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Increase of Efficiency of the Mobile Bio-Acoustic System for Scaring Birds within the Airport Area

B. Efanov

The world aviation community has not so far obtained the universal "antibird" instrument, which is the evidence of the complexity of the bird strike prevention problem. At present one has to implement a whole series, of measures to decrease the amount of bird strikes to aircraft.

Dispersal of birds from airfields by playing back the magnetic tape recordings of different birds' distress calls is being used in many countries for a long time with some success. We have tried to investigate the reasons which decrease the effectiveness of the bio-acoustic method and to work out the ways to improve the bird repellent signal effect.

As the result of the work conducted we came to the conclusion that the effect of the bio-acoustic bird scaring depends upon a number, of factors of technical, biological and administrative nature. With these factors being underestimated, the birds quickly get used to the broadcasted calls and as, the result the bio-acoustic technique becomes less effective.

The frequency range of sounds produced by certain birds is from 0.06 to 50 kHz. The vocal range of the absolute majority of bird species is from 0.2 to 12 kHz. The low threshold of bird hearing perception is 50 to 70 Hz, whereas the upper limit can be as high as 35 kHz. The maximum of the vocal energy spectrum of the most of birds is within the range of 2 to 8 kHz, which is substantially higher than that of the human speech energy spectrum. This fenomenon imposes essential limitations on the use of common broadcasting systems for the bird scaring purposes.

As the result of the research work carried out, the Soviet specialists have developed a mobile bio-acoustic system having the following specifications:

1. Nominal output power of the amplifier at the impedance of 8 OHM - 80 W,
2. Maximum output power - 140 W,
3. Efficiency at the nominal output power - 65%
   at the maximum output power - 8[illegible]%,

4. Frequency range at the level of 3 dB - 0.3 - 18 kHz,
5. Effective frequency range with sound pressure having uneven frequncy of 15 dB (acoustic system) - 0.3 - 18 kHz,
6. Nominal acoustic power - 100 W,
7. Dimensions: acoustic system - 530 x 240 x 270 mm,
   amplifier - 310 x 190 x 105 mm,
   recorder - 318 x 225 x 85 mm,
8. Mass: acoustic system - 10,7 kg,
   amplifier - 5.2 kg,
   recorder - 3 kg.

Reasonable approach to the bio-acoustic technical requirements with due account to the bird cries spectrum characteristics made it possible to develop a kind of broadcasting system having sophisticated technical and economic characteristics.

Unlike other similar systems the power supply of the bio-acoustic system is provided by the vehicle battery with the voltage of 12.4 V and the minus lead grounded. The system needs no additional batteries. As far as the circuit voltage when the vehicle engine works may reach 15.5 V the system is equipped with a stabilizer. The system is also protected against shortenings, overloads, shifts of power supply from plus to minus and provided with the Built-in Control Unit which allows to monitor its operation in the field without any additional control equipment.

The wide broadcasting frequency range is achieved by means of a double-band acoustic system with a separation frequency of 5 kHz. As the medium-frequency loudspeakers the system incorporates narrownecked horn heads with the cut exponential fiberglass horns, the shape of which changes smoothly from round to rectangular. High frequency heads have aluminium quasi-exponential horns consisting of external and enternal parts which are the protruded Vente bodies. Due to the implementation of narrownecked horn loudspeakers the system has a high electroacoustic efficiency resulting in high sound pressure which is necessary for the operation of the system within the airport area. Maximum sound pressure at the distance of 1 m along the acoustic axis when emitting the siren type signal is 136 dB. The voice signal broadcasting range of the system is more than 1 km.

The high intelligibility of speech and repellent sygnals is achieved by special treatment of these signals in the electric

circuit of the bio-acoustic system. This treatment is done by limiting the signal spectrum both at the high and low frequencies and by the introduction of frequency pre-distortions. Researches witness that within the airport area where the background noise level is substantially high it is reasonable to use specifically treated high level signals. For instance when repellent signals that had pre-distortions within the frequency range of 0.4 to 5 kHz with the positive amplitude-frequency slope of 3 dB/oct were broadcasted for the seagull-type bird congregation at the distance of 300 to 400 m, the disperse effect of such signals was more efficient. This kind of treatment of the bird calls recordings counterbalances the attenuation of high frequency components of these signals in the air.

The results of our preliminary study show that the low frequency limitation of the frequency range up to 400 Hz does not influence the signal efficiency, but makes it possible to substantially reduce the size of the amplifier and acoustic antennas.

Substantial increase of the bio-acoustic technique efficiency is provided by the appropriate choice of the repellent signal. Although the recordings of the "emergency-pain" cries produced by birds under simulated conditions do have the scaring effect, it is of a short-term nature. Birds, especially belonging to the local area, soon get used to these recorded signals. The most efficient calls are those recorded in the nature. These are the calls produced by birds when they are attacked by the bird of prey or when they unexpectedly get into a trap.

Further study of bird calls will enable the development of efficient scaring systems utilizing the synthesized calls.

It is a common observation that birds demonstrate the following response sequence to the transmitted repellent signal. They take off, fly up to the source of the sound, circle round and fly away or alight. We believe that this kind of bird response is normally observed only when a less efficient signal (mainly "emergency-pain" cry) is transmitted, when it is unintelligible or when birds become accustomed to the frequently transmitted signal.

As far as the bio-acoustic method implies the natural response of birds to distress calls, it is quite necessary to accompany the broadcasting with the "loud" [illegible]

as a support from time to time.

The bio-acoustic system was used not only to disperse birds from airfields. It was quite successfully utilized in cities to provide anti-bird protection of public buildings and historic monuments. The two-year operational experience proves high efficiency of the system.

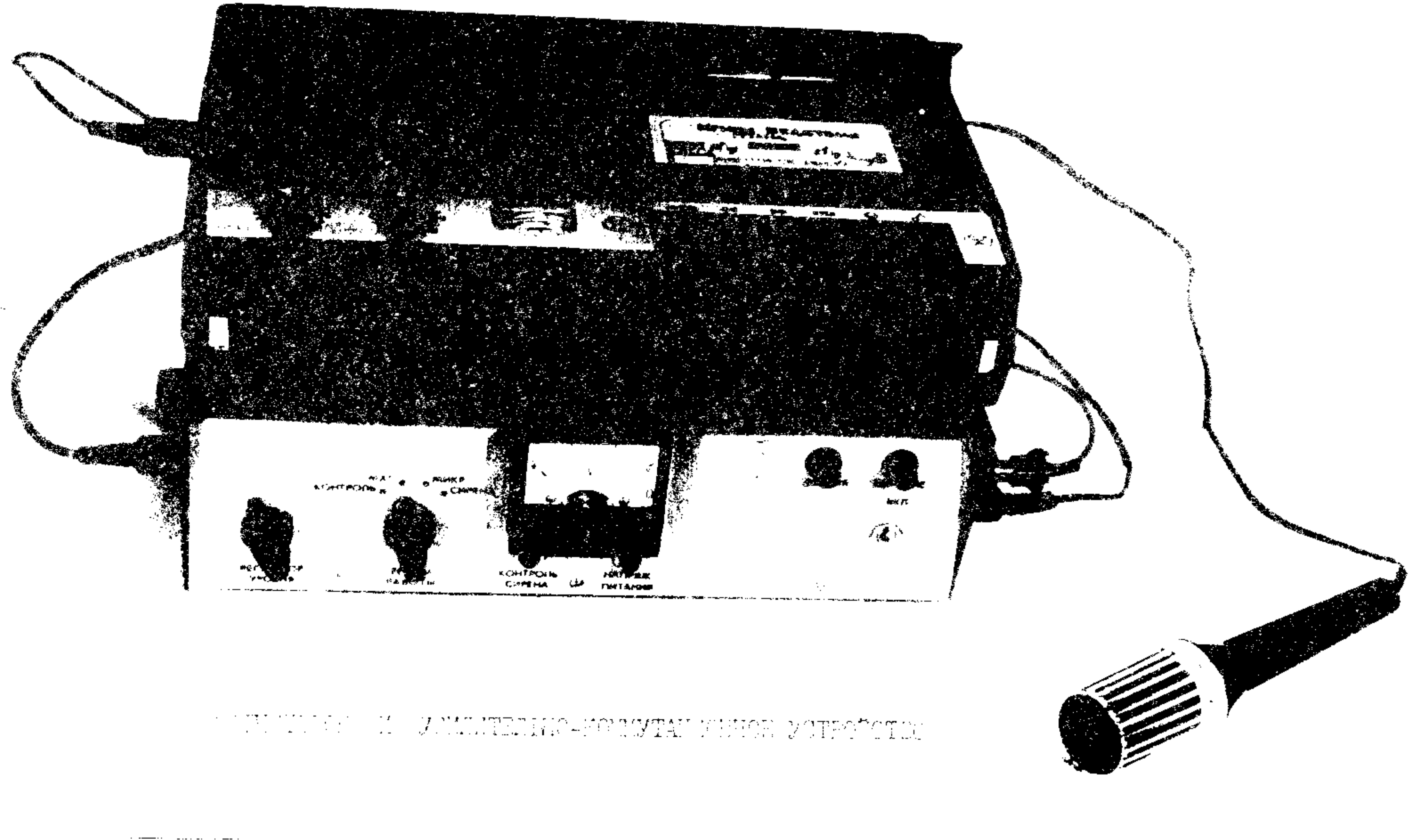

Рисунок 1. Усилительно-коммутационное устройство