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THIS IS UNEVALUATED INFORMATION. SOURCE GRADINGS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

1. 105-page, English-language, 50X1-HUM Soviet manual entitled AD-30 Type Unified Diesel-Electric Generator Units, Description and Operating Instructions

2. The manual states that the diesel-electric generator is designed for supplying 30 kilowatts of three-phase alternating currant and is built for continuous duty. The generator is available in three models as follows: 50X1-HUM

   a. AD-30-T/230 supplies 230 volts at 50 cycles and 94 amperes.
   b. AD-30-T/400 supplies 400 volts at 50 cycles and 56 amperes.
   c. AD-30-T/230/Ch-400 supplies 230 volts at 400 cycles and 94 amperes.

3. The prime mover for the generator is a YaAZ M-204G, a 60-horsepower diesel engine, which turns the generator at 1500 rpm.

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AD-30 TYPE
UNIFIED
DIESEL-ELECTRIC GENERATOR UNITS

DESCRIPTION AND OPERATING INSTRUCTIONS

АД-30 TYPE

UNIFIED

DIESEL-ELECTRIC GENERATOR UNITS

Description and Operating Instructions

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PART ONE

DESCRIPTION

CHAPTER ONE

G E N E R A L

1. Application

The diesel-electric (unified), type АД-30 a.c. generator units are designed for supplying various users with three-phase alternating current.

In this description are given data pertaining to all types of unified diesel-electric units of the АД-30 a.c. type.

The units are made with the following output ratings:

1. АД-30-Т/230, voltage 230 V, frequency 50 c/s;
2. АД-30-Т/400, voltage 400 V, frequency 50 c/s;
3. АД-30-Т/230/4-400, voltage 230 V, frequency 400 c/s.

Apart from the above classifications, the units can vary by their design versions, which are as follows:

1. With a metal protection hood and with four feeder leads;
2. Without hood (open model) with four feeder leads;
3. Without hood (open model) with a single feeder lead;
4. Without hood (open model) with a single feeder lead and shortened frame;
5. With metal protection hood and a single feeder lead.

In those cases when the information given in the description refers only to a certain unit model, it is specially emphasized.

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2. SPECIFICATIONS

(Rated data)

Name	Type		
	АД-30-Т/230	АД-30-Т/400	АД-30-Т/230-Ч/400
1	2	3	4
Current	A. C., three-phase		
Power, kW	30	30	30
Line voltage, V	230	400	230
Current, A	94	56	94
Frequency, c/s	50	50	400
Power factor (cos φ)	0.8	0.8	0.8
Generator winding connection	Star-connected with brought out neutral		
Speed, r.p.m.	1500	1500	1500
Duty	c o n t i n u o u s		
Power of engine (or diesel), HP	60	60	60
Fuel	Diesel fuel for high-speed engines ГОСТ 4749-49or ГОСТ 305-42		
Oil	Diesel oil ГОСТ 5304-54		
Fuel consumption, kg/hr	14.4	14.4	14.4
Oil consumption, kg/hr	0.6	0.6	0.6
Fuel tank capacity, litres	80	80	80

1	2	3	4
Lubrication system capacity, litres	16.5	16.5	16.5
Cooling system capacity, litres	22	22	22
Weight of unit, kg . .			
a) dry, with hood, spare parts, tools and accessories (without fuel, oil and water)	2090	2090	2010
Total weight (with spare parts, tools, accessories, fuel, oil and water) . .	2200	2200	2120
b) without hood, with four leads, dry weight, kg . . .	1860	1860	1780
Total weight, kg	1970	1970	1890
c) without hood, with single lead, dry weight, kg . . .	1840	1840	1760
Total weight, kg	1950	1950	1870
d) without hood, with single lead and shortened frame, dry weight, kg	1700	1700	1620
Total weight, kg	1810	1810	1730

1	2	3	4
Overall dimensions, mm			
a) with hood			
length (including frame)	2400	2400	2400
height	1720	1720	1720
width (including frame)	960	960	960
b) without hood			
length	2400	2400	2400
height (without silencer)	1450	1450	1450
width	960	960	960
c) without hood, with single lead and shortened			
frame length	2300	2300	2175
height (without silencer)	1450	1450	1450
width	960	960	960

The units operate normally under the following conditions:

1. Height above sea level to 1000 m;

2. Ambient temperature range from -40 to +50°C;

3. Relative humidity of the air to 98% at a temperature of +20°C;

4. Prolonged road transportation at speeds permissible for trucks.

The units display normal operation at overloads to 10% for one hour at the above given ambient temperatures.

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All units provide for automatic voltage regulation at any changes in balanced load with a power factor from 1.0 to 0.8 (inductive) in the following ranges:

a) ±2% of the average regulated voltage value for loads from 50 to 100 per cent;

b) ±3% of the average regulated voltage value for loads from 0 to 100 per cent;

c) ±12% during transients when dropping load and reloading from 0 to 100 per cent.

The transient period does not exceed 3 seconds.

NOTE. The average regulated voltage is defined as the half-sum of the maximum and minimum values of voltage, obtained with change of load in the range of 50 to 100 per cent and from 0 to 100 per cent of the rated value and at power factors in the range from 1.0 to 0.8 (inductive).

The ЯАЗМ-204Г engine regulator provides a constant range of r.p.m. regulation, i.e. constant frequency of current developed by the generator in the following range:

a) with constant load of 50 to 100 per cent of the rated load, the frequency non-stability is ±1.3 per cent of the rated frequency.

NOTE. It is assumed that the rated frequency of the current (50 c/s) is set up by means of additional fuel delivery regulation carried out by hand.

b) Variation of steady current frequency, at any changes of load in the range of 100 to 50 per cent — +2 per cent of the rated frequency.

At any change in load in the range of 50 to 100 per cent — 1.3 per cent of the rated frequency. 50X1

c) Maximum variation (surge) of current frequency at sudden change in load from 100 to 50 per cent and vice versa (drop and increase in load), not more than 6.6 per cent at each change in load.

d) At 10 per cent overload the reduction in current frequency is not more than 2 per cent;

The non-balance of the load should not exceed 25 per cent of the rated value, the difference across phases not deviating more than 10 per cent of the rated value.

3. Equipment Set and Layout

Each unit includes the following elements:

1. The prime mover, a RAB-M204T type two-cycle four-cylinder diesel with instruments and devices necessary for its operation.

2. An a.c. three-phase synchronous generator.

3. Auxiliary parts (coupling, frame, support).

4. Switchboard.

5. Spare parts, tools, accessories.

6. Connection leads.

The units are mounted on a common frame.

The engine and the generator are rigidly connected with the help of a flange connection and represent a single block fixed to the frame of the unit in three points.

Rotation is transmitted from the engine to the generator with the help of a rigid coupling which connects the engine flywheel to the generator shaft.

The water cooled radiator is fixed to the frame supports in front of the engine fan. Over the generator on a pillar fixed to the frame baseplate is the switchboard which contains the instruments and control devices for the engine.

On the frame under the generator exciter are mounted two storage batteries for feeding the instruments, illumination of the unit and starting the engine.

No batteries are mounted on shortened frame units.

The units are fitted with the necessary instruments for control and inspection of the unit operation.

Each unit model has a different type of power take-off. In some models power take-off is provided through three feeder lines.

Through lines N 2 and N 3 it is possible to use to 50 per cent (through each line) of the power produced by the unit.

Full power take-off is carried out through line N 1 terminals. Besides, a spare socket is provided for feeding full power parallel to the terminals of line N 1.

With other models full power take-off may be obtained through terminals provided for on the control switchboard.

The units permit starting of squirrel cage induction motors with ratings to 21 kW loaded to 30 per cent of rated load.

The electrical circuit of the unit provides for stable parallel operation with other units of similar output ratings.

In units with four circuit breakers it is possible to use the switchgear for feeding consumers from the power mains.

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In units with a single breaker when feeding consumers from the power mains the voltmeter and frequency meter are used to check the frequency and voltage of the circuit.

CHAPTER TWO

CONSTRUCTION AND OPERATION OF THE ELEMENTS AND SYSTEMS OF THE UNITS

A. Prime Mover

The prime mover of the units is a four-cylinder two-cycle engine with compression-type ignition of the ЯАЗ-М204Г type.

The description which follows gives only main engine characteristics. For complete description of the engine and operation of its elements see book "The ЯАЗ-М204 and ЯАЗ-М206 Engines".

Specifications

Number of cylinders	4
Diameter of cylinder, mm	108
Stroke, mm	127
Cylinder displacement, litre	1.163
Compression ratio	16
Cylinder working sequence	1-3-4-2
Rated power, H.P.	60
Rated engine speed, r.p.m.	1500
Maximum power, HP.	70
Rotation of crankshaft	clockwise, as viewed from the fan

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Specific fuel consumption, gram per el HP/hr . .	230
Specific oil consumption, gram per el HP/hr . .	10
Dry weight of engine, kg	790

The Manufacturer has introduced some changes in the engine design. The main of these are:

1. The fan design has been changed so as to change the direction of cooling air flow.

2. The plug of the oil housing has been replaced by a branch pipe with a cock to facilitate draining of oil from the housing.

3. The exhaust collector has been turned upwards.

Below is given a description of those parts of the engine systems that have undergone changes while being mounted.

1. Fuel System

The fuel system comprises the fuel pump, the filter for preliminary cleaning, a pump-atomizer, the fuel tank, piping and disconnection cock.

The fuel-pump sucks fuel from the tank into the coarse filter and then pumps it through the fine filter into the pump atomizer which injects the atomized fuel into the ignition chamber. Excess fuel returns from the pump-atomizer to the tank through a pipe.

Between the tank and the fuel pump a disconnection cock is provided.

A remote fuel level measuring system is used. The tank is provided with a fuel level indicator with a float pickup. A

change in tank fuel level, i.e. a change of float location, causes a change in resistance of the pick-up rheostat which is indicated by an instrument on the engine control board.

2. System for Regulating the Engine r.p.m.

Regulation of the quantity of fuel delivered by the pump-atomizer and consequently the change in speed of the engine crankshaft is carried out by hand with the help of the fuel delivery control handle placed on the support.

The handle is linked through a system of levers to the control lever located on the engine regulator lid.

When the handle is turned towards the operator, fuel delivery is decreased and the speed of rotation of the crankshaft falls.

When the handle is turned away from the operator, fuel delivery is increased and the speed of rotation increases.

The constancy of engine crankshaft speed rotation at a given speed range is maintained by a single-range centrifugal regulator, mounted on the engine.

3. Device for Emergency Stopping of Engine

To stop the engine immediately in cases of emergency, it is necessary to turn upward the engine handle marked in red letters "asap.cron" (emergency stop).

This device should be used only in extreme cases when it is necessary to stop the engine immediately.

4. Lubrication System

The entire lubrication system is of a combined type. Force feed lubrication is applied to the crankshaft bearings, the distribution and balancing shafts, the shafts of the intermediate pinion, balancer rods, compressor drive, and the gudgeon pins. To the other parts oil is sprayed or delivered by gravity. The oil is sucked in by a pump from the engine sump and delivered through the coarse filter to the oil radiator and from it through ducts to the internal mechanisms of the engine.

The waste oil from the engine sump is drained through a pipe with a cock, located in the lower part of the sump.

A pressure gauge is supplied on the engine control panel to check the pressure.

5. The Cooling System

The engine is cooled by water recirculated by a centrifugal pump in a closed system through a radiator and the engine water jackets.

The liquid in the radiator is cooled by the air flow, created by the engine fan.

To facilitate cooling the air flow is directed so as to be sucked in by the fan at the generator side and exhausted through the radiator.

The cooling liquid is poured into the radiator through the orifice.

A telethermometer is mounted on the engine control panel to watch the temperature of the cooling liquid.

The thermometer transmitter is screwed into a tapped hole provided for this purpose in the rear part of the water piping of the cylinder head.

6. The Starting System

The electrical circuit diagram of the engine is shown in the circuit diagram drawings (see Supplement).

The engine is started by an electric starter, mounted on the engine. The start button is mounted on the engine control panel.

To facilitate starting of the engine at the ambient temperature from +5 to -5°C an electric torch heater is used comprising:

a) a starting plunger pump (for fuel delivery), located on the control panel;

b) a tank for fuel delivery to the pump, located on the support;

c) the starting heater housing, the atomizer, filter, ignition plugs, high-voltage ignition coils with an electromagnetic interrupter, located on the engine;

d) starting heater switch, located on the control panel.

At an ambient temperature range of -5 to -40°C the engine is started with the aid of a starter, an electric torch heater and heating starter equipment fitted with a heating lamp with a blower delivered with the unit.

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7. The Exhaust System

From the engine cylinders the exhaust gases pass into the engine exhaust collector and then through a pipe into the silencer.

When the unit works inside truck bodies, in closed premises or shelters, the exhaust gases may be removed from the silencer by means of hoses or pipes of adequate diameter.

8. Generators

The units are fitted with three-phase synchronous generators which are the source of electrical current. These have built-in exciters. Below are given the technical characteristics of the generators mounted in the a.c. АД-30 type units of various models.

Specifications

Name	Unit model		
	АД-30-Т/230	АД-30-Т/400	АД-30-Т/230/400
Type	ДГС-91/4Ю2	ДГС-91/4Ю2	ГСВ-30
Voltage, V	230	400	230
Winding diagram	Star with neutral brought out		
Output, kW	30	30	30
Current, A	94	56	94
Duty	C o n t i n u o u s		
Rotation	Clockwise as viewed from the drive side		
Weight, kg	475	475	400

All generators are spray-protected, self-ventilated and fitted with flanges.

The exciter in all generator models is a four-pole d.c. shunt generator without commutating poles.

C. Auxiliary devices.

1. The engine-generator block and coupling

The engine and the generator are connected together with the help of a cast flange end shield on the generator and form a common engine-generator block.

The generator flange and the engine flywheel crankcase have centering surfaces for fitting which provide for the coincidence of engine crankshaft and generator shaft axes.

The torque from the engine to the generator is transmitted as follows.

The engine flywheel is fitted with a steel toothed rim which engages with a textolite pinion of the coupling. The coupling is tightly keyed on to the generator shaft. To protect against axial backlash the coupling is fixed by a special washer mounted on to the generator shaft butt end.

Small misalignments of the engine and generator shafts are compensated by the clearance in the textolite pinion and steel toothed rim gearing.

2. Supports of the engine-generator block

The engine-generator block is fixed to the frame at three points. The front point of the support of the block is a special bearing in which is located the journal of the front

lower engine cover. The bearing is bolted through shock-absorbers by two bolts to the front support of the base-plate of the unit.

The support lugs of the generator are fixed on two supports through shock-absorbers.

The engine-generator block has frame shock-absorbers from both sides.

3. Frame

The frame is a welded structure onto which are fixed all the main assemblies of the unit: the engine-generator block, the radiator, the support for the electrical equipment and the fuel tank.

Two longitudinals of the frame made of channel steel № 12 are connected by transverse members made of steel sheet and angle iron in the form of channel iron. From the bottom the frame is closed up by a sump made of sheet steel which protects the unit from penetration of dust and dirt.

The sumps are fitted with drain holes.

Each of the frame longitudinal channels (from both sides) have holes which may be used for handling the units and also for moving units not mounted on vehicles over short distances.

4. Vertical support

The vertical support for fixing the control instruments is a welded structure of angle steel. Onto it are fixed: the switchboard, the engine control panel, the small tank for feeding the pump of the electric torch heater and the segment with

the engine r.p.m. control handle.

The support is bolted to the unit frame.

5. Hood

The units that are not designed for installation in special trucks or indoors are closed by metal removable hoods.

The hood is a point and electrical rivet welded casing which has two openings in each side wall and one opening in each butt wall. Each opening is closed by two doors, the top one being hinged to the casing and the lower one is removable. The doors have rubber gasket which protects the unit from penetration of dirt, dust and water. All doors have turning locks which press them against the casing.

The top of the hood has two holes with covers for filling the radiator with water and the engine with oil and one hole for bringing out the silencer pipe.

On the cover and walls of the hood there are special fixtures for the fire extinguisher, for the earthing bores, exhauster extensions, funnels.

The hood is bolted to the frame. Between the hood and the frame a cotton strip (a TPI grade ribbon) is used as a gasket.

D. Switchgear

1. Switchboard

The switchboard contains control and measuring instruments, and switching appliances.

The instrument panel comprises three a.c. ammeters, a

voltmeter, a frequency meter, generator and power circuit pilot lamps, instrument illumination lamps, lighting change over switch, synchronization switch, voltage and frequency change-over switch, duty selector switch, voltage adjustment rheostat knob and five fuses. Two capacitors and two resistors are fastened to the inner wall of the instrument panel.

The instrument panels of the АД-30-Т/230 and АД-30-Т/400 units are furnished with wattmeters. In the АД-30-Т/230-Ч-400 units there being no wattmeter, the openings for the wattmeter are plugged.

Inside the switchboard frame there are three instrument transformers, the parallel operation transformer, voltage regulator block. In the upper part of the frame are fixed two resistor tubes and the frequency-meter additional resistance.

In the АД-30-Т/230 and the АД-30-Т/400 units in the upper part of the frame is fixed the additional resistance for the wattmeter.

All types of units with four automatic circuit breakers have the breakers fixed on the switchboard frame supports. On the power take-off panels in the АД-30-Т/230 and АД-30-Т/230--Ч/400 type units with four circuit breakers are located three flat plug and socket devices, a signal lamp, and a panel with four terminals.

On the inside of the panel a capacitor is fixed (in the АД-30-Т/400 type unit, besides the capacitor, a voltmeter additional resistance is mounted).

On the power feed take-off panel in the АД-30-Т/230 and

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АП-30-Т/230-Ч/400 type units with a single circuit breaker is mounted a panel with four terminals, closed by a cramp and a signal lamp. On the inside of the panel the capacitor is fixed.

The power feed take-off and the instrument panels may be opened without disturbing the wiring of the board, thus allowing access to the equipment mounted both on the panels and inside the switchboard.

Each panel is fixed in a vertical position with the help of two clasps.

On the side of the switchboard are fixed: a lamp on a bracket and a socket.

The switchboard is fixed to the supports on six shock absorbers.

2. Voltage regulator block

The voltage regulator block is designed for stabilization of voltage at the generator terminals and for balancing the reactive loads between parallel operating generators.

The voltage regulator block comprises a carbon type voltage regulator, a step-down transformer, a stabilizing transformer, two selenium rectifiers, two capacitors and four resistors.

All the elements of the voltage regulator block are mounted inside the switchboard.

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E. ELECTRICAL CIRCUIT

1. Description of electric circuit diagram and operation of electrical equipment

The electrical circuit diagram of the unit is given in the following drawings and consists of the following circuits:

a) the main circuit of the unit,

b) the voltage regulation circuit,

c) the synchronization and parallel operation circuit,

d) the auxiliary circuits of the unit.

a) Main circuit of the Unit

For all unit models with four automatic circuit breakers the main circuit includes the following elements:

three-phase generator (Г), phases of which are star-connected with the neutral brought out;

current transformers ($ТР_1$), ($ТР_2$), ($ТР_3$), ($ТР_4$);

three-pole a.c. automatic circuit breakers with front connection (АВГ), ($АВ_I$), ($АВ_2$), ($АВ_3$);

sockets ($Ш_1$), ($Ш_2$), ($Ш_3$);

terminal board (П).

Across the main circuit generator terminals is mounted a three-pole circuit breaker with a thermal overload trip (АВГ), protecting the generator from continuous overloads.

After the automatic breaker (АВГ) into the main circuit are inserted the primaries of three instrument current transformers ($ТР_1$), ($ТР_2$), ($ТР_3$) into the secondaries of which are connected:

three ammeters (A_1), (A_2), (A_3) and wattmeter (K_w), for АД-30-Т/230 and АД-30-Т/400 units,

three ammeters (A_1), (A_2), (A_3) for АД-30-Т/230-Ч/400 units.

Further the main circuit is divided into three load lines: line № 1 designed for full power of unit and lines № 2 and № 3 designed each for half of the total output.

Onto line № 1 is mounted the circuit breaker (AB_1) — a three-pole unit with an electromagnetic trip, designed for short circuit protection of the generator.

Onto lines № 2 and № 3 are mounted circuit breakers (AB_2) and (AB_3) which are of the three-pole type with a combined thermal and electromagnetic trip.

Protection devices (АТ), (AB_2), (AB_3) allow 10 per cent overload, at which they should not operate for one hour, but should operate in one hour with 35% overload. (These norms are specified for an ambient temperature of +40°C).

In line № 1 before the breaker (AB_1) of the first phase is mounted the current transformer (TP_4) (the parallel operation transformer), its secondary being inserted into the circuit of the carbon voltage regulator (УРН).

For all unit models with one automatic circuit breaker, the main circuit includes the following elements:

three phase generator (Г), star-connected and with a brought out neutral;

a.c. three-pole automatic circuit breaker with a front connection (АВ);

current transformers (TP_1), (TP_2), (TP_3), (TP_4);

terminal board (П).

On the generator terminals is mounted a three pole circuit breaker with a combined thermal and electromagnetic trip, protecting the generator from continuous overloads and short circuit currents.

The (AB) protection device allows 10 per cent overloads at which it should not operate for one hour but should operate after one hour with 35 per cent overload.

After the circuit breaker (AB) into the main line are inserted the primary windings of three instrument current transformers (TP_1), (TP_2), (TP_3), into the secondaries of which are connected: three ammeters (A_1), (A_2), (A_3) and wattmeter (K_W) for the АД-30-Т/230 and АД-30-Т/400 type units; three ammeters (A_1), (A_2), (A_3) for АД-30-Т/230-Ч-400.

In the first phase is also mounted the current transformer (TP_4) (parallel operation transformer), the secondary winding of which is inserted into the carbon voltage regulator (УРН).

b) Voltage regulation circuits

The electrical circuits of the unit provide for both automatic and manual voltage regulation.

Manual voltage regulation is provided by a rheostat (РР) which is connected in series with resistance (R_2) in the excitation circuit of the exciter.

Automatic voltage regulation is provided by a voltage regulator unit.

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The voltage regulation circuit includes the following elements:

a carbon-pile voltage regulator (УРН),

a step down transformer ($ТР_5$),

a selenium rectifier ($ВС_1$),

a capacitor ($С_2$) (absent in the АД-30-Т/230-4/400 type units),

a stabilizing transformer ($ТР_6$),

a selenium rectifier ($ВС_2$),

resistors (R_1), (R_2), (R_3), (R_4), (R_5),

a voltage regulation rheostat (РУ),

a duty changeover switch ($ПК_3$)

The voltage regulator (УРН) coil is connected across the generator line voltage through a stepdown transformer ($ТР_5$) and selenium rectifier ($ВС_1$).

To smooth the rectified voltage delivered to the (УРН) electromagnet winding a double capacitor ($С_2$) is inserted after the rectifier ($ВС_1$) (absent in АД-30-Т/230-4/400 units).

The carbon pile of the voltage regulator (rheostat) is connected directly into the excitation winding of the exciter.

To decrease dissipation of power in the carbon pile, an additional resistance (R_3) is connected in series with it.

The level of the automatically regulated voltage is established with the help of rheostat (РУ), connected into the circuit of the transformer ($ТР_5$) secondary. To decrease voltage deviation due to temperature effect into the ($ТР_5$) transformer primary is inserted a resistor of high-resistance constantan wire (R_5).

Change over from automatic voltage regulation to manual, and vice versa is carried out with the help of rotary switch ($ПК_3$), according to the table for the changing of duty.

To avoid constant voltage fluctuations of generator due to regulation changes, the scheme includes a stabilizing transformer ($ТР_6$), which provides for a sufficiently rapid establishment of the voltage at changes in load. The primary is connected through an additional resistance (R_4) across the exciter armature voltage. The secondary is connected in series with the electromagnet (УРН) winding.

During transient processes (change of load, short circuit etc.) large overvoltages are created across the exciter excitation winding due to its large inductance. To prevent burning of the voltage regulator carbon pile due to overvoltage, parallel with the exciter excitation winding is connected the selenium rectifier ($ВС_2$). Through it the e.m.f. of self-induction created in the excitation winding is discharged.

Under normal operating conditions current does not flow through the rectifier ($ВС_2$).

The rheostat for manual control of voltage and the rheostat for setting the level of the automatically regulated voltage are mechanically ganged without any electrical connection between them. Both resistances are changed by turning the same handle.

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c) Synchronization circuits and parallel operation

The following elements are included in the synchronization and parallel operation circuits:

fuses ($ПР_1$), ($ПР_2$), ($ПР_4$), ($ПР_5$),

switch ($В_2$),

change-over switch ($ПК_2$),

parallel operation transformer ($ТР_4$),

resistor (R_1),

resistors (R_7), (R_8)

The synchronization circuits serve for connecting the units for parallel operation and to provide for correct conditions for parallel operation of two or more units.

The electrical scheme of the unit provides for the possibility of connecting it for parallel operation with identical units or the power supply circuit by means of precise synchronization.

The unit is connected for parallel operation through terminal board (П). Prior to connecting for parallel operation frequency and voltage at the generator terminals should be uniform.

The lamp-synchronoscope is inserted into the first generator phase through fuse ($ПР_2$). Then, in series are connected resistance (R_7) for reducing voltage to the lamp; switch ($В_2$) that cuts in the lamp-synchronoscope fuse ($ПР_4$). Into the second phase, for closing the lamp-synchronoscope circuit resistance (R_8) is inserted through fuses ($ПР_1$) and ($ПР_5$).

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To measure voltage and frequency at the generator terminals, the changeover switch (K_2) through fuses ($ПР_1$), ($ПР_2$), ($ПР_4$), ($ПР_5$) is provided, that switches voltmeter (V) and frequency-meter (H_z), either to the generator terminals (Г) or to the board terminal (П).

For signalling presence of voltage across generator terminals, through fuses ($ПР_I$) and ($ПР_2$) is inserted signal lamp ($ЛС_I$) with capacitor (C_3) for the АД-30-Т/230 and АД-30-Т/400 units or (C_1) for АД-30-Т/230-Ч/400 units.

For signalling presence of voltage across the terminals of board (П) signal lamps ($ЛС_3$), ($ЛС_4$) with capacitors (C_4) and (C_5) for the АД-30-Т/230 and АД-30-Т/400 units or (C_2) and (C_3) for the АД-30-Т/230-Ч/400 units are used.

The lamp-synchroscope is connected so as to be dark at synchronism. When it becomes dark, the units may be switched on for parallel operation.

At parallel operation the distribution of reactive power between units is carried out automatically with the help of the voltage regulators.

The parallel operation transformers (TP_4) of both units affect the measuring circuits of the voltage regulators through resistor (R_1).

The resistor (R_1) consists of three sections.

The first section (marked 62- 3) is permanently connected into the circuit of the secondary winding of transformer (TP_5) and serves for regulating the limits of the voltage range when adjusting the circuit.

The resistance of the second resistor section (marked

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3-64) equals the resistance of the third section(marked 64-65).

When the unit operates in parallel, the second resistor section is connected, while the third section is short-circuited.

When the unit works individually, the second resistor section is short-circuited and the third section is connected. Thus the total resistance does not change and this allows for a non-changeable voltage regulation level in various operation conditions.

The transformer (TP_4) that feeds the second resistor section (R_1) during parallel operation by means of its secondary winding, creates in it a certain voltage drop, its value changing in proportion to change in the current flowing through its primary.

This voltage across the second resistor section (R_1) (marked 3-64) geometrically adds to the voltage of the transformer (TP_5) secondary (more precisely it adds to the voltage across points 60- 3) and the geometrical sum of these voltages is delivered to the selenium rectifier (BC_1) (terminals 60-65).

The rectified and smoothed out by means of capacitor (C_2) (for the АД-30-Т/230 and АД-30-Т/400 type units) voltage at the selenium bridge output is delivered to the winding (УРН).

Thus a change in generator load current, i.e. current flowing through the transformer (TP_4) primary, causes a change in generator excitation and hence a change in its load.

The transformer (TP_4) is connected into the first generator phase, whereas the (TP_5) transformer is connected into the second and third generator phases. The transformer (TP_4) and (TP_5) secondaries voltage vectors will be so shifted in

respect to each other, that maximum effect on the generator excitation current will be rendered by the reactive component of load. An increase of generator reactive current involves a decrease in generator excitation and the deficiency in reactive power required begins to be covered by the second generator, working in parallel with the first.

Thus a sufficiently uniform distribution of reactive power between the two parallel operating units is attained.

d) Auxiliary circuits

To the auxiliary circuits belong:

- lighting the switchboard ($ЛН_1$) and ($ЛН_2$),
- lighting the unit ($ЛН_3$),
- electrical equipment circuits of the engine.

The illumination lamps are energized by the storage batteries ($Б_1$) ($Б_2$), connected in series through fuse ($ПР_7$) and switch ($ПК_1$).

The auxiliary circuit includes also socket (ЛР) for 24 V, which is also powered from storage batteries.

The electrical equipment of the engine includes:

- storage batteries ($Б_1$) and ($Б_2$),
- starter ($С_1$)
- start button (КП),
- charging generator (ГЗ),
- relay-regulator (РЗ),
- ammeters ($А_1$),
- fuses ($ПР_7$), ($ПР_8$),
- engine ($В_1$) control instrument switch, etc.

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The engine starter is fed from two series connected storage batteries.

Fuse ($ПР_8$) protects the charging generator from short-circuit currents. To measure the current in the battery circuit, the ammeter (A^1_1) is used. The switch (B_1) serves for switching the control and signal instruments of the engine.

2. Electrical wiring circuit. Wire markings.

The control board is connected to the generator by means of cable sheathed wires. The cables are led in through sleeves.

All connection wires are marked according to legends on the diagrams.

3. Earth protection device

The earth protection of the unit is done with the help of two earthing borers, connected by special cables to the earthing bolts on the frame of the unit.

The earthing auger is a cast aluminium conical rod with a cast bronze tip. At the top the rod has a pass-through hole into which a wrench or crow-bar is inserted.

The open-type units are delivered without earthing devices and earthing cables. The earthing of the units should be provided when mounting them at the site.

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CHAPTER THREE

SPARE PARTS, TOOLS AND ACCESSORIES

1. Set of spare parts, tools and accessories

The set of spare parts, tools and accessories (ЗИП) provided with the unit is enumerated in the lists of spare parts, tools and accessories.

The complete ЗИП is grouped in the lists as follows:

a) Spare parts for the unit,

b) Spare parts for the ЯАЗ-М204Г type engine,

c) Spare parts for the generator,

d) Spare parts for the electrical equipment,

e) Tools for the unit,

f) Tools for the ЯАЗ-М204Г type engine,

g) Accessories for the unit.

In the sheets there is a column in which the location of the implements is indicated.

2. Packaging of spare parts and accessories

Most of the implements are located in two boxes and a bag. Besides, for non-hood type units, part of the accessories (see list) is delivered without a special box. (Packed only when sent separately).

Inside the box on the lid a complete list is given. The more often used tools are put into the bag.

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PART TWO

OPERATING AND MAINTENANCE INSTRUCTIONS

Chapter One

Safety

Only qualified personnel that have passed a special training course and who clearly understand the work of the electrical equipment and the other parts of the unit are allowed to operate the unit. This personnel should also be properly acquainted with the safety rules for proper handling of the unit, instructions for electrical and other shocks first aid, and for fire fighting.

1. Safety rules to be observed when handling the Unit

1. To prevent personnel from becoming victims of electric shocks when attending the unit, in cases of faults in the distributing system of the unit or in the circuit, the frame of the unit must be earthed. It is strictly forbidden to operate an unearthed unit. Two metal coniform hollow earthing conductors (augers) are provided for this purpose.

An auger is provided at the lower part of each earthing conductor. A hole in the upper part is provided to insert a crowbar as a lever.

Two men pushing against the crowbar from both sides of the earthing conductor and turning it clockwise should screw the

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earthing conductor into the soil until the contact bolt will be some 2 to 3 cm from the ground surface. To make the turning easier, water may be poured inside the borer.

To provide for a greater depth of bore penetration in cases of hard caked soil, it is allowed first to dig a small pit half the length of the bore and then screw it into the pit bottom. After the screwing is completed, the pit is refilled with soil, which should be watered and properly rammed.

For better soil contact with the earthing bore, water (preferably salted) may be poured into it.

The two earthing borers are placed from both sides of the unit at a distance 3 to 3.5 m from the engine sides (or as much as the earthing wires permit).

On both sides of the frame special earthing bolts are provided. These bolts by means of two wires delivered together with the spare parts, tools and accessories set are connected to the terminals of the earthing borers.

The reliability of the protective earthing system depends on the resistance of the earthing system. It is necessary that this resistance be as small as possible and for this purpose the earthing bore should be fully screwed in and the bolt contacts properly tightened.

2. During operation of the unit, no line terminals or current carrying conductors should be touched upon both outside the unit and inside the switchboard frame.

3. If the load wires are to be connected to the terminals of any line while the unit is in operation, it is necessary preliminarily to open the corresponding line automatic circuit

breaker for all types of units with 4 automatic circuit breakers. For all types of units with one circuit breaker it is necessary to open the automatic breaker (AB).

4. Check for proper condition of fan enclosure, do not touch on any moving parts of the ventilating system, the motor, driving belts and charging generator to avoid accidents.

5. Check for absence of fuel leakage in the tanks and piping. When loakage is detected, it should be immediately eliminated.

6. Carefully remove all dirt and wipe up all fuel and oil leaks.

7. Do not lubricate or clean the engine while it is working.

8. If the engine is overheated, to avoid burns when opening the radiator filling inlet, it is necessary to put on gloves and keep the face away from the inlet.

9. While the unit is working, no admittance of outsiders should be allowed.

10. Night-work without lights is prohibited.

11. In cases of damage the engine should be stopped immediately with the help of the emergency stop.

12. Take care that no inflammable materials be deposited near the exhaust pipe.

13. When filling fuel and oil no smoking or open fire should be allowed near-by. The filling should be done through special funnels to avoid spillage of fuel or oil.

14. In cases when the fuel or oil ignites, the flames

should be smothered with earth, sand or by covering them with felt or tarpaulin.

It is strictly prohibited to use water to fight fires.

15. Carefully check the insulation of the wiring and reliability of contacts thus avoiding overheat or fires due to short circuits or loose contacts.

16. Take care to keep fire extinguishers in proper order and in readiness for use.

Chapter Two

Fuel and Oil

1. Permissible fuels and oil grades

Only high-grade, duly certified, diesel fuel and oil should be used.

The fuel and oil grades permitted for use are indicated in the book "Maintenance Instructions for ЯАЗ-М204 and ЯАЗ-М206 Engines".

2. Requirements for Preliminary Filtering

Prior to filling the tank it is recommended that the fuel be allowed to settle for at least 10 days. To fill the fuel tank of the unit it is necessary to use the specially supplied ware (pail, funnel).

The fuel should be poured into the tank through the funnels and the tank inlets fitted with strainers.

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Chapter Three

Operation

1. Preparation of Unit for Work

The unit should be arranged for working at a site as near as possible to the load and on a level surface.

If the unit is conserved, first it is necessary to restore it to normal condition (see Chapter 8, Part 2, Deconservation procedure) and make ready for checking its condition.

Pour water into the cooling system through the radiator opening. By opening the drain cock mounted on the pipe near to the water pipe, check the filling of the cooling system with water.

Pour filtered oil into the engine sump up to the top mark on the engine oil level indicator. Turning the engine crankshaft several times by hand or by the starter, make sure (watch the pressure gauge) of presence of pressure in the oil mains and consequently of good working order of the oil pump.

Pour fuel into the fuel tank. Open the disconnecting cock of the fuel system and fill the system with fuel.

Check for absence of leaks in the water and fuel pipes.

Check for presence and good order of earthing system.

All units of the open type are delivered without earthing devices and earth cables. But this does not give the operator any right to work with an unearthed unit.

The unit must be earthed and this should be done when it is set in place.

Check and prepare for starting the electrical equipment, and for this it is necessary:

a) For units of all types with four automatic circuit breakers on the switchboard to set to the "off" ("откл") position the automatic switches (АВГ "Generator"/"АВГ генератор"/) ($АВ_1$ "line № 1" /"$АВ_1$ линия № 1"/), ($АВ_2$ "line № 2" /$АВ_2$ линия №2) ($АВ_3$ "line № 3" /"$АВ_3$ линия №3"/), and for units of other types with one circuit breaker -- to АВ "generator" ("АВ генератор")

Set the lighting switch ($ПК_I$) to the "on" ("вкл") position. The engine is started with manual voltage regulation of the generator; for this purpose the handle "voltage regulation changeover switch" ("переключатель регул.напряж.) is set in the position "manual" ("ручное").

The handle of the rheostat for regulating voltage should be turned to the right extreme end ("voltage lower"), ("напряжение ниже").

b) For units of all types with four automatic circuit breakers connect the load (depending on the needs of the consumer in the rated load range) to the sockets "line № 1," "line № 2" "line № 3", and for units of all types with one circuit breaker connect the load to panel (П) terminals.

c) Connect cable for parallel operation to terminals of panel (П), if parallel operation of several units is required.

d) Close "signalling switch" ("включатель сигнализации") on the diesel panel.

e) Open switch of starting heater (ВПК) on the diesel panel.

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12. Starting the Unit

The engine is started at ambient temperatures above +5°C by pressing the start button with the fuel delivery handle at the extreme "from the operator" ("от себя") position.

Duration of continuous work of the starter should not exceed 5 to 6 sec.; after each start an intermission of 7 to 10 sec. should be made. Not more than four successive starts should be made, and if the engine still does not start, detect and eliminate the fault.

The start of the unit at ambient temperatures from +5 to -40°C is carried out in compliance with par. 7 of this Chapter.

13. Attending the Unit During Operation

After start the engine should be properly warmed up at no load with a gradual increase of revolutions during warm-up, until the temperature of water and oil reaches 50°C; only after this may the load be connected to the unit.

After the engine has been warmed up, set the rated speed of rotation at 1500 r.p.m. and by turning the voltage regulation rheostat handle towards "voltage higher" ("напряжение выше") set the generator rated voltage by means of the voltmeter. In this case the green signal lamp "generator" ("генератор") should light up.

By turning the handle of the voltage changeover switch check presence of voltage across all three generator phases and frequency-meter indications that should read 50 c/s.

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For changing to automatic voltage regulation it is necessary to turn the voltage regulation rheostat handle into the position "voltage lower" ("напряжение ниже"). Set regulation change-over switch into position "automatic" ("автомат") and then by means of the voltage regulation rheostat set the necessary voltage value.

Check the work of all engine control instruments.

For rated performance the engine instruments should give the following readings:

a) the oil pressure should be in the range of 1.5 to 4.5 kg per sq.cm.

b) temperature of cooling liquid should be in the range of 70° to 95°C;

c) the d.c. ammeter should indicate the charging current of the storage batteries; in this case the charge current value decreases with charge.

d) the fuel level indicator should show the level of the fuel in the tank.

If the consumers are ready to receive power, then in units of all types with four automatic circuit breakers the generator circuit breaker is first closed, then breakers of the corresponding lines.

In units of all types with one automatic breaker this breaker is closed. In this case on the switchboard the red signal lamps should light: one on the instrument panel, the other on the power feed take-off panel.

By means of the switchboard ammeters check the load of each phase.

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When the unit is in operation, the operators should adhere to the following rules:

a) not to allow full load until the temperature of the cooling liquid attains +50°C;

b) not to allow the temperature of the cooling liquid to fall below +70°C;

c) not to allow the temperature of the cooling liquid to grow above +95°C;

d) watch the oil pressure. In case of fall of oil pressure below 1.5 kg per sq.cm for rated conditions, the engine should be stopped immediately and the fault eliminated;

e) check for leakage in fuel and water system piping.

When leakages are discovered, the causes should be eliminated in proper time.

f) watch the indications of the control and measuring instruments of the switchboard and the engine control board;

g) observe the brushes on the commutator and contact generator rings.

With normal working a small sparking under the brushes which does not leave any marks on the surface of the commutator or rings is allowed.

When the sparking increases, it is necessary to detect the cause and eliminate it;

h) observe the generator bearings, their heating, increase of noise and when such defects occur, the unit should be stopped;

i) fill oil into the engine crankcase every 8 to 10 hours of working.

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4. Procedure for running Units in parallel operation for Units of all types with four circuit breakers

When parallel operation is required the sequence of operations depends on the distribution of load on the unit among the lines in each individual case.

First case. One or both units work at no loud or at load. Let us assume that unit № 2 works at no load and should be connected for parallel operation with unit № 1 which is either idle or working at load. In this case it is necessary to:

a) Make sure that the circuit breaker (ABГ "generator") of the unit, that is to be synchronized is open, and that the automatic circuit breakers (AB1 "line № 1") of both units is also open.

b) Connect the contact terminals (П) designed for parallel operation by wires the cross-section of which is calculated for full power of unit, observing proper sequence of phases of both units, i.e. the first phase of one unit should be connected with the first phase of the other unit, etc.

Note. With incorrect connection of phases it will not be possible to achieve the darkening of the synchronization lamp at any change of revolutions of unit № 2 and if the unit were to be connected for parallel operation the circuit breaker (AB) would immediately open.

To avoid any mistake, prior to connection of units for parallel operation the sequence of phases should be checked

with the phase indicator supplied with the tool set. The disk of the phase indicator should turn clockwise, the terminal "A" being connected to socket "R" or terminal "I", terminal of phase indicator "B" to socket "S" or to terminal "II" and terminal of phase indicator "C" to socket "T" or terminal "III".

Note. On the plug-and-socket devices the notation of phases "R", "S" and "T" are marked from the wiring connections side and therefore for convenience of checking it is necessary to follow the disposition of phases in respect to socket "O" as indicated in the drawing (viewed from the side of load connection).

c) Close automatic switches (AB, "line № 1") of both units.

d) Set "voltage changeover switch" ("переключатель регул. напряжения") of both units in position "Automatic parallel" (Автомат. паралл.)

e) Set rated values of voltage and frequency for each unit.

f) Parallel operation will take place on closing of circuit breaker (АВГ-"generator") of unit № 2.

The operations which follow should be carried out at the switchboard of unit № 2. The red lamp "line № 1" on the instrument panel of the switchboard of this unit should be

lighted up.

g) Close switch "synchronoscope" ("СИНХРОНОСКОП") setting it in position "on" ("ВКЛ") and make sure that the lamp "synchronoscope" periodically flashes and goes out (the lamp will flash and go out because it is impossible to maintain the r.p.m. of both engines of the units and consequently the frequency of the generator at the same value for long periods).

h) Check equality of voltages and frequencies of both units switching the voltmeter and frequency-meter with the help of handle "voltmeter and frequency-meter changeover switch" ("переключатель вольтм. и частотом") alternatively to positions "line № 1" and "phases I-II". In cases of non-equality of voltage, balance them with the help of the voltage regulation rheostat (РУ). The more precise the equality of setting of the voltages of both units, the less the circulating current arising when the units are connected for parallel operation.

i) At the instant the synchronization lamps go dark quickly close the automatic circuit breaker (АВГ "generator") (АВГ "генератор").

Both units will then be working in parallel.

j) When the АД-30-Т/230 or the АД-30-Т/400 type units are operating in parallel, to attain more balanced distribution of the load, they should be regulated by fuel delivery control so, that the wattmeter readings are of the same value. To balance the reactive load it is permitted to regulate within a small range the exciter excitation by means of the voltage regulation rheostat (РУ), tending to attain similar ammeter indications.

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The connection for parallel operation of units, working at load is similar to that described above and differs only in that the connection to the common buses is carried out by circuit breaker (AB_1 "Line № 1") of one of the units.

Second case. The operation of the unit in parallel with a large-capacity circuit. As a rule, the unit is not used for parallel operation with a large-capacity circuit, but acts as a stand-by for a part of the circuit and starts operation when a fault disrupts the main supply. The starting and connection procedure of the unit is carried out similarly to the first case, the phase sequence necessarily being checked with the help of the phase indicator.

For units of all types with one circuit breaker.

One or both units work idle or at load. Let us assume that unit № 2 operates at no load and is to be connected for parallel operation with unit № 1 which is either working at load or also idle.

In this case it is necessary:

a) To make sure that the circuit breaker (AB) of the unit which is to undergo the synchronization procedure is open.

b) Connect the contact terminals (Ш) by conductors the cross section of which is calculated for full power of unit, observing proper correspondence of phases of both units, i.e. the first phase of one unit, should be connected with the first phase of the other unit, etc.

Note. At incorrect connection of phases it will not be possible to achieve the dark indication of the synchronization lamp at any change of revolutions of

unit № 2 and if the unit were to be connected for parallel operation, the automatic breaker (AB) would immediately open the circuit.

To avoid mistakes, prior to connection of units for parallel operation, the phase sequence should be checked by the phase indicator (delivered with the tool set). For this purpose three terminals of the phase indicator should be connected with contact terminals (П) first of one, and then of the other unit.

For this purpose the terminals (A), (B), (C) of the phase indicator should be connected correspondingly to terminals (I), (II), (III) of panel (П).

Rotation of the phase indicator disc in one direction will indicate the regular sequence of phases.

c) Set "voltmeter and frequency-meter changeover" switch of both units to position "automatic parallel" ("Автомат паралл").

d) Set rated voltage and frequency for each unit.

e) Connection for parallel operation will be carried out by circuit breaker (AB) of unit № 2.

The following operations should be performed at the switch board of unit № 2.

The red signal lamp "line" ("ЛИНИЯ") on the instrument panel of the switchboard of this unit should be lighted up.

f) Close the switch "synchronoscope" ("СИНХРОНОСКОП") setting it to position "on" ("ВКЛ") and make sure that the synchronization lamp periodically flashes and goes out (the lamp will flash and go out because it is impossible to keep up the engine r.p.m. of both units, and hence the frequency of the generators at equal value for a long period).

g) Check equality of voltage and frequency of both units, switching over the voltmeter and frequency-meter with the help of handle "changeover switch of voltmeter and frequency meter" ("переключатель вольтм. и частотом") alternatively to position "line" and "phases I-II". In cases of non-equality of voltages, they should be balanced with the help of voltage regulation rheostat (РУ). The more precise the setting of equal voltages of both units, the smaller the circulating current when they are connected for parallel operation.

h) The instant the synchronization lamp goes dark, the circuit breaker (АВ) should be quickly closed.

Both units will then be operating in parallel.

i) When the АД-30-Т/230 and АД-30-Т/400 type units are operating in parallel to balance load more uniformly, the fuel delivery should be regulated so that the watmeter indications be the same. To balance the reactive load, it is permitted to regulate within a small range the excitation of the exciter by means of the voltage regulation rheostat (РУ) tending to attain the same ammeter indications.

5. Stopping the Unit

The unit is stopped in the following sequence:

a) For units of all types with four circuit breakers disconnect the load, by shifting the handles of the setting 3-pole automatic circuit breakers (АВГ), ($АВ_1$), ($АВ_2$), ($АВ_3$) to position "off"; for units of all types with one circuit breaker cut off the load shifting the handle of the setting circuit breaker (АВ) to position "off" ("откл.").

b) Turn handle of voltage regulation rheostat to position "voltage lower" ("напряжение ниже"), i.e. to the extreme right, after which the regulation switch should be set to position "manual" ("ручное").

c) Decrease speed of engine crankshaft to 1200 r.p.m. and work with these r.p.m. at no load for 3 to 5 minutes. Then lowering the r.p.m. by shifting the fuel delivery handle slowly stop the engine.

d) Open the signalling switch (B_1).

e) Close the disconnecting cock of the fuel system.

6. Inspection and Maintenance of Unit After Close-down

a) Disconnect load cables.

b) Set to the "off" position, the lighting switch on switch-board.

c) Eliminate defects noticed during operation of unit.

d) Wipe up with dry rags the engine and the generator and remove any accumulated oil and water on the crankcase.

e) Check condition and fixing of pipes; if defects are found, eliminate them.

f) Check fixture of main parts, eliminating all faults.

g) If operation of unit is to be continued, it is necessary to check the quantity of water, oil and fuel in the systems and fill up to normal levels.

h) If operation of unit is to be discontinued, then at low ambient temperatures let out the water and drain the oil into a special container. After draining the water and oil, turn the

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engine by means of the starter several times and remove the remains of water from the pump.

i) If the unit is to be taken out of commission for a long time, it should undergo conservation.

7. Procedure for Operation of Unit at Low Ambient Temperatures

a) General

At ambient temperatures below 0° C the operation of the unit becomes somewhat more complicated and additional safety measures are necessary to avoid freeze ups of engine and water radiator.

To provide for normal operation of the unit in winter time, the following preparatory operations are necessary:

Change the oil in the unit in accordance with the directions given below.

Wash out the fuel tank, fuel piping, fuel filters and replace the fine fuel filter element.

Fill up the tank with winter diesel fuel.

Prepare and check the work of the electric torch device and the heating lamp. Preparation and lighting of lamp is carried out according to a special instruction, delivered with the unit.

To provide for a quicker engine start at low ambient temperatures, it is recommended to build a warm place for storing the storage batteries during idle periods.

Replace water for antifreeze in the cooling systems.

Replace the electrolyte in the storage batteries for the electrolyte of winter grade, according to rules for maintenance of storage batteries.

b) Starting the engine at ambient temperatures of +5 to -5°C

Starting the engine at ambient temperatures of +5 to -5°C is done with the help of a starter and electric torch device in the following sequence: close the signal switch (B_1), turn handle (rim) of switch of starting heater clockwise after which inside the transparent head of the handle a lamp is lighted up with a red light.

One to two minutes after closing the ignition circuit press the start button, simultaneously setting the fuel delivery handle in the extreme "from the operator" position and pulling out the handle of the pump of the start heating device. During starter operation make 4 to 5 pumpings with the pump evenly pressing on its handle with a force of about 5 kg.

If the engine does not start, repeat the above procedure after an interval of one minute.

After the engine has been started, switch off the electric torch heating device, shifting counterclockwise the handle (rim) of the switch of the start heater (the lamp inside the handle should go out). Push in to the end the pump handle. Switch the motor over to idle duty.

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c) Starting the engine at ambient temperatures of -5 to -40°C

Starting of the engine at ambient temperatures of -5 to -40°C is carried out by means of the starter and by using the electric torch and the heating start device fitted with a heating lamp and a blower. Heating up of the engine with the help of the heating start device is carried out in the following sequence:

Prepare and ignite the heating lamp. Open the engine by-pass pipe baffle-plate.

The handle of the open baffle-plate should be located along the pipe.

Set the burning heating lamp with funnel towards the inlet orifice of the heating start device, providing a small clearance between them (about 6 mm).

Warm up the cooling liquid and the oil of the engine. A reliable start is attained when the oil is heated to a temperature of +5° to +10°C.

The start of the heated engine is carried out with the help of the starter and electric torch heating device using the procedure given above.

After starting the engine close the lid of the orifice of the heating start device and also the baffle-plate of the by-pass pipe, turn out and put away the lamp.

d) Cooling system maintenance

When the unit is operated at low temperatures, the following rules should be adhered to:

During operation of the unit observe temperature of water or of antifreeze compound in the cooling system maintaining it at a temperature not below +70°C.

Carefully watch water temperature when diesel is stopped not allowing it to fall below 40°C. The unit should be placed so that it is protected from the wind.

When the unit is taken out of commission for long periods, it is necessary to drain water from the system.

It should be kept in mind, that when water is left in the cooling system, it may lead to very serious damage: when water freezes, the cylinder block head, lower tank, and radiator tubes may burst.

When draining the water from the cooling system it is necessary to place the unit on a horizontal surface and cool the water down to a temperature of 50° to 60°C, after this open the drain cock located on the piping connecting the oil radiator branch pipe to the water radiator.

The liquid remains should be drained through small cock on the water pump frame. Pour the liquid into a clean container so as to reuse it with future refill.

After pouring the liquid from the cooling system turn the engine crankshaft 5 to 10 revolutions with the help of a special key, the fuel delivery being cut off, and then make sure that the liquid has been entirely drained from the system.

To avoid any possibility of accumulation of remaining liquid in the cooling system, all draining holes should be left open and the radiator filling orifice lid should be closed.

A notice "Water drained" should be set on the unit.

At low temperatures, to protect the cooling system from freezing, it is recommended to use special cooling mixtures, which have a freezing points much lower than for water.

As a cooling liquid a low temperature freezing cooling liquid (antifreeze) grade "40" or "65" (TOCT 159-52) is used.

The freezing point of the liquid for grade "40" is not higher than $-40^{\circ}C$, for grade "65" not above $-65^{\circ}C$.

The antifreeze compound is poisonous, therefore sucking it in with the mouth is unconditionally prohibited, since even negligible quantities when reaching the stomach may cause lethal poisoning.

When the cooling system is primed with antifreeze 0.7 litres less than water amount should be poured in because when heated the antifreeze will greatly expand.

The antifreeze is safe, therefore it is allowed to heat up the engine with the help of an open-flame lamp.

If during the operation period the level of the antifreeze is reduced due to evaporation, it is necessary to refill the radiator with clean water bringing up the level to normal. Periodically, every 25 to 30 hours of operation of the unit, the amount of antifreeze in the cooling system should be checked.

When no antifreeze compound is available, it is permitted to use alcohol-glycerine mixtures as cooling liquids.

e) Maintenance of fuel feed system

When fuel for high-speed diesels ГОСТ 4749-49 is available, the grades to be used in winter are:

for temperatures 0° to -30°C winter diesel fuel З3 grade, and for temperatures below -30°C, arctic diesel fuel ЗА grade.

If diesel fuel ГОСТ 305-42 is available, at ambient temperatures below -5°C winter diesel fuel should be used and at temperatures below -30°C it is permitted to add lighting kerosene to the winter diesel fuel in the following proportions:

for temperatures within the range -20° to -30°C — 25%

for temperatures below -30°C — 60%

The diesel fuel should be mixed with kerosene prior to pouring it into the fuel tank.

When priming an empty system of fuel feed it is preliminarily heated to about 50-60°C.

f) Lubrication system maintenance

At low ambient temperatures use for lubrication only winter oil grades that have less viscosity and a lower freezing point.

When the unit is stopped for long periods, oil should be drained from the sump into a clean tightly closing vessel.

A cold diesel should be primed with oil heated to temperature of 70 to 80°C.

Heating of the oil is performed in a hot water bath; it is prohibited to heat the oil by an open flame.

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g) Storage battery maintenance

Working conditions of the storage battery at low temperatures become more difficult. When a battery becomes greatly discharged, the electrolyte freezes at higher temperatures therefore the specific gravity value of the electrolyte in the cells should not fall below 1.22.

Storage batteries at low temperatures should be maintained in full compliance with the maintenance manual delivered with the unit.

When the cell is cooled, its working capacity is greatly lowered, therefore steps should be taken to warm up the battery. It is advisable to disconnect the battery when the unit is stopped and store the elements in a warm room.

Chapter Four

Maintenance of Unit and Its Elements

1. General

The handling and servicing of the unit should be carried out in full compliance with given instructions and description of the unit. The operators prior to beginning work independently should pass the necessary theoretical and practical instruction. The operators should have a thorough knowledge of the design, location, designation and operation of the spare parts of the unit. Only careful study of the unit will help to quickly and correctly find out the reason of the occurring fault.

To provide for normal operation, it is necessary that the unit itself, the auxiliaries and tools always be kept clean, in good order and their assigned places.

2. Engine maintenance

Maintenance of the ЯА3-М204 engine is to be carried out in accordance with the instruction for servicing the ЯА3-М204 and ЯА3-М206 type engine delivered together with each engine and also in accordance with the data given in the Appendix.

3. Maintenance of the generator

The generator and the exciter should be kept clean and periodically, not less than once a month, be cleaned of dust and dirt. After lengthy stops and repairs of the generator its insulation resistance should be checked.

If the generator windings have become moist and the insulation resistance falls below 0.3 megohm, it is necessary to dry out the insulation with electric current.

A generator which is very wet or has been under water should not be dried with current. In this case it should be dried externally. When drying moderate ventilation should be provided to eliminate the water vapours.

The commutator and contact rings should be systematically wiped over with a soft rag moistened in benzine. If any burns have been found which cannot be wiped off with benzine, the commutator should be cleaned a little while the armature runs at low speed with the help of sandpaper № 00, wrapped around a wooden stick. If there are no burns, the commutator should not be sandpapered. It is necessary to watch the wear of the generator and exciter brushes.

4. Maintenance of the switching equipment

The electrical switching equipment does not require any special care besides periodic cleaning, tightening of bolts, screws and nuts. Changing of fuses should be carried out as a rule only when the unit has been stopped or when the generator is not excited. It is necessary to watch that the blown fuses should be replaced by special fuses calibrated for the corresponding current.

It is most strictly forbidden to insert into the plugs pieces of wire or other metal bits instead of standard fuses.

Chapter Five

Possible Faults and Their Remedies

When trouble in the work of the unit occurs, it is first necessary to check if there are any external reasons that cause the trouble. Balance of load should be checked, absence of breakage in outgoing cables, integrity of contacts and fuses.

Dismantling, repairs or replacement of any unit element should be carried out only after it is established that the fault in the work of the unit is due to damage of some element.

1. Faults in engine

For engine faults see book "ЯА3-М204 and ЯА3-М206 type engines."

2. Generator faults

№	Fault	Cause	Remedy
1	Sparking of brushes.	1. Brushes poorly ground-in.	1. Grind in brushes properly.
		2. Insufficient pressure at brushes.	2. Increase pressure to normal.
		3. Brushes shifted from neutral.	3. Turn brush holder until the mark on the holder coincides with that on frame.
		4. Dirty commutator.	4. Clean with benzine, and when burnt, sandpaper it.

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No.	Fault	Cause	Remedy
		5. Excessive brush wear.	5. Replace with spare.
		6. Excessive commutator wear.	6. Turn commutator (send to shop).
		7. Breakage or bad soldering of the winding ends into commutator risers.	7. Connect ends and solder.
		8. Overloads above rated power of generator.	8. Remove excessive generator overloads.
2.	Burning of commutator.	Loosening of commutator bars or breakage of armature winding.	Armature should be sent to shop for repairs.
3.	Generator develops voltage below rated value.	Wrong position of brush holder arm of exciter.	Set brush holder arm right.
4.	Generator buzzes and smoke emerges.	1. Short-circuiting of turns.	1. Replace faulty coil.
		2. Short-circuiting of phases.	2. Eliminate short-circuiting.
		3. Earth-fault of stator in two places.	3. Eliminate earth-fault.

№	Fault	Cause	Remedy
5.	Escape of lubrication from bearings.	1. Bad grade lubrication used.	1. Wash bearings with benzine or bensene and change lubrication.
		2. Overheat of bearings.	2. Check condition of bearing (by turning, by inspection and checking clearance).
6.	Overheating of generator.	1. Short-circuiting of winding turns.	1. Send to shop for repairs.
		2. Dirt in generator.	2. Dismantle generator, clean and blow through with compressed air.
7.	Drop of insulation resistance.	1. Dirty or moist windings.	1. Dismantle generator, clean and blow through. Dry out.
		2. Wear and ageing of insulation.	2. Rewind winding (in shop).

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3. Control Circuit and Switchgear Faults

a) Main possible faults in carbon regulator circuit and in YPH type regulator proper

№	Fault	Cause	Remedy
1.	Voltage is not sufficiently precisely regulated. Random fluctuations of voltage without definite periodicity may be created. Sparking is possible observed under the carbon pile compressing screw when load is dropped.	1. Burning of carbon pile plate.	1. Replace carbon regulator.
2.	Voltage is not sufficiently precisely regulated.	2. Change in adjustment of regulator due to wear and contraction of carbon pile plates.	2. Replace regulator.
3.	Voltage is above rated value and cannot be regulated.	3. Broken coil circuit in regulator.	3. Eliminate breakage. If there is a break in the coil, replace the regulator check for breakdown of selenium

№	Fault	Cause	Remedy
			rectifier, feeding the regulator coil.
4.	Increase of generator voltage, overheating of regulator coil.	4. Short-circuit in regulator coil turns.	4. Replace regulator. Check other elements of coil circuit.

b) Faults of BC-1 type selenium rectifier feeding the YPB carbon regulator coil

№	Fault	Cause	Remedy
1.	Overheating of rectifier (separate plates). Increased voltage at generator terminals. Carbon voltage regulator does not regulate.	Breakdown of selenium rectifier.	Replace selenium rectifier.

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c) Faults of BC-2 selenium rectifier shunting the exciter excitation winding

№	Fault	Cause	Remedy
1.	Generator does not excite.	Breakdown of selenium rectifier.	Replace selenium rectifier.

4. Engine Electrical Equipment Faults

№	Fault	Cause	Remedy
1.	When start button is pressed, the armature of starter does not turn.	1. "Earth" wire of storage battery № 2 is loose.	1. Check and connect wire.
		2. One of the wires connected to storage battery terminals is loose.	2. Check and connect wires.
		3. Break in starter relay circuit.	3. Check external circuit. Replace broken wires. Tighten loose contacts. In case of breaks in relay winding remove relay for repairs.

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№	Fault	Cause	Remedy
2.	When start button is pressed, the starter relay closes, then opens again.	2. Break[illegible]fault in hol[illegible]g winding of [illegible]tarter relay.	2. Check circuit, eliminate fault.
3.	When pressing button for starting, the starter relay operates but the armature does not turn.	3. Heavily burnt working contacts in starter relay.	3. Remove starter for repairs.
4.	When starter button is pressed, the starter armature turns, but the pinion does not engage with the flywheel toothed rim.	4. Disturbed operation of the electromechanical drive.	4. Remove starter and eliminate defect.
5.	When start button is pressed, the pinion of the starter engages with the toothed rim, but the starter does not turn the engine.	5. Seizure of engine crankshaft.	1. Turn engine crankshaft by means of setting special key on hexagonal head of bolt fixing crankshaft flywheel.

№	Fault	Cause	Remedy
		2. Clips of wires attached to storage battery are oxidized.	2. Clean the clips.
		3. Storage battery is discharged.	3. Check degree of battery discharge. Charge or replace battery.
		4. Dirty starter commutator and brushes.	4. Clean commutator and brushes, rub commutator with rag moistened in benzine.
6.	When closing switch the ignition coil does not work (no spark).	1. Fuse link in fuse Пр7 has blown.	1. Replace fuse.
		2. Loose or oxidized contacts in the ignition coil circuit.	2. Clean or tighten contact.
		3. Ignition coil vibrator contacts are welded.	3. Remove and repair.
		4. No contact of ignition coil with "earth" frame.	4. Restore contact.
		5. Break in primary or secondary windings.	5. Replace coil.

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№	Fault	Cause	Remedy
7.	Ammeter shows discharge when engine works with average or high r.p.m.	1. The generator driving belt has become loose.	1. Tension the belt.
		2. No contact in the circuit between generator and relay regulator.	2. Check circuit, restore contact.
		3. Absence of contact in circuit between relay-regulator and fuse #p 8.	3. Check circuit restore contact.
		4. No connection between regulator frame and "earth" engine frame.	4. Check and restore connection of frame to "earth".
		5. The 20A fuse in the charging circuit has blown.	5. Replace fuse.
8.	Ammeters show excessive charge current, pointer moves to the right extreme position.	Fault in relay-regulator of voltage regulator.	Check and eliminate fault.

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5. Instructions

a) Replacement of fan belts

To remove a worn out fan belt, do the following:

loosen the belt tension;

remove the belt from the flywheels;

place the belt under the special recess in the fan housing;

turning the fan, pass all its blades through the belt;

take out removed belt from the space between the fan and the radiator cells.

The belt is put on in the reverse order.

b) Replacement of the УРН carbon regulator

When replacing the carbon regulator do the following:

disconnect wires and remove faulty regulator;

replace with new regulator from the spares and connect the wires;

turn in position "lower voltage" ("напряжение ниже") the voltage regulation rheostat (extreme right position) set duty changeover switch to position "automatic" ("автомат");

start diesel with the generator at no load;

check with voltage regulation rheostat the possible range of voltage change (turn rheostat handle from position "lower voltage" ("напряжение ниже") to position "higher voltage" ("напряжение выше") watching the voltmeter.

In this case the lower voltage limit should not exceed 220 V, the top not less than 245 V (for the АД-30-Т/230 and АД-30-Т/230-4/400 types). For the АД-30-Т/400 type the lower

limit should be not more than 380 V, and the top limit not less than 420 V.

In case when these limits cannot be attained, it is necessary to move the clips on the R_5 resistor tubes, located in the voltage regulator block; to increase the voltage, the resistance R_5 should be increased.

After regulation the clips should be tightened up again.

c) Rules for indoor running the unit

It is prohibited to run the unit outdoors under conditions of atmospheric precipitation without the hood.

When the unit is to be used indoors, the following should be provided:

- removal of exhaust gases into atmosphere through hoses;
- circulation of air for normal cooling of all parts of unit and removal of escaped exhaust gases;
- convenient access to all the unit parts for inspection and maintenance.

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Chapter Six

Inspection of Unit

1. Engine

Inspections of the engine are carried out in accordance with the service instructions for the MA3-M204 type engine.

2. Electrical Part

It is recommended that the servicing of the electrical equipment be carried out at the same time when the engine is serviced.

Technical servicing procedure № 1

To be performed every 60 to 80 hours of operation.

a) Removal of dust and dirt from all electrical equipment.

b) Check for proper order of earthing protection.

c) Check for tagging and proper condition of wires and electrical contacts.

d) Check for wear of generator and exciter brushes.

e) Check operation of pickup and fuel level indicator.

f) Check for presence and proper condition of fuses.

g) Check for condition of illumination and signal devices.

h) Check for level and density of electrolyte in storage batteries.

Technical servicing procedure № 2

To be performed every 480 to 640 hours of operation. This procedure includes the entire procedure № 1 and besides:

a) Check of brushgear setting on neutral and condition of commutators.

b) Check of conditions of all generator ball and roller bearings by means of turning the armature by hand and listening.

c) Inspection of generator.

Chapter Seven

Instructions for lubrication of Unit

Reliable operation of the unit depends on correct working both of the cooling system and the lubrication system, and also proper and well-timed servicing of all parts of the units.

When carrying out oiling, special care should be exercised to avoid dirt entering the mechanisms and to keep everything clean. For this purpose prior to lubrication, dirt is removed from all plugs and oilers and also in their vicinity. The grease gun should be periodically disassembled and washed in kerosene and when it is filled, care should be taken that no air remains in it.

By means of the grease gun oil is forced in until it emerges from the joints of the parts of the lubricated unit. All excess oil is then removed from the outer surfaces.

The engine is lubricated in accordance with the instructions for servicing the diesel.

The generator is lubricated in accordance with the generator maintenance manual.

Chapter Eight

Conservation, Storage and Deconservation

1. General Requirements

a) Each unit, before it is shipped by rail or otherwise, prior to long term storage or during idle periods of above one month, should undergo conservation.

The conservation of the engine is the procedure carried out to protect its mechanical units and parts from corrosion during transportation or storage and to maintain the mechanisms in working order;

b) The conservation of the unit is carried out with one of the following lubrication oils: summer diesel oil ГОСТ 5304-54 or oil МТ-16П ГОСТ 6360-52;

c) It is prohibited to use for conservation purposes waste oils, recovered oils or oils containing moisture;

d) The temperature of the oil during conservation procedure should be within the range of +15 to +25°C.

e) All conservation procedures of the unit should be carried out with clean dry hands, slightly covered with oil and by using brushes and clean rags.

2. Conservation of the Unit for a Period of Three Months

The conservation procedure consists of the following:

a) Drain the cooling liquid from the engine cooling system. All cocks for draining the liquid should be left open

for the entire storage period.

b) Drain fuel from the fuel tank and the starting small tank.

Close the connection cock.

Clean the fuel tank with clean fuel, blow through with compressed air, pour in 5 litres of oil, spray it inside the tank with the help of compressed air, turning the hose inside the tank in all directions and then pour out oil from the tank through the drain hole. Cover the interior of the starting small tank with grease.

Cover with technical vaseline the orifices and lid of the fuel tank and the orifice of the radiator.

c) Drain oil from engine crankcase and close draining cock.

d) Pour into each cylinder through the inspection holes and blow holes 10 to 15 cu.cm of oil when the piston is in the lower dead point, turning the crankshaft meanwhile 3 to 5 times with a wrench.

e) Draining of the cooling liquid and oil, and the pouring of oil into the cylinders should be performed after engine operation while it is still warm.

f) Close opening of the exhaust collector by a thick oiled paper or with a special gasket.

g) Check lubrication in all necessary working places according to servicing rules for engines (*RA3-M204 and RA3-M206*).

h) Refill generator bearing lubrication (see description and maintenance instructions for generators).

i) Loosen fan and charging generator belt pull.

j) Remove storage batteries and prepare them for storage according to the maintenance manual for starter type storage batteries.

k) Pump through the heating lamp, cover burner with technical vaseline and rinse its reservoir with diesel fuel.

l) Remove with the help of compressed air and clean rags dirt and dust accumulated on the generator, switching equipment, frame, etc.

m) Under the brushes, on the exciter commutator and generator rings place gaskets of cardboard or cable paper.

n) Cover with technical vaseline all places where the galvanized surfaces are rubbed off in service.

o) Restore the spoilt painted places in the unit.

p) Cover with technical vaseline and wrap in oiled paper metal spare parts, tools and accessories.

q) All rubber and synthetic rubber parts should be protected from conservation oil and if oil, kerosene, diesel fuel or benzine does get onto them, they must be carefully wiped by dry clean rags.

Conservation carried out according to these instructions is valid for the transportation period and also for storing it for three months when adhering to the rules given below.

r) The unit should undergo reconservation when the conservation period has terminated, after lengthy transportation periods as a trailer or on an open transport unit, after transportation on board the ships and after long stays under rains, or under conditions of low or high temperatures.

s) When complete reconservation of the unit is to be carried out, the unit should first undergo deconservation and then the engine should be tried out at idle run according to the engine maintenance instructions until water and oil attain the prescribed normal temperature.

t) After performing the conservation procedure for the unit a note should be entered in the log book of the unit.

3. Storage and Inspection of Unit

Long-term storage of the unit is allowed both in special closed store-places and in a shed, the following rules being adhered to:

A. When kept in closed stores

a) The place which is intended for long-term storage of conserved unit should be dry and well aired. The relative humidity of the air should be within the range of 45 to 70 per cent, the temperature not lower than +5°C.

b) The place should be protected from penetration of any gases, fumes of acids, ammonia or other volatile matters that may cause corrosion.

c) It is strictly prohibited to store in the same place equipment and materials that evolve corrosive fumes such as: acids, alkalis, chemicals, rubber products, storage batteries, etc. and various inflammable materials.

d) The place of storage should be kept clean and orderly.

e) The unit that has been sent for storage should be carefully cleaned and inspected.

Depending on the conservation condition either complete or partial reconservation should be carried out and the painted surface restored.

f) If the unit is not to be completely reconserved, the crankshaft should not be turned.

g) Storage batteries should be kept separate from the unit in another place. They should be attended according to the maintenance manual for a starter type storage batteries.

h) Not less than once a month it is necessary to recheck the condition of the unit.

If corrosion has appeared, remove it by cleaning with sandpaper, covered by mineral oil. The cleaned places should be wiped clean with rags soaked in benzine, then with dry rags, after which they should be again covered with technical vaseline.

i) The results of the periodic inspections of the units should be entered into the log book.

b. When storing under a shed

It is permitted to store the unit under a shed protected by a wall or partition from direct sun rays and rain. When the unit is thus stored, it is necessary to inspect its condition more regularly and take all possible steps to avoid corrosion and if corrosion does appear, to eliminate it.

4. Deconservation of Unit

Before starting operation, and also when reconserving the unit, the deconservation procedure should be first carried out as follows:

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a) Clean out dust from unit, remove paper and external lubrication from conserved parts, carefully wipe first with rags moistened in kerosene and then rub over with dry rags.

b) Check all engine control mechanisms, switchgear, condition of commutator, contact rings and brushgear; remove strips from under brushes of the exciter and generator, blow through the internal parts of the generator and switchgear with dry compressed air.

c) The engine crankshaft should be slowly turned several times by hand.

d) Check and set the tension of the fan and charging generator belts.

e) The fuel tank should be rinsed with diesel fuel and the starting small tank with kerosene in the same manner as when covering with oil during the conservation procedure.

The fuel used to rinse the tank should be drained.

f) Restore the storage battery to working order according to the maintenance manual, place battery at its working place and connect wiring.

g) Prime unit with cooling liquid, oil and fuel.

h) Prepare unit for starting and try it out according to chapter three of part two of this description.

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Supplement

Electrical Circuit Diagram

Depending on type of unit one of the following diagrams is enclosed together with this description:

Unit type	Enclosed model		Open model		With one lead and shortened frame
	With four leads	With single lead	With four leads	With single lead	
АД-30-Т/230	ОДК	ОДК	ОДК	ОДК	
230 V, 50 c/s	354.576	354.579	354.576	354.579	ОДК.354.579
АД-30-Т/400	ОДК	ОДК	ОДК	ОДК	
400 V, 50 c/s	354.577	354.580	354.577	354.580	ОДК.354.580
АД-30-Т/230	ОДК	ОДК	ОДК	ОДК	
Y/400, 230 V	354.578	354.581	354.578	354.581	ОДК.354.581
400 c/s					

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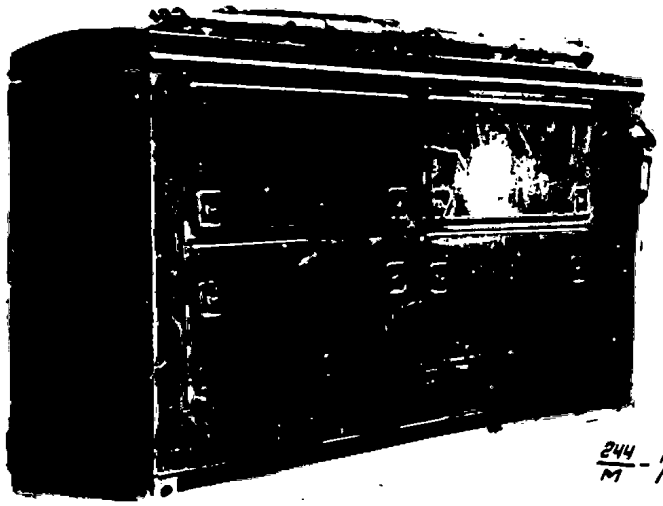

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Fig. 1.

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Fig. 2 General view of Unit from control side with optn doors of hood.

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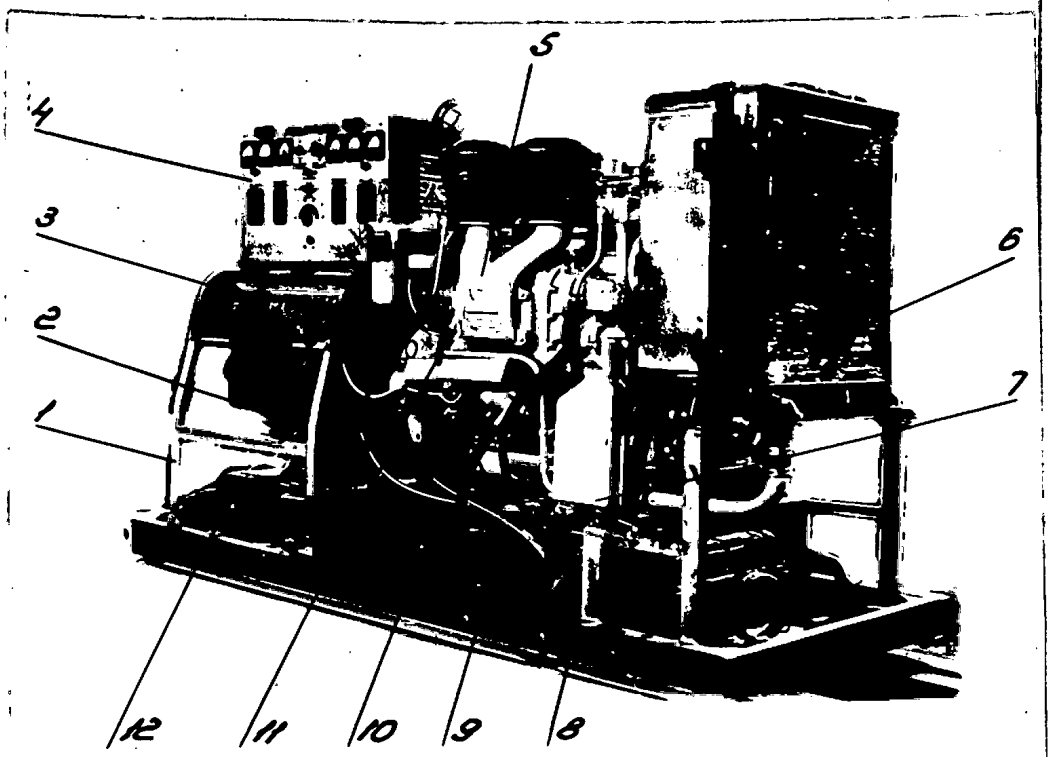

Fig. 3. Opar-type unit with four outgoing leads seen from the control side:

1. Supporting frame for apparatus
2. Generator
3. Engine control board
4. Unit switchboard
5. Engine
6. Radiator
7. Heater
8. Base frame
9. Fuel tank
10. Disconnecting cock
11. Emergency stop handle
12. Storage batteries

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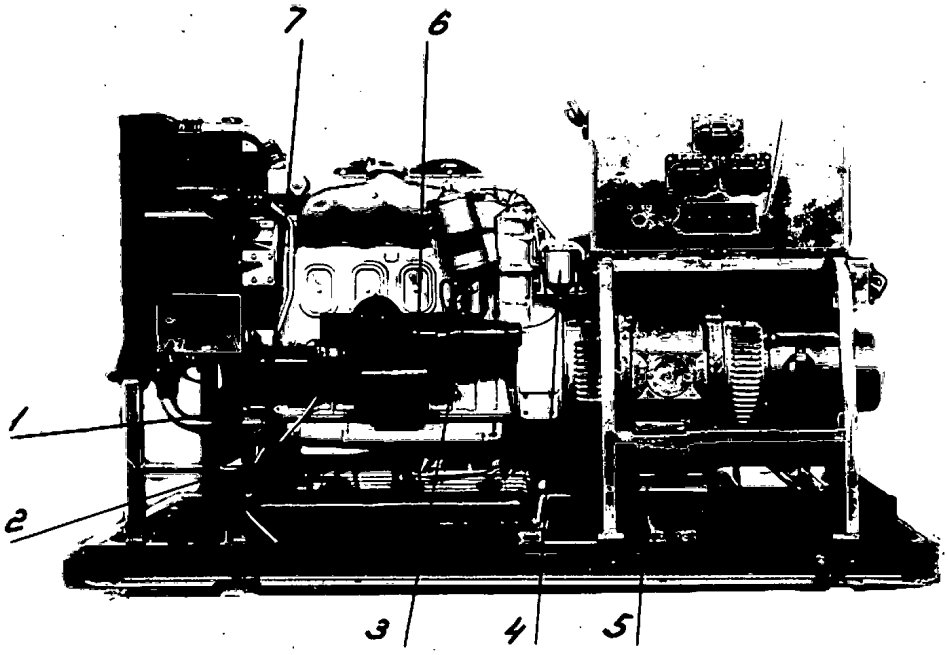

Fig. 4. Open-type unit with four outgoing leads from the side of load connection.

1. Shock absorbers of front support
2. Relay-regulator (P8)
3. Atomizing nozzle, spark plug and ignition coil
4. Starting pump feed tank
5. Shock absorbers of generator support lugs
6. Heating lamp
7. Charging d.c. generator /T8/

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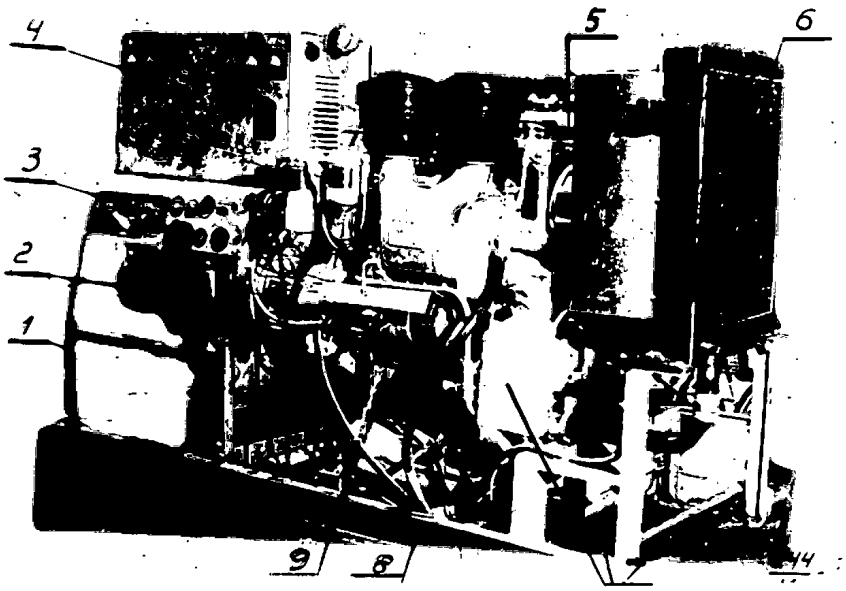

Fig. 5. Units of the AM-30-1/230 and AM-30-1/400, open type with one outgoing lead and shortened frame from the control side:

1. Supporting frame for apparatus
2. Generator
3. Engine control board
4. Unit switchboard
5. Engine
6. Radiator
7. Heater
8. Base frame
9. Fuel tank

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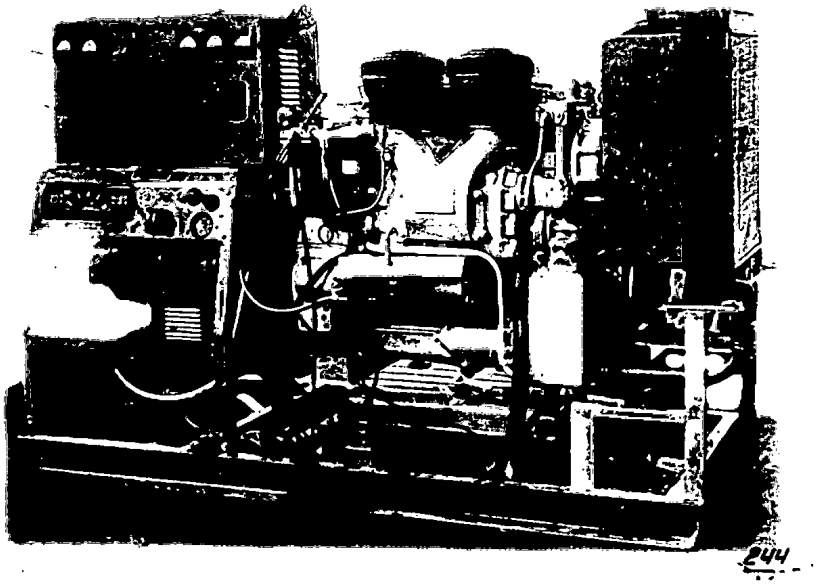

Fig. 6. [illegible]-1/230-4/400 open type unit with one outgoing lead and shortened frame, from the control side.

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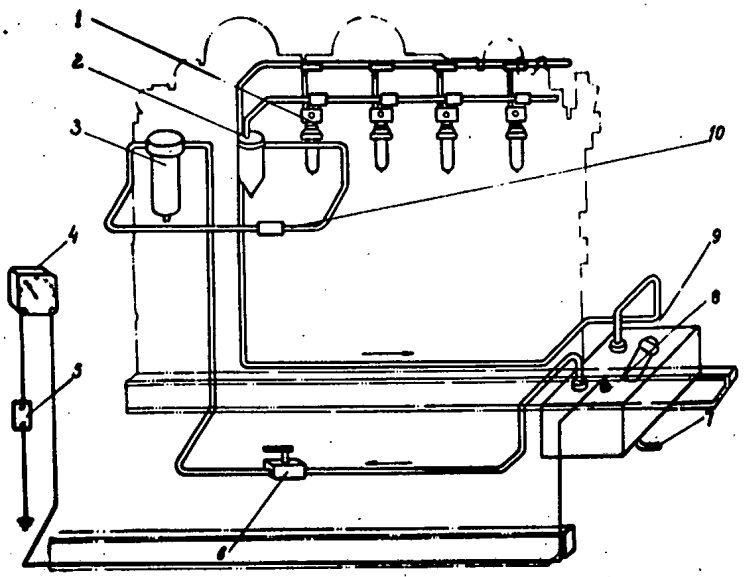

Fig. 7. Fuel feed system diagram:

1. Pump-atomizer
2. Fine filter
3. Coarse filter
4. Fuel level indicator
5. Storage battery
6. Disconnecting cock
7. Fuel drain
8. Fuel level indicator pickup
9. Tank
10. Fuel pump

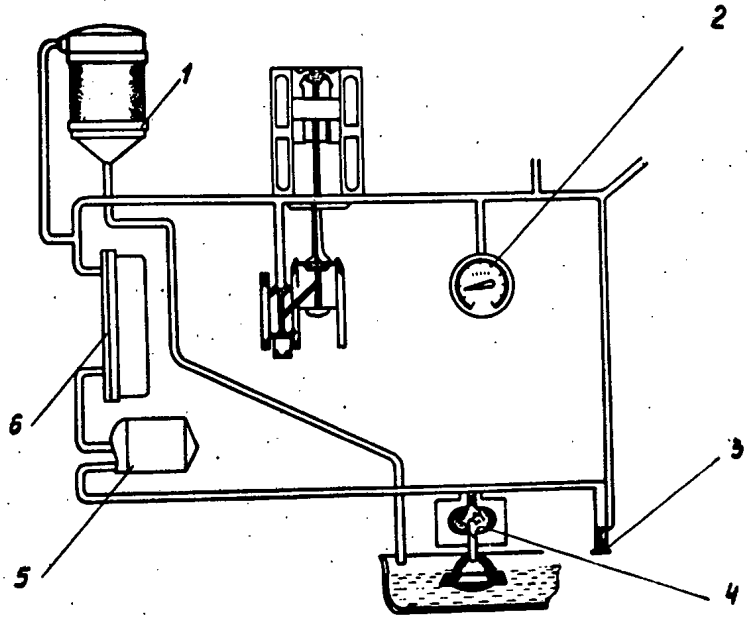

Fig. 8. Lubrication system diagram:

1. Fine filter
2. Pressure gauge
3. By-pass valve
4. Oil pump
5. Coarse filter
6. Oil radiator

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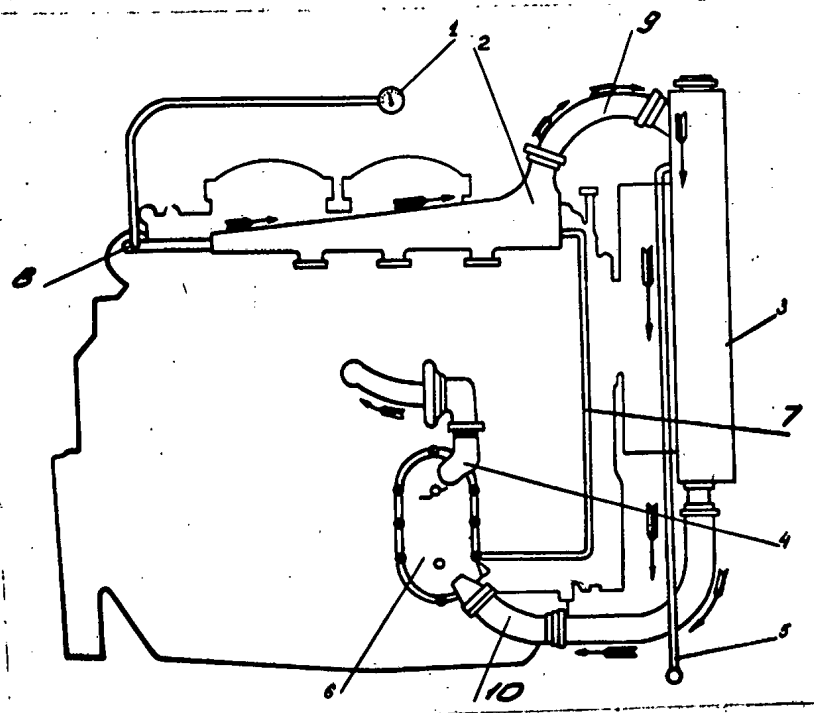

Fig. 9. Cooling system diagram:

1. Water thermostat
2. Thermostat
3. Radiator
4. Water pump
5. Steam delivery tube
6. Water-oil radiator

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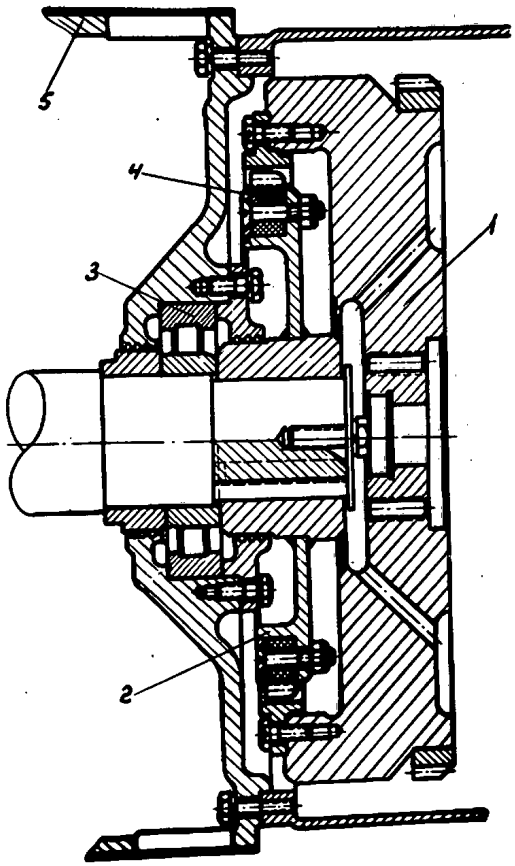

Fig. 10. Connection coupling:

1. Flywheel
2. Coupling
3. Bearing
4. Textolite toothed rim
5. Generator switchboard

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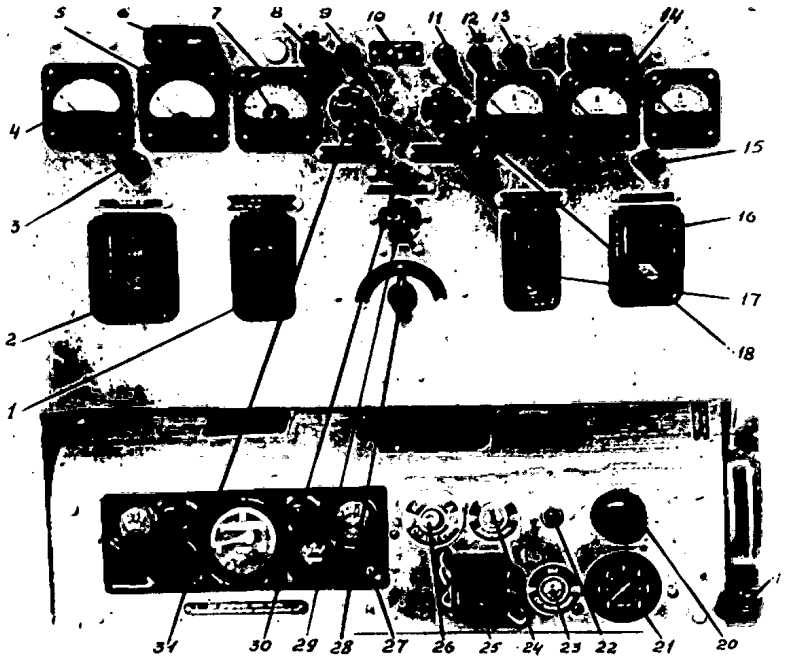

Fig.11. Switchboard for unit with four leads and engine control board:

1. Automatic circuit breaker for line № 2 ($АВ_2$)
2. Automatic circuit breaker for line № 1 ($АВ_1$)
3. Line signal lamp ($ЛС_3$)
4. A.C. voltmeter
5. Frequency meter
6. Two illumination lamps ($ЛН_1$, $ЛН_2$)
7. Kilowattmeter
8. Fuse ($ПР_5$)
9. Fuse ($ПР_4$)
10. Switch for lighting changeover from storage battery to generator ($ПК_1$)
11. Fuse ($ПР_3$)
12. Fuse ($ПР_2$)

50X1

I3. Fuse (ПР$_7$)

I4. Three a.c. ammeters

I5. Signal lamp for generator (ЛС$_4$)

I6. Setting automatic breaker (АВГ)

I7. Automatic circuit breaker No.3 (АВ$_3$)

I8. Changeover switch for voltmeter and frequ acy meter (ПК$_2$)

I9. Segment with engine r.p.m. control handle

20. Starting plunger pump

2I. Pressuregauge for the oil

22. Line signal lamp (ЛС$_5$)

23. Instrument switch (В$_I$)

24. Switch for starting coil with lamp

25. Fuse block (ПР$_{7,8}$)

26. Starting button (КП)

27. Set of instruments (УУТ, УТВ, А$_I$ tachometer and meter of unit work hours)

28. Voltage regulating rheostat (РР, Р)

29. Synchronizing switch (В$_2$)

30. Synchronizing lamp (ЛС$_3$)

3I. Duty changeover switch (ПК$_3$)

50X1

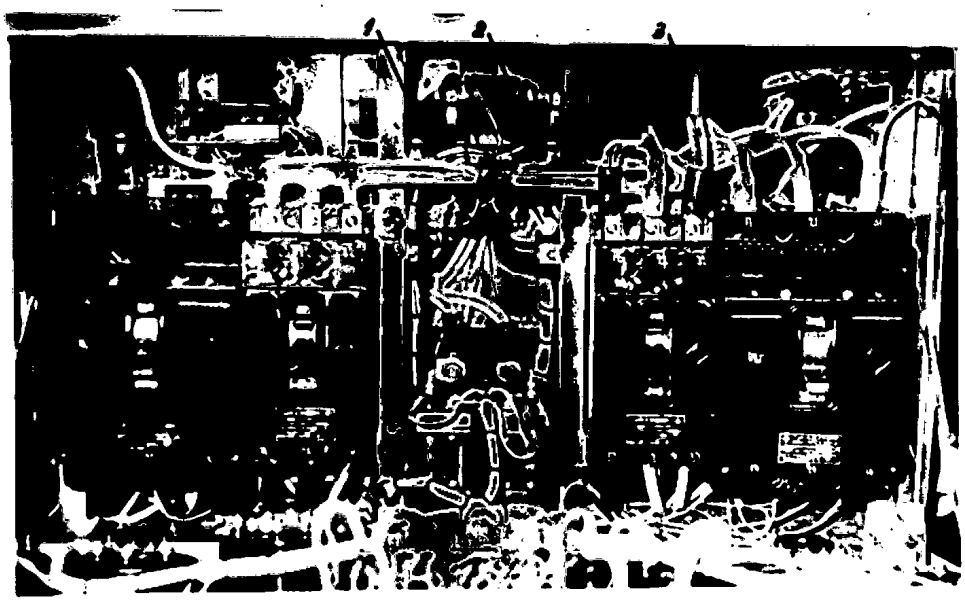

Fig. 12. Switchboard for unit with four leads (with board removed):

1. Resistance for adjusting БРН (R_1)
2. Resistance for adjusting БРН for parallel operation (R_2)
3. Additional resistance for wattmeter (RG_1)

50X1

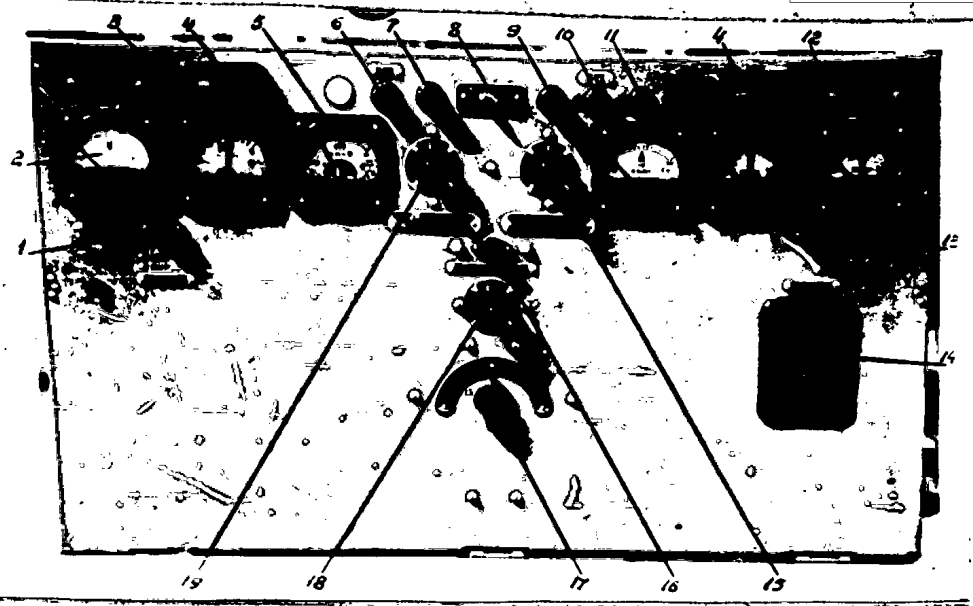

Fig. 13. Switchboard for unit with one lead:

1. Line signal lamp ($ЛС_3$)
2. A.C. voltmeter
3. Frequency meter
4. Two illumination lamps ($ЛН_1$, $ЛН_2$)
5. Kilowattmeter
6. Fuse ($ПР_5$)
7. Fuse ($ПР_4$)
8. Switch for lighting changeover from storage batteries to generator ($ПК_1$)
9. Fuse ($ПР_3$)
10. Fuse ($ПР_2$)
11. Fuse ($ПР_1$)
12. Three A.C. ammeters
13. Generator signal lamp ($ЛС_1$)
14. Setting automatic breaker
15. Changeover switch for voltmeter and frequency meter ($ПК_2$)
16. Synchronizing lamp ($ЛС_2$)
17. Voltage regulation rheostat (РГ, РУ)
18. Synchronizing switch ($В_2$)
19. Duty changeover switch ($ПК_3$)

50X1

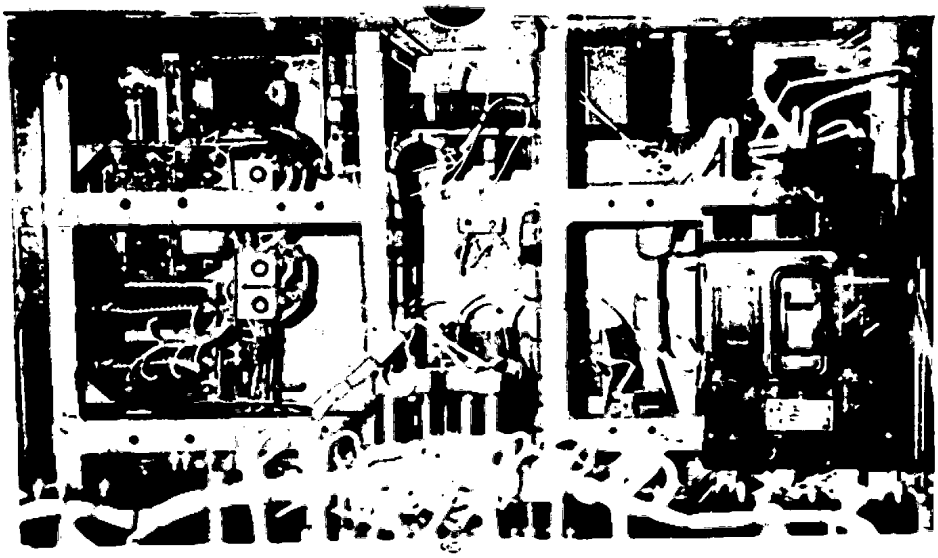

Fig. 14: Control switchboard for unit with single lead (with board removed)

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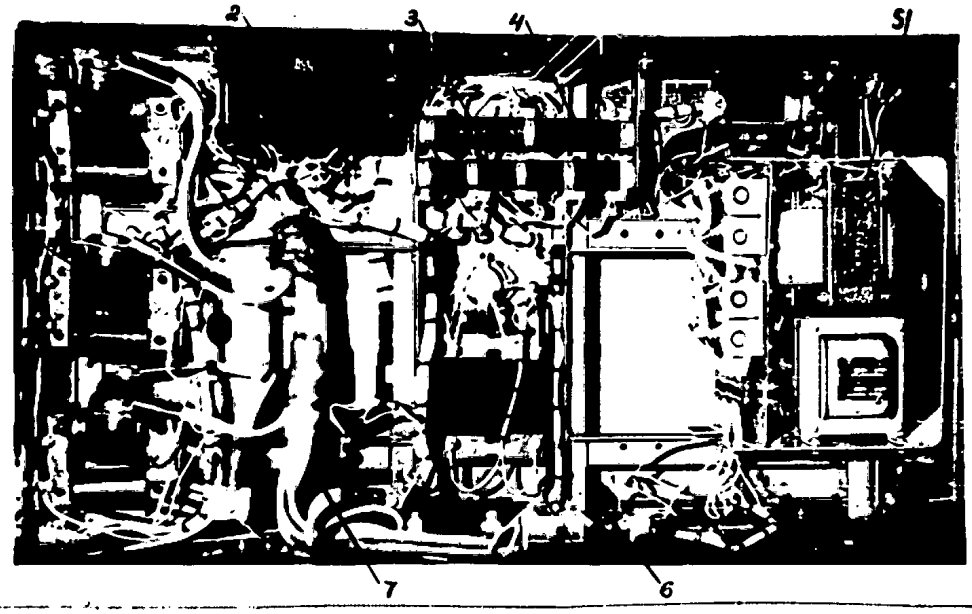

Fig. 15. Control switchboard for unit with single lead fro.. the side of load connection (with board removed)

1. Three current transformers (Tp_1, Tp_2, Tp_3)
2. Frequency meter extension (ДУЧ)
3. Resistance for adjusting voltage regulator block БРН for parallel working (R_2)
4. Resistance for adjusting voltage regulator block БРН (R_1)
5. Voltage regulator block (БРН)
6. Terminal board ($ПЗ_I$)
7. Current transformer for parallel operation (Tp_4).

50X1

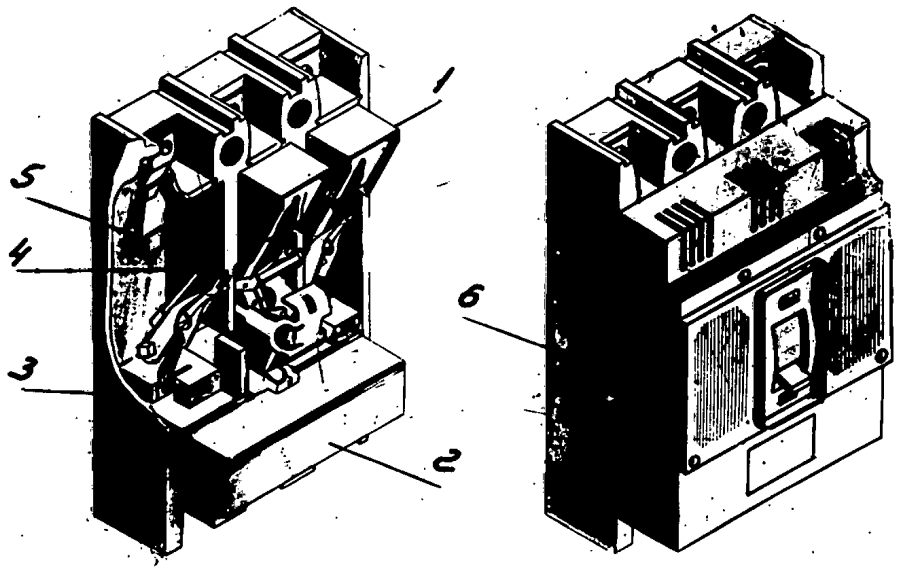

Fig. 16. Setting automatic breaker with cover removed:

1. Arc-chute chamber
2. Trip
3. Circuit breaker frame
4. Movable contact
5. Stationary contact
6. Breaker cover

50X1

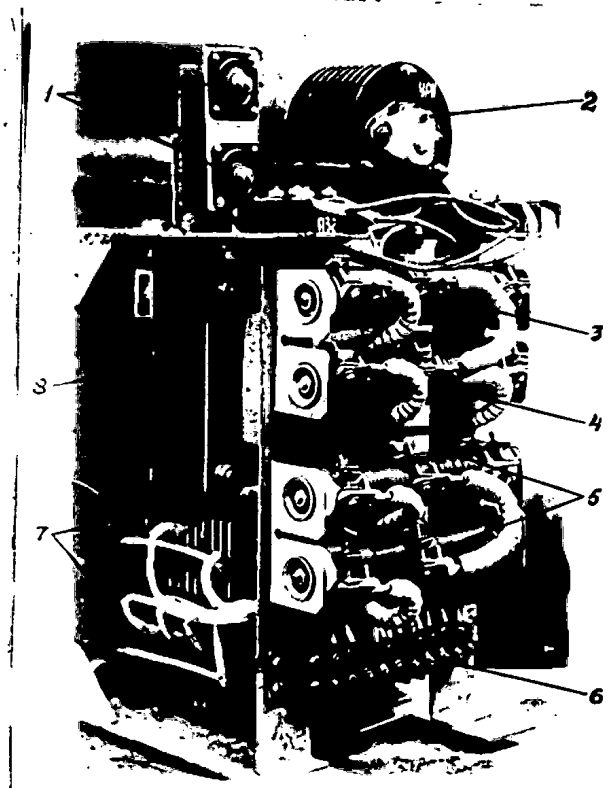

Fig. 17. Voltage regulator block (BPH) with cover removed:

1. Shock absorbers
2. Carbon regulators UPH-423
3. Resistor R_3
4. Resistor R_4
5. Resistor R_5
6. Terminal board
7. Selenium rectifier (block)
8. Stabilizing transformer (TP_6)

50X1

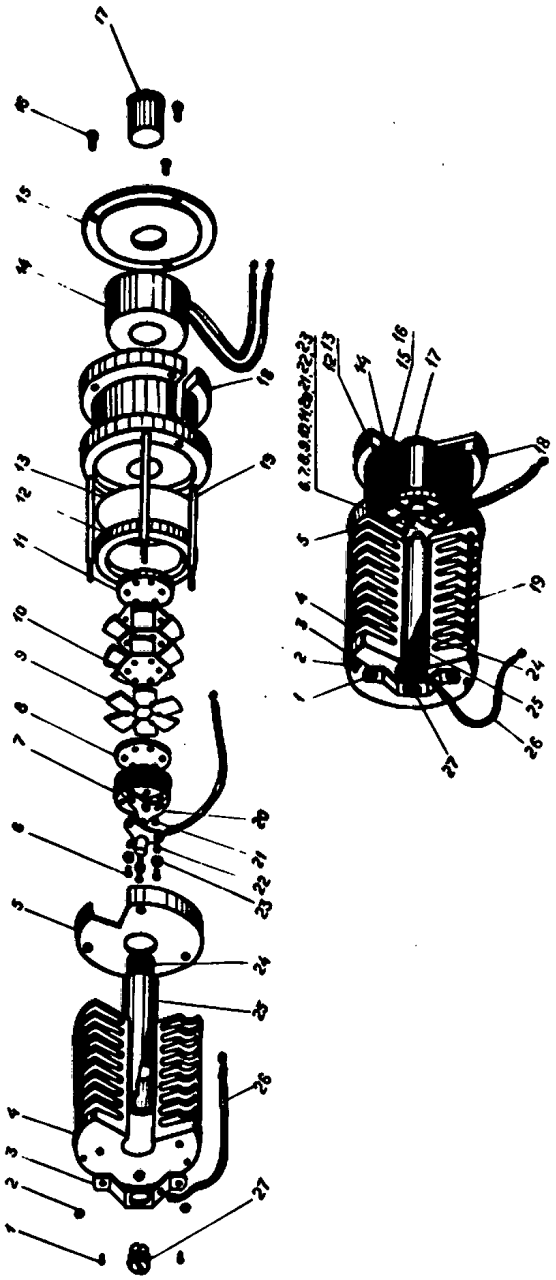

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Fig. 18. Carbon voltage regulator in cross-section:

1. Screw	2	15. Magnetic circuit base	1
2. Nut	3	16. Screw	3
3. Clamp	1	17. Core	1
4. Frame	1	18. Magnet circuit	1
5. Cap	1	19. Tie rod	3
6. Screw	3	20. Contact plate	2
7. Gasket	4	21. Screw	3
8. Gasket	1	22. Porcelain gasket	3
9. Spring	3	23. Mica gasket	3
10. Plate	3	24. Carbon pile	1
11. Plate	1	25. Porcelain tube	1
12. Support ring	1	26. Conductor	4
13. Disk	1	27. Clamping screw	1
14. Coil	1		

50X1

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1 SCHEMATIC CIRCUIT DIAGRAM

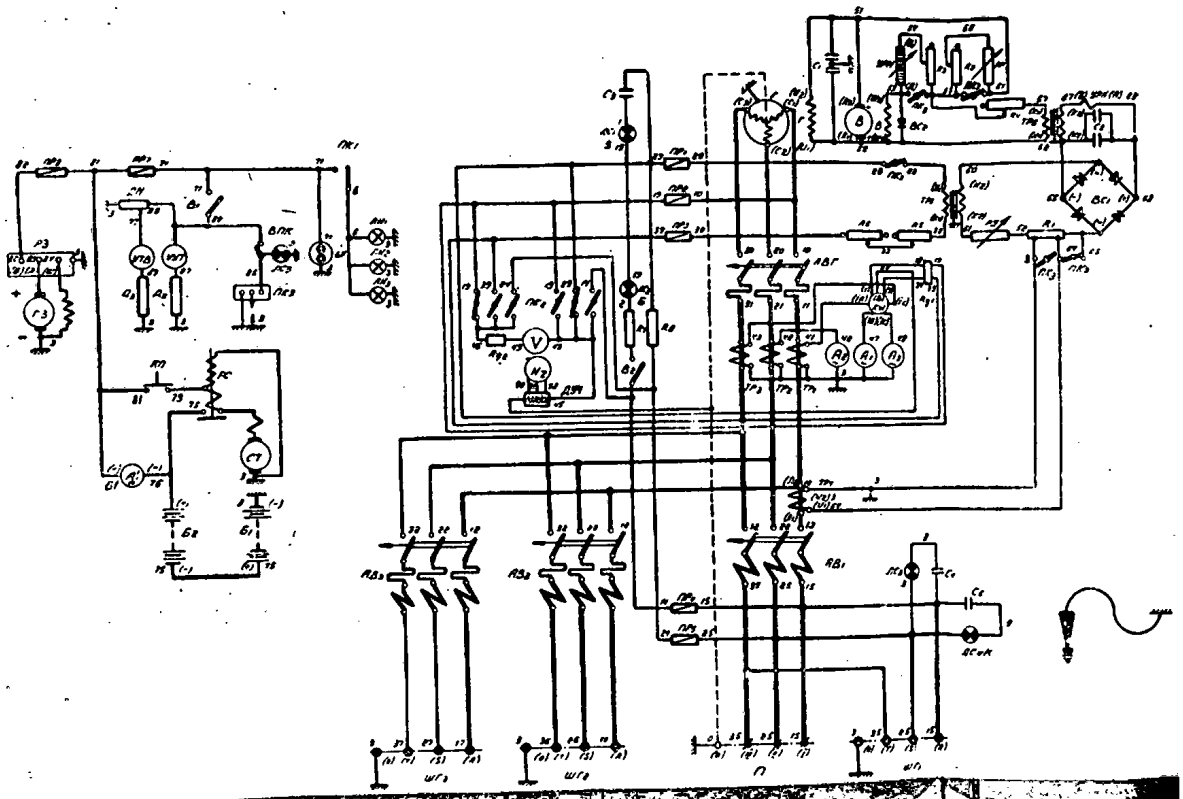
ОДК 354.577

2 Feeder No.

3 50% of power-unit output

4 (Reserve)

ОДК 354.577



50X1

Symbol on circuit diagram	Name	Type or design-ation	Technical data	Notes	Quan-tity
AB_1	Air circuit breaker, three-pole a.c., for front connection	A 3124	With electro-magnetic overcurrent, settings from 110 a up to 600 a		1
AB_2, AB_3	Air circuit breaker, three-pole a.c. for front connection	A-3114/1	With combination overcurrent for 32 a		2
ABT	Air circuit breaker, three-pole a.c., for front connection	A-3124	With thermal overload relay rated for 55 a		1
A_1, A_2, A_3	A.c. ammeter	8-421	0-75 a scale		3
B	Exciter			Part of generator set	1
B_2	Packet-type switch	ПКІ-10	380v, 6 a		1
BC_1, BC_2	Selenium rectifier	ABC-40-60			2
Г	Generator	ДГС-91/4-ЩФ2	400v, 3.5kva, 50c/s		1
ДУЧ	Auxiliary unit for frequency	Д8Ч/3		Part of frequency meter set	1
$ЛС_1$ through $ЛС_4$	Signal lamp	МН-17	26v, 0.12a		4
$ПК_2$	Voltmeter and frequency meter selector switch	ПП 10/СП7	10 a		1
$ПК_3$	Operation selector switch	ПП10/СП6	10 a		1
$ПР_1$ through $ПР_5$	Fuse	ПК-45-5	500v, 5 a		5
П	Terminal panel	6ДК.267.299			1
РР	Voltage adjusting rheostat	6ДК.274.051	Resist. 63 ohms		1
РУ			Resist. 110 ohms		

Symbol on circuit diagram	Name	Type or design-ation	Technical data	Notes	Qu-ty
TP_1, TP_2, TP_3	Current transformer (instrument)	TKM-05	75/5 a		3
TP_4	Current transformer (parallel operation control)	TMP	100/1 a		1
TP_5	Transformer (voltage adjusting circuit)	6AK.174.012	230v/77v		1
TP_6	Stabilizing transformer	6AK.174.014	60v		1
VH	Voltage regulator (carbon pile)	VPH-423	60 w		1
[illegible]	Plug socket	SAK.573.035	4x60a-380v		3
C_1	Capacitor		2x0.5mfd ±20%	With generator set	1
C_2	Capacitor	MBGCh-2-200-A-10-11	10mfd, 200 v		2
C_3 through C_5	Capacitor	MBGCh-2-600-A-1-11	1mfd, 600 v		3
Hz	Frequency meter	D4	45 to 55c/s		1
R_1	Resistor	6AK.273.046	47±10% ohms		1
R_2	Resistor	6AK.273.045	10±10% ohms		1
R_3	Resistor	6AK.273.076	6±10% ohms		1
R_4	Resistor	6AK.273.074	65±10% ohms		1
R_5	Resistor	6AK.273.072	2700±10% ohms		2
R_7	Resistor	PEV-15	3300 ohms		1
R_8	Resistor	PEV-15	3600 ohms		1
Rq_1	Instrument multiplier-resistor for wattmeter	D-700	380 v	Furnished with voltmeter	1
Rq_2	Instrument multiplier-resistor for	P-102		Furnished with voltmeter	1

50X1

Symbol on circuit diagram	Name	Type or designation	Technical data	Notes	Quantity
V	A.c. voltmeter	6-421	0-460v scale		1
P_W	Wattmeter	P-700	10-0-40 kw scale, 380v		1
A_1	D.c. ammeter		20-0-20 a scale		1
B_1, B_2	Storage battery	6-CT3H-140 a			2
B_1	Instrument panel switch	BK-26			1
ВПК	Starting-coil switch	BK-26			1
Г5	D.c. generator	Г-106	24v, 250w		1
ДН	Voltage divider	СД-250			1
$Д_2$	Fuel-level transmitter-indicator	ТМ3			1
$Д_3$	Water-temperature transmitter-indicator				1
КП	Start button	СВВ-4001			1
$ЛН_1$, $ЛН_2$, $ЛН_3$	Incandescent lamp	СМ-16	26v, 15 w		3
$ЛС_5$	Signal lamp	А 28-1			1
$ПР_7$	Fuse		10 a		1
$ПР_8$	Fuse		20 a		1
$ПК_1$	Lighting switch	87-К	15 a, 28 v		1
ПК3	Ignition starting coil	Б-200			1
Р3	Relay-regulator	РР-106			1
РС	Starter relay			Furnished with starter	1
СТ	Starter complete with switch-in relay	СТ-26			1
УТВ	Water-temperature indicator				1
УУТ	Fuel-level indicator				1
ШР	Plug socket	47-К	6 a, 28 v		1