



Fig. 1. The KB-2C Bantam microphone compared in size and appearance to the familiar 44-BX.

# The Bantam Velocity Microphone

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Design details for a miniature velocity microphone are discussed by the engineers who developed the KB-2C.

**T**HE INTRODUCTION of the Type KB-2C Microphone has provided the broadcast industry with a valuable tool. This new microphone, about the size of a package of cigarettes, in many respects approximates the performance of the popular Type 44-BX Velocity Microphone and offers some further operational advantages. It is so small that the artist's or speaker's face is not hidden, a feature which is valuable on remote programs and on television pick-ups where the microphone must be in the picture. It is also very light and requires no special amplifiers or cables, thereby simplifying transport, in addition to making possible the use of light supporting means.

Small size, as shown in Fig. 1, and weight have been obtained without sacrifice in output level. Compactness has actually resulted in directional characteristics which more nearly approach the ideal for a velocity microphone over the entire frequency range (see Figs. 2 and 3). The frequency range is fully adequate for all operations. Aside from its small size, the microphone contains many interesting mechanical features. It incorporates a sponge rubber mounting between the head and the shank assembly, and additional cushioning should be necessary only when the microphone is used on a boom where the location of the microphone is changed frequently and rapidly. The usual unsightly cable and plug connection is "built-in" to the shank portion of the microphone, which in addition to serving as a mounting may also be used as a handle when one is required. Access to the connecting plug is obtained by means of a hinged cover forming the rear portion of the shank.

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The Cannon Type XL Connector was chosen for the application because its small size and quality are in keeping with the purpose of the design.

The microphone also contains electrical features which are equally as useful as the mechanical features previously described. The low-frequency response is readily adjustable for either voice or music operation by means of a switch that may be operated from the outside of the microphone by use of a small screw driver. The characteristic for the voice position has been selected so that response is approximately flat when the sound source is located about nine inches from the microphone (see Fig. 4). The design of the coupling transformer has resulted in a sensitivity to stray 60-cps magnetic fields low enough for any normal application. Since the sensitivity of the microphone to stray fields is a function of the direction of the field, it is possible in many applications where high intensity fields are encountered to minimize the pick up by rotating the microphone. Sensitivity to high-frequency fields is kept low by proper grounding and complete enclosure of the microphone parts in the external metal screen and case.

## Design Features

The question naturally arises as to how all of these things can be accomplished in a microphone of such small size without any apparent sacrifice. The answer lies in painstaking design—the careful selection and use of materials in the most advantageous places. Involved in the design, and all inter-related, are acoustical, electrical, magnetic, and mechanical problems.

In a velocity microphone, the response-frequency characteristic will be flat over the frequency range in which the moving system is mass controlled, and the pressure gradient applied is

directly proportional to frequency.<sup>1</sup> In the case of a plane-wave sound field this means that the response will be constant for any frequency well above the resonance of the ribbon and below the frequency at which the gradient is no longer proportional to frequency due to the physical dimensions of the parts surrounding the ribbon.

Because of its relationship to the low-frequency response, the resonant frequency of the ribbon was the first characteristic considered in the design of the microphone. The ribbon is clamped at the ends, and the system is a combination of a stretched string and a bar clamped at the two ends.<sup>2</sup> The lowest resonance frequency will be obtained when the tension is zero, and this resonance will largely determine the absolute limit of the low-frequency response. The resonant frequency for the condition of zero tension is

$$f = \frac{3.56}{l^2} \sqrt{\frac{QK^2}{\rho}} \quad \text{cps}$$

For an aluminum ribbon 0.0001 in. thick,

$K = 7.3 \times 10^{-5}$  Radius of gyration

$Q = 5 \times 10^{11}$  Modulus of elasticity, dynes/cm<sup>2</sup>.

$\rho = 2.7$  Density, grams/cm<sup>3</sup>.

$l =$  length of ribbon, cm.

In most of the microphone structures, the air load will approximately equal the ribbon density for a ribbon 0.0001 in. thick. The effective value of  $\rho$  will therefore be about 4. Substituting in the above

$$f = \frac{93}{l^2} \quad \text{cps}$$

<sup>1</sup> Dr. H. F. Olson, Elements of Acoustical Engineering, 2nd Edition. Chapter VIII, pp. 237-252.

<sup>2</sup> Dr. H. F. Olson, Unpublished Technical Report.