



Western Electric
Cardioid Directional Microphone
639 A



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Western Electric

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Cardioid Directional Microphone

639A

A development of Bell Telephone Laboratories, the research laboratories of the American Telephone and Telegraph Company and the Western Electric Company.

Western Electric's Cardioid Directional Microphone is the realization of the sound transmission engineer's long cherished dream — pick-up control at the microphone.

Here is a microphone that brings a new concept of quality, performance and universality — a microphone that sets new high standards of efficiency, convenience, appearance and functional control.

Performance—Cardioid Directional

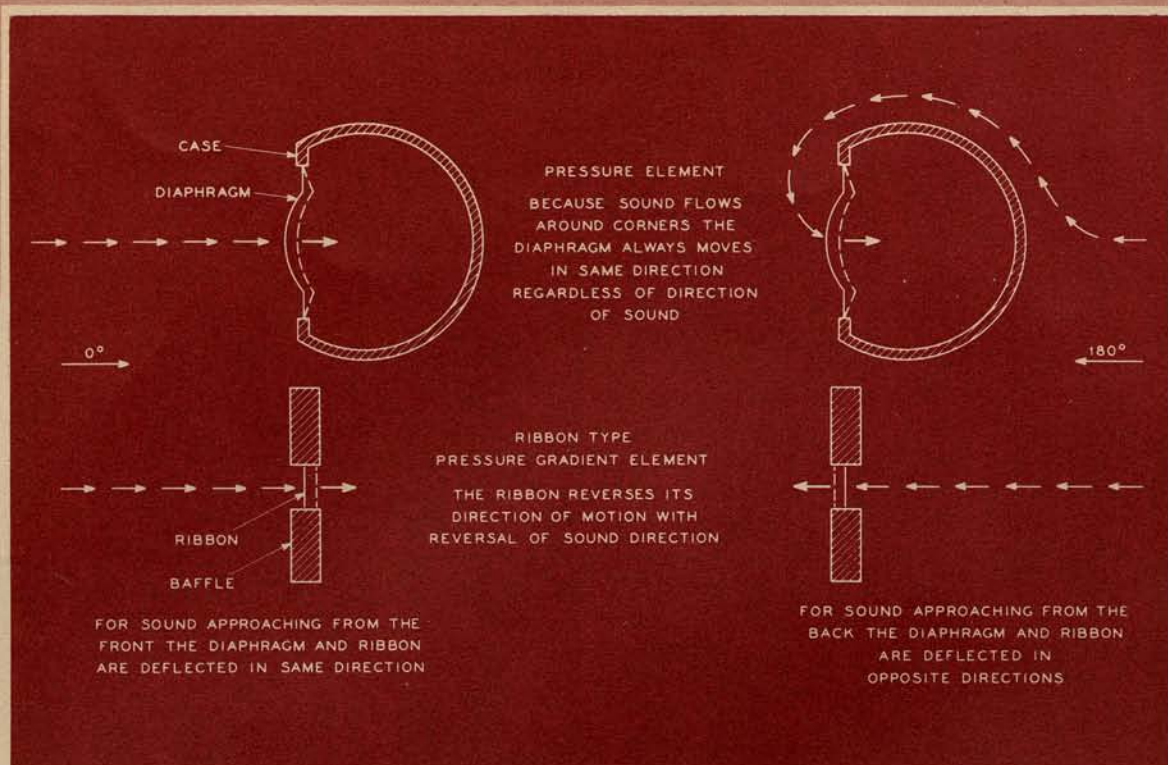
The cardioid directional performance of the 639A covers the wide angle of pick-up which experience has shown to be desirable in the majority of applications.

"Cardioid" has been the term used by mathematicians for centuries to express the plot of $1 + \cos \theta$, because of its heart-like shape. Technically, a curve (see page 6) in polar coordinates that represents the sensitivity of the microphone versus the angle of sound approach is similar to the plot of $1 + \cos \theta$, that is, a "cardioid."

The Theory of the Cardioid

Theoretically in microphones, the cardioid directional response can be obtained by combining the outputs of an ideal, completely non-directional pressure unit, with an ideal bi-directional pressure-gradient unit, commonly known as the "velocity" type. The output of the pressure unit is independent of direction, and may be represented by

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Schematic illustration of the action of the Cardioid Directional Microphone

a pure number, say unity. The pressure-gradient unit has an output which reverses in phase when the sound direction is reversed, and is actually proportional to the cosine of the angle. Adding the two together, the result is $1 + \cos \theta$, the "cardioid."

The Application

Practically speaking, there are no pressure or pressure-gradient (velocity) microphones available which are ideal for the purpose at a workable efficiency and ruggedness except over a limited middle frequency range. Therefore, their simple combination in a so-called uni-directional microphone produces good directional characteristics only over a limited frequency range, and does not give a true cardioid directional performance for bass or treble tones. This results in a distorted balance in the quality of pick-up.

The reason that the Western Electric 639A achieves true cardioid directional performance lies in the units selected and the method of equalizing and combining the outputs. For the pressure element the dynamic unit of the well-known Western Electric 630A or "Eight Ball" was selected because of its demonstrated reliability, efficiency and small size. For the pressure-gradient or velocity element it was necessary, in order to obtain performance comparable to that of the dynamic unit, to design a special, ribbon-type structure using a uniquely shaped ribbon which operates under conditions heretofore considered impossible for this type of microphone.

CARDIOID DIRECTIONAL MICROPHONE 639A

Directivity Over Wide Frequency Range

Because of its unique construction, the Western Electric 639A actually approaches ideal cardioid directivity for bass and treble tones as well as for intermediate ones. The minimum discrimination between front and back is 15 db in the range from 70 to 6000 cycles, 10 db from 40 to 70 cycles and from 6000 to 8000 cycles. The average discrimination is 20 db over the range from 40 to 10,000 cycles.

Wide Pick-up Zone

Cardioid directional performance over the entire useful frequency range insures a practical, wide pick-up angle of 120° within which there is no change in quality and with barely a perceptible change in sensitivity. The various pick-up zones are shown in the drawing on page 6 which is also shaded from light to dark to illustrate visually the variation in sensitivity with angle. The fading zone is still useful for there is no quality change but it may become necessary to make a slight adjustment for the change in sensitivity. The zone between 90° and 60° has been designated "announcer's" because at this angle the ribbon element contributes very little to the total output and an "announcer" may talk close to the microphone without employing a "voice strap." The dead zone of 60° is not sharp and the discrimination is just as good as that for 180° anywhere in this region.

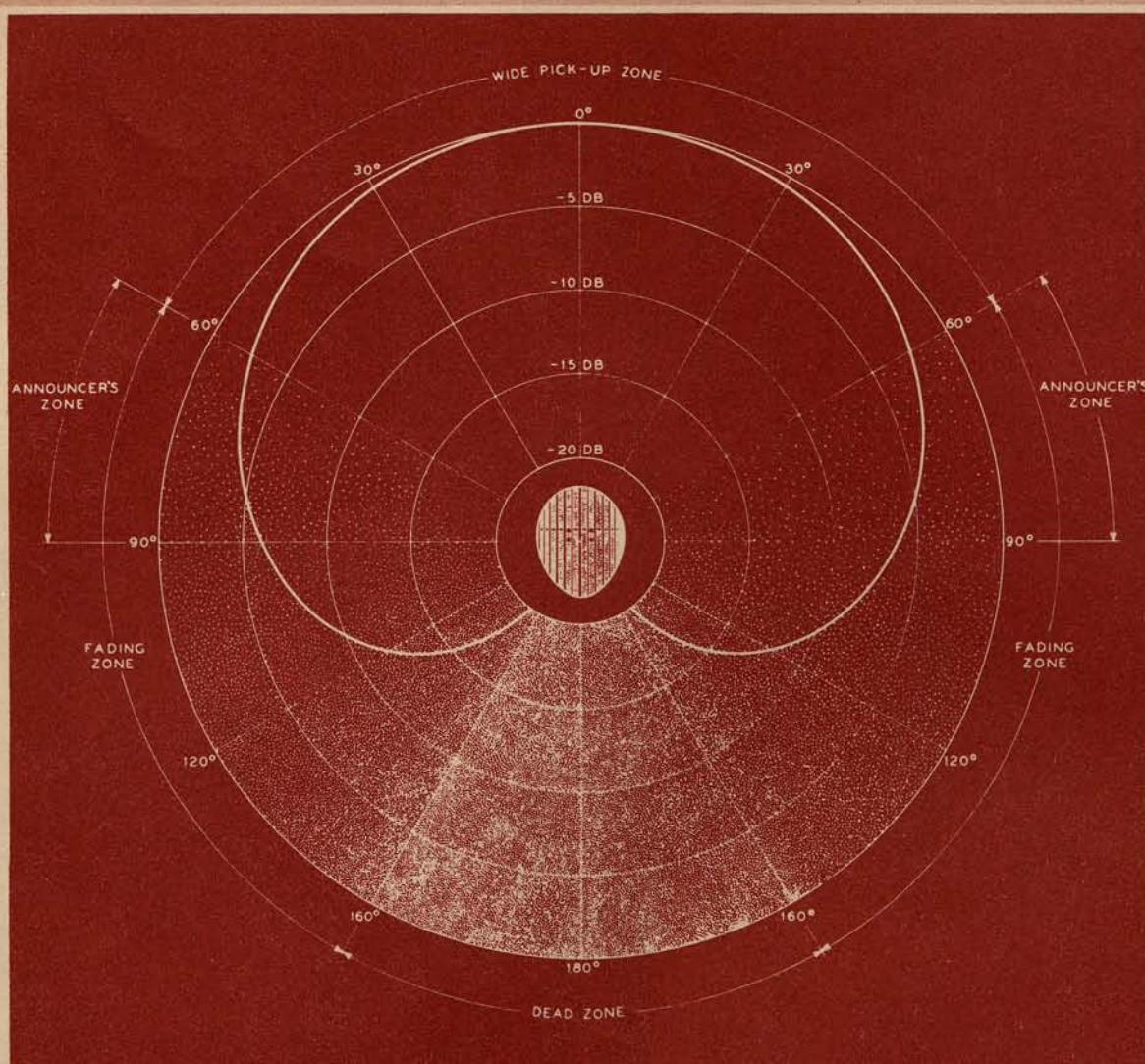
High Output Level

The 639A Cardioid Directional Microphone is designed to be used with the well-known Western Electric 80A or 104 type, 30 ohm input pre-mixing amplifiers. The open circuit output level is 84 db below 1 volt/bar or 64 db below 1 volt/10 bars. Terminated in its own impedance the power output level is 84 db below .006 watts. In other words, the output level is 4 to 5 db higher than the well-known Eight Ball (630A) or Salt-Shaker (633A) Western Electric dynamic microphones and only 2 db lower than the efficient 618A dynamic.

Functional Design

The components of the microphone are compactly assembled in a cast housing which is a combination wind screen for the ribbon unit, case for the dynamic unit, and terminal mounting, resulting in a compact and efficient instrument smaller than an ordinary "velocity" microphone alone of comparable output level. The microphone has been styled along the aerodynamic convention to convey an idea of its directivity and to





Cardioid Directional Response
Western Electric 639 A Microphone

symbolize its position in the "world of tomorrow." The housing and grille structure is of cast metal, attractively finished in aluminum gray with the horizontal lines in satin chrome separated by a red streamline. The overall height of the microphone including the plug terminal is $7\frac{1}{2}$ " and the weight is approximately $4\frac{1}{2}$ lbs.

Ruggedness

Experience leaves no doubt that the dynamic unit can be subjected to all sorts of conditions of temperature, wind and shock. However, the delicate ribbon-type microphone has long been considered too frail to withstand even slight breezes without becoming noisy and in some cases failing all together. The uniquely shaped ribbon employed in the new 639A introduces a new concept of the possibilities of ribbon structures. Wind noise is much lower than that normally encountered in previous

designs, and the 639A may be used successfully in outdoor locations. In fact, the new Western Electric 639A may be used for any remote job as well as in the studio.

Mounting Facilities

For general applications the 639A Microphone is designed for use with the Western Electric 442A Jack, which, together with an adapter, provides a mounting link for floor and desk stand use. The microphone cord may be brought out either through the center of "self-feeding" floor or desk stands or through a slotted connector attachment. An attractive streamlined desk stand has been designed especially for use with this microphone.

No tilting of the microphone is ordinarily necessary. Because of its broad pick-up angle, sufficient adjustment may be obtained by setting the stand in the right direction. Special cases, however, such as stage productions, suspension or other placement, may require tilting. For this purpose, a universal swivel mounting is available. With this mounting, the microphone is suspended from its center of gravity and friction joints allow setting of the instrument in any direction. The mounting may be either suspended by cords or attached to a floor or desk stand.

Three Microphones in One

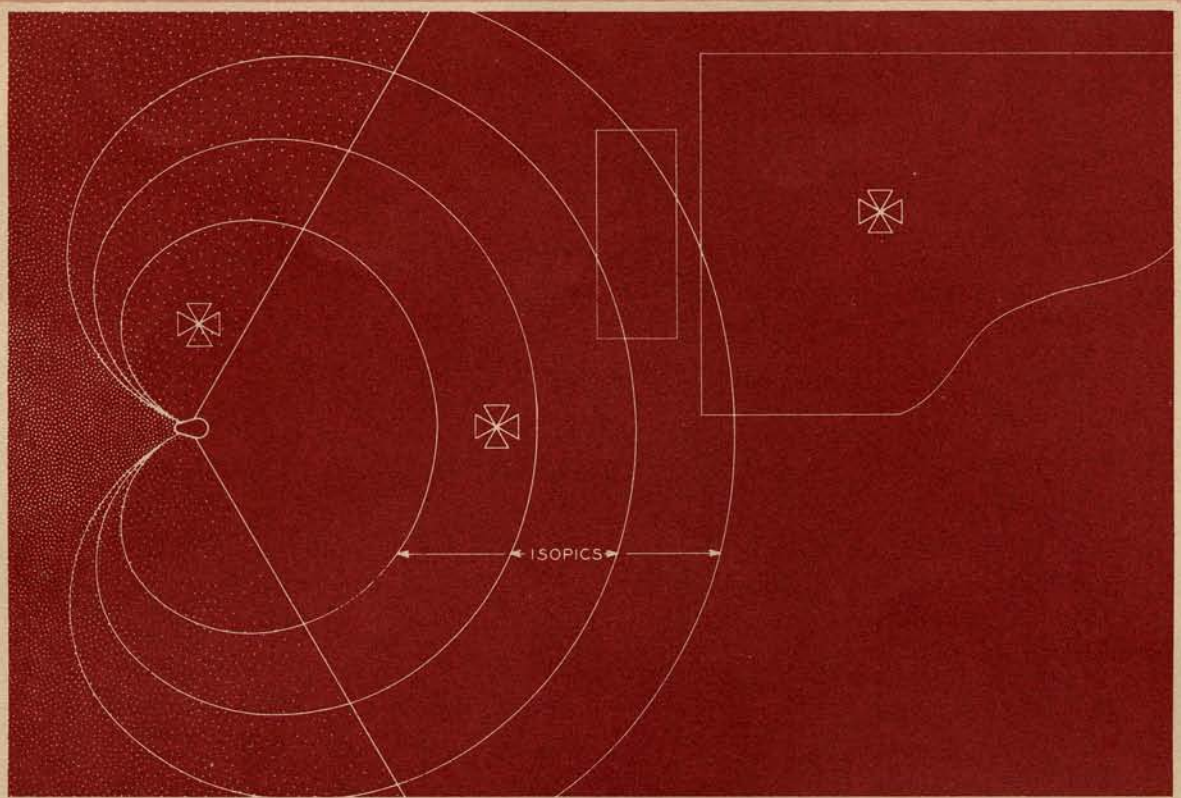
Since the pressure and pressure-gradient elements are separated mechanically, the choice of either unit individually instead of the combination is made possible by means of a simple switch. The slotted control shaft of the switch is set flush in the surface of the housing. The three positions are designated by the letters C (cardioid), D (dynamic), R (ribbon). The performance in the dynamic position is equivalent to that of the Western Electric dynamic 630A with baffle or 633A with baffle both as to quality and output level. The ribbon position provides bi-directional response of studio quality at the same output level.

Experience and tests have shown that true cardioid directional performance is by far the most desirable of the three and will prove entirely satisfactory for the majority of pick-up conditions. Yet, the 639A microphone may be immediately converted into either of the basic types should special occasion demand. Therefore, the engineer handling a remote pick-up in untried surroundings can feel assured that one or more 639A's will handle any situation.

Suggested Applications

"Isopics"

Under the heading "Performance Cardioid Directional" page 3 the basic principles are outlined and the illustration on page 6 sums up the matter for quick reference. As a guide to the studio engineer who wishes to utilize the "Fading Zone" a few "isopics" are shown in the drawing, page 8. "Isopics" are lines along which an announcer or artist may move approximately without changing the volume. In the wide pick-up zone the



1. Microphone placed with dead zone toward wall increases useful floor space
2. 120° wide angle pick-up eliminating tilting of microphone
3. Isopics are lines of equal pick-up

Cardioid Directional Microphone, Studio Use

"isopics" are very nearly arcs of circles. Keeping the "isopic" contours in mind may prove a valuable aid to the technician trusted with the placement of musicians or performers for the best results.

Studio Use

The lower sketch on page 8 shows the microphone placed with the "dead" zone backed against the wall leaving the center of the studio free for use. Echoes from this back wall will be suppressed. For example, in the case of symphony orchestra, prominence will be given to the direct sound, so that the individuality of the instruments will not be lost. In other words, the quality of the reproduced sounds will be characterized by unusual definition of every instrument; the brasses, the woodwinds and the strings standing out in full naturalness, with the bass very rich and clear without being "boomy." It will be noted that the wide pick-up zone, which applies vertically as well as horizontally, makes tilting of the microphone unnecessary. Because of the true cardioid directional performance, true balance of both lows and highs is assured under reverberant conditions.

Theatre or Auditorium

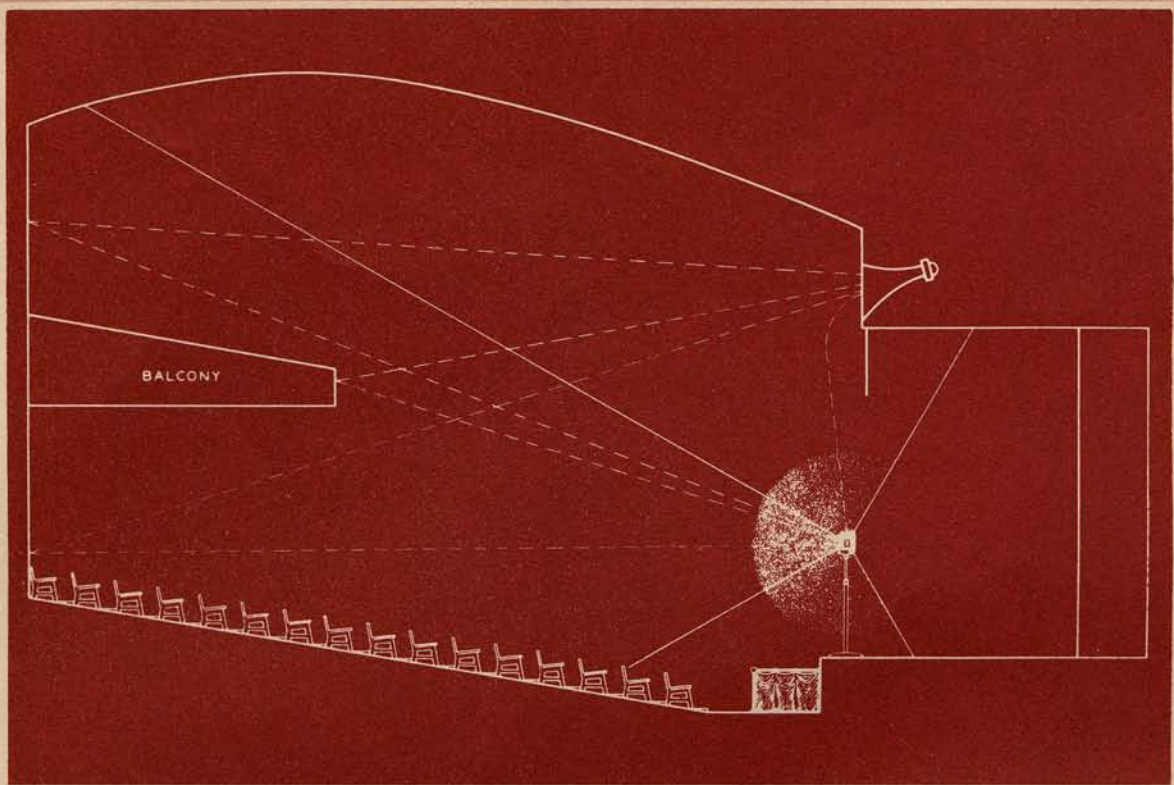
For theatre or auditorium use, the 639A is a "natural", for its directional characteristic automatically divides the audience from the stage. The lower sketch, page 10, illustrates how the microphone may be placed for theatre and auditorium application.

Public Address

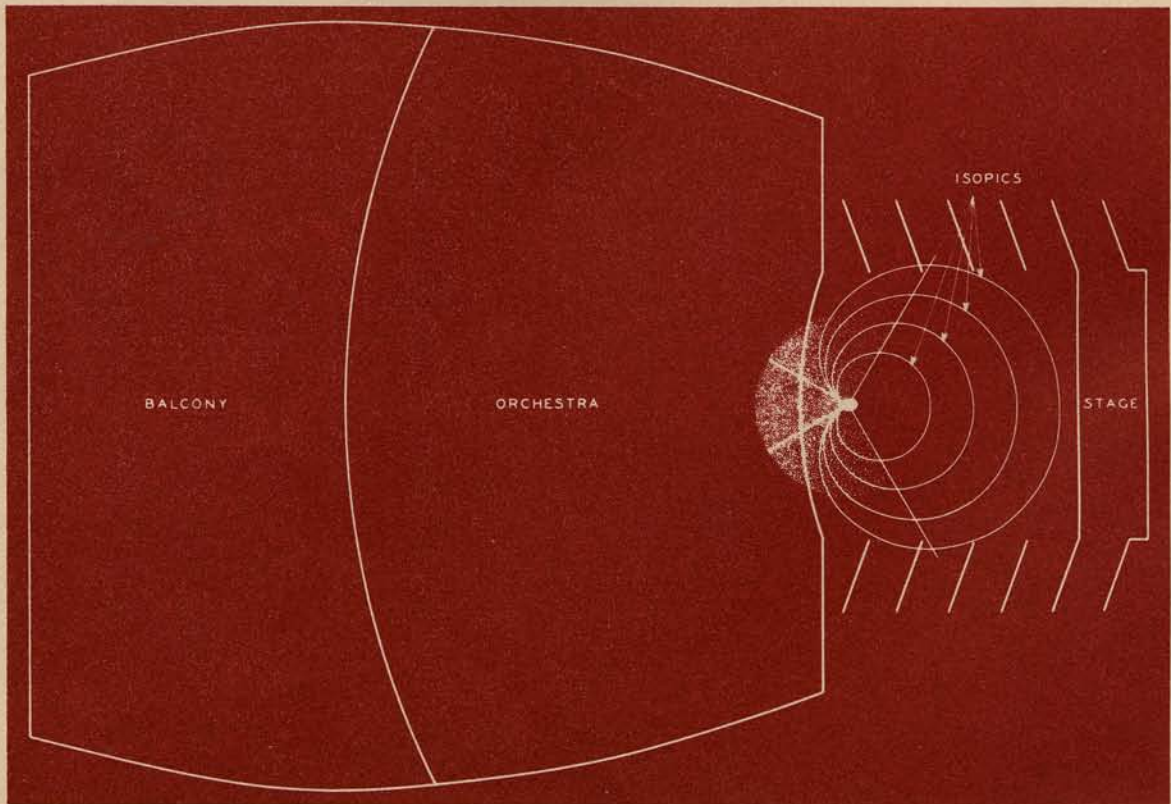
The microphone's directional characteristic naturally divides the audience from the stage. From a feedback angle, the 639A Cardioid Directional Microphone will solve many troublesome problems in theatres, banquet halls and auditoriums. Since the microphone is directional at low frequencies down to the loudspeaker cut-off, by proper positioning of the microphone and loudspeakers, feedback can be reduced to the tertiary form, that is, sound only may be fed back by reflection into the face of the microphone after successive reflection from the rear of the house and the back of the stage. With this condition, considerably more sound reinforcement may be obtained. The upper sketch, on page 10 shows a simple theatre installation.

The above applications of studio, theatre, auditorium and public address pick-up are of predominant importance. The sound engineer will find many further uses by taking advantage of any or all of them. A trial with this new microphone will convince him regarding its efficiency and versatility in solving his various problems. In addition to its ability to handle varying situations and to provide control at the microphone, the 639A simplifies the existing microphone technique because of its truly cardioid characteristics over the frequency range of from 40 to 10,000 cycles.





When the Western Electric Cardioid Directional Microphone is used for sound reinforcement, feedback from the rear of the auditorium is completely eliminated and direct spill-over can be either prevented or considerably reduced (This applies down to 50 cycles)



The Western Electric Cardioid Directional Microphone is ideal for dividing the Stage and Audience

For Further Information

If additional information is desired regarding this microphone or Western Electric microphone equipment in general, it is suggested that you direct inquiries to any of the Western Electric distributors listed on the last page of this booklet.





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