Oct. 16, 1945. A. L. W. WILLIAMS 2,386,996

SOUND TRANSLATING APPARATUS

Filed Aug. 28, 1942 2 Sheets-Sheet 1

FIG. 1

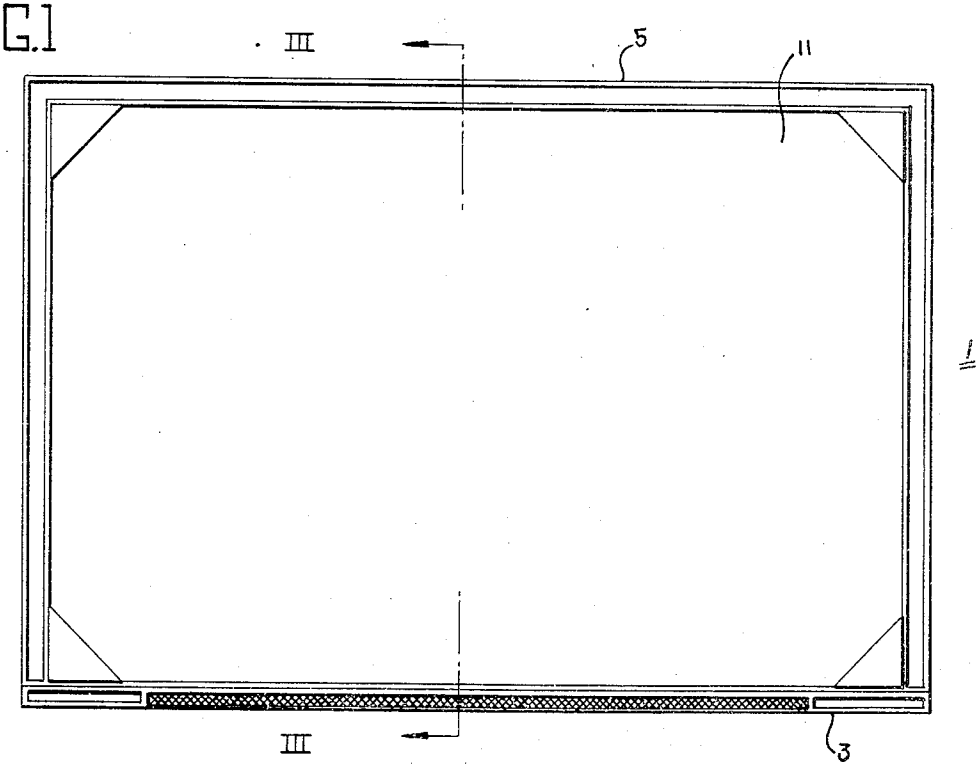
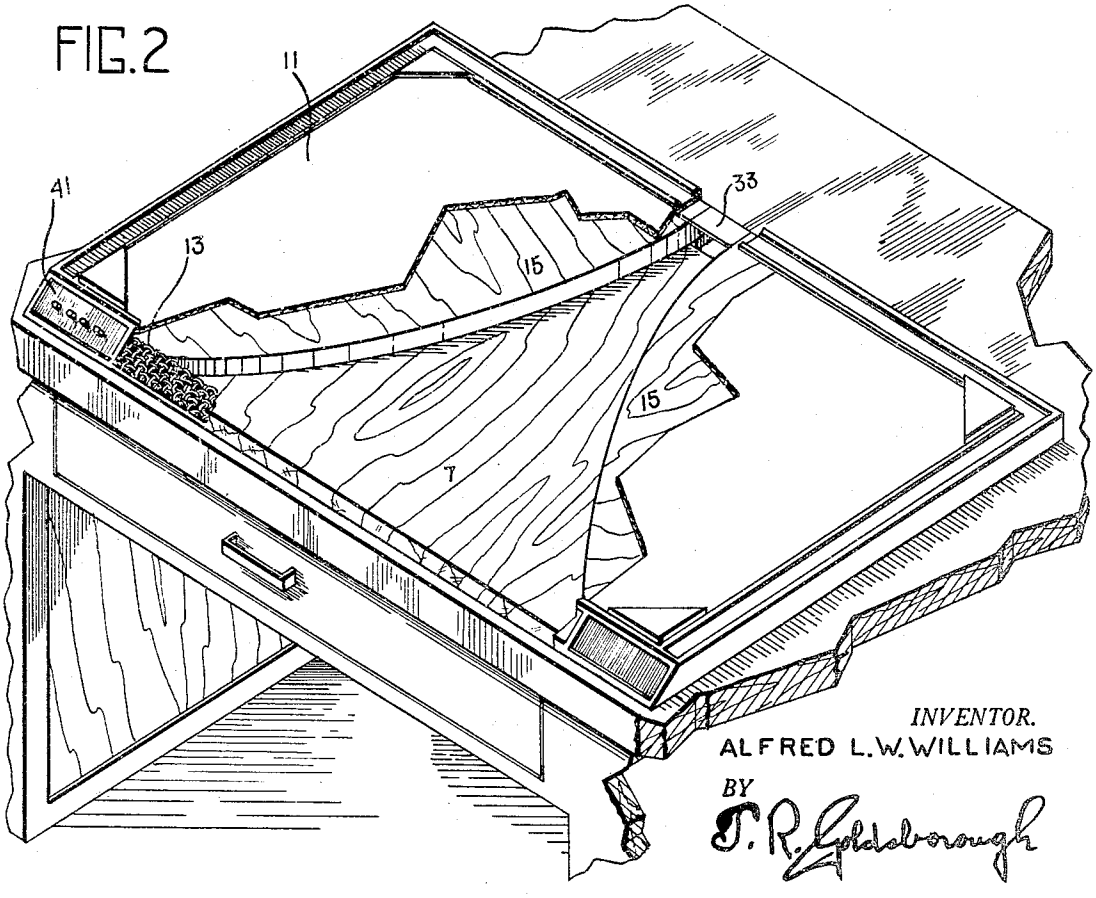


FIG. 2



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Filed Aug. 28, 1942 2 Sheets-Sheet 2

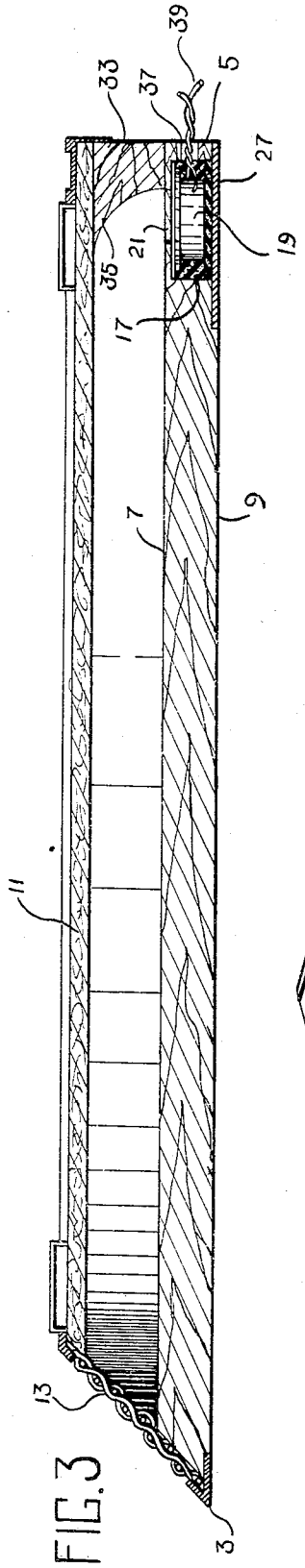


FIG. 3

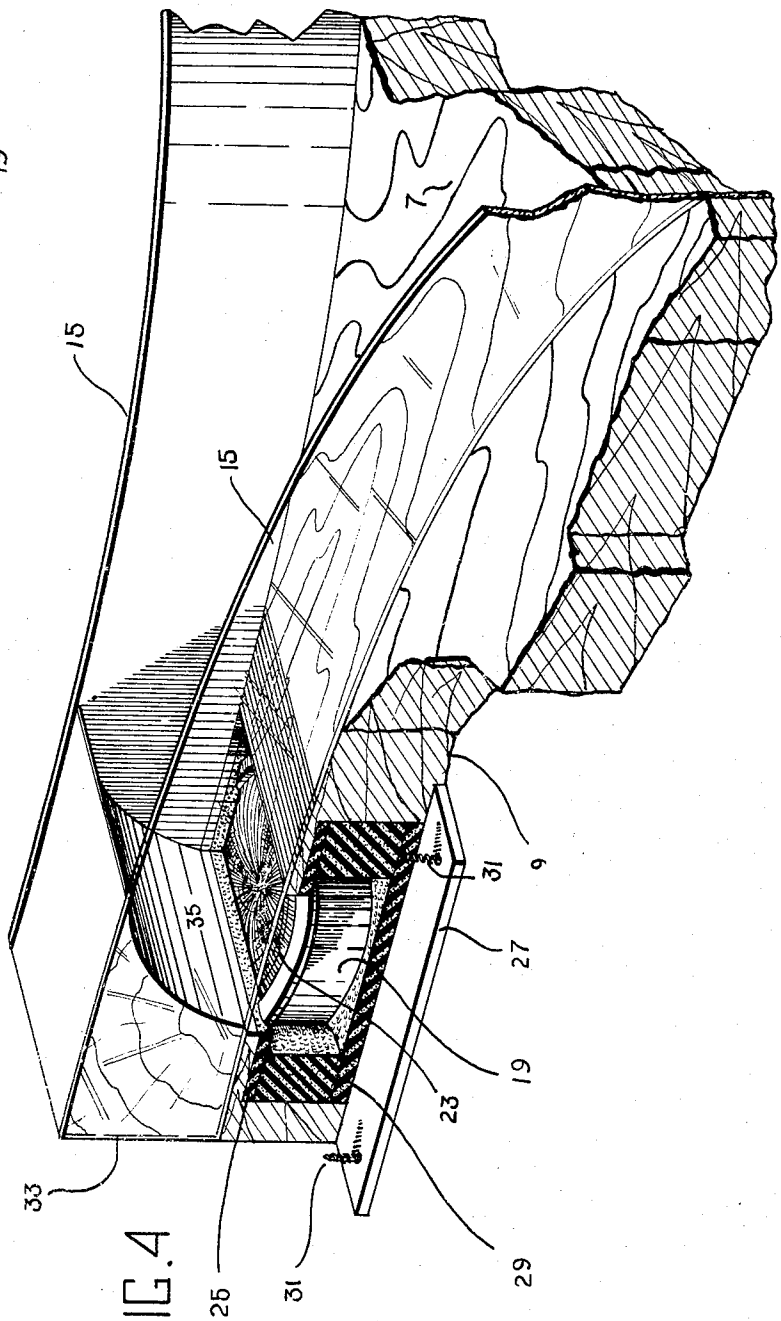


FIG. 4

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UNITED STATES PATENT OFFICE

2,386,996

SOUND TRANSLATING APPARATUS

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Application August 28, 1942, Serial No. 456,529

6 Claims. (Cl. 181—27)

This invention relates to sound translating apparatus and, more particularly, to transducers of the type capable of functioning either as a telephone transmitter or as a loudspeaker. The invention is especially applicable to dictating machines and, as will be pointed out hereinafter, it may be employed advantageously in interphone communicating systems and the like.

Apparatus of the general type to which this invention may be applied is exemplified by the United States patent to Feyrer, No. 2,152,585, which discloses a dictating machine equipped with an electrical transmitter-receiver, and the patent to Norton, No. 2,143,819, which discloses somewhat similar apparatus.

A disadvantage of dictating machines of the patented types is the necessity for handling the transmitter-receiver while dictating. For that reason, it has been proposed to mount those units, or a combined unit, within a small cabinet such, for example, as the cabinet shown in the United States patent to Glaser, No. 2,087,027. The cabinet, however, occupies otherwise usable space on an office desk. Furthermore, the transmitter does not discriminate between the voice of a dictator and the ambient noise in the room wherein the device is located, nor is it frequency-selective to any pronounced degree. The cabinet type, therefore, has not given entire satisfaction in noisy environments.

It is, accordingly, an object of this invention to provide an improved transmitter-receiver suitable for use in connection with a dictating machine or in interphone systems and the like.

Another object is to provide a device of the type described that shall have such frequency and directional response characteristics as to render it especially useful in noisy locations.

Another object is to provide apparatus of the type described, having directional characteristics such that, when it is employed as an adjunct to a dictating machine or as a constituent part of an interphone system, the user is not required to assume any particular posture with respect thereto when speaking.

Another object is to provide a device of the type described that shall discriminate against ambient noise at high frequencies and provide a better signal-to-noise ratio than analogous devices heretofore known.

A still further object is to provide a device of the type described that shall be unobtrusive and shall occupy minimum space on an office desk or the like.

The foregoing objects and other objects ancillary thereto are attained, in a preferred embodiment of the invention, by providing a piezoelectric transducer with a flat horn that flares exponentially in the horizontal direction only, the mouth opening of the horn being in the form of a long narrow slot, and by so disposing the horn within a desk-blotter holder or pad that the opening lies along an edge of the pad that is parallel to the front of a desk on which the pad is used. The flare of the horn, in a plane parallel to the surface of the pad, is so chosen that the low frequency cut-off is in the neighborhood of 500 cycles per second.

Because of the shape and positioning of the mouth opening, the device discriminates between sounds at high frequencies that reach the opening from directions parallel to the long dimension thereof and sounds, such as the voice of a person dictating, that arrive in phase over the entire plane of the opening. It has maximum high frequency response to sounds originating at points forward of the mouth of the horn and lying in a plane normal to the plane of the horn opening at the center thereof.

The directional response of the device and the low frequency cut-off enable the device to exhibit a high signal-to-noise ratio and render it especially useful for interphones or for dictating in noisy locations.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of a specific embodiment when read in connection with the accompanying drawings, in which:

Figure 1 is a top plan view of a translating device constructed according to the invention;

Figure 2 is a perspective view of the device, upper portions thereof being broken away to more clearly illustrate the interior construction;

Figure 3 is a vertical cross-sectional view of the device, taken along a line corresponding to the line III—III in Figure 1, and

Figure 4 is a fragmentary "phantom" view of the device, illustrating the relation between the piezoelectric transducer portion thereof and the flat, exponential type horn.

Referring now to the drawings, sound-translating apparatus, constructed according to the invention, may comprise a flat, rectangular base of wood or the like, designated in its entirety by the numeral 1, which is slightly longer and wider than the usual desk-blotter pad and which has a thickness of the order of three-quarters of an inch. For purposes of convenience in description, the base is assumed to be horizontal, and it will be referred to as having a front edge 3, a rear edge 5, a top surface 7 and a bottom surface 9. A flat, rectangular blotter-accommodating top 11 is disposed vertically above and parallel to the base, the space between the top and base, approximately one-half inch, being utilized

to conceal a flat horn that flares exponentially in a plane parallel to the base and opens in a narrow slot along the front edge 3 thereof. A wire screen 13 may be disposed over the mouth opening, if desired.

The horn may be an element separate from either the base or top, or it may be defined, as shown in Figures 2, 3 and 4 of the drawings, by the inner opposed curved edges of two flat spacer-inserts 15 affixed to the base, on the upper surfaces of which the blotter-accommodating top 11 is fixedly positioned. Suitable means, such as a plurality of small screws (not shown), cement, or the like, may be employed for fastening the top, the spacer-inserts and the bottom together. Alternatively, the base and the inserts may be integral or any other construction may be resorted to for the purpose of providing a flat horn having a slot-like mouth opening adjacent the front edge of the base and a throat to which an electrical transducer may be coupled to function either as a transmitter or a receiver of sound-waves.

The top, bottom and spacers may be fabricated of any suitable material such as wood, plywood, plastic, metal or the like that is sufficiently light and strong for the purpose.

In the embodiment of the invention chosen for purposes of explanation, the bottom surface of the base, adjacent to the rear edge 5 thereof and immediately below the throat of the horn, is countersunk to provide an upwardly directed well 17 in which an electrical transducer 19 is positioned. In the drawings, the well is illustrated as square and as terminating in a slightly smaller upper opening 21 which communicates with the throat of the horn.

The transducer, which preferably is of the piezoelectric type comprising a crystal element connected to a vibratile diaphragm 23, is so held resiliently in position within the well that the diaphragm is directed upward toward the opening in the well that communicates with the throat of the horn. A gasket 25 of sponge rubber, or the like, having a central opening coaxial with the diaphragm, is interposed between the upper rim of the transducer and the periphery of the opening in the well and sufficient pressure is applied upwardly on the bottom of the transducer to hold it fixed in position.

Means for retaining the transducer in place may be constituted by a removable coverplate 27 for the bottom opening of the well, between which plate and the bottom of the transducer is interposed a layer 29 of resilient material such as rubber. The coverplate may be provided with a plurality of holding screws 31, and the bottom of the base may be so countersunk around the well, as shown in Figure 4, that the coverplate, when in position, is flush with the lower surface of the base.

The small end of the horn is closed by a solid plug 33 having a curved inner surface 35 extending upwardly and inwardly over the transducer diaphragm. The curvature may be parabolic or cylindrical, and the surface should merge smoothly with the inner surface of the blotter-supporting top 11 of the device.

A channel 37 may open into the well from the rear edge of the base, through which channel the leads 39 from the transducer, as well as electrical connections from a plurality of switches (not shown), concealed within the base, may extend.

As shown in Figures 2 and 3, the front-to-back dimension, or width, of the top is less than that of the base. The plane of the mouth opening of the horn, therefore, slants back and it is advantageously oriented to receive sound waves emanating from the mouth of a person who is dictating and, so long as he speaks from a position in front of or above the said opening, there is no necessity for him to assume any fixed posture. At the same time, sounds at high frequencies arriving at the mouth opening in a plane parallel thereto are discriminated against and the signal-to-noise ratio of the apparatus is enhanced.

It is to be understood, of course, that the plane of the mouth opening may be parallel to the plane of the blotter supporting surface or that the opening may lie entirely in the front wall of the device.

The flare of the exponential horn is preferably such that it has a low frequency cut-off in the neighborhood of 500 cycles per second. A smooth response is thus obtained at the higher voice frequencies and, by precluding response to lower frequencies, the intelligibility of a voice-record is improved, particularly when dictating is done in a noisy environment. For the same reasons, the device is well adapted to interphone use in factories and the like.

The design of exponential horns is now well understood by those skilled in the art. Should further information be needed, however, attention may be directed to the United States patent to H. C. Harrison, No. 1,730,425.

In addition to the acoustic advantages accruing from the design and positioning of the horn per se, the combination of piezoelectric transducer and horn permits good reproduction of the higher audio frequencies. Accordingly, the sibilants are emphasized and the differentiation between such words as "sat," "fat," "chat," etc., is facilitated.

Inasmuch as transducers are quite well-known to those skilled in the art, no necessity is seen for illustrating specific details. It is believed sufficient to state that the transducer may comprise a rectangular Rochelle salt crystal element of the "Bimorph" twister type, three corners of which are restrained and the third corner of which is directly connected to a diaphragm. The transducer functions either as a transmitter to generate electrical potentials representative of sound waves impinging upon the diaphragm or as a receiver to set up sound waves representative of electrical potentials impressed across the "Bimorph" electrodes. Other transducers, of course, may be employed with varying success, without departing from the spirit of the invention.

Should the device be intended for use with a remotely controlled dictating machine, the electrical switches necessary may be concealed within the base. The switch-knobs or buttons may be mounted on the small sloping panels at each side of the horn mouth, at the front edge of the base, as indicated generally by the numeral 41 in Figure 2. Such switches may include an on-off switch for the motor and amplifier, a three-position switch for placing the traveling carriage in recording, play-back or free position, a mandrel-clutch-control switch and a carriage re-set control switch, etc. The provision of such switches forms no part of the present invention; they have been referred to merely as indicative of one manner in which the improved sound-translator may be utilized.

The device may also be incorporated into an interoffice communicating system and additional control and indicating devices, including a "press-to-talk" switch, could be installed therein. In such event, a "stand-by" switch might additionally be provided for including the transducer in the interphone system between periods of dictation, and a visible signal for notifying a dictator that someone wants to break in. These suggestions also form no part of the invention and, consequently, no need is seen for their illustration.

The principal advantages of the improved sound translating device may be recapitulated and summarized as follows

1. The cut-off resulting from the flare of the exponential horn is set in the neighborhood of 500 cycles both because of the smoother response characteristic which can be obtained in a relatively short exponential horn in the higher frequency range, and also because of the far better intelligibility that is obtainable from a reproducing system operating in a relatively noisy environment when the low frequencies are eliminated from the reproduction.

2. The form of the blotter type unit causes the microphone location to be relatively close to the mouth of the person sitting at the desk as compared to a conventional unit which is generally located near a far corner of the desk. This means that the desk blotter unit will provide an improved signal-to-noise ratio as far as the acoustic system is concerned which, in turn, means a better voice record or better reproduction at a distant station.

3. The long and narrow slot which forms the sound pickup area for the unit has a relatively limited pickup zone in the plane of the desk whereas it will be substantially non-directional in a plane at right angles to the plane of the desk. This means that in actual use the efficiency of pickup will not vary appreciably whether a person is leaning over his desk and talking or whether he is sitting back in his chair.

4. The physical structure is such that the unit is always ready for use without disturbing any papers or articles that may be on top of the desk or on top of the special speaker-microphone unit.

Although I have illustrated and described an embodiment of my invention that is satisfactory in operation, I am fully aware that many additional modifications thereof will be apparent to those skilled in the art. The invention, therefore, is not to be limited except insofar as is necessitated by the prior art and by the spirit of the appended claims.

What is claimed is:

1. A transducer horn comprising a base member on the order of ¾ of an inch in thickness and whose thickness is small compared to its other dimensions, said base having a hollow space adapted to receive a horizontally positioned transducer, a flat top portion spaced about ½ of an inch from said base member, and spacer means positioned between and connected to said base member and said flat top portion, said spacer means having wall surfaces defining an exponentially flared channel from said hollow space in said base opening to an edge of said spacer means, and include a curved wall surface overlying said transducer whereby a vibrational wave entering said flared channel is reflected toward said transducer.

2. A transducer horn as set forth in claim 1 further characterized by said curved wall being positioned at one edge of said hollow space and being curved above said transducer to reflect pressure waves from said hollow space into said flared channel and from said flared channel into said hollow space.

3. A transducer horn as set forth in claim 1 further characterized in this; that the said horn is light and portable, and is adapted to be placed on the top of a desk.

4. A transducer horn which in its length and width dimensions is generally the size of a desk blotter and which in its thickness dimension is on the order of one inch, comprising a base member, a flat top portion spaced from said base member and extending substantially parallel thereto, and spacer means positioned between and connected to said base member and said flat top portion, said spacer means having wall surfaces defining a flared channel having an opening at one of the edges defined by the thickness dimension and either the length or width dimension of the horn, said horn due to said small thickness dimension being non-directional in a vertical plane and due to the long length or width dimension being directional in a horizontal plane.

5. A light-weight portable transducer horn which in its length and width dimensions is generally at least the size of a desk blotter, comprising, a base member having a recess therein adapted to hold a transducer, a flat top portion substantially coextensive with and extending substantially parallel to said base member and spaced therefrom a distance of only several inches, spacer means positioned between said base member and said top portion and connected thereto for maintaining said base member and said flat top in said spaced apart position, said spacer means having an open channel flared outwardly from a location substantially adjacent the said recess in the said base member to a relatively wide and thin opening at the edge of said horn, said opening being thin to cause said horn to be non-directional in a vertical plane and wide to cause said horn to be directional in a horizontal plane.

6. In a speaker adapted to be placed on a desk and utilized in combination with a dictating machine, frame means substantially rectangular in plan and about 24 inches by 19 inches in length and width and about 1½ inches thick, said frame means including flat substantially parallel top and bottom surface members the top surface of which is adapted to support a desk blotter, a transducer mounted within said frame, wall means mounted within said frame and defining an exponentially flared channel opening from said transducer to one of the 24-inch long edges of said frame, the said flat substantially parallel top and bottom surface members forming the top and bottom walls of said flared channel opening, said speaker due to its small thickness dimension being substantially non-directional in a vertical plane whereby upon said speaker being placed on a desk or the like where the mouth of a person seated at the desk is well above the plane of the speaker the transducer will "pick up" the words of the person, and said speaker due to the length of the said opening being broadly directional in a horizontal plane whereby a person seated at the desk may vary his position with respect to the desk by a nominal amount and may talk at an angle to the front edge of the desk and the transducer will "pick up" the words.

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