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MEASUREMENT OF METEOROLOGICAL DISTANCE VISIBILITY ON THE HORIZONTAL ROUTES OF THE GROUND ATMOSFERE

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***Abstract* - Optical-electronic automatic measuring complex is described, intended for the operative measurement of atmosphere transparency in the wavelengths region of 0.35-1.03μ and of the meteorological distance visibility in different climatical conditions from 0.1 to 300km. The measurements of meteorological distance visibility on λ = 0.55μ are realized with the sensitivity of the apparatus not worse than $3.4 \cdot 10^{-5} km^{-1}$ /mv.**

***Keywords* - Optical-electronic system, meteorological distance visibility, atmosphere's infrared transparency.**

I. INTRODUCTION

Meteorological distance visibility (S_m) is one of the major optical-physical parameters of atmosphere, especially at flight and landing of aircrafts. In many airports the most frequent weather phenomena lowering distance of visibility are fog and snow-fall. At these weather terms insignificant absorption and insignificant changes of index of weakening of atmosphere are usually marked at the change of wave-length. The weather phenomena that can substantially worsen visibility include the strong rain, smoke, sand and dust. In optical-electronic instrument production a special place is taken by the measuring complexes intended for research of physical properties, in particular, of the ground and top layers of the atmosphere. In this aspect the optical-physic measurements of radiation fields caused by molecular and aerosol dispersion have main role. Such measuring systems play rather important role not only in the scientific research of physical properties of atmosphere, but also in the 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 meteorological distance visibility (under the name of the Field Optical-Meteorological Post Automatic FOMPA) has a valuable role in the natural tests of various thermovision apparatus, exact estimation of the transparency of atmosphere in the infrared region of spectrum.

II. STRUCTURE AND PURPOSE OF THE EQUIPMENT

The measurer is intended for continuous measurement of meteorological distant visibility (S_m), or parameter of attenuation ($\alpha(\lambda)$) of the atmosphere in the region of wave lengths from 0.35 to 1.1 μm and automatic processing of results of atmosphere's spectral transparency in the range from 1 to 14μm. The working spectral diapason is allocated with the help of 4 narrow-band interferential light filters in the wavelengths range from 0.35 to 1.1μm. The complex works day and night, in various seasons of year, at any condition of "Optical weather": in clear atmosphere, in gauze, fogs, rain and snowfall. The complex FOMPA consists of two basic parts: measuring and recording (processing). The measuring part includes nephelometrical device in having a structure of two blocks: optical-mechanical and board of electronic management [1], [2], [3].
The optical circuit OMB is shown in fig. 1.

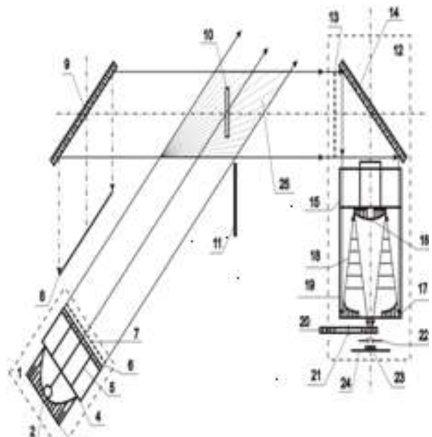

Fig. 1. Optical Circuit OMB of the Measurer of Atmosphere's Meteorological Distance Visibility

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, 25-Worker volume of the device.

The OMB consists of four basic units: the gaffer, photometer, trap of light and control cattering. The basic element of the OMB is pulse xenon lamp ISS-100-5 of high intensity.
The pulse of light radiation by duration 1-1.5 μs is disseminated in the atmosphere and is weakened basically under the action of processes of aerosol and molecular dispersion. The part of absent-minded radiation in a direction of 45^0 is accepted in the photometer of the device, which target signal is direct-proportional to attenuation parameter of the atmosphere. The factor of proportionality between the size of a signal and attenuation parameter as a constant A is determined with the help of calibrating device under the known characteristics of molecular dispersion of clean gases or dairy glass [4].

III. Measurement Methods

Optical-electronic path of the device is formed by three channels; measuring, background and control. The measuring channel is formed by an optical method: by crossing a beam of light and field of sight of photometer. The background channel of the system is formed by the measuring channel in the absence of lamp radiation light flow within the limits of working volume of the atmosphere. The measurement background of the Sun and noise electrical signal on the background channel is spent in intervals between light flares with frequency equal to the frequency of radiation of a pulse lamp. The Control channel is formed in a mechanical way - by the introduction in the working volume of the device control scattering (see fig. 1). In contrast to the remote OMB block, which works directly in the atmosphere, BEM and recording part of the complex can be on the premise or in the body of auto laboratory and operate by functioning of the equipment on a distance. At natural measurements in the atmosphere the account of the attenuation parameter of the atmosphere $\alpha(t_i)$ and meteorological range of visibility $S_m(t_i)$ at any moment of time t_i in absolute units is spent 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 the following relation: $\alpha(t_i)=A\cdot(U_3(0)/U_3(t_i))(U_1(t_i)-U_2(t_i))$, $S_m(ti)=3,91/\alpha(t_i)$ on length of a wave $\lambda=0,55\mu m$. The final results of measurement $\alpha(0.55)$ and S_m also turn out in absolute units, [km^{-1}] and [km] accordingly, are deduced on light indication and registration.

IV. CONCLUSION

The developed complex provides definition of values of meteorological distance visibility in a range from 0.1 to 300km on direct measurements of the basis parameter of the atmospheric attenuation. It is necessary to note that the essential advantage of the above described optical-electronic complex FOMPA developed by us, in comparison with the similar devices [5] maintained now (especially on services of aircraft) is the opportunity of maintenance of the periodic control of sensitivity of the equipment during operation and realization of all measurements on a background of a "black" mirror that provides high sensitivity of reception system.

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