UNI-DIRECTIONAL MICROPHONE

77-A

AN INGENIOUS NEW TYPE OF HIGH FIDELITY MICROPHONE

A TRUE UNI-DIRECTIONAL MICROPHONE

Uniform Wide-Angle Response from the Front Side, Negligible Response at All Frequencies from the Back

TYPE 77-A UNI-DIRECTIONAL MICROPHONE

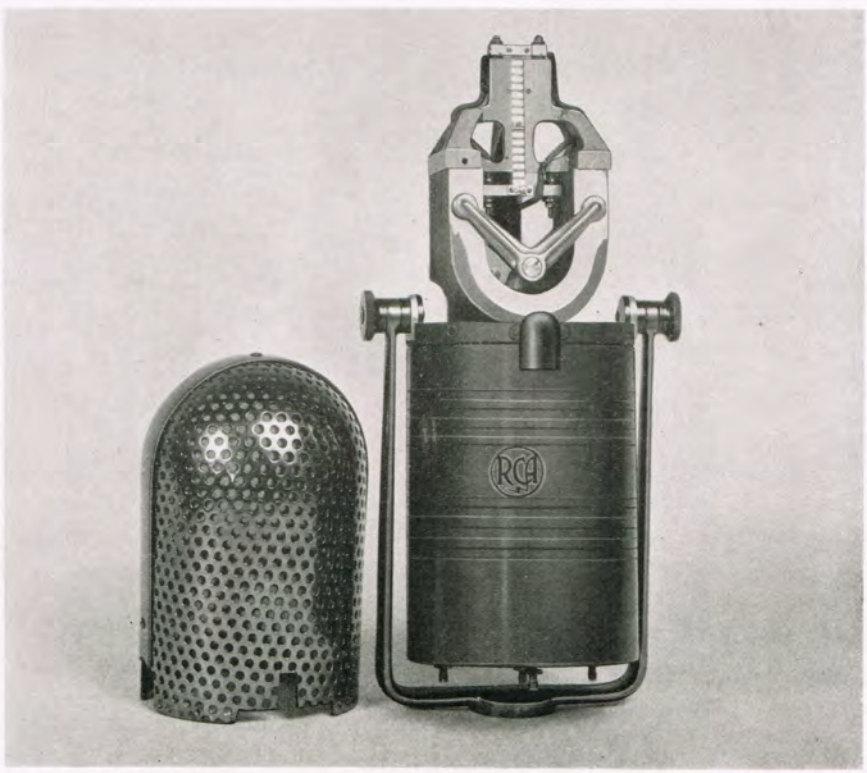
An exclusive RCA development

RCA Type 77-A Uni-Directional Microphone

A New High-Quality Microphone with Unique Directional Characteristics

An Entirely New Type of Microphone The RCA Type 77-A Uni-directional Microphone is a spectacular new type of microphone—a microphone which has a directional pickup pattern totally different from that of any other microphone. It presents studio engineers and production men with a new tool—one which has any number of unique possibilities, and which is certain greatly to facilitate many types of pickups now made with difficulty. It is not, most definitely not, just another model of the standard Velocity Microphone. While it resembles the Velocity Microphone in appearance and construction, and in fact evolved from research and development work on the latter, it is not strictly velocity-actuated, but rather combines velocity and pressure operation. Because of this, it secures in surprising degree the best features of each type, and overcomes disadvantages inherent in both. Of its several unusual features the most striking, and the one which gives it its name, is the ability to pick up sound arriving from one direction—or, more accurately, from one side—while almost completely rejecting sound from the other side. This characteristic and the other advantageous properties of this microphone are derived from the radically new design, which is totally different from that of any other microphone, and is an exclusive RCA development.

The Microphone the Experts Demanded The Type 77-A Uni-directional Microphone is certain of its acceptance, because it was literally demanded by the leaders among the group of engineers who will use it. It has long been recognized that the men who are using equipment in the field, day in and day out, are often better able to see the need for a particular item of equipment than are the men who develop equipment in the laboratory. From this viewpoint, the demand for the Uni-directional Microphone is a logical and easily understood development. The engineers who have the responsibility of solving the many varied pickup problems of modern broadcasting, as they became acquainted with the various types of microphones available, gradually analyzed the possibilities of each type. They found that they had—



The Type 77-A Microphone with outer shield removed. The construction is quite similar to that of the Velocity Microphone, but the ribbon, instead of being entirely free, is rigidly clamped at the center and the upper half enclosed in the rear in order to obtain pressure operation.

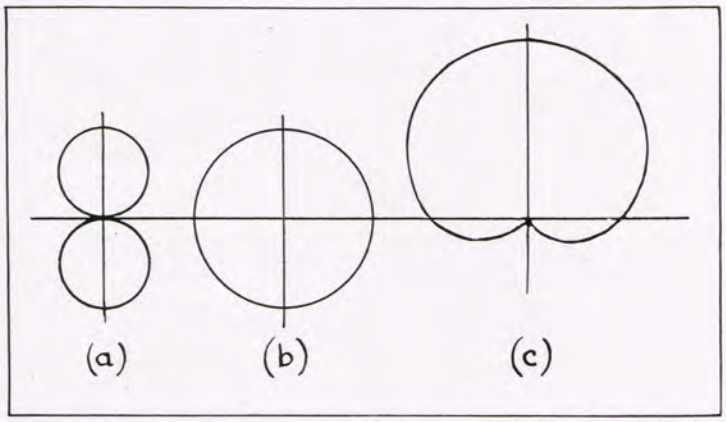
THE MICROPHONE

the experts demanded

A disassembled view of the Type 77-A Microphone. Note particularly the pipe which encloses the rear of the upper (pressure-actuated) half of the ribbon, and the ingeniously arranged labyrinth which furnishes the proper acoustic termination for the pipe.

when classified according to pickup properties—three distinct types of microphones. First, of course, were the pressure-operated diaphragm types, which, while providing satisfactory pickup from only one direction, were, nevertheless, non-directional insofar as low frequencies were concerned, and hence picked up reverberatory and other extraneous noises from all directions. Secondly, they had the so-called "non-directional" types which, while affording response of fair quality from all directions in the horizontal plane—and thus having some advantage for a small group of applications—nevertheless, had the same disadvantage of picking up undesirable noises from all directions. Thirdly, and finally, they had the standard Velocity Microphone which, with its figure-8 pattern, identical in the vertical and horizontal planes, allowed practically as much floor space for artists as the "non-directional" type and had the advantage, because of being dead on the sides, top and bottom, of cutting out two-thirds of the energy of reverberation and similar unwanted noises—and which, moreover, could be tilted or rotated to increase or decrease "liveness," or to attenuate a particularly objectionable noise source. Nevertheless, it soon became evident to these engineers that they lacked one possible type—perhaps the very best—viz., a microphone with good pickup from one side and with no pickup at all from the other side. What they wanted, they said, was a pattern equivalent to just one of the lobes of the Velocity Microphone pattern. To the layman such a characteristic would probably seem the simplest and most elementary. However, everyone who has studied

Fig. 1—The figure 8 directional pattern (a) of the velocity-actuated part of the ribbon combines with the circular pattern (b) of the pressure-actuated half to provide an overall pattern (c) which takes the form of a cardioid.



the theory of sound recognizes the difficulty of obtaining such a pattern. Nevertheless, it so happened that Dr. H. F. Olson of the RCA research staff had, while developing the Velocity Microphone, hit on an idea for a uni-directional microphone, and had even built and tested a model. Unfortunately this microphone, although quite simple in design and construction, turned out to be relatively expensive to build and, no immediate demand for it being evident, was not put into production. Before long, however, information of it trickled into the field, and sound engineers who knew what they wanted began to ask for it. Gradually, as recording engineers, movie sound men and broadcast engineers joined in, these requests became a demand. And it is, therefore, "by request" of these discriminating engineers, who insist on the best regardless of price, that the Type 77-A Uni-directional Microphone—a microphone which meets their specifications to the dot—is now made available.

Combining Two Microphones in One The construction and operation of the Type 77-A Uni-directional Microphone is best understood by considering it as two separate microphones combined in a single case. One of these microphones is velocity-actuated while the other is pressure-actuated. The idea of combining the action of these two different types of microphones has probably occurred to many engineers—and not a few have tried to carry out the idea by using the two types side-by-side, and combining the outputs. The difficulty with such an arrangement is that the space between the two, even when only a few inches, is comparable to the wave-lengths of high-frequency sounds. Thus the outputs of the two microphones are out of phase, and the result—analogous to pressure-doubling in the diaphragm type microphones—is a sharp high-frequency peak. In the Type 77-A Uni-directional Microphone this has been overcome by making the two microphones the respective halves of a single ribbon. The main construction of the microphone is almost identical to that of the standard Velocity Microphone. However, the ribbon is rigidly clamped at the center, as well as at the top and bottom. The lower half is open in front and back, and hence operates as a regular velocity microphone. In order to make the upper half of the ribbon operate as a pressure microphone, it is, of course, necessary that the rear of this be inclosed. At the same time it is not possible just to block this off, as this would result

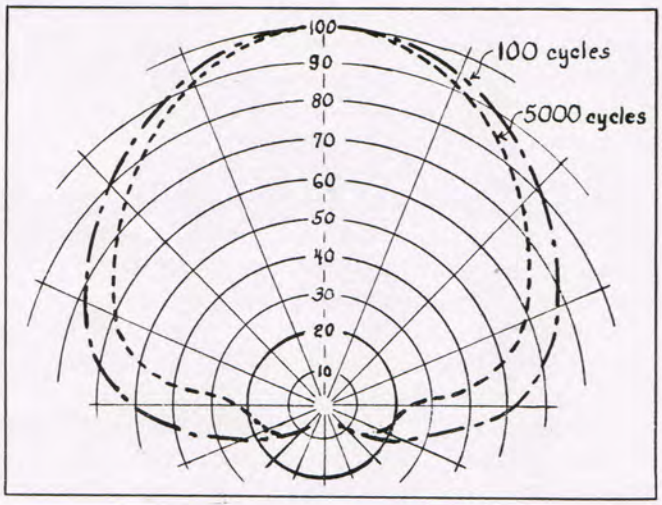
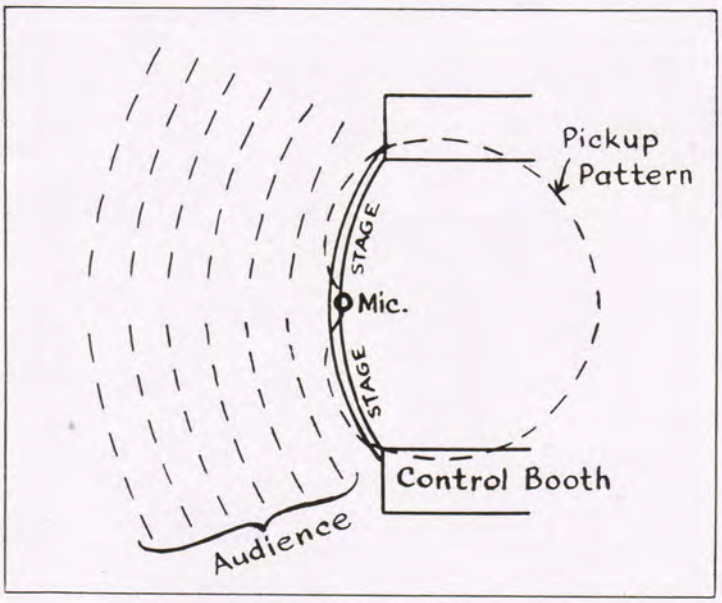


Fig. 2—The measured directional response of the Type 77-A Microphone. The wide angle of pickup is a particularly noteworthy feature. The two curves are typical of the response at high and low frequencies respectively. Curves for intermediate frequencies lie between these.

Fig. 3—(Right)—The Type 77-A Microphone is uniquely adapted for pickups in auditoriums, theatres, night clubs and the like, where audience noise is always a problem. Because of the wide angle of pickup, one microphone will usually suffice, even for large ensembles.



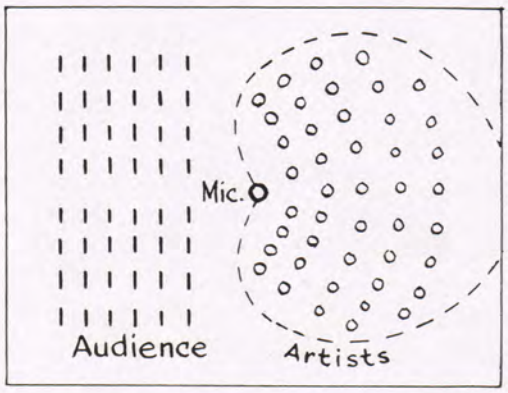


Figure 4—(Above)—The noise-discriminating feature of this microphone is similarly valuable in large studios, particularly when a large audience must be admitted to a limited space.

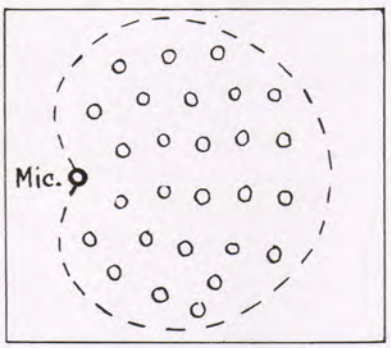


Fig. 5—(Left)—In small studios, the Type 77-A Microphone has the advantage that it can be placed very close to the back wall, and very much less "dead-end" absorption material is required.

in a response increasing with frequency. Rather it is necessary to present an acoustic impedance to the back of this part of the ribbon. An infinitely long tube would be the ideal impedance, but this, of course, is impractical. Instead, an ingenious labyrinth which gives practically the same effect is used. While this has a finite length, the desired damping of reflection is obtained by padding it very lightly with absorbing material. The result is that the upper half of the ribbon becomes an efficient pressure-actuated microphone with a very good response over the whole frequency range. And, since the two microphones are part of the same ribbon, the voltages induced in the two are, of course, in series, and the output is obtained from the ends of the ribbon precisely as in the Velocity Microphone. Since the dimensions of the ribbon are small, the two voltages are closely in phase except at the very high frequencies.

Cardioid Directional Pattern Obtained The advantage of the Type 77-A Unidirectional Microphone results from the manner in which the voltages generated respectively in the velocity-actuated and pressure-actuated parts of the ribbon add together. Without going into the mathematical expressions for these voltages, it is possible to obtain a picture of the action from a consideration of the three patterns shown in Fig. 1. In this illustration (a) is the directional pattern of a velocity microphone, (b) is the directional pattern of a pressure microphone. While these figures are the theoretical or idealized patterns, they correspond, for ribbon-type microphones, quite closely to the actual measured characteristics. When these patterns are added the forward lobe of the figure-8 pattern adds to the circular pattern, while the rear lobe, which is 180 degrees out of phase, opposes. The result is the same as that when the signals of a vertical antenna and a loop antenna are added, viz., a cardioid of revolution, as shown at (c). In practice the actual measured response of the Type 77-A Microphone, shown in Fig. 2, approaches this theoretical cardioid very closely. For all frequencies up to 6,000 cycles, the cancelation is very good. At higher frequencies a small "tail" occurs because of the slight phase displacement which begins to become noticeable in this range.

Advantages of Uni-Directional Pickup The advantages of the uni-directional characteristic of the Type 77-A Microphone will be so evident to the experienced engineer that it is almost unnecessary to stress them. On the front side this microphone has a very uniform response, while on the back side sounds are attenuated an average of 20 db.—giving a 10-to-1 ratio of desired to undesired pickup. Numerous advantageous applications will be immediately apparent. First, and perhaps most important, of these will be those pickups of the type which occur in the case of auditorium-type studios, and other large studios, where a sizable audience is present in the studio—and in remote pickups at theatres, night clubs, and the like. In all such situations the audience noise presents a serious problem. In some cases the standard Velocity Microphone can be oriented so as to overcome this. However, the same effect can be obtained to a much greater degree, and with much greater ease, by simply placing a Type 77-A Uni-directional Microphone with its dead-side toward the audience. When placed close to the footlights, or in an equivalent position, the 20 db. discrimination will provide the desired attenuation of audience noise, while the broad pickup angle—useful through nearly 150 degrees—will afford pickup of the whole stage, or that part of the studio in which the artists are located. The wide pickup angle of the Type 77-A Microphone is the second important feature. It is practically twice as wide an angle as that of the diaphragm-type microphones, and even wider than that of the lobes of the standard Velocity Microphone. As a result, one of these microphones will nearly always suffice for any type of pickup, and will often take the place of two or three other types.

Another very interesting application of the Type 77-A Microphone is its use in relatively small studios. For this use it has unique advantages even when no audience is present. This follows from the fact that it can be placed, as shown in Fig. 5, much closer to the rear wall than any other type of microphone—since its pickup from the back, and hence its pickup of reflected sound, is so very much lower. Moreover, such pickup as does occur from the rear is of frequencies over 6,000 cycles, and these are the frequencies which are almost entirely absorbed even by ordinary wall constructions. The same effect will also allow of a great reduction in the amount of absorbing material used on the back walls—and in many cases will probably allow the "dead-end" construction to be done away with entirely. In addition to these outstanding advantages of a general nature, many special advantages under particular conditions will be apparent.

Fidelity Equal to that of the Velocity Microphone The foregoing paragraphs on the construction, operation and advantages of the Type 77-A Microphone have emphasized the outstanding directional characteristics of this unique microphone. In addition to these advantages, this new microphone has all of the inherent advantages of the standard Velocity Microphone. The frequency response has the same excellent uniformity throughout the whole audio range, and the reproduction it affords has the smoothness and naturalness which engineers have come to associate exclusively with the velocity-type microphone. The sensitivity, also, is of approximately the same order. For an input signal of 10 bars (10 dynes per sq. cm.) the output level, across a 250 ohm line, is —69 db. (zero level of 12.5 milliwatts). Because of these similarities the Type 77-A Microphone may be used interchangeably with the standard Velocity Microphone, and may be conveniently mixed with these, if desired.

Standard Finish, Mountings and Accessories The Type 77-A Microphone, as has been previously noted, is constructed along lines very similar to those of the Type 44 Velocity Microphone. The outer shield has a slightly different appearance, being rounded in order to conform to the circular construction of the labyrinth which occupies the lower part of the case. The whole assembly is finished in polished black nickel, as are other new RCA deluxe microphones. It is mounted on a U-bracket which allows it to be tilted as desired. The microphone is intended to be used with standard RCA microphone fittings, and can be furnished with suspension program type stand.

SPECIFICATIONS OF THE TYPE 77-A UNI-DIRECTIONAL MICROPHONE

Output impedance	250 ohms
Output level (10 bar input) (12.5 mw. zero level)	—69 db.
Directional ratio	10-to-1
Finish	polished black
Mountings	standard

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A Service of the Radio Corporation of America

Printed in U. S. A.

Form 1135