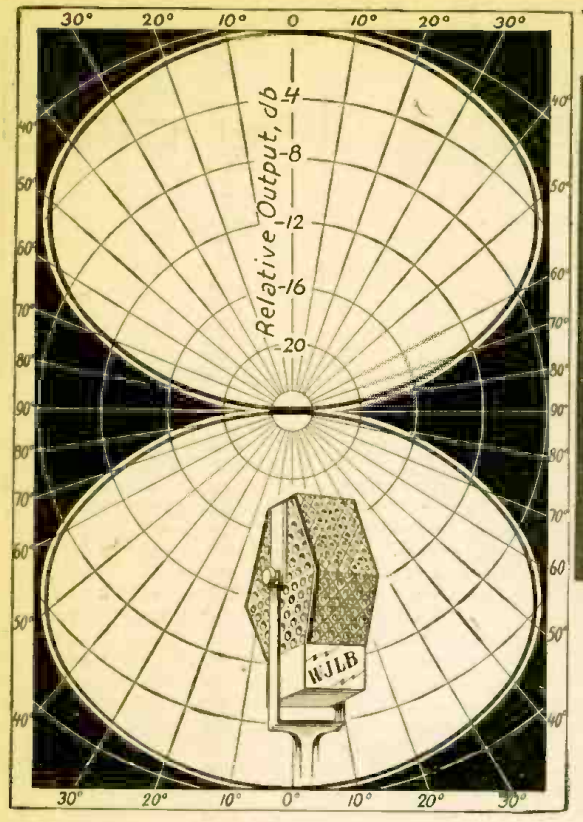


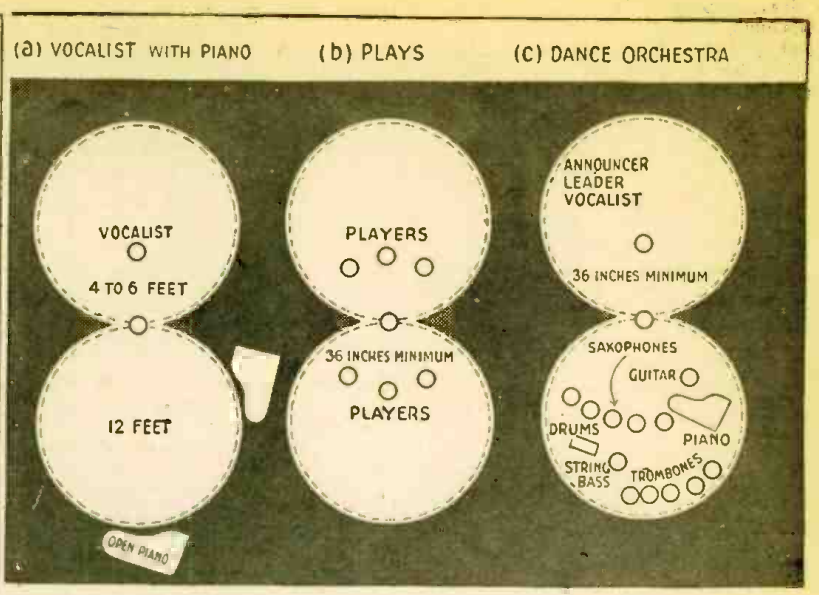


Fig. 1, left—Directional characteristic of velocity mike. Figures on side are degrees. Fig. 2, above—Set-up for vocalist with piano, players, or for orchestra and vocalist.

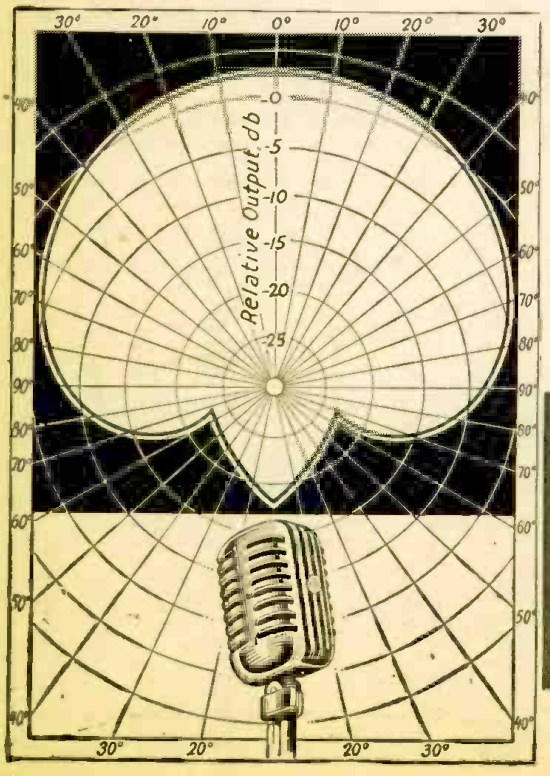
PLACING THE MIKE IN SOUND STUDIOS

By DON C. HOEFLER

WE have seen that a subject of extreme importance in high-fidelity audio reproduction is that of providing favorable acoustic conditions at the studio or auditorium. Also worthy of equal consideration is the proper placement of microphones with respect to the program sources.

In broadcasting's younger years, it was commonly accepted procedure to use several microphones at various locations to pick up a program, particularly when working with large groups of performers. This seemed necessary at the time, due to the low sensitivity and inherently high noise level in the "telephone transmitters" of that era. However, it was found that the outputs of the microphones, when used simultaneously and fed into a common amplifier, were considerably distorted, due to phase differences in the sound waves arriving at the various microphones. Therefore, the advent of more sensitive and less noisy microphones naturally led to single-microphone techniques. In modern practice, the microphone is placed at such a distance from the group that it alone is usually able to provide the desired acoustic balance. Thus the practice of using several microphones simultaneously, with accompanying phase distortion, is avoided. Of course, when a certain desired emphasis can in no way be given a particular group when using a single microphone, it may become necessary to fade in one or more additional mikes at certain times. This is done only during the time interval that the prominence is desired, to stress a certain vocalist, instrumentalist, announcer, or sound-effect. Absolute control of the individual microphone circuits in this arrangement must be exercised by a competent engineer at the control-room mixing panel. Furthermore, extensive rehearsals and remote listening tests will usually be required to achieve the desired effects and proper balance of the several input circuits.

The volume ranges of various musical instruments denote their combination into several general groups, each instrument in a given group being placed approximately equidistant from the microphone. The first group usually contains the violins, violas, and



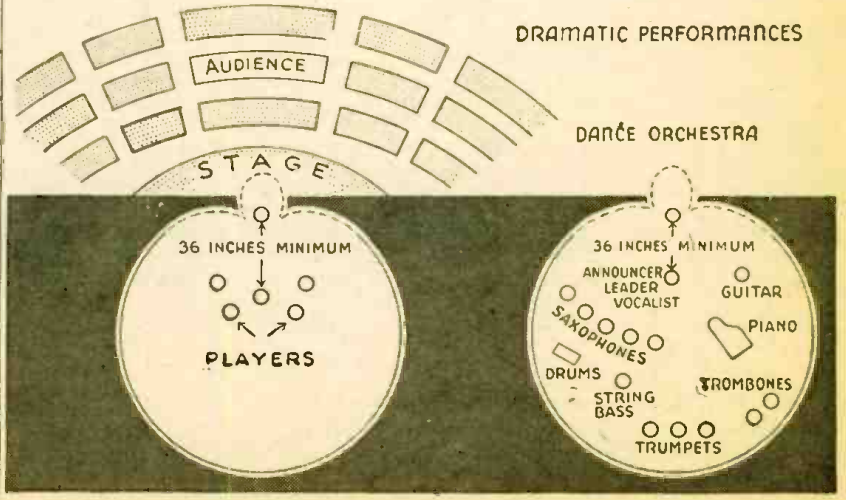


Fig. 3, left—The highly directional cardioid microphone, used in most stage installations. Fig. 4, above—How its directional characteristics are used in theatres and dance halls.

cellos; the second group, the piano, harp, clarinets, and flutes; the third group, the oboes, bassoons, English horns, and (French) horns; the fourth group, the doublebass (string bass), tuba, and percussion section; the fifth group, the trumpets and trombones. In dance bands, the guitar is in the first group, the saxophones in the second or third, and the banjo in the fourth.

The directivity characteristic of the velocity or ribbon microphone is shown in Fig. 1. It is evident that this instrument is markedly directional, a property which is practically independent of the frequency. This is of considerable advantage in remote broadcast pick-ups and public-address locations, since extraneous sounds arriving from side directions will have little effect. Therefore, there is allowed more than a little improvement in balance, clarity, selectivity, and all-around naturalness. The speaker, vocalist, or musical instrument should not be placed closer to the microphone than 2 feet, and a distance of 3 or 4 feet is preferable. Neither should the microphone be placed closer than 3 feet from any solid reflecting surface. At shorter distances there is a tendency toward "boominess." At (a) of Fig. 2 is seen a common set-up used for a vocal soloist and piano accompanist. This arrangement permits the two performers to face each other, which allows for better coordination of timing and cuing. For any dramatic presentations, as shown at (b), the bi-directional characteristic may be used to its fullest advantage, as the actors may be grouped about the microphone at the proper distances and positions, and all have practically unlimited freedom of movement. The dance band set-up shown at (c) allows fine balance, and permits the principals to coordinate their actions to the part each has on the program. For example, the announcer, band leader, and vocalist, all may take the position before the microphone and facing the orchestra, at the various times each of their particular parts may be called for. In public-address applications, this microphone may usually be placed within 3 or 4 feet of the speaker, but it is imperative that the direction of minimum sensitivity is toward the loud-speaker system.

In many studio and public-address applications, it is desirable to eliminate the pick-up of unwanted sound in the rear of the microphone, such as crowd noise or reverberation roar and echo. The "cardioid" or unidirectional velocity microphone is very useful for such purposes. As shown in Fig. 3, this instrument was designed to pick up sound arriving from one side only, while almost completely rejecting sound from the other side. The angle of useful pick-up is approximately 150 degrees. As with the bi-directional type, the source of sound should never be closer than 2 feet, with 3 or 4 feet preferred. Although this microphone may be used in many types of studio work, it is of particular advantage in the case of stage plays, auditorium studios, and in remote pickups at theaters, ballrooms, and night clubs, where crowd noises may present a serious problem. By placing the microphone with its "dead" side toward the audience, a 20-decibel discrimination will provide the desired attenuation of audience noise. Fig. 4 shows typical set-ups for plays and dance orchestras.

In the final analysis, the only satisfactory reproduction of sound is that which presents a pleasing effect to the human ear. Thus the sound engineer must give due consideration to the physiological process of hearing as well as the physical properties of the sounds being reproduced. Therefore, the final proof of the value of any microphone set-up lies in actual listening tests over a high-fidelity monitoring system, conducted by one who has a trained ear for music and experience in the determination of high-quality sound.

"Metered Sound"

Muted Megaphone Helps Fit Hearing Aids

TESTS for fitting hearing aids have been considerably simplified by a device described by Drs. Walter Hughson and Eva Thompson in a recent issue of the *Journal of the American Medical Association*. It is an ordinary acoustic megaphone, suitably muted by four felt disks, of such size that when placed in the megaphone they will be spaced at equal intervals along the flare.

Apparatus for producing sound which can be accurately varied in volume is much rarer than accurate sound-measuring and analyzing equipment (though certainly no harder to design or manufacture). Especially is it likely to be lacking in the offices of the usual ear, eye, nose and throat specialist who is commonly responsible for prescribing and fitting the hearing aid.

Lacking correct apparatus, the practice is to test the patient by repeating words or sentences at progressively lower intensity levels, or moving farther from the patient and repeating them at the same level. This method may be grossly inaccurate. It is extremely difficult to control the voice to give various gradations of intensity, and when walking away from a patient there is an instinctive tendency to raise the voice. It has been found, however, that it is easy to maintain a relatively constant loudness for direct conversational speech.

The muted megaphone offers a technique which takes advantage of the constant volume tendency of the conversational voice. The person making the test talks in a normal tone, which is attenuated by placing one, two, three or four of the disks in the megaphone.

By careful and accurate acoustic measurement it has been found that at a distance 6 feet from the speaker normal conversational voice is amplified 20 decibels by the use of a 2 foot megaphone. If the megaphone is damped or "muted" by the placement of specially designed felt disks, the voice is attenuated or reduced from 10 to 15 decibels for each disk. With four disks in place the voice is attenuated to a level at which only the normal hearing person can understand the spoken words.

Conversational voice is from 40 to 50 decibels above the normal threshold. The unmuted megaphone increases it 20 decibels more or from 60 to 70 decibels above the normal threshold and an even greater increase may be obtained by shortening the distance between the megaphone and the patient which may be necessary in the case of the profoundly deafened individual. If each disk gives an attenuation of 10 to 15 decibels, the maximum attenuation of the four disks is approximately 50 decibels. Measurements have been made to determine whether there was frequency discrimination. This does not occur to any appreciable extent. In order to eliminate leakage of sound outside the megaphone a sponge rubber cushion is placed around the mouthpiece. The disks are constructed of one-half inch felt backed by wire mesh for support, with a knob in the center to facilitate placement and removal. Two strips of tape are placed lengthwise inside the megaphone to keep the felt disks in place.

The patient is seated in a chair 6 feet from the unmuted megaphone and asked to repeat the test sentences spoken by the examiner through the megaphone. The conversational voice is either attenuated by the placement of the felt disks inside the megaphone or made louder by shortening the distance between the megaphone and the patient, until a point is determined at which at least 60 per cent of the sentences can be repeated correctly. This distance is recorded and maintained throughout the rest of the test.

A hearing aid is then placed on the patient's ear, the type of aid and the ear on which it is used having been determined by previous audiometric tests. One or two of the smaller felt disks are placed in the megaphone, sentences again delivered to the patient and adjustment of the volume control of the hearing aid made.

According to the minimum requirements for acceptance by the Council on Physical Therapy of the American Medical Association, an electrical hearing aid shall improve at least 30 decibels for speech the hearing of the deafened ear for which it is prescribed or fitted. If the patient can understand speech with three disks in place the aid is supplying a completely adequate gain of more than 30 decibels. If speech is not intelligible with the three disks the aid is inadequate. Four disks in place would mean a gain of about 50 decibels and is the maximum any hearing aid can give without distortion. In most instances this amount of gain is not necessary.

This method should be used, of course, only when accurately controlled electrical equipment is not available.