FIELD PROBLEMS IN MICROPHONE PLACEMENT

Part 1 - Broadcasting

The microphone is the electric ear of the sound system, and what it "hears" depends a great deal on its location just as the auditory impressions of a listener are determined by his position relative to the source of sound and the acoustic nature of the surroundings. A good pair of ears will not serve their owner very well if the desired sound reaching them is faint and partially masked by noise. Likewise, even the best obtainable microphone will function very poorly unless it is properly placed to intercept the desired sounds to best advantage. However, the principles of microphone placement are not solely concerned with the intensity of the sounds produced by the speaker, artist or musical group, since it is also important that the electrical translation be similar to the original sound in frequency content or musical range and balance or "acoustic perspective". As the reader well knows, the principles and methods of solution vary considerably with individual cases and some experimenting is almost always necessary to secure best results. A knowledge of the basic principles and methods employed in the more common cases of microphone placement, however, will enable the engineer to solve these field problems with a minimum loss of time.

STUDIO PICKUPS

The most elementary problem in broadcast microphone placement involves a single speaker or artist. The speaker should have the option of sitting or standing while height of the microphone to be adjusted easily. The center of the microphone should be two to three inches below the level of the speaker's mouth. Best results are obtained by talking across the diaphragm at an angle of 45 degrees or so, with the mouth about six to twelve inches away from the diaphragm. This tends to reduce the pickup of sibilants or "es" sounds, fricatives and breath noises due to the directional characteristics of diaphragm-type devices at the higher speech frequencies. Fig. 1 is an excellent example of correct positioning of artist and microphone. If the speaker sits at a desk, a short desk stand is advantageous.

Vocal soloists almost invariably stand when singing. Some artists with considerable experience before the microphone find it helpful to partially counteract volume differences by moving back from the normal position before the microphone for loud passages and closer for soft passages. This is due, of course, to the fact that the electrical level of the program must be kept within rather definite limits for best transmission. Singers who play their own piano accompaniments often use a microphone suspended from the ceiling, since it is not good practice to place the microphone stand on the piano due to the vibration and the
relatively great distance to the artist's mouth. In one prominent station, a floor stand with a long horizontal boom provides a convenient suspension of the microphone within range of the singer, but without obstructing the keyboard or surrounding floor space in any way. A single microphone placed in this manner results in good balance between voice and piano pickup.

When the singer is accompanied on the piano, a single floor stand microphone for the artist, located within about four feet of the piano, is usually a satisfactory arrangement. It is always advisable, however, to try several different placements, during rehearsals so that the best effect may be obtained. The actual distance between the singer's microphone and the piano differs with the type of music, and depends on the relative prominence that is to be given the accompaniment.

Orchestra or dance-band music, with solo vocal chorus, is frequently picked up without special microphone facilities for the singer. The band plays rather softly and the singer steps close to the microphone so that the voice will be well above the musical background. It is preferable, however, to provide a separate microphone for the singer, for a great deal of confusion and moving about is eliminated and in addition, it is possible to control the balance between voice and orchestra electrically in the studio mixing panel; This independence of control enables the operator to make frequent readjustments, if necessary, for the correct volume balance during the program, whereas with the single microphone pickup, the results are dependent on highly accurate performance by both singer and orchestra leader, both of whom are at a disadvantage in judging the correctness of the final result. The proper placements for orchestra pickups will be discussed later.

It is often difficult to pick up all the members of a group of four or more people with a single microphone. The reason is that the end members of a quartet, for instance, are considerably farther from the microphone diaphragm than those in the middle, and in addition they face the diaphragm at a wider angle than those in the center. Since the sound pressure at a point is inversely proportional to the square of the distance from the sound source, there is an appreciably lower sound level from the artists located farthest from the microphone. In addition to the loss of volume due to the greater distance, the high-frequency response will be somewhat impaired due to the directional characteristics of the microphone in the upper end of the audio spectrum. Fig. 2 shows a typical directional characteristic for a condenser type of stretched-diaphragm instruments. The directional effect is not apparent below about 1,000 cycles per second; at 60 degrees from the "head-on" position, the 5,000 cycle response is about 10 db below that obtained when facing the microphone at normal incidence. One means of minimizing this directional frequency discrimination is to increase the distance from the microphone until the artists are included within an angle of 30 degrees either side of the microphone axis, making a total angle of 60 degrees. This will reduce the 5,000-cycle directional loss to about 2 db, and it is feasible to have the artists stand in a circle around the microphone, highly satisfactory pickup can be obtained with a condenser microphone by placing the transmitter diaphragm in a horizontal plane. It should be remembered that the carbon microphone must always be operated with the diaphragm in a vertical plane, and this type of pickup is out of the question with the carbon transmitter.

Dramatic productions require a detailed analysis of the continuity when considering the microphone requirements. Almost invariably a number of microphones will be necessary. At least one microphone must be provided for dialogue pickup from the radio studio, and in the production of a large one, as many as three or four microphones may be devoted to this purpose. Additional microphones will be required for theme-song or intermission selections by the orchestra. In Script calls for sound effects, still other microphones will be used for this purpose. Due to the widely differing conditions in such broadcasts, it is evidently impossible to outline any definite microphone technique which would apply to all cases. A point which should be noted, however, is that the dramatic production always entails more or less moving about on the part of the actor, despite the fact that the audience gains its impressions entirely through the sense of hearing. If the action calls for a character to begin a speech after entering a room, the artist will probably begin his lines across the studio, advancing toward the microphone so as to convey the desired effect to the listeners who must hear rather than see the action. In general, the problem is one of providing enough microphones so that all members of the cast will be able to deliver their lines promptly and smoothly without crowding or other disconcerting confusion. The musical part of the production is a straightforward problem in orchestra pickup.

Sound Effects

Even if sound effects are to be produced in the same
Studio with the dramatic cast, one or more separate and distinct microphones are always devoted exclusively to this purpose. Sound effects are designed and worked out to produce the correct character and quality of sound without particular regard to intensity or volume. The use of distinct microphones allows the control operator to properly proportion the sound-effect volume to the general level of the program through adjustment of the mixing controls. For the most part, sound effects are produced "artificially" by mechanical devices, and since the sound level is usually very low, the microphone must be placed very close to the source of sound. An amusing example of this technique is the imitation of the noise of a splintering beam by breaking a match stick close to the diaphragm. The characteristic sounds heard in bowling have been successfully reproduced with the aid of child's toy pins set up in another studio. The balls were merely rolled along the floor in the usual manner. It was necessary in this particular case to use two condenser microphones, one placed on the floor close to the point where the balls were released and the other placed at the end of the "alley" but some distance from the pins. Most of the pickup came through the microphone farthest from the pins, but the additional transmitter was necessary to obtain the characteristic high-frequency components resulting from the tumbling of the pins against each other. Rather complicated machines are used to produce sound effects automatically, and sometimes entire studios are devoted exclusively to this purpose in the larger stations.

Orchestra Pickups
The technique of orchestra pickups has received a great deal of study since the inception of broadcasting. The problems encountered in remote pickups are considerably different from those in the studio, due to differences in noise level of the surroundings and practical limitations on microphone location in remote work.

Both single and multiple microphone setups are used in the studio. Recently there seems to have been a trend toward the use of a single microphone but not all productions can be handled in this way. When using a single microphone pickup. Some experienced leaders prefer this arrangement, since the transmitted program will sound very much as it does to the leader in the studio. On the other hand, it is contended that proper reproduction should closely resemble the effect which the listener gains at a distance, and this effect can be approached by using a number of microphones located across the front of the orchestra. Careful control operation is necessary when using more than one microphone. The multiple microphone system is probably preferable with carbon transmitters, while either the single or multiple system may be used with condenser type transmitters. Fig. 3 shows the general seating arrangement for the various sections of the orchestra and suggested locations for microphones, which should be front to eight feet above the floor. Floor stands, adjusted to maximum height, are satisfactory in the studio.

REMOTE PICKUPS
Remote pickups, as contrasted with studio pickups, always take place under existing conditions of noise and local acoustic peculiarities. Sometimes the noise background lends interest and creates atmosphere for the broadcast, but this is probably the exception rather than the rule, and the microphone facilities are usually placed to minimize noise pickup. The most obvious method of accomplishing this is to locate the microphones very close to the source of sound, so that the desired sounds will have a higher level than the unwanted noise. This procedure is followed for broadcasts of speeches and similar events. If there are to be a number of speeches, it is obviously necessary to provide enough microphones so that
each speaker will come within the required distance of the transmitter. It is usually not permissible to move the microphones about at banquets and similar functions. The unused microphones are switched out of the circuit so as to contribute unnecessary noise.

Dance orchestras are picked up with a number of microphones which are placed rather close to the musicians. The close placement is often necessary due to the limited space on the band stand, as well as to minimize the noise background. The multiple microphone system is, of course, essential with close placement in order to secure proper balance and to keep down directional frequency discrimination.

Other types of musical programs do not lend themselves to the multiple pickup. This is particularly true of large symphony orchestras and opera. The symphony orchestra is conducted so as to produce the proper effect to the audience at considerable distance from the musicians. A single microphone pickup near the conductor is not feasible due to the large space occupied by the musicians. A highly satisfactory solution of this problem has been worked out using a parabolic reflector on a microphone located in a balcony or box. The use of the reflector results in a very directional pickup and the device must be accurately pointed at the source of sound. Since the distance between microphone and orchestra is large, the reproduction is well balanced and closely approaches what would be heard by a listener located near the microphone. The directional feature also tends to reduce the pickup of local noise and minimizes the effect of acoustical peculiarities of the hall. Fig. 4 shows the principle of the parabolic reflector. Note that the microphone diaphragm faces the reflector rather than the source of sound. This device has been used in sound picture recording for some time, where it possesses some advantages for many purposes over the ordinary non-directional pickup.

(Go to be continued)

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Editor's Note. Forthcoming issues of the TECHNICAL BULLETIN will continue the discussion of microphone placement problems in public address work, sound-picture recording, and other applications.

A future issue will be devoted entirely to unusual microphone applications. We are particularly interested in additional data on scientific and industrial problems which have been solved with the aid of the microphone. No doubt many advantages for many programs have first-hand information on such topics. The Editor will be glad to receive such contributions and suitable material will be incorporated in the BULLETIN. There is no payment for contributions, but full acknowledgment to the author will be made.

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