Russian Voltage Regulators
(Реле-регулятор напряжения)
Part XXVIII: Evolution of Russian Motorcycle Voltage Regulators

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### Types of Generators/Alternators for Ural (Урал) and Dnepr (Днепр)

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### Notes:
1. Nomenclature: The Cyrillic letter “Г” transliterates (Russian-to-Latin) to “G” or “L” or “T.” Thus we see Г-414 or G-414 or L-414 or T-414, all for the same part.
2. Cannot use Alternator with discharged battery or without battery.
Alternators have progressed in output voltage and power, from the Г-11 (Г-11) generator of 6-Volts/45-Watts in 1941, the Г-11А in 1952, the Г-414 of 6-Volts/65-Watt in 1957, the Г-424 of 12-Volts/150-Watts in 1974, the 14.3771 of 12-Volts/500-Watts in 1998.5, to the present-day Nippon-Denso alternator of 12-Volts/770-Watts.
6-Volt Electro-Magnetic (Relay-Type) Regulator (PP-1/-30/-31/-31A) for the \( \Gamma \)-11/-11A 7-Amp Alternator

**Background**
- Voltage Regulators Paired with Specific Generators/Alternators
- Time-Line for Generators/Alternators/Regulators
- Specs for Compatible 6-Volt \( \Gamma \)-11/-11A Generator
- Generator Application in Ural (M-72, -72M)/ Dnepr (M-72, -72N, K-750, -750M, Late MT-9, MT-10) Wiring

**What Are the PP-1/-30/-31/-31A Regulators?**
- External Voltage Regulator for \( \Gamma \)-11/-11A Generator (7-Amp/45-Watt)
- Electro-Magnetic (Relay-Type) Design
- Years of Regulator Application: 1941 -to- 1963
- First 6-Volt Russian Motorcycle Regulators
- Later Superceded by PP-302 Regulator in 1963

**How Does It Work?**
- Regulates Generator Output Voltage to 6-Volts
- Supplies Exciter Current to Vary Stator Magnetic Field
- Provides Constant Voltage Regardless of Rotor Speed and Load

**Circuit Description and Operation**

**Replacement**
- Replace PP-1 with PP-30/ -31/ -31A, Available over Internet

The Relay-Regulator (PP-1, a.k.a RR-1) was the first 6-Volt regulator used on Russian sidecar motorcycles.
Ural (Урал) M-72 with PP-1 Regulator (1941-1949)

1. Generator: Г-11
2. Regulator
3. Battery
4. Distributor
5. Breaker Points
6. Ignition Coil
7. Spark Plugs
8. Horn
9. Headlight
10. Lamp
11. Parking Light
12. Tail-Light
13. Sidecar Tail-light
14. Front Sidecar Light
15. Indicator Light
16. Central Switch
17. Ignition Key
18. Indicator
19. Dimmer Switch (Г-11A, 1950+)
20. Light Switch: Hi/Lo
21. Horn Button
22. Spark Advance

Ural (Урал) M-72 with PP-31 Regulator (post-1949)

Generator (Г-11A, 1950+)

Regulator (PP-31)
Russian generators differ from alternators in that the magnetic (exciter) field is stationary and the generator windings are rotated. The output at the commutator is DC.
The PP-1 automatic voltage regulator consists of two relays; the reverse-current switch and the voltage regulator.
**Relay-Regulator (RR) Description**

- **Electro-Magnetic (Relay) Device**
  - Periodically Switches Additional Resistance into Generator Exciter Winding
- **Consists of Two Relays:**
  - **Voltage Regulator (PH)**
    - Automatic Voltage Control as Number of Revolutions and/or Load Current Changes
    - Voltage Regulator Decreases Output Voltage as Load Current Increases
  - **Reverse-Relay (POT)**
    - Switches Battery In-and-Out
    - Automatic Connect/Disconnect of Generator
- **Factory-Set, Lead-Sealed Housing**

The Г-11 generator puts out 6.5-Volts at 1,500 rpm and 8.5-Volts at 5,000 rpm (no load). At full-load (7-Amps) the generator produces 6.5-Volts at 2,500 rpm and remains at 7-Volts up to 6,000 rpm. The PP-1 relay-regulator keeps the output voltage between 6.5 and 7.0-Volts.
The PP-1 is distinguished from the PP-30/-31 series of regulators in that it has a taller cap with hold-down nuts.
Relay-Regulator PP-1 (Реле-регулятор напряжения PP-1)

PP-1 Regulator
List Price: 378 rubles
(motofan.in.ua)
Voltage Regulator PP-31

1 - Contact screw
2 - Reverse circuit breaker
3 - Reverse circuit breaker winding
4 - Fixed contact
5 - Reverse circuit breaker
6 - Contact screw ground connection
7 - Housing
8 - Gasket
9 - Limit bar
10 - Movable contact plate
11 - Fixed contact plate
12 - Voltage regulator armature
13 - Voltage regulator main winding
14 - Lid
15 - Coil of the voltage regulator
16 - Voltage regulator yoke
17 - Voltage regulator spring
18 - Adjusting nut
19 - Resistance wire
20 - Carbon resistor
21 - Reverse current switch spring
22 - Rubber cap
It is important to identify the exact component used on your Russian motorcycle, so that you can find the correct schematic and secure exact replacement parts.
Dnepr (Днепр) Early K-750 and K-750M
(with Ignition Coil B2B and Distributor PM-05 for Manual Control of Firing Angle)

Dnepr (Днепр) Early MT-9: Manual Control of Firing Angle
(B2B Ignition Coil and PM-05 Breaker/Distributor)

Later MT-9: Automatic Spark Advance and MT-10
(B201A Ignition Coil and PM-302 Breaker)
6-Volt Electro-Magnetic (Relay-Type) Regulator (PP-302/PP-302A) for the Г-414 10-Amp Generator

• Background
  – Voltage Regulators Paired with Specific Generators/Alternators
  – Time-Line for Generators/Alternators/Regulators
  – Specs for 6-Volt Г-414 Compatible Generator

• What Is the PP-302?
  – External Voltage Regulator for Г-414 (10-Amp/65-Watt) Generator
  – Electro-Magnetic (Relay-Type) Design
  – Years of Application: 1963 -to- 1974
  – Upgraded from PP-31/31A (6-Volt Regulator)
  – Later Superceded by PP-330 Regulator in 1974

• How Does It Work?
  – Regulates Generator Output Voltage to 6-Volts
  – Supplies Exciter Current to Vary Stator Magnetic Field
  – Provides Constant Voltage Regardless of Rotor Speed and Load

• Circuit Description and Operation

• Replacement
  – Replacement Purchased On-Line over Internet

The Relay-Regulator (PP-302, a.k.a. RR-302) was the final 6-Volt and the first 12-Volt regulator used on Ural and Dnepr motorcycles.
6-Volt PP-302 / -302A Regulator

- Operates in Conjunction with Г-414 Generator
- Current & Voltage Regulator with Two Elements:
  - Reverse-Current Relay
    - Cut-In Voltage of Reverse-Current Relay: 6.0 to 6.6-V
    - Reverse Current for Cut-Off Reverse-Current Relay: 0.5 to 3.5-A
  - Voltage Regulator Relay
    - Regulated Voltage @3,500 rpm Generator Speed
      - Load Current 10-Amp: 6.5 to 7.0-Volts
      - Load Current 0-Amp: < 8 V

The PP-302 maintains a constant supply voltage by controlling stator exciter (magnetic field) current from terminal Ш.
Russian generators differ from alternators in that the magnetic (exciter) field is stationary and the generator windings are rotated. The output at the commutator is DC.
Ural (Урал) М-52, М-61 and М-72K, М-72M with PP-302 Regulator

15. Generator (Г-11А)

24. Regulator

18. Manual Spark Advance

19. Hi/Lo Beam Switch

20. Breaker/Distributor PM-05

21. Horn Button

22. Horn

23. Foot Brake-Light Switch

24. PP-302 Regulator

(output, Я)

(exciter, Ш)

(battery, Б)

(turn signal)

(battery, 3MT-6 or 3MT-7)
Dnepr (Днепр) K-750M, MB-750, K-650 and MB-750M

1 - passing-beam and high-light lamp A6-32 + 32; 2 - key; 3 - fuse; 4 - head of the FG-116; 5 - central switch; 6 - wire "mass"; 7 - high voltage wire; 8 - the tip of the candle; 9 - ignition lights A8U; 10 - high voltage wire; 11 - ignition coil B2B; 12 - overall lamp; 13 – sidecar front lamp PF-200; 14 - horn C-37A; 15 - a wire of a forward lantern of sidecar; 16 - wire connector; 17 - rear lamp ФП-220; 18 - “stop” lamp A16-15 brake signal; 19 - rear lamp (A6-3); 20 - stroke lantern cable; 21 - brake lamp switch lamp; 22 - wire to license plate illumination lamp; 23 - stop light sensor; 24 - relay controller; 25 - direct current generator Г-414; 26 - portable lamp PLTM (only for motorcycles MB-750 and MB-750M); 27 - socket 47K (only for MB-750 and MB-750M); 28 - wire to socket; 29 - battery "mass" wire; 30 - rechargeable battery 3MT-12; 31 - interrupter-distributor PM-05; 32 - horn button; 33 - signal wire; 34 - ignition coin; 35 - speedometer illuminator; 36 - control lamp of generator activation A6-0,25; 37 - Bowden cable for light switch; 38 - high and passing light switch; 39 - parking lamp A6-2

24. Voltage Regulator (PP-302)

25. Generator (Г-414)

36. Generator Charge Indicator
12-Volt Electro-Magnetic (Relay-Type) Regulator (PP-330) for the Г-424 11-Amp Alternator

- **Background**
  - Voltage Regulators Paired with Specific Generators/Alternators
  - Time-Line for Generators/Alternators/Regulators
  - Г-424 Alternator Performance
  - Specs for the Г-424 Alternator
  - Alternator Application in Ural (M-67, -67.3 and “650cc” Series) / Dnepr (MT-10, -11 and -16) Wiring
- **What Is the PP-330?**
  - External Voltage Regulator for 11-Amp Г-424 Alternator
  - Electro-Magnetic (Relay-Type) Design
  - Years of Application: 1974 -to- 1992
  - Upgraded to 12-Volts from 6-Volt PP-302 Regulator
  - Later Superceded by Solid-State (Electronic) 33.3702 Regulator in 1992
- **How Does It Work?**
  - Regulates Alternator Output Voltage to 14-Volts
  - Supplies Exciter Current to Vary Magnetic Field in Rotor
  - Provides Constant Voltage Regardless of Rotor Speed and Load
- **Circuit Description and Operation**
- **Replacement**
  - Replacement Purchased On-Line

Relay-Regulator (PP-330, a.k.a RR-330) was the first 12-Volt regulator used on a Russian motorcycle (Ural M-67 and Dnepr MT-10).
**Relay-Regulator PP-330 (Реле-регулятор PP-330)**

- Regulates Voltage of G-424 Alternator 14-Volts and Nominal Current Value of 11-Amps
- Connected by Negative Conclusion to the Ground "mass"
- Signal Indicator "Charging-Discharge" of Battery
- Consists of Single-Stage Vibration Regulator of Voltage and Control Relay of Control (Indicator) Lamp
- PP-330 Has Five Connection Terminals:
  - "ВЗ" - Connection to Positive Terminal of Rectifiers thru Ignition Switch Contacts
  - "Ш" - Connection to Alternator's Ш terminal
  - “ЛК” ("LC“) - Connection to Indicator Lamp
  - "~" - Attach to Output of Alternator Phase
  - "М" - On Body of Regulator to Connect Wire from Ground "mass" of the Rectifier
- Relay-Regulator (Voltage Regulator) PP-330 Shown
The PP-330 voltage regulator varies the current in the rotor coil (terminal \( \varpi \)) to maintain a constant output voltage at the “+” terminal.

PP-330 Voltage Regulator Application

With one end of the \( \Gamma-424 \)’s Rotor grounded, the regulator must be connected between the battery and the other end of the rotor.

Rectifier Diodes to convert generated AC to battery DC

Regulator modulates exciter current to control the magnetic field

Slip-Ring Connections for Rotor (exciter) Coil

The PP-330 voltage regulator varies the current in the rotor coil (terminal \( \varpi \)) to maintain a constant output voltage at the “+” terminal.
The PP-330 utilizes two electro-magnetic relays to maintain a constant output voltage from the alternator, and to control a red “alternator fault” indicator light.
Application of PP-330 Voltage Regulator with Г-424 Alternator

- Ignition Switch "Run" Position
- Red "Alternator Failure" Indicator Lamp
- Lamp Control Relay $P_{VL}$
- Over/Under-Voltage Relay $P_{H}$
- Full-Wave 3-Phase Rectifier
- Rotor (Field)
- Stator
- Alternator Terminal Block
- Ватер Терминал
- Power (positive) Terminal
- Excitation Terminal
- Terminal Control
- Voltage Regulator
- Ground
- Lamp Control Relay $P_{VL}$
- Battery
- Over/Under-Voltage Relay $P_{H}$
- 83/VЗ/ВZ
- Alternator Terminal Block
- Alternator Г-424
1974 Dniepr MT-10

2. Turn Signal Flasher
3. Instrument Illumination
4. Headlight
5. Parking light
6. Ignition Switch
7. Front Left Turn Signal - Bike
8. High Beam Switch
9. Right Turn Signal - Sidecar
10. Front Right Turn Signal - Bike
11. Battery
12. Fuse
13. Turn Signal Indicator
14. Oil Pressure Indicator
15. High Beam Indicator
16. Charge Indicator
17. Oil Pressure Switch
18. Neutral Switch
19. Neutral Indicator
20. Horn
21. Coil
22. Voltage Regulator
23. Generator
24. Spark plugs
25. Points/Contact Breaker
26. Rear Right Turn Signal - Bike
27. Wire Connector
28. Ground
29. Brake Light
30. Tail Light

22. Voltage Regulator (PP-330)
23. Alternator (Γ-424)
21. Horn Button
16. Charge Indicator
11. Master Switch
3. Battery (2X 3MT-6)
1. Oil Pressure Switch
9. Breaker (PM-302/PM-302A)
8. Neutral Switch
7. Horn Button
4. Turn Signal
6. Foot Brake Light Switch
Dнепр (Днепр) Early MT-11 and MT-16
with PP-330 Regulator, later replaced with 33.3072 (solid-state)
Migration from the Mechanical (PP-330) to Electronic (33.3702) Regulator

Diagram is useful when unmarked wires are removed from unmarked terminals!

'+' (output) goes to the battery
'W' (field) goes to the regulator
'~' is not used. Used only with the old electromechanical regulators (PP-330).
The electronic regulator (33.3072) was a welcome substitute for the vibration-sensitive PP-330 (electro-magnetic) mechanical regulator used in the Г-424 11-amp alternator.
33.3702: Solid-State 12-Volt Regulator for the Г-424 Alternator

- Rated for 1.5-Amp Current from the Rotor (Exciter) Coil
- Used on Ural (Урал, IMZ): 650-сс 8.903, 8.923, 8.103
- Used on Днепр (Днепр, КМЗ): MT-10, -10.36, -11,-14, -16
- Standard Fitment on Last Years MT-11 Production
- Main Manufacturer: АО КЗАМЭ (AO KZAME, Russia, Kaluga)
- 6 Transistors
- No Adjustment Possible
- Board Covered with Thick Layer of Lacquer

The 33.3702 regulator is readily available from various Ural / Dnepr “parts suppliers” on the Internet.
The electronic (33.3072) regulator varies the current in the rotor coil (terminal $\Psi$) to maintain a constant output voltage at the “+” terminal.
Voltage Regulator Types

• Grounded Regulator or a Grounded Field Regulator?
  – Grounded Regulator Works by Controlling the Amount of Grounding (−) the Alternator Windings Are Permitted thru the Regulator
  – Grounded Field Regulator Works by Controlling the Amount of Battery Voltage (+) Applied to the Alternator Windings thru the Regulator

• 33.3072 Voltage Regulator Is Grounded Field Regulator
  – Magnetic Field Generated by Rotating Exciter Field
  – One End of Rotor Field Grounded
  – Intensity of Magnetic Field Dependent on Exciter Voltage

The 33.3072 voltage regulator is a grounded-field regulator.
Dnepr (Днепр) MT-11, MT-14 and MT-16
(showing replacement of PP-330 Regulator with the Solid-State 33.3702)

Older Models:
- PP-330 (Relay-Type)

Battery Regulator (33.3702)
- Oil Pressure Switch
- Regulator
- Neutral Switch
- Master Switch
- Brake
- Horn
- Alternator (Г-424)
- Oil Pressure Switch
- Flasher
- Ignition Coil (B204)
- Breaker points
- Horn Button
- Turn Signal

schemat instalacji
do Dniepra MT-11, 14 i 16
12-Volt Regulator (Я212А11Е / YA212A11E / 36.3702) for the Russian 14.3771 35-Amp Alternator

- **Background**
  - Voltage Regulators Paired with Specific Generators/Alternators
  - Time-Line for Generators/Alternators/Regulators
  - Comparison of Alternator Performance: Г-424 vs. 14.3771
  - Specs for the 14.3771 Alternator
  - Alternator Application in Ural Wiring

- **What is it?**
  - Internal (Built-In) Voltage Regulator for the Ural 14.3771 35-Amp Alternator
  - Completely Solid-State
  - Years of Application: 1998.5-to-2004
  - Replaced the Г-424 (14-Amp) Alternator in ‘98.5 with its PP-330 Mechanical Regulator or the 33.3072 Electronic Regulator
  - Later Superseded by the More-Reliable Nippon-Denso 55-Amp Alternator with Built-In Regulator

- **How Does It Work?**
  - Regulates Alternator Output Voltage to 14-Volts
  - Provides Constant Voltage Regardless of Rotor Speed
  - Supplies Exciter Current to Vary Magnetic Field in Rotor

- **Circuit Description and Operation**

- **Replacement**
  - Widely Used in Lada (Russian) Vehicles
  - Replacement (with brushes) Purchased On-Line

The YA212A11E built-in, solid-state voltage regulator was a step forward in maintenance-free operation. Unfortunately it was married to the 14.3771 alternator, which suffered from a bad-reliability reputation.
14.3771: 12-Volt Alternator Application (12/09)

36.3702 Regulator (Я212А11Е / YA212A11E)

- Ignition Switch
- Instrument Panel & Indicator Lights
- Parallel Resistor (in case lamp blows)
- RPM Indicator Signal (not used on Ural)
- Positive Terminal
- Alternator Exciter (+Fault Terminal)

Full-Wave Rectifier (6X 20-Amp Diodes)

- Rectifiers Used to Supply Rotor Current while Running

Unwanted Circuitry in Orange (not connected)

- Stator (3-Ø)
- Rotor (Rotating Magnetic Field)
- Output Transistor
- Carbon Brush

- Alternator/Rectifier (not used on Ural)
- Chassis Ground
- Battery

- “Alternator Fault” Indicator Lamp
- Red indicator

YA212A11E Built-In Regulator

Red “Alternator Fault” Indicator Lamp

(not used on Ural)
36.3702 (Я212А11Е / YA212A11E) Voltage Regulator for 14.3771 Alternator

- **Built-In Brushes for Alternator Slip-Rings**
- **Rated at 12-Volts / 5-Amps**
- **Standard Threshold Regulators Must Be within 13.6-14.4 Volts (typ. 14-V)**
- **Since 2002, Output Transistor Used a Powerful Field-Effect Transistor (FET)**
  - Sharply Lowered Power Losses Given Off in the Form of Heat
  - Load and Current High-Speed Characteristics Improved Reliability
- **Used In:**
  - Vehicles (Russian): VAZ (Lada) -2108, -09, -10, -11, -12, -23; VAZ -21214, -15; NIVA, GAZ (Gorky Automobile Plant) - 3102, -29, 3302; & "Ural“ Motorcycle
  - Alternators: 372.3701; 373.3701; 9402.3701-01; 9402.3701; 412.3701-01; 9422.3701; 26.3771; 2502.3771-01; 37.3701 (VAZ-2110, 2112, 2111); 14.3771 (Ural)
  - Available in Russian Auto Shops (hanging on the wall) or Off the Internet
12-Volt Regulator (N-D Part # 126000-0600) for the Nippon-Denso 55-Amp Alternator

• Background
  – Voltage Regulators Paired with Specific Generators/Alternators
  – Time-Line for Generators/Alternators/Regulators
  – Performance Specs for the Nippon-Denso (N-D) Alternator
  – Alternator Application in Ural Wiring

• What is it?
  – Internal (Built-In) Voltage Regulator for the Ural Nippon-Denso (N-D) Alternator
  – Completely Solid-State
  – Years of Application: 2004-to-Present
  – Retro-fitable to 14.377 (35-Amp) and Г-424 (11-Amp) Applications

• How Does It Work?
  – Regulates Alternator Output Voltage to 14.5-Volts
  – Provides Constant Voltage Regardless of Rotor Speed
  – Supplies Exciter Current to Vary Magnetic Field of Rotor

• Circuit Description and Operation

• Replacement
  – Widely Used in Nippon-Denso (Denso), Daihatsu, Kubota and Suzuki Alternators
  – Replacement Parts Readily Purchased On-Line

The Nippon-Denso 126000-0600 built-in, solid-state voltage regulator is a widely-used, reliable unit.
Recent Ural Starter/Generator/Alternator Time-line

- **Engine Size**
  - 650 cc
  - 750 cc Engine

- **Start Relays (RY-115)**
  - One Relay
  - Two Relays

- **Voltage Regulator**
  - 33.3720200 Solid-State

- **Type of Ignition**
  - Type I
  - Type II
  - Type III Ignition
  - Type IV
  - Type V

- **Gen/Alt**
  - Kick-Start Only
  - 14 Amp Russian Г-424 Alternator (150 W)
  - 18 Amp Hitachi Starter/Generator (300 W)
  - Electric-Start (E-Start) Option & Retrofit introduced by CSMI
  - Factory Electric-Start (E-Start) Offered (Starter/Alternator at Timing Gear)

- **Roughly Wattage**
  - $W = 14 \text{ Volts} \times A\text{mps}$

- **Year**
  - 1994
  - 1995
  - 1996
  - 1997
  - 1998
  - 1999
  - 2000
  - 2001
  - 2002
  - 2003
  - 2004
  - 2005
  - 2006
  - 2007

- **Type of Alternator**
  - 35 Amp Russian Alternator: 14.3771 (Hand Grenade) (500 W, black-plastic rear cap)
  - 55 Amp Nippon Denso Alternator (770 W, metal rear cap) (Increased length by 20 mm)

- **Type of Voltage Regulator**
  - Internal to Alternator

- **Type of Relays**
  - One Relay
  - Two Relays

- **Type of Starter**
  - No points-ignition Urals Approved for U.S. sale

- **Ural imported to U.S. by CSMI (Classic Motorcycles and Sidecars, Inc.)**

1998.5
Nippon-Denso Installation Wiring Diagram

L: Lamp - connect via the warning lamp to +12v

B+ Battery: Main current connection - connect to the battery positive via heavy duty wire.

IG: Ignition - connect to ignition switched +12V, provides about 0.25Amp to drive the regulator.

“Fault” Light is Optional on N-D Alternator (note: light was mandatory for initial rotor current in previous 14,3771 35-Amp alternator (Russian hand grenade))

Access Hole for Terminal “F” of Rotor

Grounding the “F” terminal gives “full-field” for testing.
The voltage regulator is the brain of the charging system, monitoring both battery and stator voltages. Depending on the measured voltages, the regulator will adjust the amount of rotor field current to control alternator output.

Solid-state voltage regulator has only two external connections; L (output to the indicator lamp) and IG (input from the ignition switch).

“L” Terminal provides ground to light the “Fault” warning indicator.

Connections to the ND Voltage Regulator

Heat Sink

Regulator Case

Ground

Stator
 (Terminal P of Stator)

F
 (Terminal F of Rotor)

B+

IG

L

The voltage regulator is the brain of the charging system, monitoring both battery and stator voltages. Depending on the measured voltages, the regulator will adjust the amount of rotor field current to control alternator output.
Inside the Nippon-Denso Voltage Regulator

The regulator controls the amount of battery current going to the field winding in the rotor.