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APPLICATION OF SOUND SENSITIVE ELECTRET CABLE IN PARAMETRIC SONAR SYSTEMS

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The parametric short-range sounding systems have such singularity, as inevitability to receive broadband echo signals of difference frequencies on a hindering echo signals hum of high intensity waves of pump. It is impossible to suppress ghost echo signals by electrical filters at once after antenna up to enough low level, that cause the distortion of a hydroacoustic information. The application of sound sensitive electret cable as the active element of a receiving antenna allows to avoid the influence of this hindering effect. The amplitude-frequency characteristic (AFC) of electret cable sensitivity is the same, as AFC of electrical low-pass filter, that appreciably allows to loosen signals of pump in the receiving antenna. The parameters of two types of sound sensitive electret cables and the results of their use as receiving antennas in sounding systems are presented in the paper. The perspectives of using electret cables in acoustic systems of ocean heterogeneities and marine soil sounding are discussed.

The parametric acoustic emitters are successfully and for a long time used for solving a series

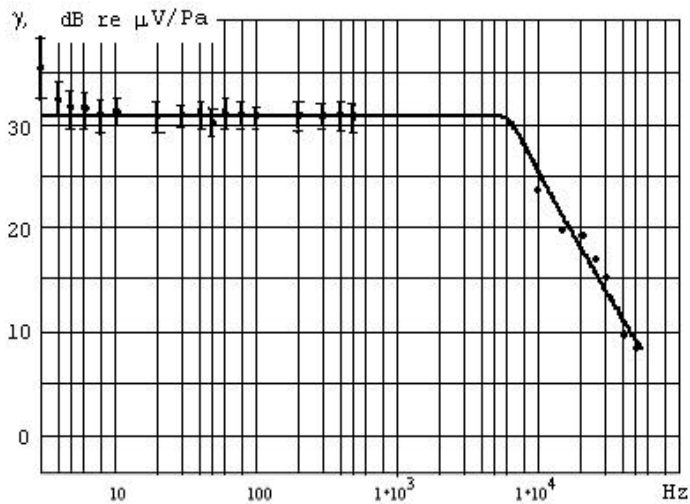


Fig.1 Amplitude-frequency characteristic of electret cable SEC-4.

of hydroacoustic problems [1,2]. Especially effective they can be used at researches of small-scale hydrophysical heterogeneities of ocean, thin marine soil structure, detection and specific classification of fish schools and separate fishes in shelf zones and etc., that is in all those cases, when the solving of problem is impossible without overlapping such characteristics of a hydroacoustic system, as a high directness of a sound ray and low level of the side field of radiating antenna in a broad band of operational frequencies.

However, alongside with sound waves of operational frequencies range (it is usual the waves of difference frequency), in a medium the high-power primary sound waves, created by pump

transducer are propagated. Therefore parametric short-range sounding systems have such specific particularity, as inevitability to receive broadband echo signals of difference frequency on a hum of

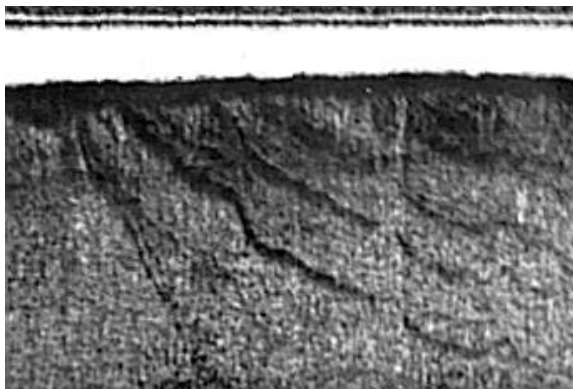


Fig.2. Echo graph of a bottom site in the Azov Sea.

hindering power echo signals from waves of pump. And, even the side field of pump waves is much more than base field of difference frequency waves. It led to emerging on out of broadband receiving antenna the hindering high level signals of pump with a useful signal simultaneously, which are distort hydroacoustic information obtained on the difference frequency channel. These signals cannot be suppressed up to enough low level and without distortions of difference frequency broadband signals by electrical filters immediately after receiving piezoceramic antennas. That considerably reduces a dynamic range of a system,



Fig.3. Receiving antenna constructed on the base of electret cable SEC-4.



Fig.4. Receiving antenna constructed on the base of electret cable SEC-5.

worsens a signal - parasite ratio and distorts a useful information. Besides, one from the elements of a modern line construction of hydroacoustic equipment is the maximal possible circuit approximation of the analog-to-digital converters block of receiving tract to a receiving antenna. It superimposes the even more rigid requirements to electrical filters and to dynamic range of entering analog circuits. Therefore there is a necessity of effective suppression of signals of pump right in the receiving antenna.

Thus, the amplitude-frequency characteristic of receiving antenna sensitivity or its active elements should be such, that its sensitivity in pump waves frequencies range should be much below than sensitivity in an effective range of difference frequencies. Active elements based on sound sensitive electret cable are possess such a feature.

The amplitude-frequency characteristic of sound sensitive electret cable (SEC-4) with diameter $d = 10$ mm and electret's area density of charge $s = 5 \cdot 10^{-6}$ Cb/m² is presented in Fig.1. The sensitivity of a cable is a little more then 30 iV/Pa. The low-frequency site of electret cable SEC-4 AFC was measured by comparison method with hydrophones, located together with electret cable on the 50m depth. The broadband signals sources were a various types of seafaring noisiness objects. The solid line indicated a calculated AFC of sound sensitive electret cable. The similar character of AFC has electret cable SEC-5. But its sensitivity is $g = 80$ iV/Pa, diameter $d = 6$ mm, charge of electret $s = 4 \cdot 10^{-5}$ Cb/m², and AFC "falling" is observed from 25 kHz frequency.

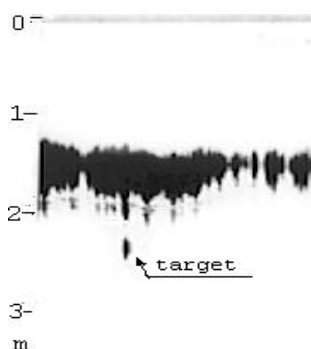


Fig.5. Echo graph of steel sphere.

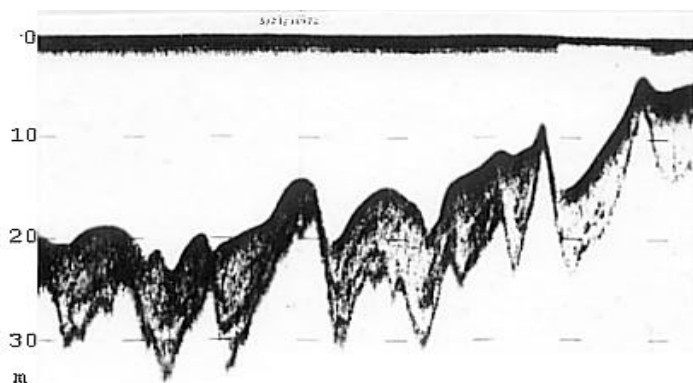


Fig.6. Profile of a marine ground in the White Sea.

Fig.1 shows, that AFC of electret cables is like as AFC of low-pass filter. Therefore at use of difference frequencies of a parametric emitter in a range lower than 25 ... 30 kHz, it is possible essentially to suppress pump waves echo signals, as they are usually selected on frequency more then difference frequencies in 5 ... 10 times and lay on AFC site with a small sensitivity value.

On the base of sound sensitive electret cable the linear, planar and volume acoustic antennas and antenna arrays can be made. Echo graph, gotten by parametric sonar system in which the receiving antenna was the planar antenna, made on the base of rolled into a spiral (see Fig.3.) sound sensitive electret cable SEC-4, is represented in Fig.2; antenna's diameter – 0.8m. Difference frequency of parametric emitter – 5 kHz, duration of emitted acoustic pulses – 0.5 ms. Primary frequencies: 160 and 165 kHz. The waves of difference frequencies are well penetrate even into bedrock, being reflected from various ground structure heterogeneities. The waves of pump, despite of shallow region (depth is 5m) and repeated reflections, were essentially attenuating by the receiving electret antenna, that has allowed to receive a rather contrast record of a bottom ground structure. The trials of a parametric system were carried out on the Azov Sea.

The photo of one more spiral antenna carried out from sound sensitive electret cable SEC-5 is shown on fig.4. In difference from the previous antenna, it is filled with harden castor-oil and has a back acoustic baffle. Antenna's diameter – 45 cm. The parametric system with this antenna was used in the White Sea for sounding the dug at 90cm depth in silty sand hollow steel 200mm diameter sphere, (Fig.5) and for marine bottom, consisting of bedrock and sediments, profiling (Fig.6). The duration of emitted pulses was 0.5ms, operative (difference) frequency – 10 kHz.

The carried out experiments on a shared use of receiving electret antennas and parametric emitters, and also high sensitive's stability of electret cables that are used during more than 15 years, are confirm the perspectives of it use in parametric sonar systems, especially at study of ocean heterogeneities which have bad acoustic visibility on difference frequencies and high on frequencies of pump.

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