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English translation of a Russian-language manual entitled Aeronavigational Navigator's Drift Indicator AB-52 50X1-HUM (Aeronavigatsionnyy bortovoy vizir shturmana AB-52)

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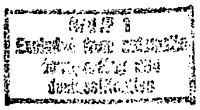
AERONAVIGATIONAL

NAVIGATOR'S

DRIFT INDICATOR

AB-52



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I. Designation and Operating Principle

The Aeronavigational Navigator's Drift Indicator AB-52 (Fig. 1) is designated for inflight determination of the following:

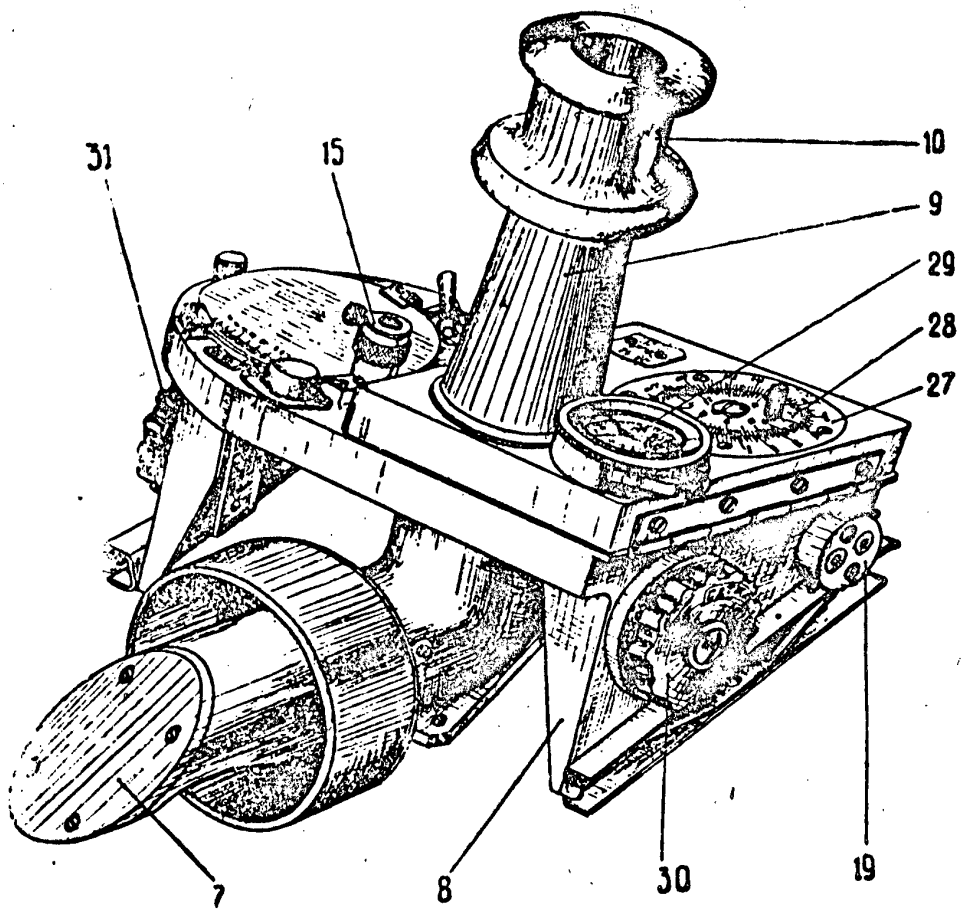

Fig. 1

1) average values of drift angles;
2) average values of ground speed;
3) deviation of aircraft's compass, which can be corrected in flight if necessary.

According to its construction and operating principle, this indicator should be classified as an optical, rigidly attached navigator's drift indicator.

Determination of drift angles is performed directly by measurement of the angle formed between the axis of the aircraft and the direction of its movement. Determination of ground speed is based on measuring the time (with a stopwatch) the aircraft takes to cover a course equal to the optical baseline of the indicator. Inflight determination of deviation in the aircraft's compass is based on comparing the magnetic and compass courses of the aircraft, wherein the aircraft's compass course is determined with the indicator through ground reference line whose magnetic bearing is either known or may be determined from the map.

II. Parts Assembly

The parts assembly of the indicator includes:

1. Aeronavigational drift indicator.....1 each
2. Indicator bracket.....1 "
3. Mounting units.....1 set
4. Stopwatch (on the cover of the indicator).....1 each
5. Description.....1 copy
6. Nameplate.....1 "
7. Parts list (on box cover).....1 "
8. Photograph of installation (on box cover).....1 "

III. Description of the Drift Indicator

A basic element of the indicator is the optical system (Fig. 2) consisting of objective 1, two mirrors 2 and 3, intermediate lens 4, grid 5, and ocular 6. The indicator is equipped with a device for determining drift angles which includes a pantograph and two concentric disks. In addition, a flight computer is located on the cover of the indicator which is used to find the flight speed according to the true altitude and the time for the aircraft to cover the base line of the range finder.

Objective 1, mirrors 2 and 3, intermediate lens 4, and the grid 5 are mounted in the metallic tube of periscope 7 (see Fig. 1) which is fastened to cast base 8 of the indicator. Ocular 6 (see Fig. 2) is mounted in cast tube 9 (see Fig. 1) which is secured by hinges to base 8. On the end of tube 9 is placed protective annular cushion (eyepiece) 10 made of soft rubber.

Visible through ocular 6 (see Fig. 2) are four parallel lines 11 (Fig. 3) of the grid called "drift lines"; these lines are intersected

at their edges by two "time lines" 12, and by two lines 13 in the center, which are auxilliary lines used for determining deviation during flight.

Stopwatch 29 (see Fig. 1) is mounted on the hinged cover of the indicator and is used for finding the flight time when determining ground speed.

Pantograph 14 (see Fig. 3) is located inside the metal cover of the indicator which serves as a base for tube 9 (see Fig. 1) of the ocular. The pantograph consists of the system of hinged levers 14 (see Fig. 2) equipped with stylus holder 15 and pointer 16, visible on the grid background of the indicator when viewing through the ocular.

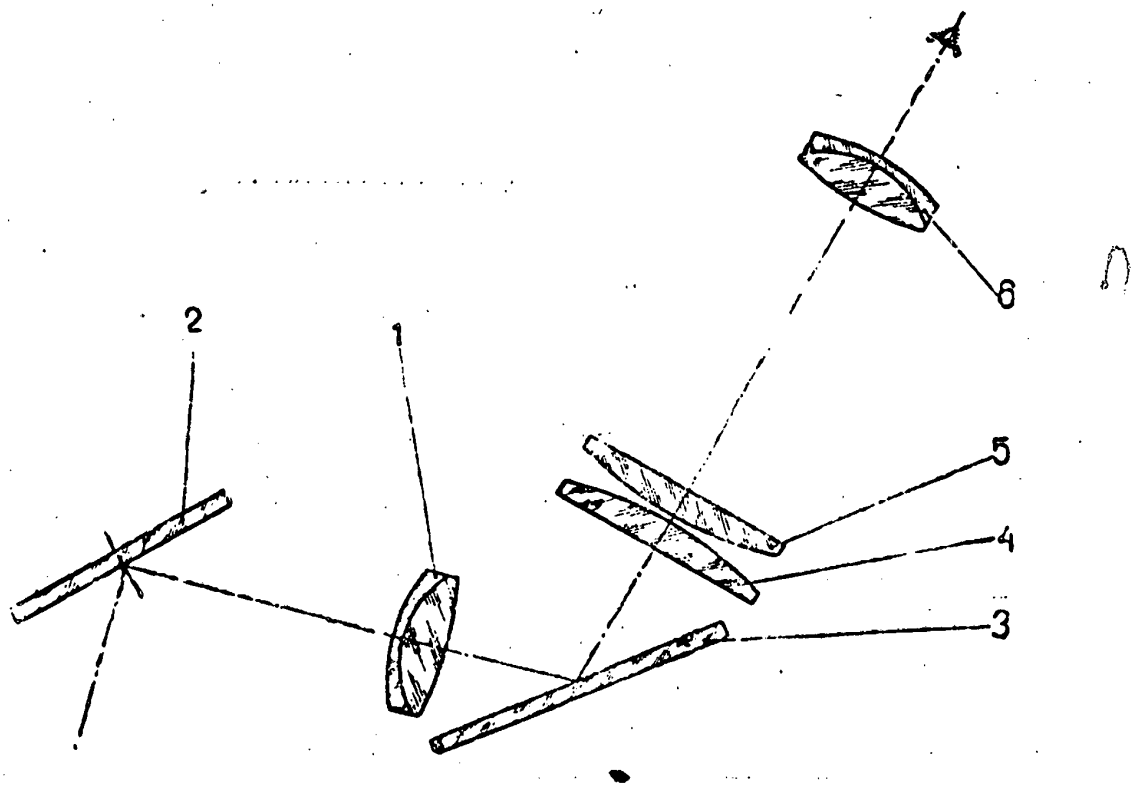

Fig. 2

The end of pointer 16 is coated with a luminescent substance which facilitates using the indicator in night flights.

For the same purpose drift angle scale 25 and index 26 are illuminated with lamp 32. The lamp is assembled from the lower side of base 8 (see Fig. 1). The lamp is protected with a shade on the side adjoining index 26 (see Fig. 3).

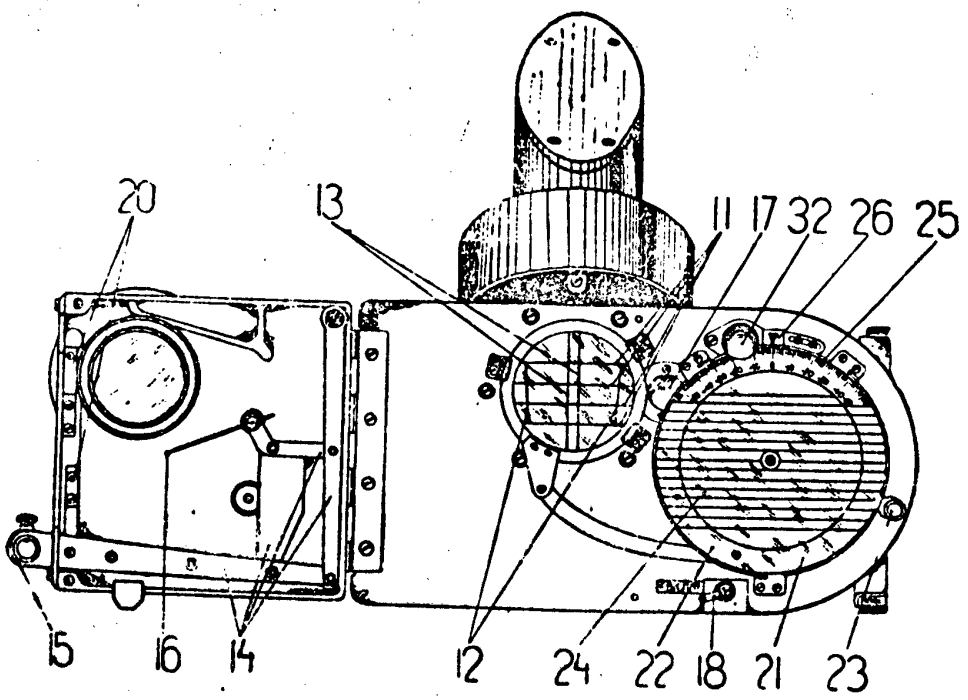

Fig. 3

The intensity of illumination of scale 25, lines 24, and index 26 is regulated with rheostat 31 (see Fig. 1).

When viewing through the indicator, lamp 32 (see Fig. 3) should be turned off and is turned on only when it is necessary to take readings from the drift angle scale 25, since the light from the lamp may fall on the grid of the indicator and interfere with the observation.

For working with the indicator in night flights, grid 5 (see Fig. 2) is illuminated with lamp 17 (see Fig. 3), and to enable working with the indicator on weakly illuminated reference points and to eliminate

light flashes observed in the field of vision, there is a red light filter located in the housing of the indicator between the lamp and the grid. The intensity of illumination is regulated with rheostat 30 (see Fig. 1). Turning lamps 17 and 32 (see Fig. 3) on and off may be done with master switch 18, or individually with rheostats 30 and 31.

The base of the indicator has connector 19 (see Fig. 1) for connecting the indicator with the aircraft circuit.

Under the pantograph stylus are located two concentric disks. Upper transparent disk 21 (see Fig. 3) is stationary and the stylus of the pantograph moves on it. Lower disk 22 rotates about its center and is kinematically connected with the grid of the indicator.

To increase the moment of friction between drift angle disk 22 (see Fig. 2 [sic]) and base 8 (see Fig. 1) the disk is seated rigidly on an axle by which it is pressed against the base with a flat spring, mounted on the lower side of the base.

Knob 23 fastened on disk 22 serves to rotate the grid and disk 22. On the surface of disk 22 are 15 parallel lines 24 and scale 25 which has divisions and numeration to 55° for reading, according to stationary index 26, the values and directions (±) of drift angles. Angles of right drift are designated with a plus sign (+), and angles of left drift with a minus (-) sign.

The flight computer on the cover of the indicator consists of two annular logarithmic scales. The logarithmic design of the scales permits multiplying or dividing the scale numeration by 10 to establish the necessary data. On outer stationary scale 27 (see Fig. 1) are inscribed altitudes (or ground speeds).

By multiplying the numeration by 10, it is possible to obtain any altitude from 100 to 9000 meters.

Example. If the base line time measurement was 1 minute 30 seconds, it is necessary to reduce the time to seconds (which will be equal to 90 seconds) and set the altitude of flight opposite 9.

On inner movable scale 28 are inscribed seconds. By multiplying the numeration by 10, it is possible to establish seconds greater than 45.

The speed of the aircraft is determined on outer, stationary scale 27 by markings inscribed on inner disk 28 in km./hr., m.m/час (nautical miles per hour), and in a.m/час (English miles per hour).

Note. A nautical mile equals 1.85 km. An English mile equals 1.61 km.

The indicator is secured in the aircraft with a special bracket.

IV. Basic Technical Specifications of the Drift Indicator

1. Drift angle measurement limits..... ±30°
2. Course angle measurement limits..... ±55°
3. Ground speed measurement range..... 100-900 km/hr
4. Field of view, minimum..... 30°
5. Range finder base line..... 0.5H (H = alt in m)
6. Rated voltage for lighting of indicator..... 27 v
7. Dimensions of indicator with bracket (with guides in horizontal position..... 282 x 335 x 280 mm (wdth x lgth x hgt)
8. Weight of indicator:

   a) without bracket, with power cable..... 2.7 kg
   b) with bracket, power cable and mounting units..... 3.3 kg

V. Operating Instructions

A. Installation of the Drift Indicator

The drift indicator is mounted in the navigator's compartment, on the right side of the aircraft. The basic requirements for installation to provide normal operation of the indicator are as follows:

1. The plane passing through the lower runners of the base of the indicator should be horizontal.

2. When aligning the 0 of scale 25 (see Fig. 3) on disk 22 with index 26 of line 24 of disk 22, and consequently also "drift lines" 11, the grid lines of the drift indicator should be parallel to the longtudinal axis of the aircraft.

3. The height at which the drift indicator is to be installed above the compartment floor should be selected, on one hand, so as to provide for facility of operation with the indicator and, on the other hand, so that the side covering of the aircraft would not fall into the field of view of the indicator (installed too high).

Prior to installing the drift indicator the aircraft is positioned in a level-flight attitude on a horizontal platform (wings level).

The fasteners for the bracket are installed and the bracket is adjusted in them so that the plane formed by its guides is horizontal (checked with a level). The drift indicator is installed in the bracket and simultaneously the position of the rubber collar on the objective tube is adjusted so that it [the rubber collar] comes in full contact with the skin of the fuselage.

On the ground beneath the aircraft a string is stretched in such a way so that it is parallel to the longitudinal axis of symmetry

of the aircraft and is in the field of view of the drift indicator. The zero division on scale 25 is aligned with index 26 using knob 23 and the adjustable screws fastening the indicator to the side, and, if necessary, by adding spacers under these adjustable fasteners so that "drift lines" 11, visible on grid 5 (see Fig. 2), are parallel to the string stretched on the ground.

The levelness of the plane formed by the guides of the bracket is checked again with a level. It is checked to see that the side covering of the aircraft or any other of its parts do not fall into the field of view of the drift indicator. The power cable for lighting the indicator is plugged in to the indicator and the aircraft electrical circuit.

This completes the installation of the drift indicator.

B. Handling Instructions

1. When the drift indicator is not being used the pantograph should be positioned on the lower rest and firmly secured by holder 20 (see Fig. 3).

2. Care should be exercised that no hard objects strike the indicator.

3. Do not use excess forces when using the indicator and when packing it in its box.

4. Clean the external optical parts carefully with the tissue provided with the unit.

5. The hinged cover with tube 9 (see Fig. 1) should not be opened in such a way that it will strike the rheostat since the cover of the rheostat is made of carbolite and the rheostat can be damaged.

6. When changing the light bulb it must be checked to see that there is no excess of solder on the bulb base, otherwise, when screwing in the bulb the sliding contact will seize in the solder and the bulb will not screw in completely.

C. Preflight Checking and Readying of the Drift Indicator

Prior to every flight the following must be done:

1. Check the surfaces of the grid, ocular, objective, and the mirror in the objective elbow of the indicator.

If they are dirty, wipe them carefully with a soft cloth (do not use paper or chamois as these might damage them). Wipe off the surface of the transparent disk below the stylus of the pantograph.

2. Check for proper illumination of the grid and drift angle scale.

3. Check to see that the bracket of the indicator is firmly secured to the fuselage.

4. Check and fasten the stylus in the clamp on the pantograph.

5. Test the stopwatch.

D. Operating the Drift Indicator in Flight

a) Determining the Drift Angle

While looking into the ocular of the drift indicator and checking the relative movement of the ground, turn the grid together with disk 22 by means of knob 23 (see Fig. 3) and set it so that "drift lines" 11, which can be seen through the ocular, coincide with the direction of movement of the ground references. Then index 26 will point out on scale 25 the magnitude and direction of drift ("plus" indicates drift to the right and "minus" indicates drift to the left).

In actual practice, due to yawing of the aircraft and continuous changes in the speed of the wind the angle of drift also changes within known limits. Therefore using the procedure indicated above it is possible to determine only instantaneous values for the angle of drift. Determination of averaged angles of drift with the indicator consists in the following. While observing the surface of the ground through the ocular, the pantograph mechanism is moved by the stylus until the end of pointer 16 coincides with some ground reference and then these are held in this matched position for the time it takes the reference to move through the field of view of the indicator. In the meantime light pressure is applied to the stylus which traces the line for the actual direction of movement of the aircraft. Several of such lines can be drawn to achieve higher accuracy. Afterward, disk 22 is turned so that lines 24 on it are parallel to the lines traced by the stylus on disk 21 and then the magnitude and direction of the angle of drift [sic] is read off scale 25 as shown by index 26.

b) Determination of Ground Speed

In order to find the ground speed using the drift indicator it is necessary to know the true altitude of flight over the locality and the aircraft must be in level flight.

The following must be done:

1. Measure the angle of drift by one of the methods indicated above.

2. Align the corresponding division on scale 25 with index 26 and, while looking through the ocular of the indicator, find with use of the stopwatch the time it takes any ground reference to cover the distance between the "time lines" 12 on the grid of the indicator.

3. On a flight computer set the mark, which corresponds to time found with the stopwatch (in sec), opposite the division corresponding to the true altitude of flight in meters, and find the value for the ground speed in km/hr on the outer scale opposite the mark which is noted in km/hr or in nautical miles per hour (units), opposite the mark noted in m.m/час [nautical miles per hour], or in English miles per hour opposite the mark noted in a.m/час [English miles per hour].

c) Checking Compass Deviation

To determine deviation in the aircraft's compass for any given heading, the course angle in horizontal flight is compared with a ground reference line, whose magnetic bearing is either known or can be determined from the map (such as a railroad, highway, etc.). For this purpose knob 23 is used to move "drift lines" 11 on the grid to coincide with the direction of the selected reference line; if scale 25 shows a deviation in the direction of positive drift angles by pointer 26, the course angle may be read on scale 25 from 0 to 55° (or from 180 to 235°). If scale 25 shows deviation in the direction of negative drift angles, the angle as shown by pointer 26 will be supplemental to 360° (or 180°). Lines 13 of the grid may be used if necessary to determine the course angle by also lining them up with the direction of a ground reference line. Now, when scale 25 shows a deviation in the direction of positive drift angles, 90° should be added to the reading of scale 25 to determine the course angle. If scale 25 shows negative deviation, the angle on scale should be subtracted from 90° to determine the supplemental angle (up to 360°).

The magnetic heading MK of the aircraft is found from the known course angle KU and the magnetic bearing MP:

$$MK = MK - KU,$$

whereby the sought compass deviation is equal to

$$k = MK - KK,$$

where KK is the compass course of the aircraft.

VI. Maintenance

After a minimum of two or three flights, the shaft of the pantograph and connecting rod, as well as all other moving parts of the indicator, should be lubricated with oil MVP.

After a minimum of 50 hours of flying time, it is necessary to do the following:

a) check the condition of the pantograph. To do this, one should first align 0 on scale 25 with pointer 26 and then trace out on disk 21 with the stylus of the pantograph the direction of one of the "drift lines" 11 of the grid. If the traced line deviates from the direction of parallel lines 24 on disk 22 by more than 1°30' (check with scale 25), the indicator is not suitable for use and should be sent to repair;

b) check the installation of the indicator in the aircraft (see part V.).

VII. Storage, Packing, and Transportation

Up to installation in the aircraft, the drift indicator should be stored in the case in accordance with instructions on storage of property in technical depots for aviation equipment.

The indicator is transported in the packing case.

On long trips, the packing cases with the indicators are transported in a special box. A warning notice must be put on the box.