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NUMBER..ГПК-59.....

T-1052

SHEET.....1.....OF.....196.....

SUPERSEDES..

## CONVENTIONAL INDEX.

84/084711 - 03 - C - 40039 КД .

ALBUM No. A - 1.

TECHNICAL DOCUMENT FOR  
ARTICLE : -ГПК-59TECHNICAL SPECIFICATION,  
TECHNICAL DESCRIPTION  
AND  
OPERATING AND MAINTENANCE  
INSTRUCTIONS  
TOTAL SHEETS :196.

MASTER COPY

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L I S T

ГПК-59

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ГПК-59

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Electrical gyro directional

ГПК - 59

Technical description

and

Operating and Maintenance Instructions

127 TO.

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PART I

Technical Description.

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PART I

Technical Description.

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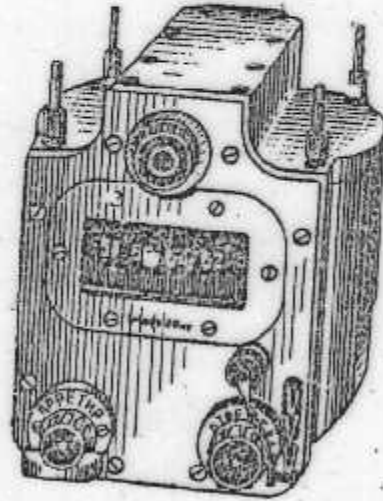


FIG. 1. DIRECTIONAL GYRO ГПК-59.

I. INTRODUCTION

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The present technical description is intended for study of design and operation of directional gyro ГНК-59 and is a guide in operating and maintenance. The technical description includes basic information required for full-scope usage of technical abilities of the device.

Operating and maintenance instructions specify instructions on mounting, maintenance and operation of directional gyro.

3. WORKING PRINCIPLE

Before checking, acceptance, mounting or working with directional gyro the maintenance crew should familiarise with the technical description and operating and maintenance instructions.

The gimbal suspension composed of two frames 2 and 3 (fig.2) is used.

2. PURPOSE AND TECHNICAL DATA

Gyro rotates freely around axis X-X, called as spinning axis or the main gyro axis.

Electrical directional gyro (Fig.1) is intended to assist in driving ground vehicles in conditions of adverse orientation. The outer frame together with the inner one and the rotor can rotate around axis Z-Z with respect to the body.

Axes X-X, Basic Technical Data are mutually perpendicular and cross at the same stationary point O.

1. Supply Voltage:

Three-phase AC  $36 \pm 4V$ , 400. HZ  $\pm 10\%$   
DC  $26V \pm 15\%$

2. Consumed Current:

AC (est)  $0.3A$  maximum in each phase.  
DC  $0.15A$  maximum.

3. Stability of Readings:

Drift of the card on horizontal vibrating base  $20$  divisions of goniometer, maximum for 30 minutes.  
Drift of the card when the vehicle is in motion  $40$  divisions of goniometer, maximum for 30 minutes.

4. Continuous operation

$10$  to  $12$  hours followed by a  $2.5$  hour break.

5. Working temperature range

$\pm 50^{\circ}C$ .

6. Weight of the directional gyro

$2200$  g, maximum.

7. Overall dimensions

$130 \times 122 \times 237$  mm.

Thus, the directional gyro helps not only to keep the direction unchanged but also to turn the vehicle to a required angle.

## 3. WORKING PRINCIPLE

Operation of ~~the~~ the directional gyro is based on use of properties of swiftly rotating rotor (gyro) one point of which is stationary. To provide free rotation of the gyro around the rest point carbon suspension composed of two frames 2 and 3 (fig.2) is used.

Gyro rotor 1 rotates with high angular velocity around axis X-X, called as spinning axis or the main gyro axis. The main axis is set in the inner frame 2 which rotates around axis Y-Y with respect to the outer frame 3.

The outer frame together with the inner one and the rotor can rotate around axis Z-Z with respect to the body.

Axes X-X, Y-Y and Z-Z are mutually perpendicular and cross at the same stationary point O.

The gimbal suspension provides free rotation of the gyro rotor with respect to the three axes. That is why the gyro is called gyro with three degrees of freedom. The gyro is called balanced or astatic type if its center of gravity coincides with the point where axes of the gimbal suspension cross.

The initial (set) position of the astatic gyro main axle remains unchanged in the universe. But with respect to the landmarks the gyro main axle turns. The speed of the turn with respect to the landmarks depends on the latitude and direction of the gyro main axle. This turn is caused by the earth rotation around its axis.

To convert the free astatic gyro into direction stabilizer with respect to the landmarks, it is necessary to compensate the effects of earth rotation, i.e., to eliminate a seeming turn of the gyro main axle around the vertical axle (in azimuth) and to keep it in the plane of the horizon. These problems are solved with azimuth horizon correcting units. The functioning of these units is based on the ability of the gyro to process under external effects.

After compensating the effects of earth daily rotation, the gyro main axle is stationary with respect to the landmarks. When the body turns with the vehicle the readings of the gyro-scale change. The difference between readings before and after the turn gives the angle of deviation of vehicle from its initial moving direction.

Thus, the directional gyro helps not only to keep the direction unchanged but also to turn the vehicle to a required angle.



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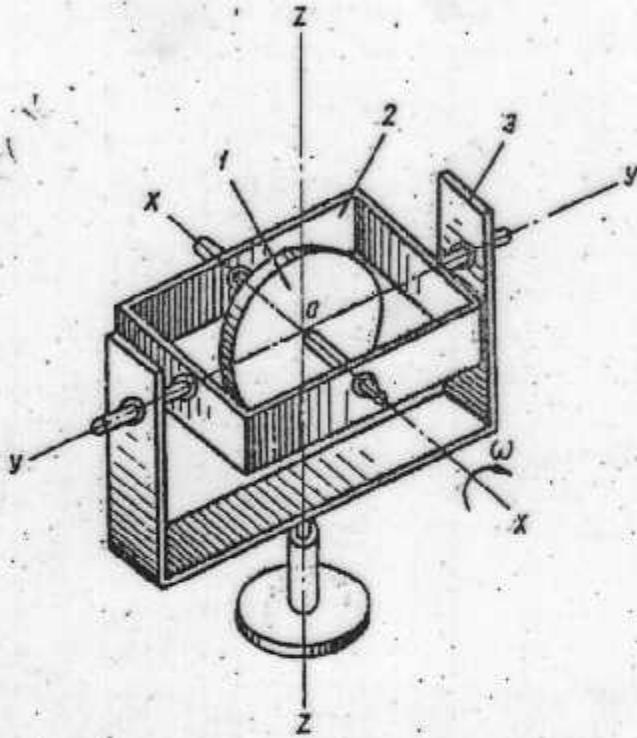


FIG. 2. DIAGRAM OF THE GYRO IN GIMBAL SUSPESION.

1. Rotor.    2, 3. Gimbal Frame.

4. DESIGN AND OPERATION

4.1. Design of the directional gyro.

xx Basic components of the gyro:

1. Gimbal suspension comprising gyromotor, gimbal inner and outer frames.
2. Body with caging mechanism.
3. Cover with contacts unit.
4. Front wall with dial lamp holder.

Gyromotor 10 (fig.3) housed in the body which serves as the inner frame of the gimbal suspension unit is known as gyro unit and can turn around the horizontal axle with respect to the outer frame of the gimbal suspension by  $\pm 45^\circ$ . The outer frame of the gimbal suspension unit 8 has a free rotation angle around the vertical axle with respect to body 29 of the instrument.

On the axle of the gyro unit body the inner races of Ball bearings 24 are set secured with nuts 23. The outer races are inserted inside bushings 25 with corrugated band 21. The Bushings 25 are threaded which helps to shift the gyro unit inside the outer frame 8 and provides axial play of the gyro unit from 0.02 to 0.04mm. After adjusting the play, bushings 25 are secured with locknuts 20. The ball bearings are protected from dust by washers 22. The lower axle of the gimbal suspension unit (see fig.4) bears against radial thrust bearing 44.

The inner race of the ball bearing is fixed on the axle with nuts 45 and the external race is set in the threaded plug 47 with corrugated band 43 and spring washer 46 which serves as a shock absorber under impact overload.

The upper axle of the gimbal suspension rotates in ball bearing 15 (see fig.3) set in threaded bushing 11 with corrugated band 16 and secured with lock ring 14. To protect the bearing from dust, Protective washer 13 is provided. The corrugated bands on which outer races of the bearing are set ~~the bands~~ uniformly distribute the load from supports along the entire circumference of the races and serve as shock absorbers at impacts.

The axial play of the gimbal unit is adjusted by threaded bushing 11 and plug 47 (see fig.4) and is set within 0.05 to 0.1mm. After adjustment, threaded bushing 11 (see fig.3) is locked with nut 12 and plug 17 (see fig.4) with nut 42.

Into the gyro unit body which serves as inner frame for the gimbal unit there is turned in a balancing screw 39 with a weight, by shifting of which azimuth correction is performed.

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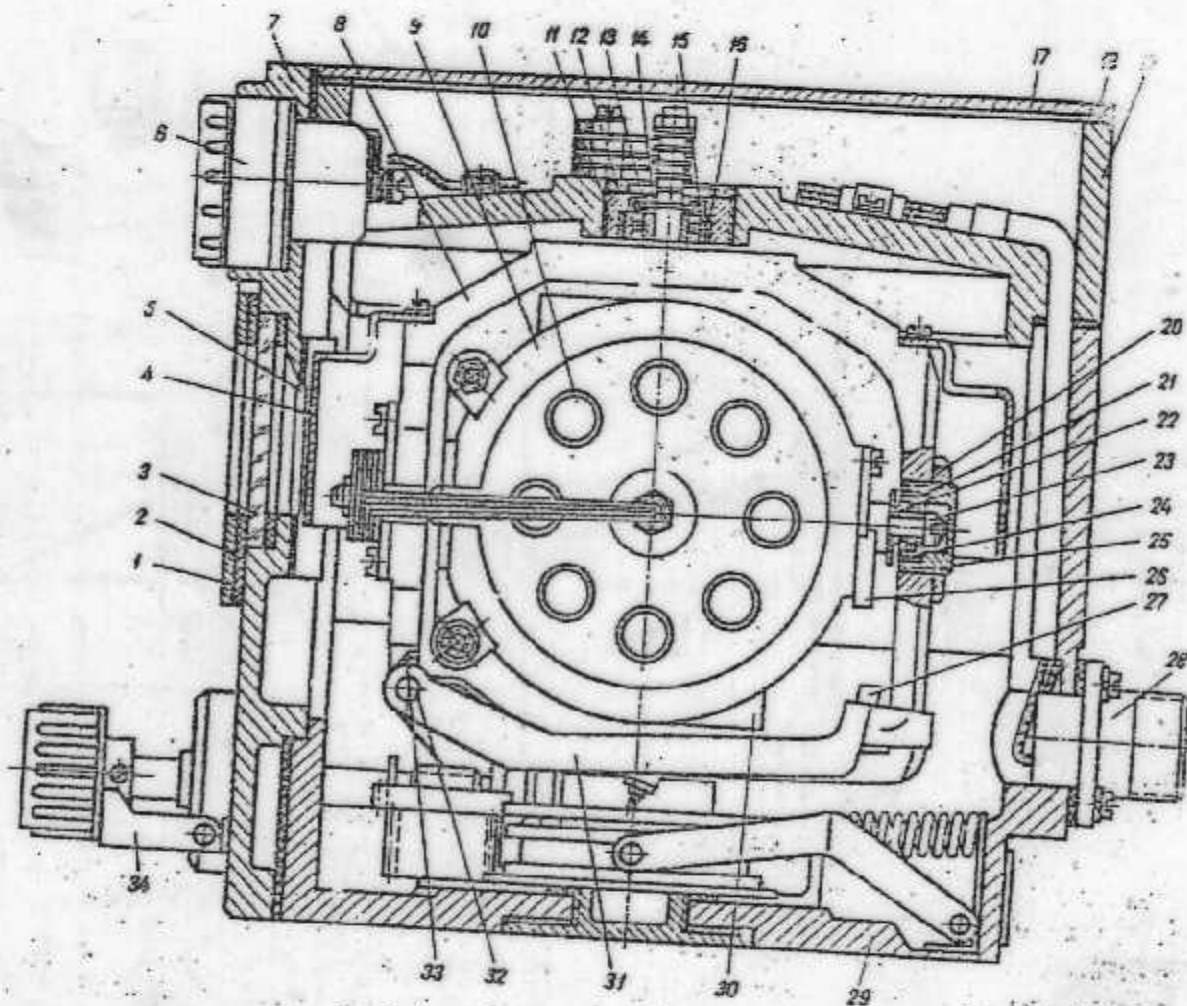
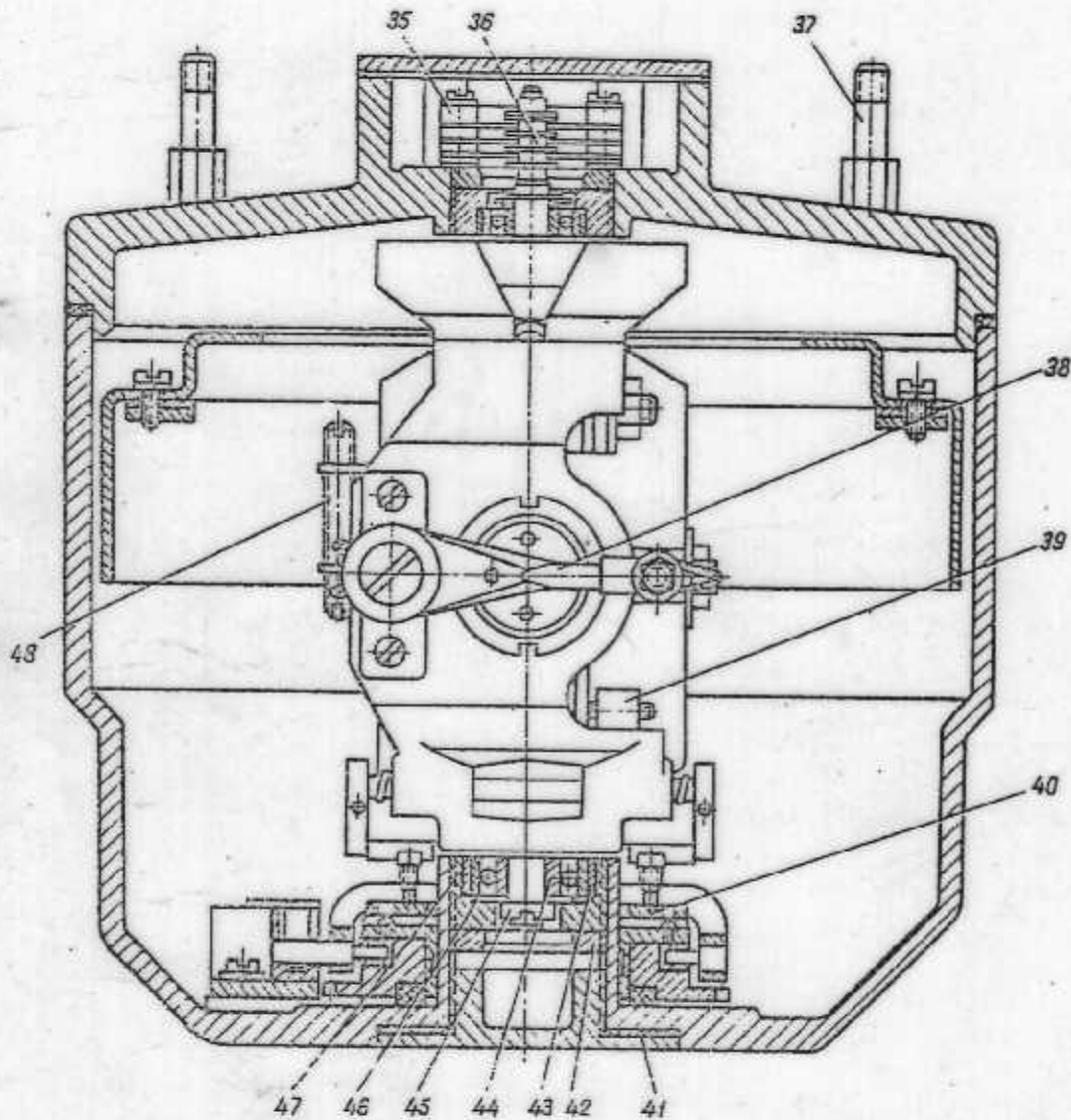


FIG. 3 GENERAL VIEW OF THE DIRECTIONAL GYRO  
(Longitudinal Cross Section)

1. Cover. 2. Gasket. 3. Glass. 4. Cord. 5. Index Plate. 6. Illumination lamp holder. 7. Front wall. 8. Frame 9. Gyromotor body. 10. Gyromotor. 11. Threaded bushing. 12. Nut. 13. Protective washer. 14. Lock ring. 15. Ball bearing. 16. Corrugated band. 17. Cover. 18. Gasket. 19. Cover. 20. Lock nut. 21. Corrugated band. 22. Protective Washer. 23. Nut. 24. Ball bearing 25. Threaded bushing 26. Cam. 27. Cage frame for tooth. 28. Plug Connector. 29. Directional Gyro body. 30. Nozzle. 31. Cage frame. 32. Cage frame axle. 33. Spring. 34. Retainer.

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**FIG. 4** GENERAL VIEW OF THE DIRECTIONAL GYRO  
(Cross Section)

- 35. Contact group. 36. Connector. 37. Pins. 38. Low moment current carrier.
- 39. Balancing Screw. 40. Caging. 41. Plug. 42. Nut. 43. Corrugated band.
- 44. Ball bearing. 45. Nut. 46. Spring washer. 47. Threaded plug. 48. Balancing Screw.

Gyro card <sup>4</sup> (see fig.3) is fastened to the gimbal outer frame. This card is paid out into 300 divisions. The value of each division is 20 small divisions of the goniometer. Numbering of scale in every two big divisions of the goniometer. On the scale, there are indicated the parts of the world N.S.F.U. The N-S direction coincides with the direction of the gyro main axle.

The front wall with a window and dial lampholder 6 is fastened to the gyro body with eight screws. The window is covered with glass 3 secured with cover 1 and rubber gasket 2. To read the device an index plate 5 is fastened onto the front wall. Power to this device is supplied through a connector 28, type 2PMTX/1854W5E2. After assembly and adjustment, this device is closed with cover 17 and plug 41 (see fig.4) with rubber washers.

#### 4.2. Gyromotor ГМА-4П

The gyromotor (fig.5) is executed as an inverted asynchronous electric motor (the stator is accommodated inside the rotor 2). Power to this motor is supplied from a 3-phase, 36V A.C., 400 HZ. Source such execution (fig.5) permits to obtain maximum inertia torque of rotor within the ~~specified~~ <sup>xxx</sup> specified overall dimensions, which provide greater stability of the directional gyro to the environmental effects.

When AC passes through the three-phase stator windings, a rotating magnetic field is developed. Rotation speed of this field is equal to 24000 rpm. Rotor 1 (see fig.6) of the electric motor is a steel <sup>fly</sup> wheel inside which a packet 2 of the rotor is pressed in. This packet has a short-circuit winding like a "squirrel cage", consisting of 19 Aluminium rods 3 inter-~~locked~~ locked between themselves from sides Aluminium rings 10, <sup>lock</sup> When the rotating magnetic field of the stator crosses the rods of rotor windings, EMF is ~~induced~~ induced in them and electric current flows.

The rotor starts rotating as a result of interaction of magnetic fields created by currents passing through from the windings of the stator and rotor.

The speed of rotation of the rotor is within 21500 to 23000 rpm. Inner races 6 of the ball bearings are connected to the gyro motor through flanges 4. The outer races 5 of the ball bearings are housed inside cups 9 and 13, press fit on the stationary axle 7 of stator 11.

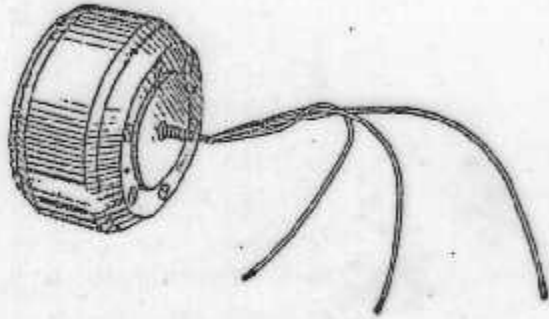


FIG. 5. GYROMOTOR ГМА-411.

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Radial-thrust ball bearings of high accuracy class are used in gyromotor and are lubricated with frost-resistant grease, grade OK5 -122-7.

Accommodated in cups 9 and 13 are lubricating gaskets 8, containing grease and spring washer protecting the bearings from jamming due to <sup>different</sup> heat expansion of parts while operating under low and high temperature conditions.

4.3. AZIMUTH CORRECTION

Azimuth correction performed with the help of correcting device is intended ~~maxim~~ to compensate the drift of directional gyro main axle with respect to the landmarks. For this purpose to the inner frame of the directional gyro with respect to axis Y-Y, an external torque of such value and direction is applied that make the directional gyro process ground the vertical axle in the direction of earth rotation with angular velocity equal to the angular velocity of the seeming, turn of gyro main axle in horizontal plane at a given latitude. This ~~give~~ torque is developed by shifting the balancing screw 39 (see fig.4) in the direction of axis X-X.

Adjustment of the device for operation at a given latitude is called as latitude balancing which compensates precession movement of the directional gyro caused by different permanent acting moments (for example, the gravity moment of gyro rotor, when the center of its gravity displaces from the cross point of axes X-X, Y-Y, Z-Z, due to prolonged functioning of device), change in temperature or moment due to friction force in the bearings.

The adjustment procedure is specified in the second part.

4.4. BLAST CORRECTION.

Blast correction performed with the help of a horizontal correction device is intended to keep the gyro main axle immovable in horizontal to plane.

In the directional gyro, the interframe correction is used to provide perpendicularity of the main axle with respect to the plane of external frame. To keep the axle perpendicular an air-jet interframe corrector is used. Formation of the air-jet required for correction is done with the help of two diametrically located recesses on the inner surface of the gyrounit body. The recesses end in nozzles 30 (fig.3). The air stalling parts of the nozzles project from the rotor at a distance of 0.03 to 0.2mm. While rotating the gyromotor rotor carries along the adjacent marginal layer of air which stalls from the surface of rotor by the nozzle air removing parts the jet of air comes out through the nozzles under a pressure



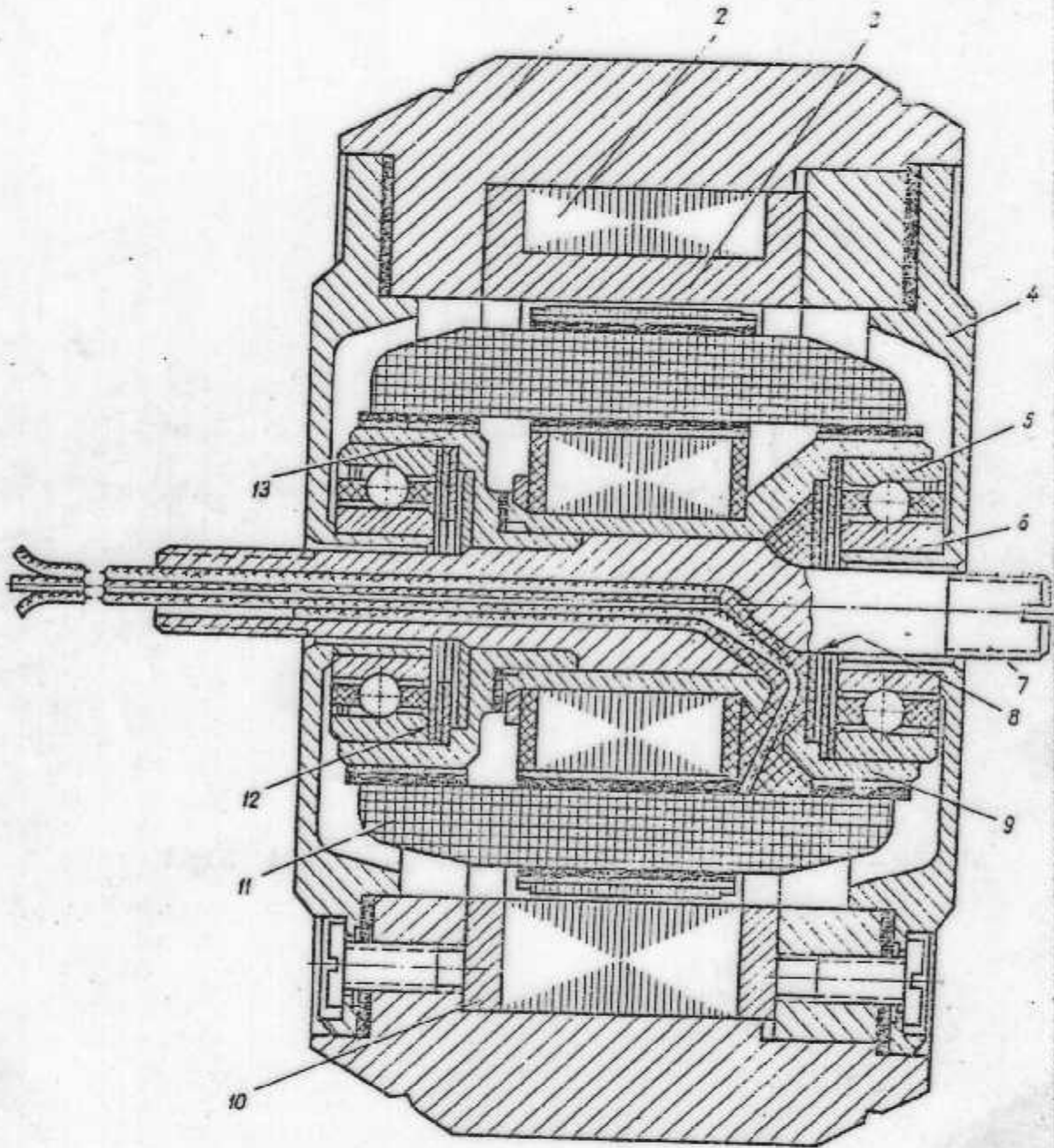


Fig. 6. DESIGN OF THE GYROMETER.

- 1. Rotor. 2. Rotor packet. 3. Winding rod. 4. Flange.
- 5. Outer race of the bearing. 6. Inner face of the bearing.
- 7. stator axle 8. Lubricating gasket. 9. Bearing Cup. 10. Ring.
- 11. stator. 12. Spring Washer. 13. Bearing Cup.

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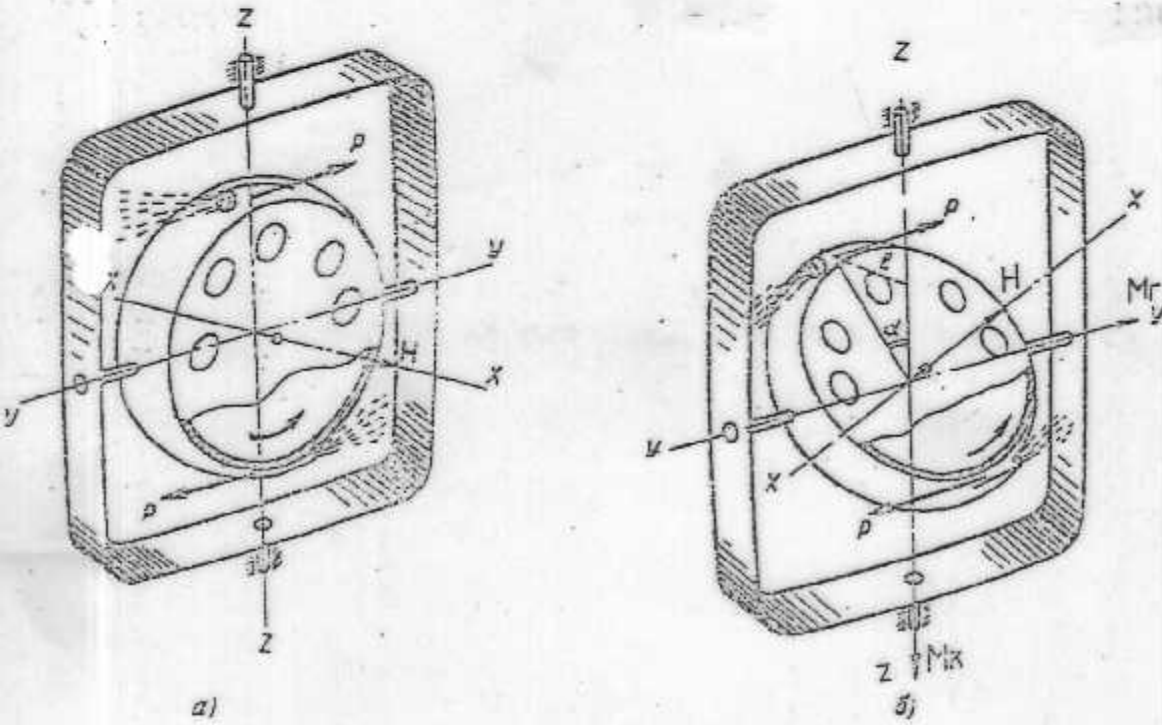


Fig. 7. Blast Correction diagram.

of about 80mm H<sub>2</sub>O, operating reactive force P directed as shown in fig.7.

If the main axle of directional gyro is perpendicular to the plane of outer frame, both nozzles lay in the plane of the outer frame and in force P (fig.7a) and therefore fail to develop a torque around the vertical axle of the gimbal. When the perpendicularity of axles of the gimbal gets disturbed (when the inner frame tilts), forces P shift from the outer frame plane and react with respect to the vertical axle at a distance of (fig.7b) developing external torque at the outer frame.

$$M_k = 2P \cdot l = 2P \cdot R \cdot \sin \alpha$$

Where

R - Distance between gyromotor spin-axis and nozzle axis;

$\alpha$  - Tilting angle of the inner frame.

Under the action of angular momentum H and correction torque  $M_k$ , the gyroscopic moment  $M_g$  is developed which tries to align the vector of angular momentum H with the vector  $M_k$  over the shortest distance (due to this moment the inner frame starts precessing towards the side opposite to the tilting). The precession continues till the acting arm of force P is equal to zero (when the nozzles are in the plane of the outer frame).

When the inner frame tilts in opposite direction, the driving torque at the outer frame changes its sign due to force P and the precession takes place in the reverse direction.

The Blast Correction has a dead zone, the value of which is determined by the friction moment in the gyromotor bearings. The tilting angle of the gyromotor at which  $M_k$  moment cannot restore its initial position is known as the dead zone. The dead zone of directional gyro blast correction is within 1°.

#### 4.5. CAGING MECHANISM

The caging mechanism is intended to cage the gimbal suspension and to turn the gyro card in the required direction.

To cage the gyro and to set the card in the required direction, it is necessary to push handle 1, (see fig.8) fixed on shaft 2 until stop. As a result, disc 3 having 20 holes along its circumference and fixed on shaft 2 engages with disc 4 in which two pins are press-fitted. Shaft 2 and connected to it slide block 6 move simultaneously, when the slide block moves, dog 8 of fork 10 of the cage slides along the edge of slide block 6. The cage fork rotates around its axis 11 and lifts the clutch with the aid of the dogs with blocks 9 fixed to the fork 10, which enter into the groove in the cage gear clutch, 13.

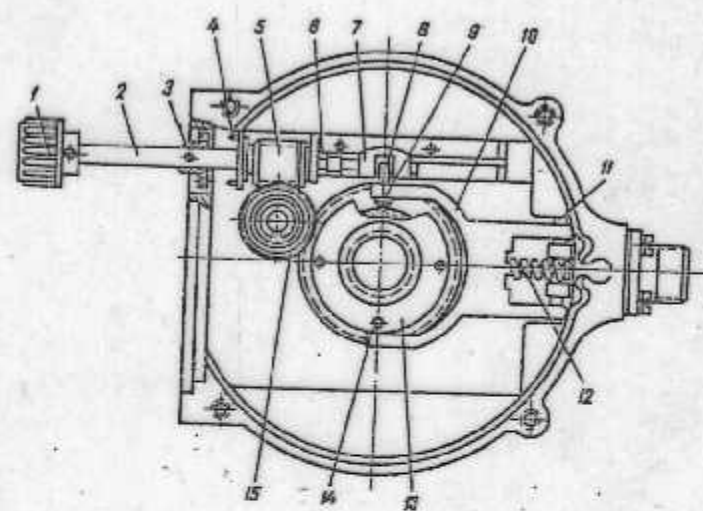


Fig. 8. BODY WITH CAGING MECHANISM.

- 1. Caging handle. 2. Shaft. 3. Disc with holes. 4. Disc with pin catchers. 5. worm. 6. slide block. 7. Latch. 8. Dog.
- 9. Block. 10. Cage fork. 11. Cage fork axle. 12. Spring.
- 13. Gear clutch. 14. Pin. 15. Worm type gear.

When the gear clutch moves upwards pins 14 press-fitted into it enter the holes of the disc with rings 40 (see fig.4). Thus, the outer gimbal frame is locked and the directional gyro is deprived of one degree of freedom.

When the cage clutch moves further up its upper butt end thrusts against the disc with rings # 40 and starts lifting it. Simultaneously, cage frame 31 pressed to the disc with posts by spring. Worm gear 15, coaxial cylindrical gear and cage gear clutch 13, to disc with rings 40 (see fig.4), which is meshed to gear clutch with pins 14. This disc is fixed to the outer gimbal frame.

Discaging of the directional gyro is performed by pulling the cage handle 1 (see fig.8) until stop. As a result disc 3 with holes gets released from disc 4 with pins. Slide block 6 moves together with handle 1 of the cage. As a result, the dog 8 of the cage fork appears above the groove of latch 7. and under the action of spring 12 falls down together with fork 10 and carries down the cage gear clutch 13. The latter <sup>disengages</sup> ~~is released~~ from the disc with rings 40 (see fig.4) and the outer gimbal frame gets freedom.

33 starts rotating around axis 32 (fig.3), rotating frames 31 by its tooth 27 presses upon cam 26 fastened to the gyromotor body 9. As a result, the gyromotor starts rotating and when the axis of the gyro is set perpendicular to the rotating axis of the outer gimbal frame, the tooth 27 of the cage frame enters the groove in the cam 26. Thus, the gyromotor cannot turn with respect to the outer gimbal frame, i.e., the inner gimbal frame gets locked and the gyro is deprived of its second degree of freedom.

The outer gimbal frame with the card fastened to it can be turned by the required angle by rotating handle 1 of the cage (see fig.8). The movement is transmitted through worm 5, connected to cage shaft 2 (as a result of engagement of discs 3 and 4), cage frame 31 (see fig.3) descends under the action of the spring 33 and its tooth 27 emerges from the groove in the cam 26 thus disengaging the gyromotor.

The control handle is fixed in two steady positions by retainer 34, which does not permit spontaneous caging and uncaging of the gyro.

The retainer mechanism consists of a clamp which is fastened to the axle of the oil seal body and kept in working position through two pushers with springs.

#### 4.6. ELECTRIC CIRCUIT

Converter - ПАГ-1Φ is used to supply power to the directional gyro in compliance with circuit diagram (fig.9).

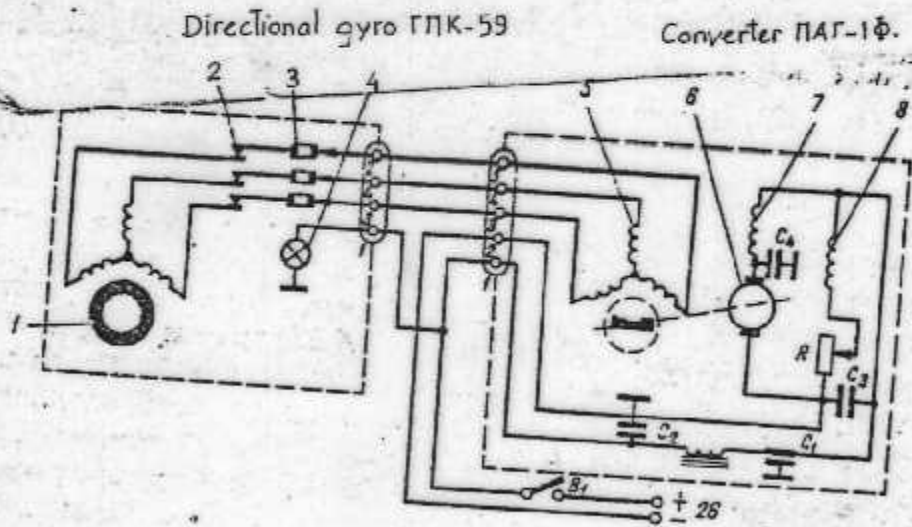


Fig 9. CONNECTION CIRCUIT DIAGRAM OF  
DIRECTIONAL GYRO ГПК-59 WITH  
CONVERTER ПАГ-1Ф

1. Gyromotor.
2. Low moment current carrier.
3. collector.
4. Illuminator.
5. Winding of generator- Converter.
6. Armature of the converter motor.
7. Series winding of the converter motor.
8. Shunt winding of the Converter motor.

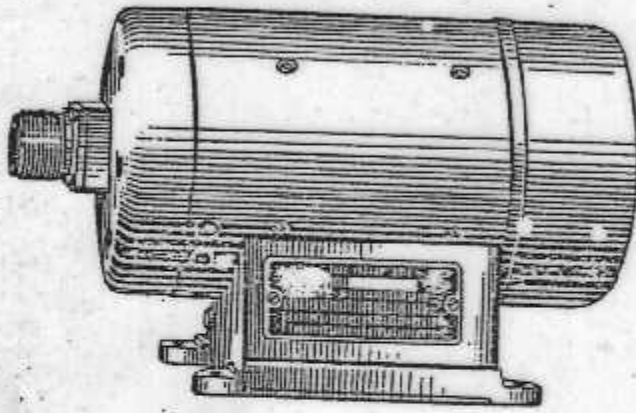


Fig. 10. CONVERTER ΠΑΓ-1Φ.

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The converter starts functioning when switch S1 is on. Voltage to the stator winding of the gyromotor is supplied from the converter generator through the plug connectors of the converter and gyro and current carriers on the axle of outer and inner frames. As a result, the rotor of gyromotor starts rotating. After 5 to 7 minutes, the gyromotor reaches rather high speed (21500 rpm, maximum at normal temperature). After this, the directional gyro may be uncaged.

Power to the outer gimbal frame is supplied through a fixed group of current feeding contacts 35 (see fig.4) and collector 36.

The group of fixed contacts 35 includes contact springs manufactured in the shape of resilient bronze plates to which brushes are welded. The plates are insulated from each other and from the body with gaskets and bushings made of insulating material. Collector 36 is mounted on the upper axle of the gimbal suspension. It comprises a ring holder and three slip-rings insulated from each other and from axle by textolite bushings and washers. Power to the gyrounit is supplied from the outer gimbal frame through low-moment current carriers 38 made as central point contacts.

The group of fixed current feeding contacts is mounted on the outer gimbal frame while the moving group - on a special bracket fastened to the gyrounit. Input and output contacts get in touch at the points arranged on the geometrical axis of rotation of the gyromotor. The accuracy is equal to  $\pm 0.05\text{mm}$ . Such a design permits to supply power to the gyrounit with insignificant friction torque.

The gyroscale is illuminated with a lamp housed in a transparent cap. Power to the positive 't' terminal is supplied through on board circuits and the other terminal is grounded to the gyro body.

#### 4.7. CONVERTER ПАГ-1Ф

The converter (fig.10) is designed to convert DC of on board main into three-phase AC required for feeding the directional gyro. The converter includes DC motor with compound excitation and 3 phase AC generator, the excitation of which is performed by a permanent magnet fastened on the shaft of the rotor. To eliminate radio-reception disturbances caused by the converter, a special filter is provided inside the converter having three-blocking and one by-passing capacitors and a choke. Adjusting resistor connected to the motor shunt circuit is placed at the base of the converter.



The adjusting resistor is intended to maintain required frequency and voltage of the generator when different loads are connected to the generator. When one directional gyro is connected to the converter, the yoke of adjusting resistor is set at mark 'ПР-1'.

To set the yoke of adjusting resistor to required position it is necessary to remove in advance the cover which closes the bottom of the converter base.

Connection of the converter to the DC circuit and of the directional gyro is performed through a 5-pin plug connector ШР20115ЭГ7.

Part II

Operating and Maintenance Instructions.

### 5. GENERAL INDICATIONS.

To operate the directional gyro observe the following rules:

1. The vehicle should not be in motion when the gyro is switched on or off.
2. The vehicle may start motion in ~~one~~<sup>five</sup> minutes after switching on the gyro.
3. Before bringing the vehicle into motion, check whether the device is uncaged. Do not start motion if device is functioning and caged.
4. The non-working device should be caged.
5. While setting the required angle on the device scale rotate the cage handle smoothly and slowly.
6. The screw driver and the plug should be in their places when the vehicle is on move and at rest. Do not move the vehicle if the screw-driver and plug are turned-out.
7. Never rotate the card when the screw-driver is inserted into the groove of the adjusting screw.
8. Do not replace the illumination lamp and do not bend the contact of the illumination lamp when the supply is on.

### 6. MOUNTING PROCEDURE.

The directional gyro with converter and on board mains should be connected as per the circuit diagram (see fig,9) wiring is carried out with wires used for wiring the instruments of the vehicle. During this, it is necessary to check for proper installation of the yoke of converters adjusting resistor (see part-I, item 47). The fastening places of all accessories, the set (plug connectors, fastening brackets and braid shielding) should be located on to the body.

The directional gyro is mounted on to the vehicle with the aid of a bracket with shock absorbers of "LORD" type on four studs 37 (see fig.4). For operation, the gyro is installed in vertical position: deflection of it's vertical axle from the vertical plane in any direction should not exceed 3° (checked by the edges of the front wall). Wiring should be performed in such a way so as to prevent directional gyro from touching other parts when the vehicle is in motion. Overall and mounting dimensions of the directional gyro are specified in fig.11.

The converter is installed in horizontal position, fastened with four M5 screws through the holes in its base and is connected to the vehicle mains through a special switch. Overall and mounting dimensions of the converter are specified in fig.12.

7. MEASURING PARAMETERS, ADJUSTMENT AND SET UP.

7.1. MEASURING PARAMETERS BEFORE MOUNTING ON VEHICLE.

Before mounting on vehicle the directional gyro is checked on  $\gamma\Pi\Gamma-48$  installation or on swinging stand base with characteristics as follows:

a) For  $\gamma\Pi\Gamma-48$  installation.

- 1) Frequency - - - - - 0.06 + 0.01 Hz
- 2) Amplitude - - - - - 127.5 divisions of goniometer.
- 3) Vibration - - - - - With a frequency of 40 to 50 Hz at overload ~~0.3 g~~ 0.3 g.

b) For swinging stand.

- 1) Frequency - - - - - 0.75 to 1.25 Hz
- 2) Amplitude - - - - - 30 to 40 divisions of goniometer.

The directional gyro is mounted with the aid of a special bracket on to the platform and is connected to the electrical measuring circuit measures the converter supply voltage line voltage and phase currents.

Proper working of directional gyro is determined as per the readings stability at the zero mark of the scale and proper operation of the caging mechanism.

Before checking the directional gyro, it is necessary to supply power of 27V  $\pm$  10% to the converter and to adjust it in such a way so that the line voltage of the converter is within 36  $\pm$  1V.

Acceleration time of the gyromotor is determined by the time required for reaching the constancy of the current consumption by phase, which should not exceed 5 minutes. The steady value of the current in each phase should not exceed 0.3A.

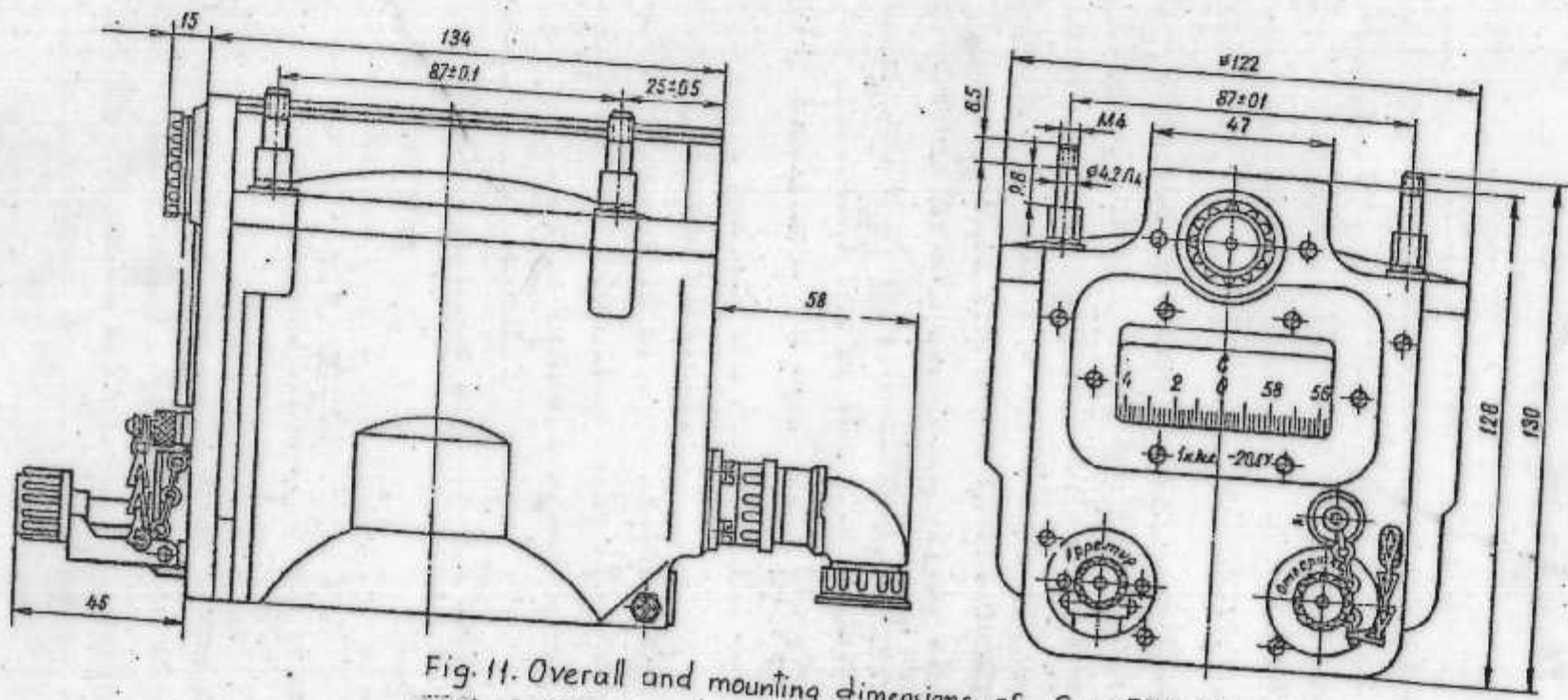
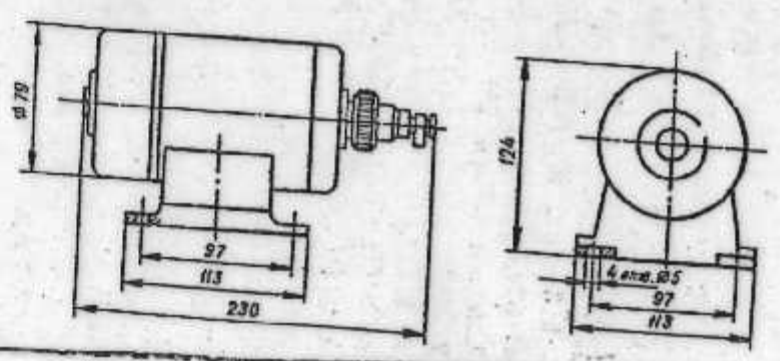


Fig. 11. Overall and mounting dimensions of Gyro ГПК-59.



To check the stability of readings it is necessary to fasten the directional gyro to the installation and to supply power. After 15 minutes when the gyromotor reaches normal speed and the directional gyro gets heated, set the gyro card to zero with the aid of caging mechanism and uncage the gyro. During this, the platform of the installation should be in it's initial position, switch the platform for swinging. After 30 minutes of swinging switch it off and bring the platform to it's initial position and mark the drift of the card. The drift should not exceed 40 divisions of goniometer. If the zero point of the card deviates more than 40 divisions from the index, the device has to be adjusted in the below given way,

- a) Cage the gyro and set the zero mark of the card against the index. Turn out the special screw driver and plug. Carefully turning insert the screw driver through a hole with a guide into the groove of the adjusting screw. Turn the screw in the direction opposite to the drift. If the zero mark drifts rightwards of the index mark then turn the screw to the left (in anticlockwise direction) and if the zero mark has drifted to the left, turn the screw rightwards (in clockwise direction).
- b) Again measure the drift of the card after 30 minutes of swinging the platform.

Adjustment is being done until the drift of the card does not exceed 40 miles in 30 minutes. To compensate the drift of 20 mills turn the screw driver to 1 to 2 divisions applied on its handle?

After adjustment replace the screw driver and plug to their seats.

#### 7.2. CHECKING FOR PROPER INSTALLATION ONTO THE VEHICLE

After mounting on the vehicle check whether the directional gyro is properly connected to the converter. For this switch on the supply to converter and after 3 minutes set the zero point of the card against the index mark and uncage the directional gyro. Screw out the screw driver and plug carefully turning insert the screwdriver into the hole and slightly press the adjusting screw. If the directional gyro is properly connected

the zero point of the card shall drift to the left from the index mark. If it drifts to the right, check for proper wiring ~~as~~ on board mains. After checking replace the screw driver and plug to their places.

7.3. CHECKING THE DRIFT FOR STEADINESS IN VEHICLE.

The drifts for steadiness are checked when the vehicle is either in motion or at rest. In this case, the voltage supplied to the converter should be (27 to 29V).

When the vehicle is at rest the check of the drift for steadiness is performed in the following way.

Switch on the supply to the converter, after warming up the directional gyro (in summer for 10 to 15 minutes, in winter for 20 to 25 minutes) set the card against mark "0" and uncage the gyro. During this, the card should be motionless. After 30 minutes of operating check, the drifts which should be within 20 divisions of goniometer. If the drifts are beyond the tolerance limits, adjust the gyro as specified in item 7.1.

When the vehicle is on move check the drifts in the following way.

Set the vehicle on a level ground (with inclination of 5° maximum), mark its position and selecting a distinctly visible landmark at a distance of at least 1 km, measure the angle of sight with the landmark, sight I. Set the initial angle on the directional gyro scale calculated by the below given formula.

$$\alpha_{init} = 60-00 - \alpha_{sight I}.$$

Further run the vehicle for 25 to 30 minutes (it is desirable to run an "eight"). After the run return the vehicle to the same place from where movement has been started and read the instrument,  $\alpha_{instr}$ . Once again orient with respect to the selected landmark and determine  $\alpha_{sight 2}$ . Calculate the value of gyro drift by the formula,

$$\Delta \alpha^1 = \alpha_{instr} - (60-00 - \alpha_{sight 2}).$$

Calculate the drift for 30 minutes by the specified formula:

$$\Delta\alpha = \frac{\Delta\alpha'}{t} = 30 \text{ divisions.}$$

--where

t - vehicle travelling time

$\Delta\alpha$  - Drift of the gyro for travelling time t.

If the drift value  $\Delta\alpha$  of the gyro is more than 40 divisions for 30 minutes adjust the gyro taking into account if obtained drift  $\Delta\alpha$  is positive (+), the device scale shifts to the left from the index mark and if it is negative (-), the device scale shifts to the right.



## 8. TROUBLES AND REMEDIES.

Faults and trouble symptoms	Probable cause	Remedies
1. Rotor of the gyromotor does not speed up.	a) $\Pi A \Gamma - I \Phi$ does not generate AC.	Repair the converter.
The gimbal unit of the device is not stable.	b) Poor contact in plug connectors.	Remove dirt oxides from pins and from plug connectors.
	c) Breaking of wires in the cable.	Replace or repair the cable.
	d) No contact in the current carrier and collector, breaking of gyromotor wires.	Repair the instrument.
2. No illumination of the device scale.	a) Bulb burned-out.	Replace the bulb with a new one taken from sPFA.
	b) No contact in the lamp holder.	Clean the contact surfaces from oxides and dirt Bend the contact ring.
	c) Breaking of wire in the device.	Repair the device.
3. The caging (mechanism) does not work.	Breaking of the caging mechanism or penetration of foreign particle.	Repair of the device.
4. Breaking of vision glass.		Repair of the device.
5. Balancing of device is not possible.	a) Disturbance in static balance or gimbal suspension unit.	Repair of the device.
	b) Clogging of the bearings of gimbal suspension.	Repair of the device.
	c) Increased play in gyro unit or gimbal suspension.	Repair of the device.
	d) The adjusting ring is broken or bent.	Repair of the device.

REMARK: Remedies excluding those in item 1b, 2a, B may be carried out by the user (customer) only after the expire of the warranty period.

## 9. MAINTENANCE.

The directional gyro undergoes scheduled preventive maintenance so as to keep it always in fit (readiness) for use;

### Types of Maintenance:

- Check
- Maintenance No.1
- Periodical checking
- Preventive maintenance.

### 9.1. CHECK.

The directional gyro is inspected when the vehicle is checked before leaving the parking area at longer halts when marching and when the vehicle is prepared to operate in special conditions. The check includes the following operations:

1. Switching on the device the converter and gyromotor of the directional gyro start working and the dial lamp lights on.
2. Checking the gyroscopic moment by slowly turning the scale of working device through small angles with the cage handle (slight resistance to rotation should be felt while turning the handle).
3. Checking for proper operation of caging mechanism to determine:
  - a) In caged condition - a possibility to turn the gyro card with the cage handle (the rotation should be smooth without jerks)
  - b) In uncaged condition - impossibility to turn the scale by rotating the cage handle and following the turning angle with a small turn of the gyro body in horizontal plane.
  - c) While uncaging - a distinct click of the following falling cage clutch.
4. Check for the presence of the screw driver and plug in the adjusting hole. The check is conducted for 5 to 7 minutes.

### 9.2. MAINTENANCE NO.1.

The maintenance No.1 of the directional gyro is performed while conducting maintenance No.1 of the vehicle (after returning

the vehicle to the parking ground after completing the march, but not <sup>than</sup> ready after 200 to 250 km, run for tracked ~~with~~ vehicle). While performing maintenance No.1 put the directional gyro in order after it's working or working of the vehicle and eliminate the simplest faults observed when the device was operating.

While performing maintenance No.1 check the directional gyro and ~~remove from stock and stock~~ carry out the following additional procedures:

- a) Clean the directional gyro and converter from dirt and dust.
- b) Check the fastening of devices, tightness of union nuts of plug connectors and their locking.
- c) Inspect the gyroglass and the external appearance of the device.
- d) Eliminate minor faults detected during operation or maintenance of the directional gyro.

Maintenance No.1 should be performed within 10 to 12 minutes (without elimination of minor faults).

### 9.3. PERIODICAL INSPECTION,

Periodical inspection of the directional gyro is carried out during maintenance No.3 of vehicle (after 2000-2400 Km, run for tracked vehicle and after 3000 Km run for wheeled vehicle, during seasonal maintenance (while transferring to spring - summer and autumn - winter operations). While conducting annual checking of the stored vehicle while mounting a new directional gyro on the vehicle and also when the vehicle is displaced over ~~±50~~ <sup>+5°</sup> latitude (more than 500 Km, along the meridian). <sup>In periodical inspection</sup> The drift of gyro main axis ~~in periodical inspection~~ is checked. During periodical inspection carry out maintenance No.1 and in addition determine the drift of gyro when the vehicle is moving (the drift should not exceed ±40 divisions - 2 small divisions of the scale for 30 minutes). If the drift exceeds the standards, adjust it as per item 7.3. If it is not possible to determine the drifts of the main of the gyro when the vehicle is on move, perform this work on a swinging platform as specified in item 7.1. In such cases, the check for the drifts is performed for 30 minutes in two directions in every 15-00 (For example 0-00 and 15-00 or 0-00 and 45-00). If the drifts exceed ± 40 divisions, balance them with adjusting screw.

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I-1059

REMARK: The drifts of gyro are determined after warming up directional gyro (in summer for 15 minutes, in winter for 20 to 25 minutes) with 27 to 29V DC.

Periodical inspection is conducted for 1.5 to 2.5 hours. This work is carried out by authorised specialists making use of the mobile workshop equipment.

#### 9.4. PREVENTIVE MAINTENANCE.

Preventive maintenance is performed after the completion of specified life of 500 hours or service life of 5 years or when the vehicle is subjected to overhaul.

The ~~preventive maintenance~~ purpose of the preventive maintenance is to determine technical condition of the device and to restore its characteristics upto standards so as to ensure further life.

Preventive maintenance is performed by opening and partial disassemble the device often with the aid of a special tools and accessories.

After preventive maintenance, the device is transferred into the next category and its further operation period is determined by the agency which has performed the maintenance.

For preventive maintenance the device is dismounted from the vehicle and is inspected in a clean, dry and duly illuminated room with air temperature,  $25 \pm 10^{\circ}\text{C}$  and relative humidity 30 to 80%.

The directional gyro is connected to  $36 \pm 4\text{V}$ ,  $400 \pm 40\text{ Hz}$  and the gyromotor speeding up time is measured (time required to match the constant value of current consumed), which should not exceed 2.5 minutes and the consumed current in each phase should not exceed 0.3A. Later, the directional gyro is mounted to the swinging platform and the drifts at four angles are measured in every 15-00 for 30 minutes with swinging parameters specified in item 7.1. In this case, the difference in drifts at different angles should not exceed 60 divisions. If this condition is met but the drifts at a certain angle exceeds 40 divisions, the gyro is to be adjusted and rechecked.

After this, remove cover 17 (see fig.3) and inspect the contact rings of the conector through a 2.5 to 4 times magnifier and measure the contact pressure of the brushes onto the collector rings with gram gauge with measure limit 0-3 gram type 6350-4769.

Unscrew plug 41 (see fig.4) and measure the axial play of the gimbal with a device, type 6350-4443 having indicator with measure accuracy,  $\pm 0.01\text{mm}$  at a load of 2,5 Kg, along the vertical axle developed with dynamometer, type 6350-1835. Enter the inspection and measuring data in the certificate.

If the drifts, current consumption and gyromotor speeding up time are within the tolerance limits, the contact ring and the connector brushes are satisfactory (small burns on the collector rings can be removed with a soft cloth soaked in alcohol), the contact pressure of brushes is at least 0.6 gr. and axial play of gimbal does not exceed 0.15mm then the device may be used further followed by conducting maintenance works after every 50h of operation or after 1 year of operation under the responsibility of the agency which has performed the maintenance works. The person in charge makes in the certificate the following note: "Preventive maintenance is performed. The article is rechecked. It is permitted to operate the article for 50 h. for a period of one year".

If the axial play of the gimbal, contact pressure, the value of current consumption, gyromotor speeding up time and drifts exceed the permissible values the device is subject to overhaul.

9.5. REQUIRED MATERIALS, TOOLS AND EQUIPMENT.

1. Swinging platform.
2. Dynamometer, type 6350-1835.
3. Device to measure axial play, type 6350-4443.
4. Gram <sup>gauge</sup> ~~gauge~~, type 6350-4769.
5. Bleached coarse calico.
6. Alcohol for industrial use.

REMARK: The required tools are delivered by the manufacturer of directional gyro upon a special agreement.

10. PACKING AND STORAGE.

The directional gyro in non-working condition should be always caged, wrapped in telephone cable paper and packed in a special cardboard box. In this box the certificate, the receiving part of the plug and ~~xxx~~ socket connector 2P: D, A18Ky - 34Г 5BI and three spare dial lamps are placed.

The card board boxes with devices are closely placed in a wooden case with a moisture-proof lining or lined from inside with packing bitumen or paper. The space between the boxes are filled in with dry wooden chips or paper strips in order that the boxes are not displaced inside the wooden case during transportation. On the outer surface of the case, the following inscriptions are applied with indelible paint.

"HANDLE WITH CARE", "DO NOT DROP OR TURN OVER", "TOP",  
- "OPEN HERE".

Each case contains a packing list indicating all packed items inside Gross weight of the case should not exceed 50 Kg.

The cases with devices are stored in a room with relative humidity upto 85% and temperature from 5 to 30°C. The room where the devices are stored should be free of acids, fumes and other aggressive agents.

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ELECTRICAL DIRECTIONAL GYRO

ГПК -59

TECHNICAL SPECIFICATIONS

127 TY.

Technical Specifications.

Electrical Directional Gyro ГПК -59.

1. Definition and Purpose.

- 1.1. The present technical specification is a basic document defining the manufacturing, delivery and acceptance conditions for electrical directional gyro ГПК-59.
- 1.2. Directional gyro ГПК-59 is designated to drive ground vehicles (along) a given course and to make accurate (exact) turns.

III. Delivery set and connection with drawings.

The delivery set includes:

Serial Number	Description	Designation	Quantity	Remark
1.	Article ГПК -59	127-сб	1	
2.	Cable socket	2PM A, 18Ky 34 - Г5 B1	1	
3.	Operation - maintenance instructions.			
4.	a) Technical description and instruction manual.	127 TO		One for 10 articles.
	b) Certificate.		1	
4.	Dial Lamp.	MH-26-012-1	3	Spare.

IV. Technical Requirements.

- 4.1. Article ГПК -59 should comply with drawings No.127 and meet requirements of the present technical specification 127-TY.
- 4.2. Overall dimensions of article ГПК-59 should comply with drawing 127-Габ.
- 4.3. The weight of article should not exceed 2200 g.

- 4.4. The external appearance of the Article should comply with the standard approved by the Chief Engineer of the agency and should meet the following requirements:
- a) The external surface of the article body should be free of dents, cracks and other defects affecting the quality of the article or it's external appearance.
  - b) The background of the device scale should have dull finish without down flows, scratches, stains and other defects making the external appearance of the scale look inferior and should comply with the approved standard.
  - c) The sight glass of the article should be transparent, slightly greenish or bluish shade not distorting the marks on scale may be permitted. Bubbles and glass seeds with 0.5mm dimension in clusters and foreign inclusions are not permitted.
  - d) The luminous compound should provide firmness to applied marks, scales, cracks and chips are not permitted.
  - e) After glow brightness of the luminous compound of temporary action in 4 minutes after stopping the excitation should provide normal visibility of divisions and numerals at a distance of 0.6m.
  - f) Damaged varnish coating at places of contact of cover with the device body is ~~is~~ connected by painting. The shades of one paint may be different.
- 4.5. The article should operate:
- a) at  $26 \pm 15\%$  V, D.C.
  - b) at  $36 \pm 4$  V,  $400 \pm 40$  Hz, A.C.
- 4.6. Maximum current consumption from A.C. circuit should not exceed 0.3A in each phase.
- 4.7. The steadyness of readings under normal conditions after warming-up for 15 minutes should meet the following requirements:
- a) After readjustment the drift of the card on vibration test stand at mark "0", should not exceed  $\pm 1$  of a small division of the scale per 30 minutes.
  - b) The drift of card on swinging platform at marks "0" and "3" or "B" should not exceed  $\pm 2$  of small divisions of scale for 30 minutes.

- 4.8. The insulation resistance of all electric circuits with respect to the body and between the electrically separated circuits should be as follows:
  - a) at least 20 megohms under normal conditions.
  - b) at least 1 megohm at elevated temperature and high humidity.
- 4.9. Under normal conditions the insulation of electric components ~~the~~ of the article should withstand the breakdown test or spark over by 500V, 50 Hz, A.C. and power source capacity of at least 0.5 kw.
- 4.10. The caging mechanism of the article should:
  - a) withstand 1500 on-off switches.
  - b) allow spontaneous caging.
- 4.11. The article should be vibration - resistant. During this, the deviation of the card with respect to the index of the article should not exceed  $\pm 1$  of a small division of the scale at vibrations in the frequency range of 10 to 120 Hz.
- 4.12. The article should be resistant to the effects of 20 impacts with an acceleration of 150 g., and pulse duration 1 to 5 m.sec.
- 4.13. The article should be resistant to cyclic changes of ambient temperature from  $+65^{\circ}\text{C}$  to  $-50^{\circ}\text{C}$ .
- 4.14. The article should be moisture proof and should maintain external appearance after being kept for 10 days at a temperature of  $+40^{\circ}\text{C}$  and relative humidity 95%.
- 4.15. The article should dew and frost resistant.
- 4.16. The article should be cold-resistant. On a swinging platform, drift of the card at mark '0' at a temperature of  $-50^{\circ}\text{C}$  should not exceed  $\pm 4$  small divisions of scale per 30 minutes.
- 4.17. The article should be heat resistant. On a swinging platform, drift of the card at mark '0' at a temperature of  $+50^{\circ}\text{C}$  should not exceed  $\pm 4$  small divisions of ~~scale~~. *Scale*
- 4.18. The article should be dust-proof.
- 4.19. The article should be splash-proof.
- 4.20. The article should be vibration-proof against vibrations with a frequency of 20 to 25 Hz and acceleration of 2g.

- 4.21. The article should be vibration-proof against prolonged vibration at a frequency range from 10 to 120 Hz.
- 4.22. The article should have shock-proof at 600 impacts action with an acceleration of 150g and pulse duration from 1 to 3 m.sec.
- 4.23. The article elements should ~~not~~ not have resonance in the frequency range from 10 to 40 Hz.
- 4.24. The article should resist to 9 single impacts with high acceleration.
- 4.25. The article should be resistant to the decreased pressure effects of 170 mm. PT.CT.

V. Acceptance Rules.

- 5.1. Compliance of article ГПК-59 with all requirements of the present technical specifications and drawings is determined by acceptance and inspection tests.
- 5.2. 100% of the submitted articles are subjected to acceptance tests. The tests are conducted by the TID inspector (representative).  
REMARK: Before conducting acceptance tests, each article should be treated on set 'SKORSBi' which imparts to the article a rotating motion with an angular inclination of  $\pm 7.5^\circ$ , angular speed 5 to 6.8 r/min, vibration 0.6 to 0.8 g for 10 hours (2.5 hours at bearings N, E, S and W).
- 5.3. Periodical inspection tests are carried out once in a year on three articles. The tests are conducted in the presence of TID representative.
- 5.4. The acceptance tests are conducted in the order and scope specified in the below given table.

Sl. No. Being checked Parameters g.	Technical requirement items.	Items of the Procedure.
1. External appearance, set.	3.1; 4.4 (a;b;c;D;E)	6.2.
2. Current consumed	4.6	6.3
3. Insulation resistance in normal conditions.	4.8a	6.4
4. Steadiness of readings of articles for 30 minutes, at normal temperature after warming-up for 15 minutes:		
a) drift of the card on the vibration test stand.	4.7a	6.5
b) drift of the card on a swinging platform.	4.7b	6.6

REMARK: The intensity of afterglowing as per item 4.4e is checked on 10% of the submitted articles selected at random.

~~xxxx~~

5.5. The inspection tests are conducted in scope and order specified below:

Sl. No.	Being Parameters checked	Items of technical specifications	Items of the procedure.
1.	Weight of the article	4.3	6.7
2.	Insulation strength	4.9	6.8
3.	Vibration resistance	4.11	6.9
4.	Impact resistance	4.12	6.10
5.	Resistance to cyclic changes in temperature.	4.13	6.11
6.	Moisture resistance	4.14	6.12
7.	Resistance to dew and frost	4.15	6.13
8.	Cold resistance	4.16	6.14
9.	Heat resistance	4.17	6.15
10.	Vibration strength at one frequency	4.20	6.18
11.	Vibration strength in the frequency range	4.21	6.19
12.	Impact resistance	4.22	6.20
13.	Efficiency of caging mechanism	4.10	6.21
14.	Life test		6.22
15.	Dust proofness	4.18	6.16
16.	Splashproofness	4.19	6.17
17.	Resonance of elements	4.23	6.23
18.	Resistance to single impacts	4.24	6.24
19.	Resistance to decreased atmospheric pressure	4.25	6.25

VI. Test Procedure

6.1. All tests (except for specific ones) are conducted in normal conditions.

Normal Conditions:

- ambient air temperature  $+25^{\circ} \pm 10^{\circ}C$
- relative air humidity  $65 \pm 15\%$
- atmospheric pressure  $750 \pm 30mm Hg.$
- illumination - daylight illumination or artificial lighting as per the illumination standards set for shops of precision machine building
- Power supply : a)  $26V \pm 15\%$  D.C.  
b)  $36 \pm 1V, 400 \pm 10Hz$  A.C.

6.2. During visual inspection check:

1. delivery set
2. correct filling out of certificate
3. proper marking
4. quality of dial lighting
5. intensity of after glow
6. functioning of the cage.

The quality of dial illumination should ensure visibility of card scale readings of the device in darkness from a distance of 0.5 to 1m when power supplied is not below 24V. Burning out of the bulb is not a reason for rejecting the article. The tests are resumed after replacing the burned-out bulb.

The intensity of after glow of the temporary luminous compound is determined visually.

The excitation of temporary luminous compound is carried out from a distance of 0.5m for 5 minutes. A filament lamp of 100W is the source for excitation.

The operation of cage is checked in the following way:

- a) While pulling the handle of the cage a click of the falling down cage clutch should be heard.
- b) The card should rotate smoothly without jerks when rotating the handle of the cage being in caged condition.

Maximum turn moment should not exceed 600 gm.cm. This is checked <sup>with a special</sup> gram ~~mm~~ gauge.

6.3. Maximum current consumed ~~mm~~ by the article is checked in 5 minutes after supplying the power by an ammeter which



permits to read with an accuracy of 0,01A and simultaneously checking the voltage with an accuracy of 0.5V.

6.4. Insulation resistance of all electric circuits the body and between the ~~separated~~<sup>Separated</sup> circuits is checked with illumination bulb removed by using megohmmeter with 100V DC. Checking is being carried out between the short-circuited pins of plug connector and between short-circuited pins 2,3,4 and pin 1 of the plug connector.

6.5. The drift value of the card on a vibration test stand under normal conditions is started to be checked 15 minutes after switching on the power supply with vibration of 40 to 50Hz and an overload of 0.2 to 0.5g.

The article is fasten in horizontal position on a bracket in shock absorbers, the card is set against mark '0', uncaged and after 30 minutes the drift is indicated which should not exceed  $\pm 1$  small division of scale.

If the drift exceeds one small division adjustment is performed asper following procedure:

The article is set against mark '0', caged and the plug is turned out from a hole in the front wall. In case, the card has drifted leftwards the balancing load is turned clockwise by a special screw driver through the hole in the front wall. If the card drifts to the right - the balancing load is turned in anticlockwise direction. To compensate the drift for one small division of the scale turn the screw driver by 1 to 4 divisions marked on it. It is not permitted to additionally adjust and recheck for more than three times. Devices which do not meet the requirements of technical specification after the third additional adjustment are sent for overhauling.

6.6. The value of drift of the card on a swinging platform is checked in normal conditions 15 minutes after supplying voltage.

The article is fasten onto a bracket in shock absorbers on installation УПГ-48, when the table of the installation is in horizontal position. The card is set against mark '0' and the article is uncaged. Then the installation УПГ-48, is switched on imparting to the article ~~an~~ rotation with angular inclination  $\pm 7.5^\circ$  number of cycles from 3.7 to 5 per minute reverse time 100 to 140 sec., and vibration 0.2g to 0.5g at a frequency of 40 to 50 Hz.

XXXX

After 30 minutes the installation is stopped, the table is set in horizontal position and the card drift is marked. In the similar way, the value of drift against one of the marks  $\frac{W}{3}$  or  $\frac{E}{B}$ , is determined.

REMARK: It is permitted to check on "SKORSBI" unit following the above specified parameters at an angular speed of 6 to 6.8 r/min, vibrations of 0.2 to 0.5g and a frequency of 40 to 50 Hz.

6.7. The weight of an article is checked on scales providing an accuracy of  $\pm 10$  gr.

6.8. Insulation strength of electric circuits with respect to the body is checked between pins of plug connector and body for a minute under normal conditions with the bulb removed on high voltage installation with a capacity of at least 0.5 KW, 50 Hz.

The test starts at a voltage nearer to zero which increases gradually with speed up to 500 V allowing to read the voltmeter.

If there is no break down or sparkover the pointer of the voltmeter shows present voltage but if there is a break down or sparkover, a sharp decrease in voltage is observed.

After one minute performance the testing voltage is gradually decreased and the installation is switched off.

6.9. Vibration resistance of the article is checked on a vibration stand at the following vibration parameters:

Frequency, Hz	10 to 20	20 to 30	30 to 50	50 to 120
Amplitude, mm	2.0	1.2	0.6	--
Acceleration, g	not checked			6

The checking is performed as follows:

- a) The article is rigidly fasten without shock absorbers to the platform of the vibration test stand so that the direction of vibration is along the vertical axis;
- b) Power is supplied to the article and in 5 minutes, the gyro is uncaged;
- c) The vibration unit is switched on.

- d) Subjecting to vibration for one minute at frequencies divisible by ten, the deviation of the card with respect to the index is determined.

After checking, the power is switched off and the article is removed from vibration test stand.

6.10. Impact resistance is checked on an impact test stand with acceleration of 150 g and pulse duration from 1 to 5 m.sec. The article fixed in shock absorbers is mounted on to the impact test stand, the power is supplied, uncaged and 20 impacts are performed along the vertical axis.

During this, the current consumption as per method specified in item 6.3 is checked.

6.11. Resistance to cyclic changes in temperature is checked on

Articles in non-operating (without power supply) condition by 3 cyclic changes in temperature following continuously one after another in the sequence below: the article is placed into a cooling chamber, precooled to a temperature of  $-50^{\circ}\text{C}$  and kept at this temperature for two hours.

After this the article is shifted into a chamber, preheated to temperature upto  $+65^{\circ}\text{C}$ , and kept at this temperature for two hours.

After keeping the article in the heating chamber, the cycle is repeated.

After the last cycle, the article is removed from the heating chamber and kept in normal climatic conditions for three hours and later checked for compliance with item 4.7.

In case the article after checking on vibration test stand does not meet tolerances specified in technical specifications, it is adjust as per the procedure of item 6.5.

6.12. Moisture resistance is checked in moisture chamber at  $+40 \pm 3^{\circ}\text{C}$  temperature and 95-98% humidity for ten days in switched-off condition. Each day, the article should be switched-on, for one hour.

After 10 days, check insulation resistance for compliance with item 4.8 as per procedure of item 6.4. Visually inspect the article for corrosion and safety of varnish coatings.

- REMARK: 1. While conducting test protect the plug of connector from moisture penetration by using insert ~~2PMF18KY34 W5BI~~ 2PMF18KY34 W5BI
2. After the test dry the device for two hours at a temperature of  $+50^{\circ}\text{C}$ .

6.13. Resistance for dew and frost is checked in normal conditions after having kept the article in cooling chamber in switched-off condition for two hours at a temperature of  $-20 \pm 5^{\circ}\text{C}$ .

After removing the article from the chamber, switch it on and keep in this condition for three hours. Immediately after switching-on and, in every 30 minutes check the current consumption as per procedure of item 6.3.

6.14. Cold resistance of the article is checked in a cool chamber. For this, keep the article for two hours in switched off condition in the chamber with a temperature of  $-50 \pm 3^{\circ}\text{C}$ . After this place the article onto a swinging base, switch-on the supply and, after 15 minutes of warming up, determine the drift of card as per procedure of item 6.6.

REMARK: After the test dry the device for two hours at a temperature of  $+50^{\circ}\text{C}$ .

Drying of the device may be combined with heat resistance test as per item 6.15. In this case, the total time of keeping in the heating chamber increases to 2.5 hours.

6.15. Heat resistance is checked in a heating chamber. The article is kept in switched off condition for two hours at  $+50 \pm 3^{\circ}\text{C}$ . After this, it is placed on a swinging base and, the drift of the card is determined as per procedure of item 6.6. Later the article is switched on placed into a thermostat, the temperature is set to  $+65 \pm 3^{\circ}\text{C}$  the article is kept at this temperature for two hours.

After this, open the thermostat, reduce the temperature to normal and after keeping in normal conditions for three hours check the article for compliance with item 4.7. In case the article after testing on vibration test stand does not meet the tolerances specified in technical specifications, adjust it as per procedure of item 6.5.

6.16. The article is checked for dust proofness in the following way:

Place the articles in a chamber filled to 0.1% of useful volume with dust mixture containing:

~~the~~ I ~~6000~~  
~~check~~ I ~~2000~~  
~~Madlyne~~ I ~~2000~~

Sand	-	60%
Chalk	-	20%
Kaoline	-	20%

The size of dust particles should not exceed 200 microns. The test is conducted for one hour at an airspeed of 8 m/sec, after this remove the devices from chamber, remove dust from their surfaces, remove the top cover and front wall and visually inspect for the absence of ingressed dust.

The article is considered to have passed the test if the device is internally free from the dust.

After testing, assemble the devices and check for compliance with 127-c6 Ty.

6.17. The article is checked for splash proofness in the following way:

Set the articles with their side walls at an angle of 45° to the vertical axis. Spray with water in turn from the 4 sides (30 minutes on each side). The intensity of spraying should be of 5 ± 2 mm/min. After two hours remove the articles from the chamber, remove moisture from the external surfaces of the devices, remove the top cover and front wall to check for ingress of water, also measure insulation resistance as per procedure of item 6.4.

The articles are considered to have passed the test, if the insulation resistance is at least, 1 megohm and there is no water inside. Drops of water on the cageshaft located inside the oilseal may be permitted.

REMARK: The difference in temperatures of the article and water should not exceed 10°C.

After test, assemble the devices and check for compliance with 127-c6 Ty.

6.18. The vibration strength of the article at one frequency is checked on a vibration test stand. For this fasten the article without shockabsorbers to the platform of the stand in horizontal position and switch-on the power. The test is conducted for 30 minutes at one of the frequencies in a range from 20 to 25 Hz, and 2g acceleration.

After the test visually inspect the article for mechanical damages and loosening of the fasteners.

6.19. The vibration strength of the article in a frequency range is checked on a vibration test stand as per specified frequencies. Fasten the article mounted on shockabsorbers onto the platform of the stand in horizontal position, switch it on and vibrate with following parameters:

Frequency, Hz	10	20	30	40	50	60	80	100	120
Amplitude, mm	2.0	1.0	0.8	0.6	0.4	0.3	-	-	-
Acceleration, g	Not Checked.						4	4	4
Duration, hours	3	9	6	4.5	4.5	1.5	1.5	1.5	1.5

After test check the article for compliance with item 4.7.

In case, the article after checking on vibration test stand does not meet the tolerances specified in technical specifications, adjust it as per procedure of item 6.5.

REMARK: If the frequency of shockabsorbers coincides with the frequency specified in the table, change the frequency so as to come out of the range shockabsorber resonance region.

2. Working time of the article is 10 to 12 hours followed by a 2.5 hours break.

6.20. Impact strength is checked on impact test stand. Fasten the article mounted on shockabsorbers to the platform of the stand, switch it on uncage and subject to 600 impacts with an acceleration of 150g, pulse duration 1 to 3 ~~ms~~ sec, along the vertical axis recurrence should be 40 to 80 impacts per minute.

After impact testing, check the article for compliance with item 4.7. In case the article while being checked on the vibration stand fails to meet the tolerances specified in technical specifications perform adjustment as per procedure of item 6.5.

- 6.21. a) The proper functioning of the caging mechanism is checked in normal conditions when device fastened and powerless is subjected to 1500 caging cycles.
- b) Check for reliable caging is performed in the following way:

Uncage the device and fix the retainer, press the cage control handle against the latch with a force of 5 Kg maximum. Rotate the body of the device from one side to the other several times. During this rubbing or stopping of the card is not permitted.

6.22. Checking the article operation for the testing period is conducted on installation УПГ -48 or "SKORSB1", for 500 hours, bearing in mind the time of operation prior to the beginning of the test as per present item. Fasten the article in a bracket in shockabsorbers, adjust the table of the installation to horizontal position and switch on the power supply. Set the card against mark '0' and uncage the article.

Then switch on the installation imparts to the article rotation with an inclination of  $\pm 7.5^\circ$ , angular speed 6 to 6.8 rpm, reverse time 100 to 140 sec., vibrations at a frequency of 40 to 50 Hz and an overload of 0.2 to 0.5g operate for the above 500 hours while in every 10 to 12 hours the card is sequentially set to marks 'N' 'E' 'S' and 'W'. Continuous operating time of the article is 10 to 12 hours followed a 2.5h break.

In every 100 hours the article is checked for compliance with item 4.7. In case the article while being checked on the vibration table, fails to meet the tolerances specified in technical specifications perform adjustment as per procedure of item 6.5.

After the completion of 500 hours testing the articles are checked in the full scope of acceptance tests and are open up. It checks the quality of units assembly for compliance with drawings, condition of the bearings, compliance of parts dimensions with approved drawings and the quality of anti-corrosive coatings.

- REMARKS:
1. Check for dimensions of parts is performed in test (instrumentation) laboratory.
  2. Check for the quality of anti-corrosive coatings is performed in the factory chemical laboratory as per special instructions.
  3. The articles are opened after the completion of all tests.

6.23. Test to detect the resonance of components is conducted on a vibration test stand in a sequence in three mutually perpendicular directions. Article in off condition without front wall and upper cover is rigidly (without shock absorbers) is fixed to the stand platform.

The test is conducted under the following conditions:

Frequency Sub-ranges, HZ	Amplitude Value, mm
10 to 20	0.5 to 0.8
20 to 25	0.5 to 0.8
25 to 40	0.3

By gradually changing the vibration frequency in each sub-range, time taken for each sub-range should be not less than 2 minutes.

Checking for lack of resonance in article is performed visually.

The article is considered to have passed the test, if there is no resonance and if during visual inspection mechanical damages are not detected after the tests.

6.24. To check the article for resistance to single impacts with high acceleration an impact test machine "K-200" is used. Set the article mounted in shock absorbers on the base of the impact test machine "K-200", supply power, uncage and carry out five impacts along the longitudinal axis and 4 impacts along the cross axis, the pendulum of the impact test machine should deflect by 90° angle.

After performing impacts, check for the absence of spontaneous uncaging and drifting of the article in compliance with item 4.7.

In case the article while being checked on vibration table, fails to meet the tolerances specified in technical specifications perform adjustment as per procedure of item 6.5.

REMARK: The test is conducted once on main batch of articles ГПК-59.

6.25. Resistance of article to low atmospheric pressure is checked in the following way:

Place the directional gyro with unscrewed plug in the



pressure chamber having normal atmospheric pressure and normal temperature. Decrease the pressure in pressure chamber to  $170 \pm 10$  mm, Hg, Keep the article in this condition for 1 hour and then gradually increase the pressure to normal. Remove the article from the pressure chamber and check drifting value of the card on a swinging base as per procedure of item 6.6.

The article is considered to have passed the test if drifting value complies with requirements of item 4.7d.

VII. Marking, Packing, Storage and Transportation

7.1 Manufacturer's plate is fixed to the body of the device with the following designation

- a) Code of the article
- b) Serial number of the article.

7.2. On the rear wall of the device body there are applied with black print ТИШФ - 53, Ty 29-02-889-79 and TID marks.

7.3. Each article is packed into a corrugated container 9Д4.180.045-01 and is stowed into a wooden packing box.

IX. List of Appendix for Technical Specifications

9.1 Appendices for technical specifications are as follows:

- 1. List of checking equipment.
- 2. Certificate 127 ~~127~~. ПСІ
- 3. Acceptance tests record.
- 4. Inspection test record.
- 5. Instructions manual for directional gyro ГПК -59, K04.12.015, edition 2-65.
- 6. List of repair and assembly tools set for overhaul and restoring articles ГПК -59.
- 7. List of spare parts repair set for overhaul and restoring directional gyro ГПК -59 (for 20 devices).

Appendix No. 1 for technical  
specifications of article ГПК-59.

LIST OF CHECKING EQUIPMENT

1. Installation УПГ-48
2. Vibration test stand.
3. Megohmmeter, 100 volts.
4. High voltage unit.
5. Impact test stand.
6. Cooling chamber.
7. Heating chamber.
8. Moist chamber.
9. 36 volts, 400 Hz, AC unit.
10. DC 27V, DC unit.
11. Scales with an accuracy of +10 grams.

1	2	3	4	5	6
14	I-1057  Testing Period.	AFTER 300 HOURS Drift on vibrating table $\pm 1$ small division			
		Drift on swinging base $\pm 2$ small divisions			
		AFTER 400 HOURS Drift on vibrating table $\pm 1$ small division			
		Drift on swinging base $\pm 2$ small divisions			
		AFTER 500 HOURS. Drift on vibrating table $\pm 1$ small division			
			Drift on swinging base $\pm 2$ small divisions.		
		Insulation resistance 20 megohm minimum.			
15	Dustproofness.	Ingress <sup>of</sup> dust inside the device is not permitted.			
16	Splashproofness.	Insulation resistance			
		Ingress of moisture is not permitted.			
17	Reasons for article Components.	Not permitted.			
18	Resistance to single impacts with high acceleration.	Drift on vibrating table $\pm 1$ small division.			
		Drift on swinging base $\pm 2$ small divisions.			

Ordnance Factory Project Hyderabad.		CONTINUED INSPECTION TEST PROTOCOL FOR ГПК-59.		NUMBER...ГПК-59.....	
				SHEET 60 OF .....	
1	2	3	4	5	6
7	Resistance to dew and frost	Current consumption should not exceed 0.3A.			
8	Cold resistance.	Drift of the card, $\pm 4$ small divisions.			
9	Heat resistance.	On swinging base drift at temperature of $+50^{\circ}\text{C}$ $\pm 4$ small divisions.			
		Drift in normal conditions after keeping under a temperature of $+65^{\circ}\text{C}$ . On vibration table, $\pm 1$ small divisions.			
		on swinging base, $\pm 2$ small divisions			
10	Vibration strength at one frequency.	Mechanical damages are not permitted			
11	Vibration strength at frequency range.	Drift on vibration table $\pm 1$ small division.			
		Drift on swinging base, $\pm 2$ small divisions.			
12	Impact resistance	Drift on vibration table, $\pm 1$ small division.			
		Drift on swinging base $\pm 2$ small divisions			
13	Workability of Caging mechanism.	1500 Cycles.			
14	Test life.	AFTER 100 hours.	Drift on vibration table $\pm 1$ small divisions		
			Drift on swinging base $\pm 2$ small divisions		
		AFTER 200 hours.	Drift on vibration table $\pm 1$ small divisions.		
			Drift on swinging base $\pm 2$ small divisions.		