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INFRARED COMPLEX

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SUMMARY: Infrared complex consists of IR system with the relative aperture 1.278 : 1, angular field of view 2.65 angular minute and IR system with the relative aperture 10 : 1, angular field of view 2 angular second, assembled on the alike equatorial assemblings.

1. INFRARED SYSTEMS

For the study of background radiation sky and astronomical objects of natural and artificial origin is designed, considering given [1, 2], and made infrared (IR) complex, optimized on spectral region 2-6 μm. Complex consists of two IR systems, assembled on the alike equatorial assemblings: azimuthal corners 0...360^0; corners of rise -7... +90^0; accuracy of reading on the azimuth and on the corner of rise 0.1^0; velocity of laying (under two turns fly - wheel at a second) on the azimuth 48^0· sec $^{-1}$ and on the corner of elevation 31.5^0 · sec $^{-1}$

Providing connection of electromechanic drive with velocities of scan on the azimuth and corner of elevation 0.5, 1, 2, 3, 6^0 · sec $^{-1}$.

As detectors in IR complex is used: lead sulfur photoresistor PbS (working temperature (T) 195 ... 300 K, area of the detector (A_d) 0.4 × 0.7, 0.7 × 0.7, 1 × 1 mm); lead tellurium photoresistor (T 77 K, A_d 0.7 × 0.7, 1 × 1 mm); indium antimony photodiode and photoresistor (T 77 K, 195 ... 300 K, A_d 0.1 × 0.1, 0.7 × 0.7, 1 × 1 mm).

Investigation spectrum regions stand out by means of the set of band and interference light filters.

1.1. INFRARED SYSTEM 1

Base IR system (refer to Fig. 1) forms a mirror objective with the focal length 639 mm, relative aperture 1.278 : 1, angular field of view 2.65 angular minute. It presents itself demountable frame a body with reinforced in him main parabolic, having hole in the centre, mirror 1 diameter 500 mm and focal length 639 mm and flat mirror 2 diameter 260 mm. Circle of diffusing objective ≤ 0.8 mm. Focusing of objective is realized for distances from ∝ before 6 м by moving a detector along main optical axis of objective with the help of planting rings or with the help of the screw mechanism. In construction of optical instrument system are provided for temperature compensators for of temperature clearances compensation both in the diametrical section , and along optical axis.

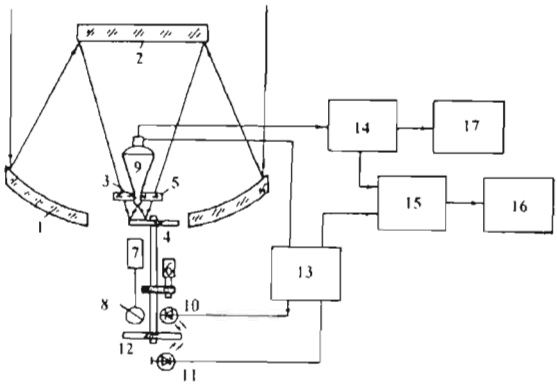
As guide was used mirror - lens telescopic objective of type MTO - 1000 with the focal length (1084 ± 16) mm, relative aperture 10.5 : 1, corner field of vision 2 ^{0} 30 ', permit in the centre 28 line / mm, on the field 16 line / mm.

Optical system with guide, lifting mechanism, pointers of corner of rise and azimuth mounted on the rotary platform that allows to direct at objective on any of a firmament area.

Principle of action IR system in the analog mode of measurement is illustrated Fig. 1. Optical system 1, 2 takes a flux of radiation from the sky and directs its on the detector

3. On way of flow of radiation is situated mirror modulator 4, insulated from the air space of objective by means of mount with the removable defensive window 5 from LiF or BaF_2 and provided in the rotation by the motor 6. Hereupon detector alternately takes a flow of radiation from the sky or from the black body 7, herewith is simultaneously realized comparison of flows and their inflection with the frequency 160 ... 960 Hz. Temperature of black body is controled by the arrowshaped instrument 8.
Detector works out an electrical signal, amplitude which proportional differences of flows of radiation from the sky and black body. This signal enters in the input circuit of preamplifier 9.

Structure scheme of the IR system



1, 2 - an optical system; 3 - a detector; 4 - a mirror modulator; 5 - a defensive window from LiF (BaF_2); 6 - a motor of mirror modulator and obturator ; 7 - a black body; 8 - a temperature indicator of black body; 9 - a preamplifier; 10 - a photodiode; 11 - a light - emitting diode; 12 - obturator; 13, 14 - amplifiers; 15 - synchrodetector; 16 - a grapher or personal computer; 17 - an oscilloscope, electromagnetic oscillograph, measuring tape-recorder or personal computer.

Fig. 1

Generator of synchronous voltage works on the principle of optical contact. It consists of the photodiode 10, light emitting diode 11 and, placed between them, revolving obturator 12. Obturator 12 on its form absolutely similar mirror modulator 4, but has smaller sizes. Surface obturator is showed black from both sides. Due to the fact that obturator is fastened on one axis with the modulator, they revolve synchronous and photodiode 10 works out pulses of voltage, frequency of repetition which strictly corresponds a carrying signal frequency. Diameter of holes in the disk obturator cosiderably exceeds a section of light flow of light - emitting diode 11. So form of generating pulses close to rectangular.
Necessary correlation of phases between synchronous and carrying signals is installed by the way of mechanical moving an optical sensor comparatively obturator 12.
Supporting voltage enters in the amplifier 13 and from it in synchrodetector 15 and in the input preamplifier circuit, where is subtracted from the voltage of signal, worked out by the detector. This operation it is required for removing from the signal, worked out by

the detector, greater its part, stipulated by the significant difference of temperatures of black body and average temperature of the sky, investigation surface or background. Amplitude and phase of compensation voltage, entering in the preamplifier, is adjusted in the amplifier 13 such thus that compensation was possible more packed. Naturally that operation of compensation possible and not to use, if in this there is no need to.
Difference signal is intensified in the preamplifier and enters in selective amplifier 14. On the grapher 16 signals enters after synchronous detectoring in the block 15. Oscilloscope 17 serves for observing a signal at the compensation, checking a voltage of compensation and checking of a value of reinforcement of signal.
For writing a signal, instead of the oscilloscope 17, to leaving an selective amplifier 14 possible connect electromagnetic oscillograph or measuring tape-recorder.
For processing a signal is provided also connection through corresponding plug-in cards personal computer to exit a selective amplifier 14 and synchrodetector 15.
Power supply the electronic blocks 14-17 is produced from network of alternating current 50 Hz, 220 V. Power supply the rest blocks is realized from the unit of type ALA-1.5-M, giving alternating current 427 Hz, 115 V, and power sources of direct current of type B5-47.
By work IR system in the mode of measurement a card or photons a motor of mirror modulator and obturator is switched off and mirror modulator stops and is fastened by means of the special fixative in such position, when on the detector is directed a flux from the sky or investigation object.

1.2 INFRARED SYSTEM 2

Base IR systems (refer to Fig. 2) form two alike mirror objective with the focal length 2025.2 mm, relative aperture 10 : 1, angular field of view 2 angular second.
Each from objective consists of: spherical concave mirror 1 diameter ∅ = 220 mm with the hole in the centre (hole is intended for the conclusion of optical radiation on detector) and radius of curvature R=2089.0 mm, spherical convex mirror 2 ∅ = 80 mm and R=1629.3 mm; demountable frame for fastening a concave mirror; arm for fastening a convex mirror; housing and cover; mount for fastening detector. Mount of detector can move in mutually perpendicular directions within 5 angular minute by adjuster screws. In construction of optical instrument system are provided for temperature compensators for of temperature clearances compensation, both in the diametrical section, and along optical axis.
As guide was used mirror - lens telescopic objective of type MTO - 1000 with the focal length (1084 ± 16) mm, relative aperture 10.5 : 1, corner field of vision $2^{0}30'$, permit in the centre 28 line / mm, on the field 16 line / mm.
Optical system with guide, lifting mechanism, pointers of corner of rise and azimuth mounted on the rotary platform that allows to direct at objective on any of a firmament area.
Principle of action IR system is illustrated Fig. 2. Optical system 1, 2 takes a flux of radiation from the sky and directs its on detector 7. On way of radiation flux is situated optical elements 3 - 6.
Detector (D) works out an electrical signal, amplitude which proportional flux of radiation from the sky.

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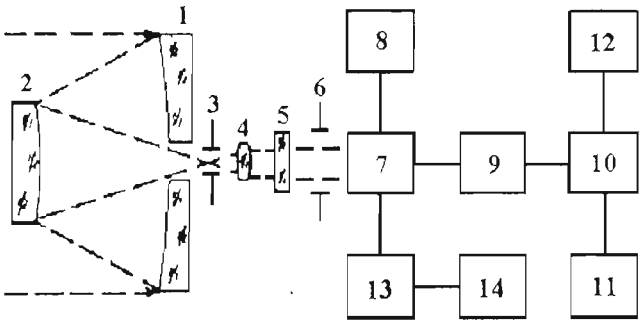

1, 2 - an optical system; 3 - a block of removable diaphragms (with the modulator and generator of supporting voltage), stated in focal plane of objective; 4 - a lens Fabri, intended for the focusing and fixing of exit pupil on detector; 5 - a block removable interference light filters; 6 - iris diaphragm; 7 - detector; 8 - thermoelectric refrigerator, cooler; 9 - a preamplifier; 10 - selective amplifier; 11 - a grapher; 12 - an oscilloscope, personal computer; 13 - a photon counter; 14 - an interface.

Fig.2

The variable electrical signal worked out D, is served on the preliminary amplifier, executed in the manner of the separate block and placed nearby D for reducing of an internal noise and avoiding of additional noise pickups. In the preamplifier output pulse of current D is transformed in the pulse of voltage. This pulse of voltage is modified and intensified to its possible was use for working the following system cascades.

By working of IR system in the analog mode of measurement a signal with D in the beginning enters in the input circuit of preamplifier 9, but then - in selective amplifier 10 and synchrodetector. On the grapher 11 signals enters after synchronous detector. Oscilloscope 12 serves for observing a signal.

In the mode of measurement a card or photons electrical signal with detector enters right in the counter of photons 13, after processing in which, is brought on the interface 14.

For processing a signal is provided also connection through corresponding plug-in cards personal computer to exit an selective amplifier 10.

2. REFERENCES

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