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भारत संस्कार

रक्षा मंत्रालय

(गुणता आश्वातन महानिदेशालय)  
GOVERNMENT OF INDIA  
MINISTRY OF DEFENCE  
(DGQA ORGANISATION)

# SARATH

QUALITY ASSURANCE INSTRUCTIONS

NO. CQA (ICV) / QAI / 054

FOR

SPEEDOMETER CP -106

ISSUED BY

गुणता आश्वातन नियंत्रणालय (स्थल सेना लडाकू वाहन)

रक्षा उत्पादन तथा आपूर्ति विभाग

रक्षा मंत्रालय

येदुमैलाराम (आं.प्र) - ५०२ २०५

CONTROLLERATE OF QUALITY ASSURANCE (INFANTRY COMBAT VEHICLES)  
DEPARTMENT OF DEFENCE PRODUCTION & SUPPLIES  
MINISTRY OF DEFENCE  
YEDDUMAILARAM 502 205

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QUALITY ASSURANCE INSTRUCTIONS

FOR

SPEEDOMETER C П -116

CONTROLLERATE OF QUALITY ASSURANCE  
INFANTRY COMBAT VEHICLES  
YEDDUMAILARAM - 502 205

ADDITIONS/AMENDMENTS

Sl No	Page & Para	Brief description of Additions/ Amendments	Date on which addition/ amendments made	Authority lette Number
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QUALITY ASSURANCE INSTRUCTIONS FOR  
SPEEDOMETER GOST 12936-82 (Indicator & Sending Unit)

1.0 INTRODUCTION : This QAI deals with inspection of Speedometer (Indicator to Drg.No.C1106-380201Cb and Sending Unit to Drg.No.M2 3016-3730010C5) intended to measure the speed of the vehicle movement and count the distance covered. This QAI is based on the relevant design documents, specifications and other literature of the collaborators.

1.1 General Instructions for Inspection : This QAI is issued to assist and guide inspector in his inspection and nothing in this instruction absolves the inspector from his responsibility to ensure that the inspection is carried out strictly as per terms of contract and the accepted stores are as per drawings and the specifications quoted in the contract in every respect.

1.2 Before commencing inspection, the inspector will make himself fully conversant with all the terms and conditions of the contract, including specifications, drawings and other literature of the collaborators.

1.3 The inspector will ensure that the stores manufactured is in conformity with the relevant specifications and drawings quoted in the contract, with a view that the stores accepted are qualitatively meeting the service requirements.

1.4 In the course of inspection, if the inspector finds any points which could be included in this QAI, he should bring such points to the notice of the AHSP.

1.5 The supplier may be shown this QAI in order to acquaint himself with the standard of inspection, so that he endeavours to improve his product.

1.6 This QAI is the property of Government of India. It is liable for amendment at any time and should not be used unless authorised by Controller, CQA(ICV), Secunderabad.

For inspection purposes only the latest issue of this QAI will be made applicable and required number of copies of this QAI can be obtained from the issuing authority, ie., the Controller, CQA(ICV), 6th floor Chandralok Building, Secunderabad-500 003. Amendments issued by CQA(ICV) from time to time shall be recorded in the amendment sheet enclosed.

1.7 Any technical queries on this QAI should be referred to issuing authority. For any departure from this QAI, the AHSP should be approached in writing and only after obtaining the written approval for the departure, the manufacturer should commence production.

1.8 A set of applicable drawings and specifications will be forwarded to the manufacturer/supplier and the respective inspection authority on placement of supply order. For any changes in the drawings, specifications, standards or written texts, prior approval in writing should be obtained from AHSP, before commencement of production. Equivalence of collaborator's specifications with other international or national specifications and standards will be decided only by the AHSP.

1.9 The supplier should provide all standard test facilities for conducting inspection smoothly, viz., inspection gauges, instruments, test stands/rigs, fixtures templates and also those recommended in the drawings, specifications.

The supplier should maintain a calibration record sheet for all the measuring instruments/machines and gauges, which will be periodically checked by the inspector.

1.10 The supplier should take up suitable corrective measures immediately if any defects/short comings are noticed during line, process and assembly inspection. In

case the defects noticed on any consignments, are attributable to manufacturing defects warranting rectification of earlier supplies, the supplier should resort to rectification of these defects in the supplies already made in consultation with the AHSP and consignee.

2. CONSTRUCTION & OPERATION : Speedometer-CN-106 is designed to measure the speed of the vehicle movement and count the distance covered. It includes sending unit 2 (fig.1) indicator 1 and electric wire. The speedometer indicator scale is graduated from 0 to 100 km/h.

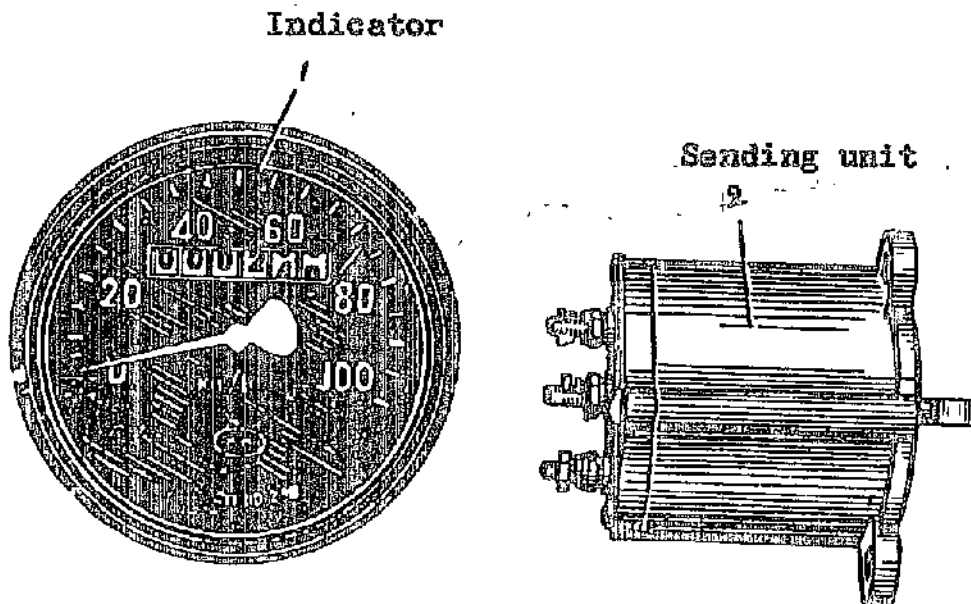


Fig-1 : SPEEDOMETER CN-106

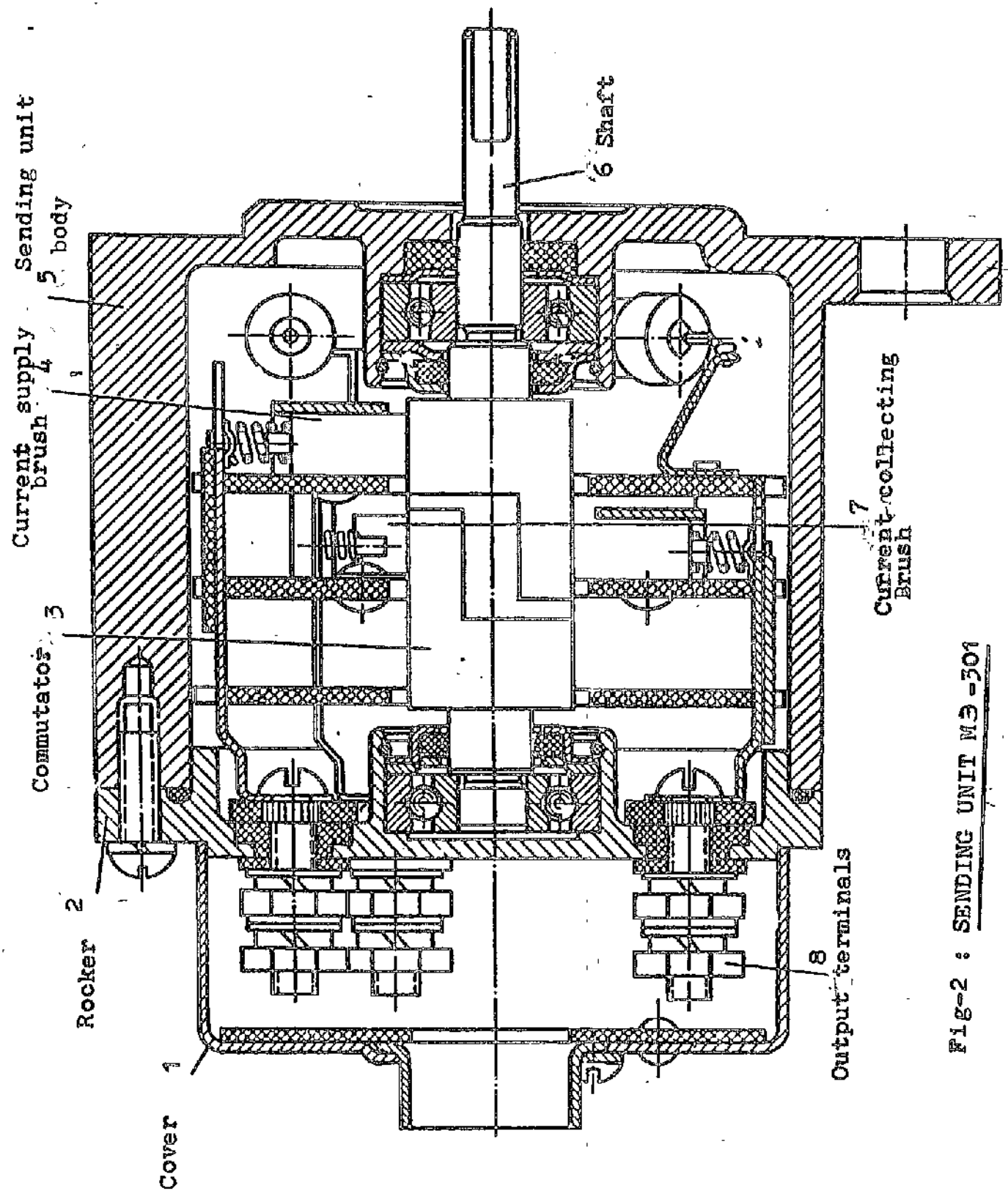


FIG-2 : SENDING UNIT M3-301

Sending Unit MЭ-301 : Fig-2 is a commutator type transducer. The basic components of the transducer are : Body 5, commutator 3 made from two hollow shaped parts (segments), rocker 2 with two current-supply brushes 4 and three current-collecting brushes 7 and cover 1. The commutator segments are fitted on a common axle and insulated from each other. They are located on the cylindrical surface of the commutator and built into the insulating bushing screwed on the axle. The direct current of the mains is delivered to the commutator segments through the slip rings and two brushes. The sending unit of the speedometer is mounted on the gear case and put into action by the drive shaft of the final drive through a worm gearing.

The indicator (fig-3) includes a synchronous three-phase electric motor, speed measurement unit and kilometrage counting unit. Two pole permanent magnet 5 secured on shaft 8 serves as the rotor of the electric motor. The winding of stator 1 is installed on three pole shoes and star-connected. The ends of the stator winding are connected to three output terminals 7 of the indicator. The rotor revolves in two ball bearings 6. The free end of the rotor shaft carries magnet 11 of the induction speed measurement unit. Rotation is imparted from shaft 8 to counting unit 2 of the indicator through worm gearing.

The speed measurement unit of the speedometer is of an induction type; it consists of permanent magnet 11, dial 9 and a spring.



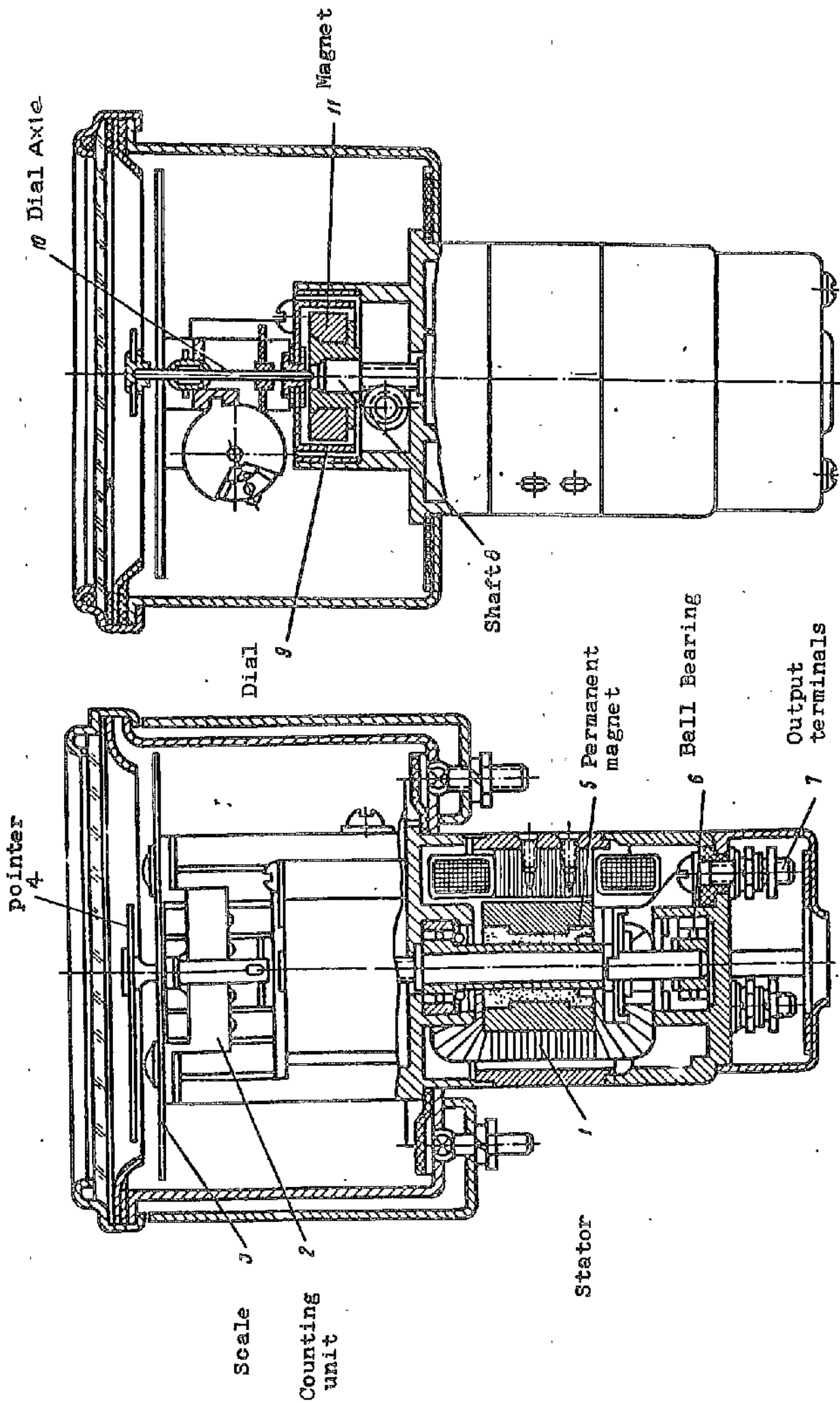


FIG. 3 SPEEDOMETER INDICATOR

The dial is fitted on axle 10, embracing the permanent magnet. The end of the dial axle holds speedometer pointer 4. The speed measurement unit operates as follows. With rotor shaft 8 revolving, magnet 11 rotates together with it, and the magnetic flux induces an electromotive force in dial 9. The electromotive force is proportional to the rotational speed of the magnet. An electric current generated in the dial induces a magnetic field interacting with the field of the rotating magnet and thus causing a torque.

The angle of deflection of the dial and pointer is proportional to the rotational speed of the rotor (magnet).

The spiral spring (hair) secured on the dial axle prevents rotation of the dial together with the magnet and counterbalances the torque produced, as a result of interaction of the magnetic field.

The counting unit is of a mechanical type; it consists of six drums counting the kilometrage covered and worm gearings. The rotor shaft revolves the right-hand drum (counting tenths of a kilometre), through a system of worm gearings. After the right-hand drum completed the tenth revolution, the neighbouring drum turns, recording 1 km, the other drums turn in succession in a similar way, thus recording the kilometrage covered.

The speedometer functions as follows. (FIG-4)

With the vehicle moving, the drive shaft of the final drive actuates shaft 1 of the sending unit and consequently, commutator 20. The mains direct current applied to the commutator through brushes 6 is inverted into a three phase pulsating current whose frequency is directly proportional to the rotational speed of the commutator.

This current flows over wires to winding 18 of the indicator motor stator. The rotating field formed in the stator makes rotor 17 of the electric motor to revolve together with magnet 9 of the speed measurement unit at a speed

proportional to the rotational speed of the drive shaft of the final drive, and consequently to the speed of the vehicle movement. Permanent magnet 9 actuates dial 10 of the speed measurement unit and thus causes indicator pointer 13 to deflect. Simultaneously, the shaft of the rotor 17 drives counting unit 15 through worm gearings 16.

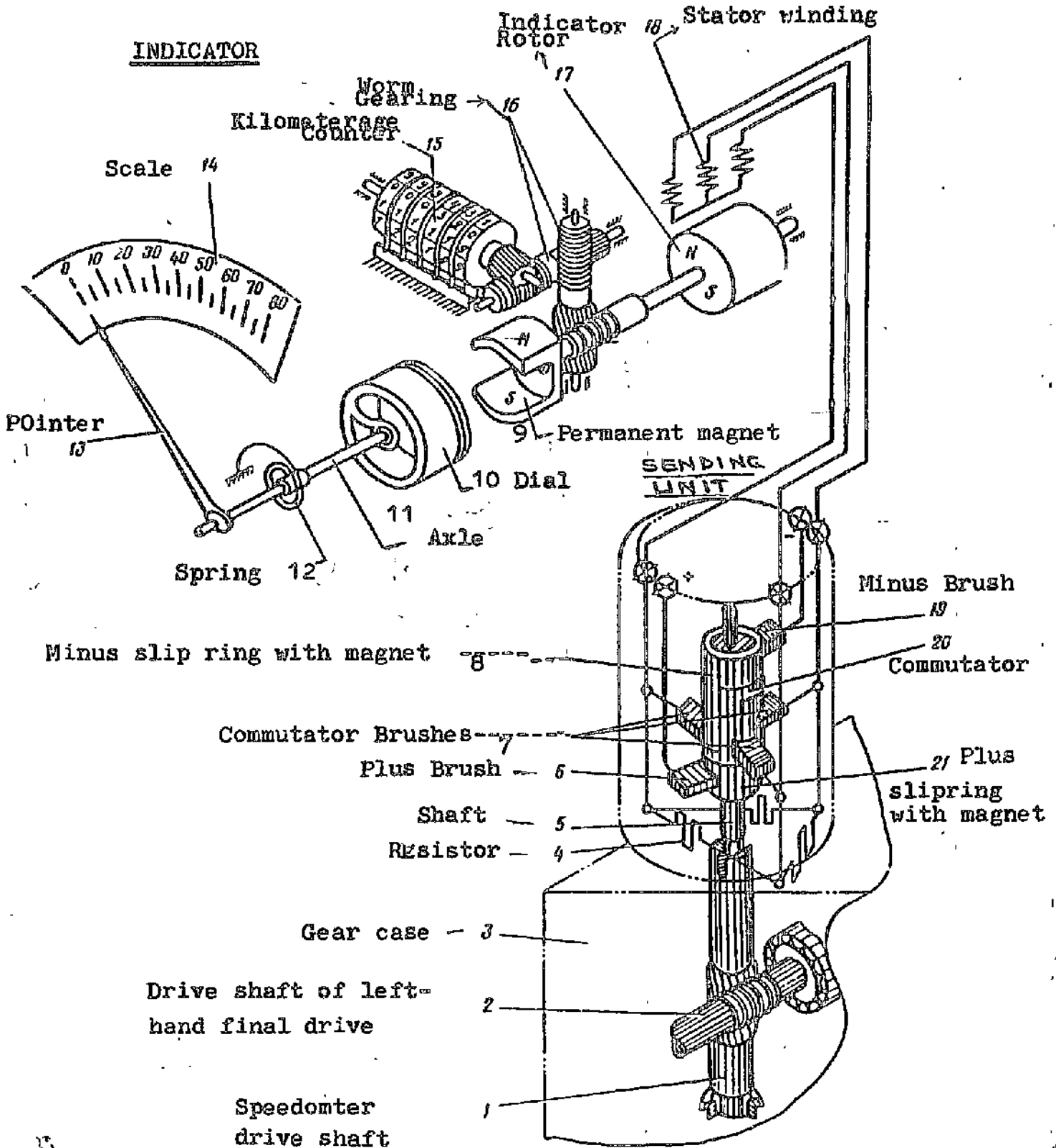


Fig-4 : DESIGN AND OPERATING PRINCIPLE OF SPEEDOMETER

### 3.0 TECHNICAL DATA/REQUIREMENTS :

- (a) Speedometer Model .. CN-106
- (b) Speed measuring range km/hr .. 0 to 100
- (c) Counter capacity (max.) km .. 99999.9 km
- (d) Rated voltage, V .. 24
- (e) Transmission ratio of speedometer mechanism with respect to drive shaft .. 624 : 1
- (f) Reading of the summing up counter & speedometer manufactured by the manufacturer (vendor) .. 15 km (max.)

3.1 The speedometer is liable for storage, transportation and operation in the environments of tropical, tropical sea coasts, dry deserts and cold climates.

### 4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection Responsibility : The supplier is responsible for satisfactory performance of the item during usage and for performance of all inspection requirements specified herein.

4.2 The supplier should carry out 100% pre-inspection before offering the items to the inspector for inspection. A test certificate indicating all the tests carried out by the supplier should be given to the inspector/AHSP, while tendering the stores for inspection. The contractor should provide free access for scrutiny of all the documents to the inspector/AHSP in order to ensure that the items offered are of the highest quality.

4.3 Supply of Literature : The supplier should provide sufficient copies of the literature of the items, such as illustrated part list, operating instructions, assembly schedule, maintenance/overhaul instructions, system layout charts, list of indigenous materials, etc., to the AHSP for vetting and distribution.

5. PILOT/BULK INSPECTION

5.1 Contractor should tender 6 pilot samples representing the bulk supplies to the inspecting officer for the pilot samples evaluation. The pilot samples tendered should bear the regular serial number in addition to the identification number in red paint as under.

"PS<sub>1</sub>, PS<sub>2</sub>, PS<sub>3</sub>, PS<sub>4</sub> -- -- -- PS<sub>6</sub>

5.2 All inspection/testing facilities for evaluation of pilot samples will be provided by the supplier at supplier's premises. The supplier should inform in advance in writing about the facilities available with them for evaluation of pilot samples. Any additional test facilities required for pilot sample evaluation will be intimated by the inspecting officer and the AHSP. Vehicle trials will be conducted as per the directions of the AHSP.

5.3 All bought out articles like bearings, brushes, etc., will be inspected by the Inspection Officer, if considered necessary. Inspection officer will also conduct stage inspection during manufacture, if necessary.

5.4 Pilot samples will be considered for acceptance only after completion of all tests indicated herein. Bulk production clearance will be accorded by the AHSP only after the approval of pilot samples. Inspection of pilot samples and bulk supplies of the item shall be carried out in accordance with this QAI and relevant drawings/specifications.

5.5 The pilot samples will be allocated for evaluation as per the details given under.

Sl.No.	Tests	Inspection level	No. of pilot samples undergoing evaluation
(a)	Visual Inspection	all 6 samples	1 to 6
(b)	Dimensional Check	-do-	-do-
(c)	Performance tests	-do-	-do-
(d)	Environmental tests	2 samples	1 and 2
(e)	Dynamic tests	-do-	3 and 4
(f)	Interchangeability tests	-do-	1 and 2
(g)	Endurance tests	1 sample	5
(h)	Fitment/performance tests on vehicle	-do-	6
(j)	Weighment check	all 6 samples	1 to 6
(k)	Preservation/packing/identification check	-do-	1 to 6

5.6 Disposal of pilot samples will be intimated by the AHSP to all concerned. Inspector should punch the acceptance mark (V ↑ mark) on the bodies of the speedometer indicator and sending unit if it complied with the requirement of this QAI in all respects. Inspector should ensure that any repairs/rectifications carried out on the items are within the acceptable limits and will not impair the performance and also complies the requirements given in this QAI. All samples rejected during the inspection should be punched with the rejection mark (R ↑ mark) distinctly on the bodies of Indicator and sending unit to avoid mixing of the same with the accepted stores.

5.7 Only approved electrical/electronic hardware such as connectors, cables, wires, plugs, sockets, insulation tapes, etc., shall be used for the speedometer.

5.8 Method of Inspection : The inspection requirements and procedure for quality assessment of the item are given below:

S.No.	Description of the test to be carried out	SAMPLING SIZE	
		Pilot	Bulk
1.	Visual Inspection	100%	100%
2.	Raw materials	one set of test bars against each material specn.	Test bars against each material Specn. from each lot.
3.	Production line inspection of individual components	100%	10%
4.	Assembly inspection	100%	10%
5.	Weighment	100%	100%
6.	<u>Performance Tests</u>		
	a) Electrical insulation strength test	100%	10%
	b) Torque test	100%	10%
	c) Basic error test	100%	10%
	d) Additional velocity error test	100%	10%
	e) Odometer error test	100%	10%
7.	<u>Environmental Tests</u>		
	a) Moisture Resistance test	2 Nos.	1 No. per each lot
	b) Cold resistance test	-do-	-do-
	c) Heat resistance test	-do-	-do-
	d) Dust proofness test for Indicator	-do-	-do-
	e) Water proofness test for sending unit	-do-	100%
8.	<u>Dynamic/Endurance Test</u>		
	a) Vibration resistance test	1 No.	1 No. from each lot
	b) Impact resistance test	-do-	-do-
	c) Guarantee life test	-do-	-do-
9.	Checking for plating, painting & varnish coatings	2 Nos.	-do-
10.	Interchangeability test	-do-	2 Nos. from each lot
11.	Fitment/performance trials	1 No.	--
12.	Preservation/identification/packing	100%	100%

6.0 The details of various tests mentioned above are explained below.

6.1 Visual Inspection : The following checks will be carried out on the speedometer Indicator and Sending Unit.

- a) Completion of the assembly as per main assembly drawing
- b) Quality of external finishing/coating
- c) Presence of loose parts/fasteners
- d) Mechanical damages/defects
- e) Correct markings

6.2 Materials : Raw material used in the manufacture of each component shall conform to the specifications mentioned in the relevant drawings. Manufacturer shall make available to the inspector all records pertaining to the raw materials used in the assembly. The raw materials shall be counter checked with relevant specifications. Test specimen and test bars representing the pilot/bulk shall be drawn from the component production line and tested for chemical composition and mechanical properties. Results shall be within the specified limits. Material test specimen for the insulating varnishes, adhesives, insulating tapes, solders and paints, etc., shall be drawn at random and tested at recognised laboratories/text houses.

6.3 Production Line Inspection of Individual Components : Detailed dimensions of all components shall be checked as per the drawing before the assembly. Any special parameters/checks indicated in the drawing like hardness, heat treatment, surface finish, protective coating, dimensional tolerance shall also be checked at this stage. The components shall also be checked for presence of defects like, cracks, dents, burrs, under cuts, etc.,.

6.4 Assembly Inspection : All assemblies shall be checked for dimensions as per the drawing. Any special parameters given in the drawing like hardness, heat treatment, surface finish, protective coating, etc., shall be checked. All assemblies shall be examined for presence of defects like improper assembling, defects in soldering/brazing, loose parts/fasteners, etc.,.



6.5 Weighment : Weight of individual components shall be controlled in such a way that the total weight of speedometer Indicator and sending unit should not exceed the following.

- i) Indicator .. 1100 gms
- ii) Sending Unit .. 550 gms

6.6 Performance Tests : The speedometer should withstand the following performance tests.

6.6.1 Electrical Insulation Strength Test : Electrical insulation of coils and current carrying parts relative to body of speedometer should withstand a test voltage of 250V, 50Hz AC for a duration of one minute without break down or spark over.

6.6.2 Torque Test : Torque at ambient temperature required for putting the sending unit (transducer) shaft into motion (action) should not exceed  $0.06 \pm 0.002$  Nm.

6.6.3 Basic Speed Error Test : Basic error of the speedometer indicator (CΠ-106) pointer, at an ambient temperature of  $+ 20 \pm 5^{\circ}\text{C}$  should not exceed the following.

<u>Numerical Marking on Dial</u>	<u>Max. Basic Error Permitted</u>
60	+ 4
80	+ 5
100	+ 6

6.6.4 Additional Error due to high & low Temperature : The effect of high/low temperatures on the accuracy of the speedometer readings shall be checked as under.

The actual speedometer readings at 60, 80 and 100kmph should be taken at an ambient temperature of  $20 \pm 5^{\circ}\text{C}$ . Then the speedometer shall be placed in a cold chamber at  $-20^{\circ}\text{C}$  and held for one hour. The speedometer readings at 60, 80 and 100 km ph should be taken preferably when the speedometer

is still inside the chamber. If it is not practicable the readings may be taken within 5 minutes of removal from the chamber. The test will be repeated in a hot chamber maintained at  $+40^{\circ}\text{C}$ .

The difference between the original readings taken at  $20 \pm 5^{\circ}\text{C}$  and after keeping in the hot/cold chamber shall not exceed  $\pm 2\%$  of the original reading.

6.6.5 Odometer (distance Indicator) Error Test : The accuracy of the distance indicated by the odometer shall be within  $\pm 0.3\%$  when tested at  $20 \pm 5^{\circ}\text{C}$ .

6.7 Environmental Tests : The speedometer should withstand the following environmental tests.

6.7.1 Moisture resistance test at relative humidity of 98.3% and temperature of  $35 \pm 3^{\circ}\text{C}$  :

The speedometer shall be retained in the humidity chamber for 48 hours.

The speedometers are considered acceptable if after the test they are serviceable and conform to the requirements of basic error test and odometer error test.

6.7.2 Cold Resistance at  $-20^{\circ}\text{C}$  &  $-45^{\circ}\text{C}$  : The speedometer shall be kept in the cold chamber for 3 hours and tested within 5 minutes after removal for basic error test. The speedometer should be functional within 3 minutes of switching on to the power supply and the basic error shall be within specified limits.

6.7.3 Hot Resistance Test at  $+60^{\circ}\text{C}$  for Indicator and  $+80^{\circ}\text{C}$  for Sending Unit :

The indicator/sending unit shall be kept in the hot chamber at specified temperatures for 3 hours. The Indicator/Sending Unit should be removed from the chamber and tested. The instruments shall become immediately operational on switching on the power supply. The basic error shall also be within the specified limits after the test.

6.7.4 Dust proofness test for Indicator (dust in suspended state of concentration  $2 \text{ kg/m}^3$ ): The indicator is kept in the chamber for 4 hours and dust is sprayed. The total quantity of dust sprayed should be  $2 \text{ kg/m}^3$  in the dust chamber of Vol.  $0.5$  to  $1.5 \text{ m}^3$ . After, the indicator is removed and checked visually for ingress of dust. The speedometer is considered acceptable if there are no traces of dust inside and the instrument meets the requirements of the basic error test.

6.7.5 Water proofness test for Sending Unit : One sending unit from pilot batch shall be immersed in water at one meter depth for 30 minutes. Appearance of air bubbles is allowed upto maximum of ten numbers in the first one minute. The remaining samples from pilot batch shall be tested in water for one minute.

6.8 Dynamic Tests : The speedometer should withstand the following dynamic tests.

6.8.1 Vibration Resistance Tests :

(a) for Indicator -  $5g$  and  $50\text{Hz}$  (b) for Sending Unit  $10g$  &  $50\text{Hz}$

The indicator/sending units are tested in about three mutually perpendicular directions. The testing in each direction should be for 2 hours 40 minutes.

Speedometers are considered acceptable, after the test if there are no mechanical damages/defects and they meet the requirements of the basic error test.

6.8.2 Impact Resistance Test :

(a) for Indicator  $10g$  and  $80 - 120$  impacts/minute

(b) for sending unit  $15g$  and  $80 - 120$  impacts/minute

The test shall be carried out for 10000 impacts. After the test, there shall not be any mechanical damages and the instruments shall conform to the requirements of basic error test.

6.8.3 Endurance Test for 500 hours : The speedometer shall be tested for 500 hours at the specified voltage, viz., 27  $\pm$  10% as per the sequence given below.

<u>Speedometer Reading</u>	<u>No. of Hours</u>
10 km ph	20
20 "	20
30 "	20
40 "	20
60 "	10
80 "	10

Five cycles as above totalling 500 hours shall be completed. After every five hours, the testing can be stopped temporarily to enable cooling of the speedometer and test equipment. After completion of the test, the speedometer shall be functional and shall meet the requirements of the basic speed error test and odometer error test.

6.9 Checking for Plating, Painting & Varnish Coatings :

The speedometer is considered acceptable, if components/assemblies of Indicator and Sending Unit do not have traces of corrosion and peeling of coatings after the tests.

6.10 Interchangeability: A sample each of sending unit and indicators, selected at random will be subjected to performance tests mentioned at para 6.6 above and should conform to the values specified.

6.11 Fitment/Performance Trials: One sample of speedometer (Indicator and sending unit) shall be fitted in the vehicle and its performance is checked (monitored during a run of 500 KMs. The speedometer (pilot sample) should be comparable with Soviet item.

6.12 Preservation/Identification/Packing: Plating, painting and protective coating shall be carried out as per the specifications quoted in the relevant drawings. The following identifications shall be inscribed on the speedometer.

- a) Manufacturers trade mark
- b) Conventional, designation of speedometer
- c) Date of Manufacture (month & year) & serial No.
- d) Technical specification No.
- e) Inspection mark

Each sending unit and Indicators are wrapped with a moisture proof paper, separately, and placed in an individual card board boxes. These card boxes are then packed in a wooden or ply wood boxes. A label indicating the following details shall be pasted on the Box.

- a) Manufacturer's trade mark
- b) Speedometer type i.e., CQ-106
- c) Date of manufacture (month & year)
- d) No. of speedometer
- e) Supply Order No. & Date
- f) Technical specification No.
- g) Inspectors Mark
- h) Consignee

6.13 Guaranty: The manufacturer has to furnish the following certificate. " The guaranteed life of speedometer CQ-106 is (2 times the guarantee period of engine) 1000 operating hours of operation on the vehicle"