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STEREOMARKING INSTRUMENTS DSI-T AND NT

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ABSTRACT: Efficient use of stereomarking instruments according to the methods and volumes of topographic map production is discussed in the paper. It presents specifications and design features of stereomarking instrument DSI-T and NT now in use for photogrammetric purposes.

Development of compilation and revision of topographic maps based upon aerial surveying data requires further perfection both the points "artificial" marking technique and technical means for the marking procedure. Due to the volumes and nature of the productional works and economical efficiency considerations technical specifications of a marking instrument are to be determined. To produce huge volumes of analytical densification of geodetic control network made on equal scale programs comparatively simple and low cost stereomarking instrument DSI-T has been developed and put in production use. In large scale mapping and compilation of the photoplans with large enlargement factor efficiency of the stereophotogrammetric method may be increased significantly when air photos with different scales are to be used.

At present the air photo scale ratios of 3-5 times are employed in mapping production. These ratios will be grow with further improvement of the air photo quality and will reach an pptimal level of 10-15 times. When topographic map revision is done and super low scale photos are used it is nesessary to process air photos with large differences of the scale factors. For these works the stereomarking instrument NT has been developed and put in production. Its cost is 2,5 times higher as compared to DSI-T. When production volumes are too great it is useful to employ DSI-T instruments for all the procedures of the map compilation and revision with equal scale photos. However for all technological schemes based upon different scale aerial photos it is reasonable to use NT-type stereomarking instruments.

General view of DSI-T is shown at the fig.1.

DSI-T is a stereocomparator in which the two photos 1 are moved on the common carriage along x - x axis with the help of the wheel 2. The right photo has parallactic movements Δx and Δy, made with the use of the micrometer screws 3. Some optical elements of the viewing system, the units with lighting sighting marks 4, and marking devices 5 are placed on the common carriage, which is capable to move along y - y axis with the help of the wheel 6. Format of the processed photos is 18x18 cm.

The principal feature of the DSI-T is rigid connection of the sighting marks with the marking devices. This feature has made it possible to exclude high requirements for the guides and ball-bearings quality and to simplify the instrument production and to reduce its cost as a result.

Observations are made through the oculars 7. Control panels 8 are mounted on the stage which comprise buttons and tumblers for switching different units of the instrument. The binocular head has rotational plate for the photos with geodetic control points. Field points on the photos are observed through magnifying glass with 8^x enlargement. The plate may be reversed on 180^o and field description of the control point may be read, which enable us to identify and to mark the point on the processed imagery. DSI-T has a device 10 for searching marking areas. It consists of the projector connected with sighting unit and a small table mounted on the x-carriage of the instrument.

If the photo with drawn zones, in which the points have been selected and marked, is placed on the small table parallel to left working photogram, light index of the projector may be entered into outlined area and simultaneously both sighting marks will be placed in according zones on the working photos. DSI-T binocular optical system has magnification 8^x and lighting measuring marks represented as dots of 40 μm diameter.

Artificial marking the points is carried out by the marker of mechanical type equipped with the heat stamp. Marking device 5 is placed between the lens and the photo carrier. To make the mark the marking device (by rotation about vertical axis) is entered in the field of view and is fixed by means of electromagnet. Procedure of fixation is made such a manner that geometrical axis of the heat stamp is fitted with projection of the sighting mark. The operation of marking device is automated and is controlled with the help of buttons on the plate 8.

The marked points are represented as a circle of 80 μm diameter or a ring with a dot in the centre of the ring. The ring of 2 mm diameter carries identification function, the dot diameter is equal to 30 μm. The former sign is used for negative point marking when the photos with large magnification factor are to be rectified, the latter one— for aerial phototriangulation. The instrumental precision of DSI-T is about 5 μm.

General view of stereomarking instrument NT is shown at Fig.2. As distinct from DSI-T NT has possibility to move only the photograms. The instrument is capable to process the photo format up to 30x30 cm. The base of the instrument consists of two boxes 1, the stage 2 is founded on the boxes. On the stage a console is mounted which carries binocular viewing system 3 and marking devices with the heat stamps 4. The photo carriers 5 are placed on the coordinate carriages, moving along X ,Y axes of the instrument. The photo carriers have both independant and combined movements. Singular displacement for each of photocarriers is made with the help of the lever 6. There are two buttons on the lever for switching the proper electromechanical clamping device providing free movement of the carriage along the guide. Such an arrangement permits to move the photo carriers quickly and provides the high productivity of the work. The levers 7 are used for the photo movement during stereoscopic observation, rotation of the levers provides micrometric displacement of the photo carrier. Micrometric drives of each coordinate carriage X_l, X_r and Y_l , Y_r are kinematically connected with the sensors 8,which convert linear displacements into digital form. The sensor are joined in pairs (X_l, Y_l ; X_r, Y_r) to digital panel 9, where the results of stereoscopic sighting are displayed.

If necessary (for example, when the points on equal scale photos of the plane terrain are to be marked) the coordinate carriages of the instrument may be rigidly connected together with the help of special device. As a result the carriages have a possibility to move along X,Y axes as a whole, as it is done in stereocomparator.

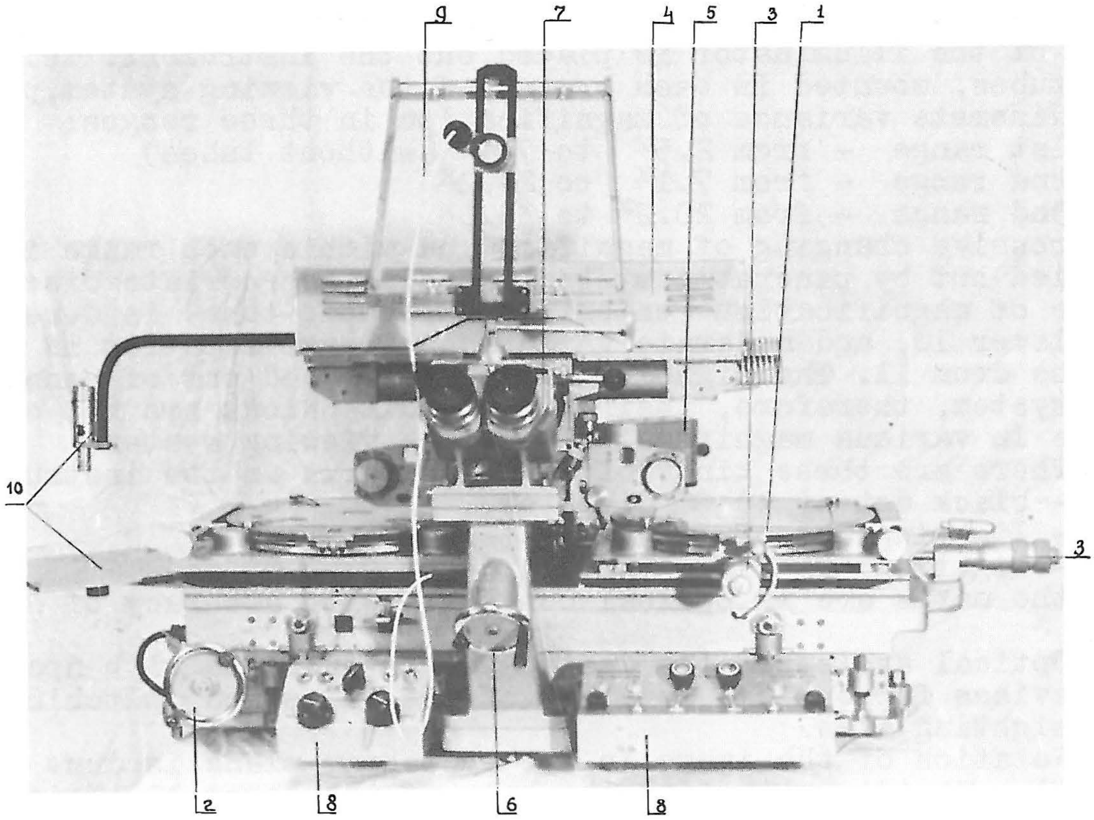

Fig.1

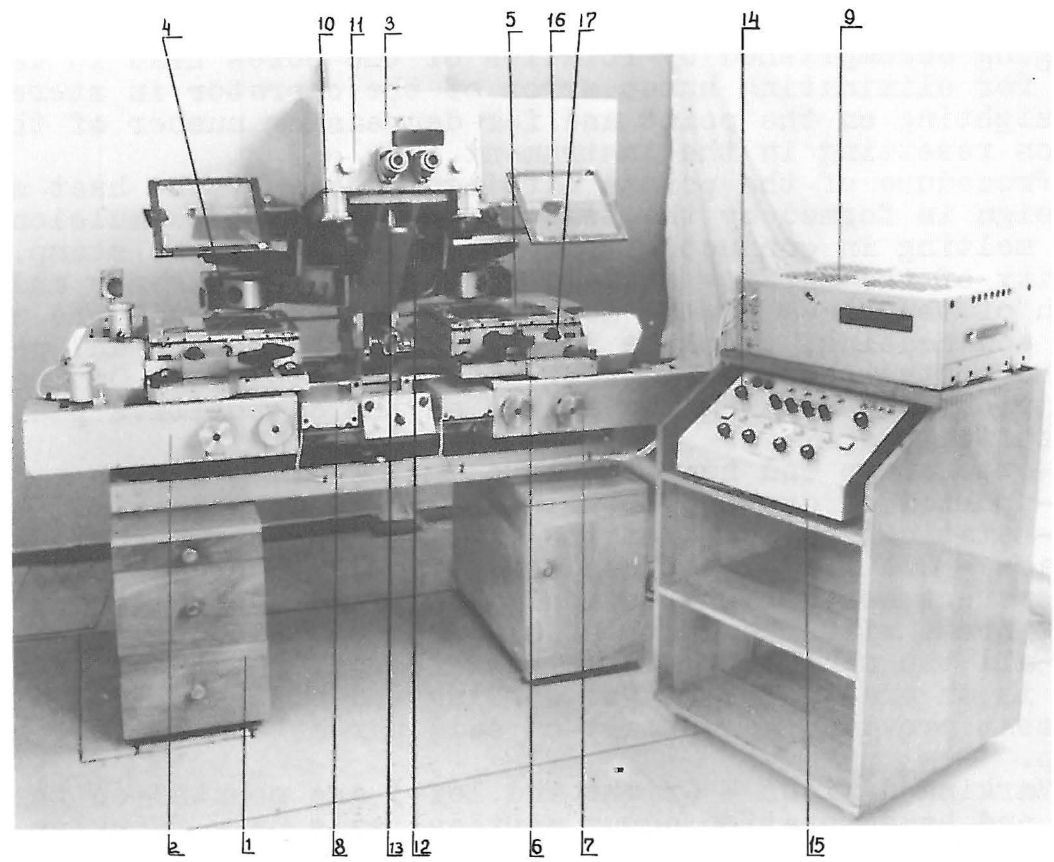

Fig.2

Viewing system is a stable binocular microscope. The photos are illuminated by special light-forced illuminator, the lamp of the illuminator is placed out the instrument. Telescopic tubes, mounted in each branch of the viewing system,permit discrete variance of magnification in three renges:

1st range - from 2.5^x to 7.1^x (without tubes)
2nd range - from 7.1^x to 20.2^x
3nd range - from 20.2^x to 35.6^x

Progressive changing of magnification within each range is carried out by pancratic system. Setting appropriate discrete range of magnification (entering telescopic tube) is done by the lever 10, and moderate variation of magnification is done by the drum 11. The sighting marks are placed out of pancratic system, therefore, their visible dimensions are not changable in various magnifications of the viewing system.

There are three kinds of sighting marks in the instrument:
- black dot of 40 μm diameter,
- lighting dot of 50 μm diameter,
- lighting angular with to sides 2.0 x 0.05 mm.

All the marks are in optical conjagate with accuracy of 0.001 mm.

Optical system of the instrument is equipped with necessary devices for optical rotation of the image and switching the sighting axes.

Rotation of the image in the photogram plane is done by rotating Shmidt prism with the help of the lever 12. This rotation is needed for obtaining stereoscopic vision and improving accuracy to remove vertical parallaxes by means of converting them into horizontal parallaxes. The sighting axes changing accomplished by rotation of the screw head 13 is used for eliminating human error of the operator in stereoscopic sighting on the point and for decreasing number of the photos resetting in the instrument.

Procedure of the points marking is done by the heat stamp. The sign is formed by the heat stamp due to photoemulsion coat melting in conjuction with working end of the stamp. Quality of the marking sigh (the bottom transparency and width of the black frame) depends on temperature of the working end heating, pressure force on the photogram, and period of the contact between working end and photolayer. Optimal conditions for marking the points on the diapositive plates are as follows:
- the stamp end heating up to 90-100°C;
- period of contact between stamp and photolayer-0.3 sec;
- statical pressure of the working end on the photogram surface - 0.1 N. Under these conditions the marking sign has transparent bottom with optical density 0.2 D outlined by black frame with the width of 0.2-0.3 to the bottom size. When all the mentioned parameters are fulfilled the marking sign is an exact copy of the working end of the stamp. NT instrument provides adjustment of said parameters for the heat stamp.

Marking devices 4 (right and left) are mounted on the console and have rotation about vertical axis only. Working position of the marking device is fixed by electromagnet. To the sighting mark with the centre of the marking sigh,recorded on the photo by the heat stamp, the first lens of the optical instrument system should be moved. The particular feature of the marking device used in NT is that operational procedure provides necessary protection of the heat stamp working end from blunting, stability of the contact durality between the stamp and photo emulsion coating, and uniform pressure of the stamp on the photo surface. Operation of marking device is carried out according program generated by the cam gear. The puncheon lifting up and down has 10 mm/sec speed, but being 0.4-0.5 mm from the surface of the photogram the speed is decreased up to 0.5 mm/sec. Total cycle of the marking device operation is equal to 2.5 sec. When the stamp is joining to photolayer electronic unit is switched on automatically and provides monitoring the momentary heating of the working end. Temperature changing for heating the stamp working end is done by adjustment of strength of the connected current. The current adjustment in the range of 5 - 50 A is accomplished with alternating resistors 14 placed on the control panel 15. Pressure force of the stamp working end on the photogram surface depend on physical and chemical properties of the photolayer and is adjusted by marking device spring.

The heat stamp consists of the carrier and interchangeable working tip. The carrier has cone-chaped axis for its mounting in the puncheon and two current cables.

Complete set of the instrument contains three kinds of the working tips providing the following marking signs:

- a circle of 0.08-0.10 mm diameter;
- a ring of 2.0 mm diameter with the dot of 0.030-0.035 mm diameter in the centre of the ring;
- a brocken cross of 2.0 mm length with side dimensions 0.7×0.04 mm.

To increase operational productivity in processing different scale photos NT has been equipped with device for searching marking zones which consists of a screen 16 and an optical projector 17 for displaying luminous index at the screen. A copy of the photo which has been set in the photocarrier is located at the plexiglass screen. The optical projector is mounted at right angle to bisector of the angle between the planes passing through the photocarrier 5 and searching screen 16. As a result the luminous index of the projector and the measuring mark of the instrument will show the same points. Flattening the photos on the film base is done by local clasp device. It consists of the spring gear which provides contact of the clasp ring with film base under given pressure force; diameter of the clasp is equal to the field of view diameter of the viewing system.

The instrumental precision of NT obtained from results of marking the crosses of the check grid copy is determined with errors of 2-3 μm.