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Physics

MEASURER OF THE ATMOSPHERE`S SPECTRAL TRANSPARENCY

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Optical-electronic measuring complex is described, intended for the operative measurement of atmosphere's transparency in the wavelengths region of $0,35-1,03\mu$ and of the meteorological optical range in the different climatically conditions from 0,1 to 300 *km*. The technique of realization of full-scale measurement of a parameter of atmospheric easing for seen beams (on $\lambda=0,55\mu$) with sensitivity not worse $3,4\cdot10^{-5}\,km^{-1}\cdot mV^{-1}$ is stated.

***Keywords*:** optical-electronic system, spectral transparency, infrared region, visual transparency.

Introduction. The measuring complexes, intended for researches of physical properties, in particular of the transparency as well as of the surface air, have the special place in optical-electronic instrument production. And in this aspect a main role have the optical-physic measurements of radiation fields, caused by molecular and aerosol dispersion. Such measuring systems have the rather important role not only in scientific researches of physical properties of atmosphere, but also in applied sense in the field of air navigation for an operative estimation of "optical weather" of atmosphere. Described in the present paper measurer of atmosphere's transparency (under the name of the Field Optical-Meteorological Post-Automatic, FOMPA) has an invaluable role at full-scale tests various thermovision apparatus, exact estimation of the transparency of atmosphere in infrared region of spectrum.

Structure and Purpose of the Equipment. Measurer of atmosphere's transparency is intended for continuous measurement of meteorological range of visibility (S_M) or parameter of attenuation ($\alpha(\lambda)$) of the atmosphere in the region of wave lengths from 0,35 to 1,03 μ and automatic processing of atmosphere's spectral transparency results in a range from 1 to 14 μ.

The working spectral range are allocated with 4 narrow-band interferential light filters in the wavelength range from 0,35 to 1,1 μ. The complex works whole days and nights, in various seasons of year, in any condition of "optical weather", i.e. in clear atmosphere, in gauze, fogs, at a rain and snowfall.

The complex FOMPA consists of two basic parts: measuring and recording (processing). The measuring part includes nephelometrical device, composed of two blocks: optical-mechanical and board of electronic management [1].

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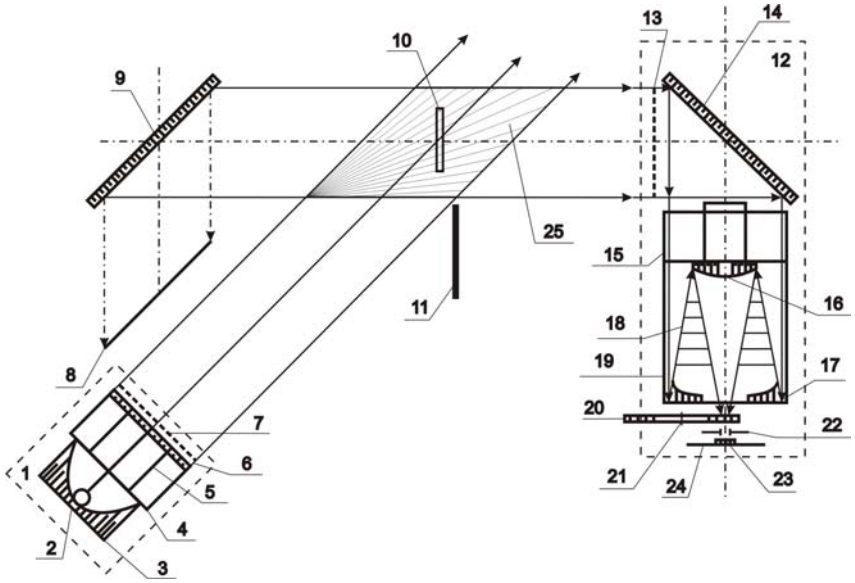
The optical circuit FOMPA is shown in Figure.



The optical circuit atmosphere's spectral transparency of the measurer FOMPA. 1 – Gaffer; 2 – Lamp ISS-100-5; 3 – Mirror parabolic; 4,15 – Cellular blends; 5,11 – Screens; 6,23 – Protective glass; 7,13 – Iris diaphragms; 8 – Trap of light; 9 – Mirror "Black"; 10 – Control scattering; 12 – Photometer; 14 – Mirror flat; 16,17 – Mirror objectives; 18 – Blend round; 19 – Blend cylindrical; 20 – Light filter; 21 – Axis rotation; 22 – Diaphragm; 24 – Plane PEM (Photoelectric multiplier); 25 – Worker volume of the device.

FOMPA consists of four basic units: the gaffer, photometer, trap of light and control scattering. The basic element FOMPA is pulse xenon lamp ISS-100-5 of high intensity. The pulse of light radiation by duration 1–1,5 *mcs* is disseminated in atmosphere and is weakened basically under action of processes of aerosol and molecular dispersion. The part of scattered radiation in a direction 45^0 is accepted by device photometer, which output signal is direct-proportional to attenuation parameter of the atmosphere.

Proportionality constant between the size of a signal and attenuation parameter as a constant A is determined by calibrating device for the known characteristics molecular dispersion of clean gases or dairy glass [2].

Measurement Method. The optical-electronic path of the device is formed of three channels: measuring, background and control. The measuring channel is formed by an optical method – by crossing a beam of light and photometer field of view. The background channel of system is formed of the measuring channel in the absence of a light flow of lamp radiation within the limits of an atmosphere working volume. The measurement background of the Sun and noise electrical signal on the background channel is conducted in the intervals between light flares with frequency, equal frequency of pulse lamp radiation. The control channel is formed by a mechanical way – by introduction in the working volume of the device control scattering (see Figure).

In contrast to the remote FOMPA block, which works directly in the atmosphere, PEM and recording part of a complex can be in a premise or in a body of auto laboratory and servo manage the equipment.

At full-scale measurements in the atmosphere the account of the attenuation parameter of atmosphere $\alpha(t_i)$ and meteorological range of visibility $S_M(t_i)$ at any moment of time t_i in absolute units are carried out on the basis of measurements of signals measuring $U_1(t_i)$, background $U_2(t_i)$ and control channels $U_3(t_i)$, according to relation

$$\alpha(t_i) = A\frac{U_3^0}{U_3(t_i)}\left[U_1(t_i) - U_2(t_i)\right], \quad S_M(t_i) = \frac{3{,}91}{\alpha(t_i)}$$

on the wave length of $\lambda = 0{,}55\mu$.

The final results of measurement $\alpha(0{,}55)$ and S_M are also obtained in absolute units ([km^{-1}] and [km] accordingly) and deduced on light indication and registration.

Conclusion. The developed complex provides definition of values of meteorological range of visibility in a range from 0,1 to 300 *km* on the basis of direct measurements of the atmospheric attenuation parameter.

It is necessary to note, that by essential advantage of optical-electronic complex, developed by us and described above, FOMPA in comparison with exploited now (especially on services of aircraft) similar devices [3] is the opportunity of provision of the intermittent monitoring of the equipment sensitivity during operation and running on a background of a "black" mirror that provides high sensitivity of reception system.

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Մթնոլորտի սպեկտրային թափանցիկության չափիչ

Նկարագրված է 0,35–1,03 *մկմ* ալիքային տիրույթում գործող օպտիկա-էլեկտրոնային չափիչ համալիր սարք՝ նախատեսված մթնոլորտի թափանցիկության և տարբեր կլիմայական պայմաններում 0,1–300 *կմ* հեռավորության սահմաններում մետեորոլոգիական տեսանելիության օպերատիվ չափումների համար: Շարադրված է տեսանելի ճառագայթների տիրույթում մթնոլորտի թուլացման ցուցչի բնական (դաշտային) չափումների մեթոդիկան: Սարքավորման զգայնությունն է $3,4\cdot10^{-5}$ *կմ*$^{-1}\cdot$*մՎ*$^{-1}$:

Измеритель спектральной прозрачности атмосферы

Описан оптико-электронный измерительный комплекс, предназначенный для оперативного измерения прозрачности атмосферы в области длин волн 0,35–1,03 *мкм* и метеорологической дальности видимости при различных климатических условиях в пределах от 0,1 до 300 *км*. Изложена методика проведения полевых измерений показателя атмосферного ослабления в области видимых лучей ($\lambda = 0,55$ *мкм*) с чувствительностью аппаратуры не ниже $3,4\cdot10^{-5}$ *км*$^{-1}\cdot$*мВ*$^{-1}$.