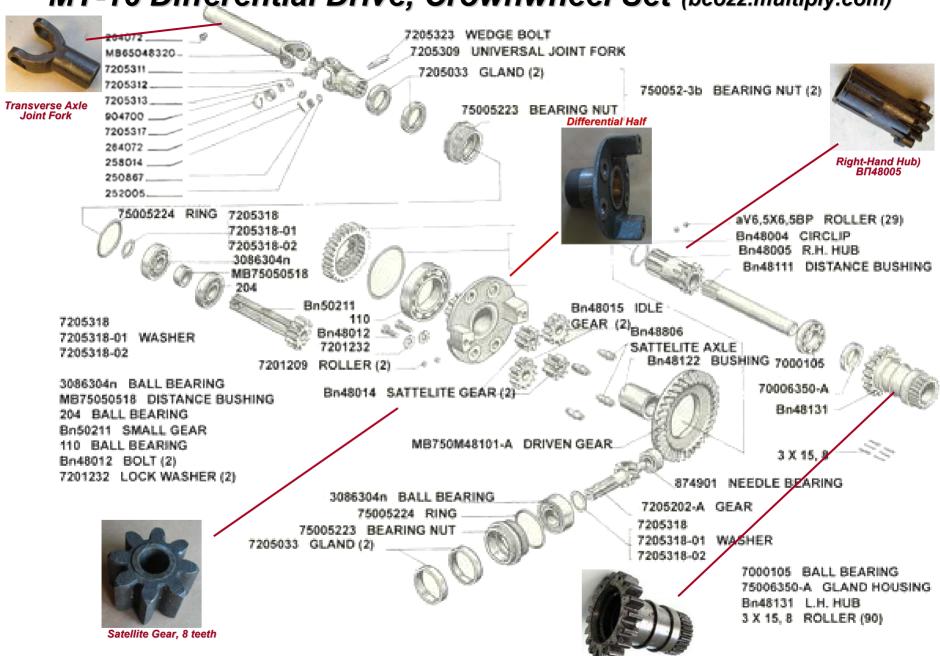


MT-16 Propeller (Cardan) Shaft

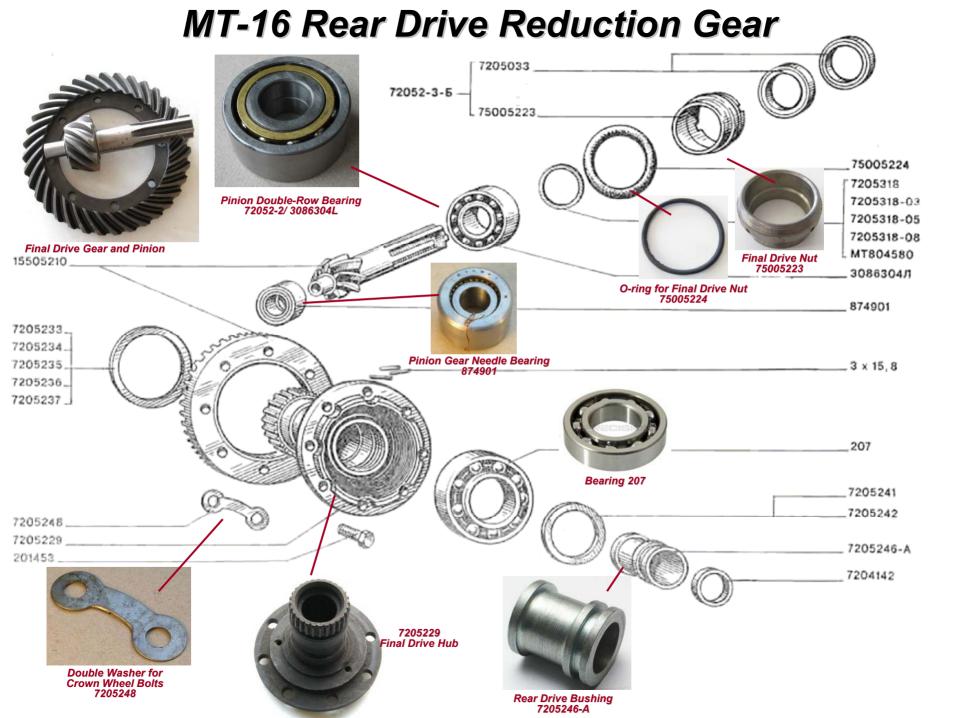


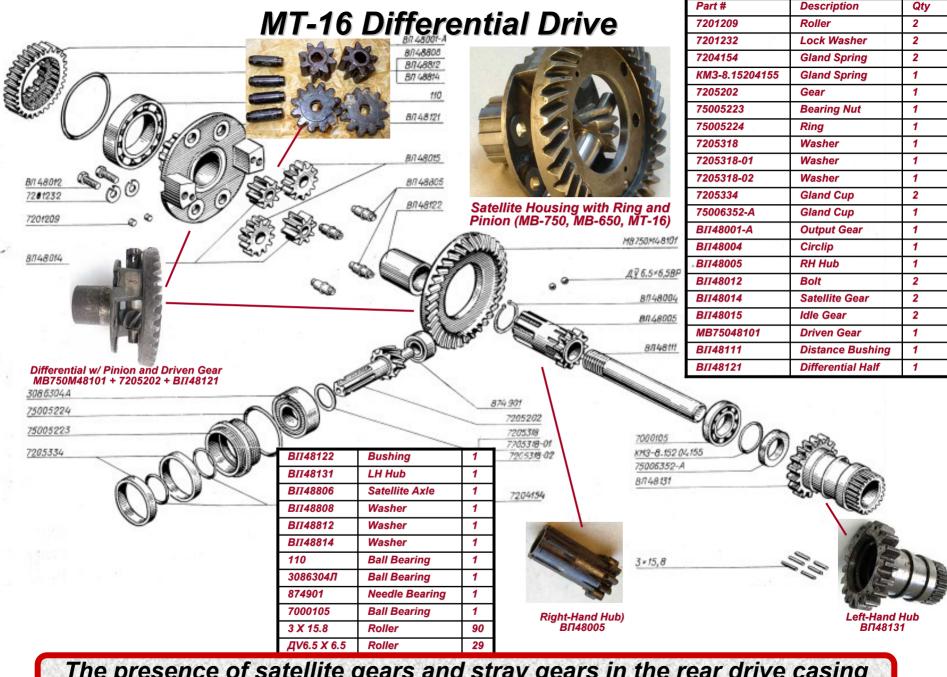
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	904700	Needle Bearing	4

MT-16 Differential Drive, Crownwheel Set (bcozz.multiply.com)



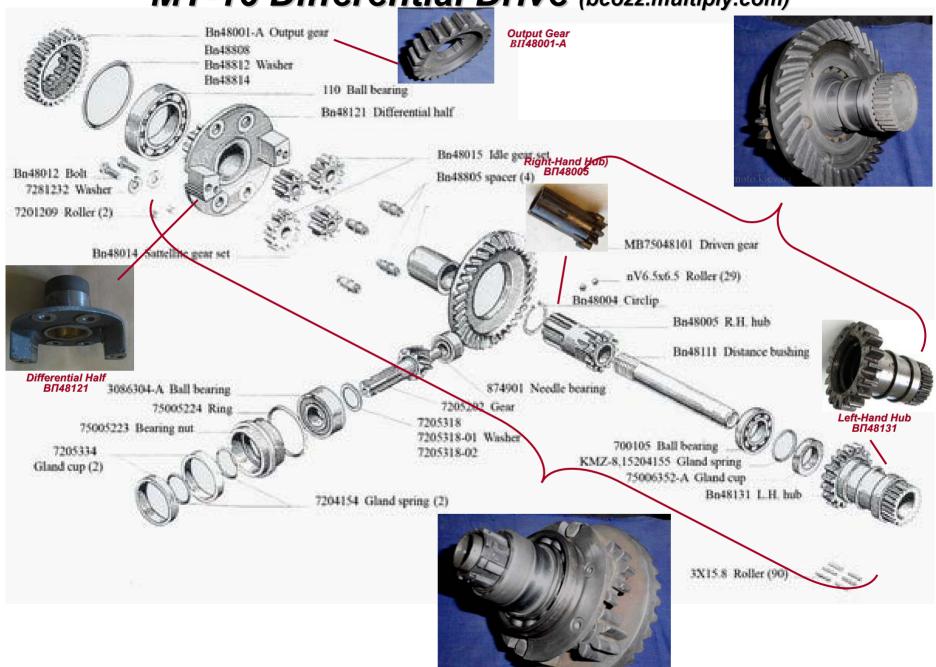
Left-Hand Hub BΠ48131





The presence of satellite gears and stray gears in the rear drive casing indicates that the rear drive is indeed a differential.

MT-16 Differential Drive (bcozz.multiply.com)



MT-16 (http://moto.kiev.ua/trid/soldadd/1270145883698)







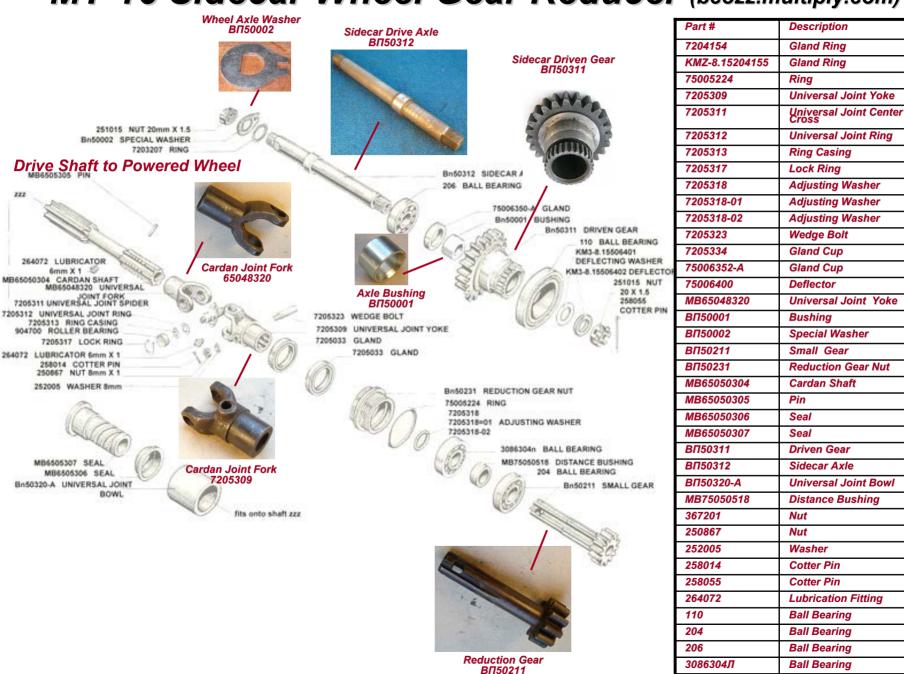


The inner workings of the MT-16 differential show the idle and satellite gears, the crown gear and the hub.

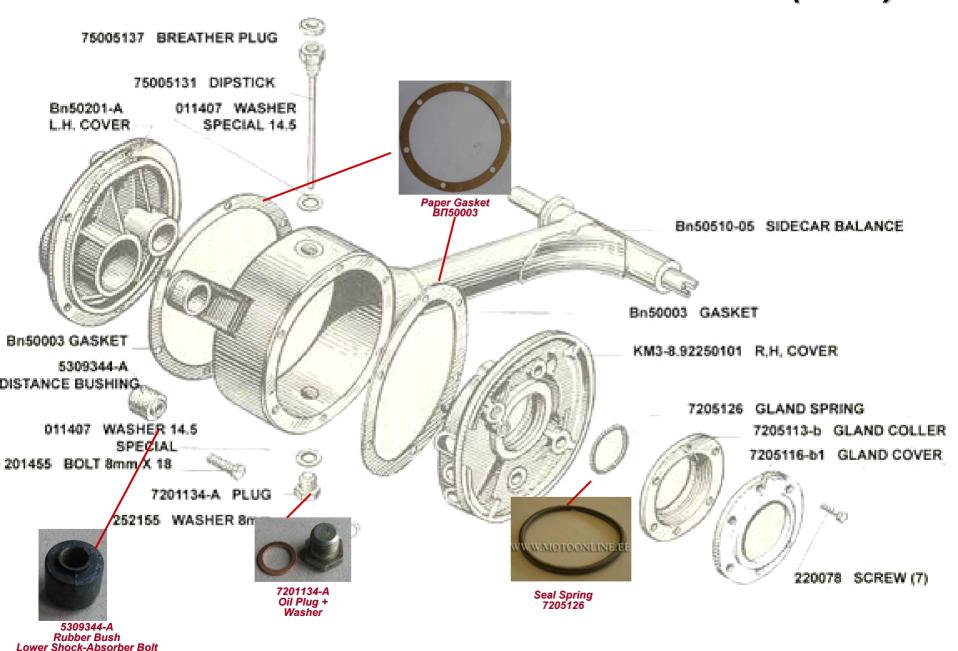
MT-16 Sidecar Wheel Gear Reducer (bcozz.multiply.com)

Qtv

Roller Bearing



MT-16 Reduction Gear Case with Covers (2WD)



Final Drive, Full-Time 2WD with non-Locking Differential









MT-16: Full-Time 2WD with non-Locking Differential









MT-16 Differential



w.moto.ki

Notice the Area of MT-16 Rear Drive Reserved for Differential Lock Engagement Lever



MT-16 Suspension (oppozit.ru)







cover.

Tighten the nuts which fasten the final drive to the swingarm. Failure to tighten the nuts in due to results in loose joints and destruction of the final drive

Ural "Sportsman" 1998, IMZ 8.107





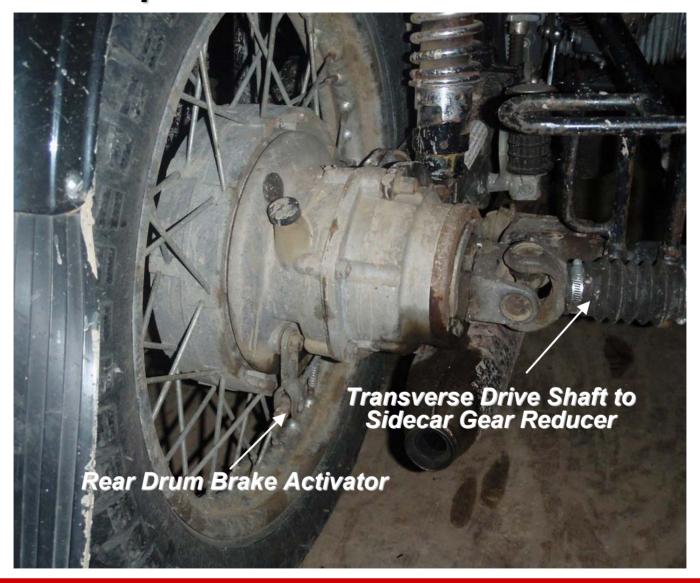




Ural Sportsman: True Differential (Diff)

- First Two-Wheel Drive (2WD) Model Offered in the USA
 - -Production: 1995-1998
- Differential in the Rear and Full-Time Two-Wheel Drive (2WD)
 - -Both Bike and Sidecar Wheels Were Powered
 - -Advantage: Excellent Sidecar Handling
 - -Disadvantages: Differential
 - · If One Wheel Lost Traction, the Bike Would Spin
 - Flew the Chair: Wheel in the Air Would Spin Wildly and Lose Power to Main Wheel and Come Back to Earth
 - -If Power to the Wheels Was Great Enough, Damage to Drive Could Result
 - If Sidecar Is Removed, the Differential Will Spin the Sidecar Shaft and No Power Goes to Rear Bike Wheel
 - -Sportsman Replaced with Patrol and Gear-Up Models
 - Single Wheel Drive Bike, with Lever to Engage Sidecar Drive
 - No Mechanical Differential (More Robust and Maintenance-Free)
 - NO differential, so the 2 wheel drive mode is strictly for off road or slippery conditions
 - -Used When You Get Stuck or Drive in Mud or Sand
 - »Can't Drive All the Time with It Engaged
 - » Rig Wants to Go Straight
 - In 1 wheel drive it handles like the other leading link Urals, in 2 wheel drive it becomes more difficult to steer as the bike tends to continue straight.
 - · can safely fly the chair in a Patrol.
 - yep fulltime two-wheel drive....they don't make them like that anymore for the US market due to a change in the law apparently. The newer models of the Gear-Up and Patrol I believe have the manual two wheel drive for

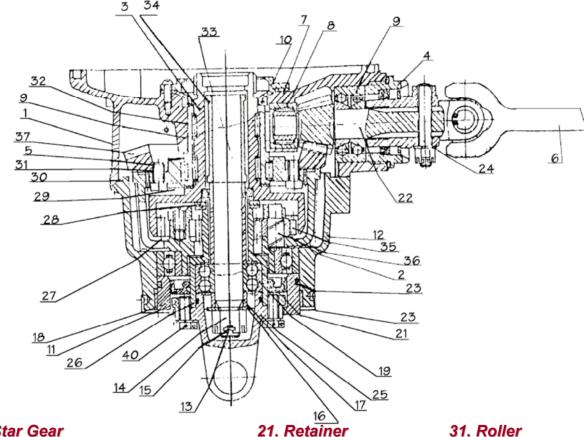
Ural "Sportsman" with Full-Time 2WD



The Ural "Sportsman" was available with full-time two-wheel drive (2WD) with differential, produced between 1995 and 1998. The Sportsman was replaced with the "Patrol" with engageable 2WD, but without a differential.

Ural Sportsman: Driven Sidecar Wheel (2000 650cc Manual)

- · Ural IMZ-8.107 "Sportsman" Has a Driven Sidecar Wheel
- Driven via Shaft Connected to Rear Drive thru Universal Joints
- Rear Drive Uses an Asymmetrical Differential that Supplies Approximately 70% of Torque to Motorcycle Rear Wheel and 30% of Torque to Sidecar Wheel



1. Gear Case
2. Differential Body
3. Idle Gear
4. Bearing Nut
5. Hub
6. Propeller Shaft
7. Case Seal
8. Needle Bearing
9. Double-Row Bearing
10. Seal Cap
-

11.Star Gear 12. Rear Drive Case Cover 13. Rear Wheel Axle 14. Axle Nut 15. Splint 16. **Ring** 17. Spacer 18. Nut

19. Double-Row Bearing

20. Sun gear Seal

23. Seal 24. Bolt 25. Propeller Shaft Fork 35. Satellite Gear 26. Seal Rings 27. Driving Ğear 28. Bronze Spacer

22. Driving gear

29. Spacer

30. Gasket

33. Spacer 34. Spacer 36. Satellite Pin 37. Driven Gear (Crown) 38. Screw 39. Ring

40. Bolt

32. Needle roller

Ural "Sportsman" Differential (sovietsteeds.com)

- Ural Differential Has a Torque Splitter
 - -Based on a set of 4 Planetary Gears Connecting a Small Central Gear to the Sidecar Axle, with a Large Internal Ring Gear, to the Bike's Pusher (Main Wheel)
 - -Provides about a 70%/30% Power Split between the Main Wheel, with It's Normally Heavier Loading, and the Sidecar Wheel with Less Loading
 - -Picture Shows the 4 Planetary Gears that Are Rotated by the Bevel Drive Ring Gear
 - -Planetary Gears in turn Drive the Small Inner Gear, which is Connected to the Sidecar Driveshaft
 - -Not shown is a Cup-Shaped, Large Internal Ring Gear that Drops over the outside of the 4 Planetary Gears and Provides Drive to the Main Wheel
 - -Planetary Gears Only Turn when the Differential Is Providing Independent Wheel Rotation Speeds

Bevel Drive Ring Gear

Inner Gear Connected to Sidecar Wheel

4 Planetary Gears



Sidecar Bearing Unit (Sportsman) (2000 650cc Manual)

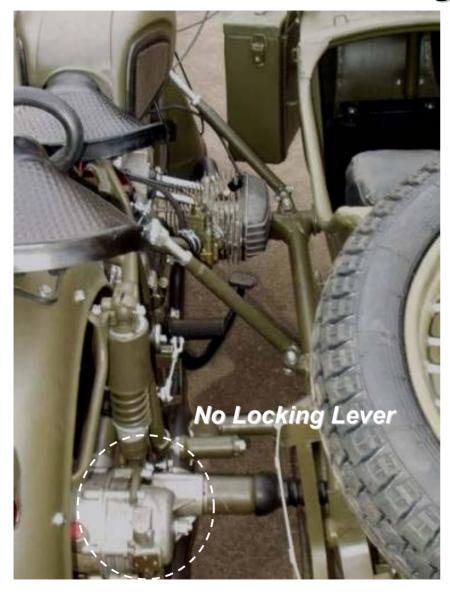
• Ural Sportsman Different from Previous 1WD Tourist Motorcycle (IMZ-8.103-40A)

-Changes to Following Units Rear Drive 13 Rear Wheel Swing-Arm 13. Propeller Shaft Sidecar Swing-Arm and Hub Addition of Sidecar Drive Shaft and Universal Joints Sidecar Chassis and Fender 14. Universal Joint Sidecar Brake Tie Rod 12 7. Protective Ring 12. Silent Block Rubber Bumper 1. Swing-Arm 2. Brake Drum Cover 💪 6. Ball Bearing 3. Slotted Hub 4. Sidecar Axle 5. Ball Bearing 8. Spacer 6. Ball Bearing 7. Protective Ring 8. Spacer 9. Rina 10. Spacer Ring 1. Swing-Arm 11. Bolt 11. Bolt 12. Shock Absorber Silent Block 13. Propeller Shaft 14. Universal Joint 2. Brake Drum Cover 5 5. Ball Bearing 10 3. Slotted Hub 9. Ring

10. Spacer Ring

4. Sidecar Axle

MB-650 Non-Locking Differential (uraldnepr.ru)



The MB-650 (1968-1984) initially had a full-time, locking differential, but later continued production with a non-locking differential.

MB-650M Sidecar Frame (www.redoctobermotorcycles.com)



The bare sidecar frame shows the transverse drive shaft connected to the gear reducer, which drives the sidecar wheel.