

Jan. 1, 1952

W. E. KOCK

2,580,439

DIRECTIONAL ACOUSTIC SYSTEM

Filed Sept. 7, 1949

FIG. 1

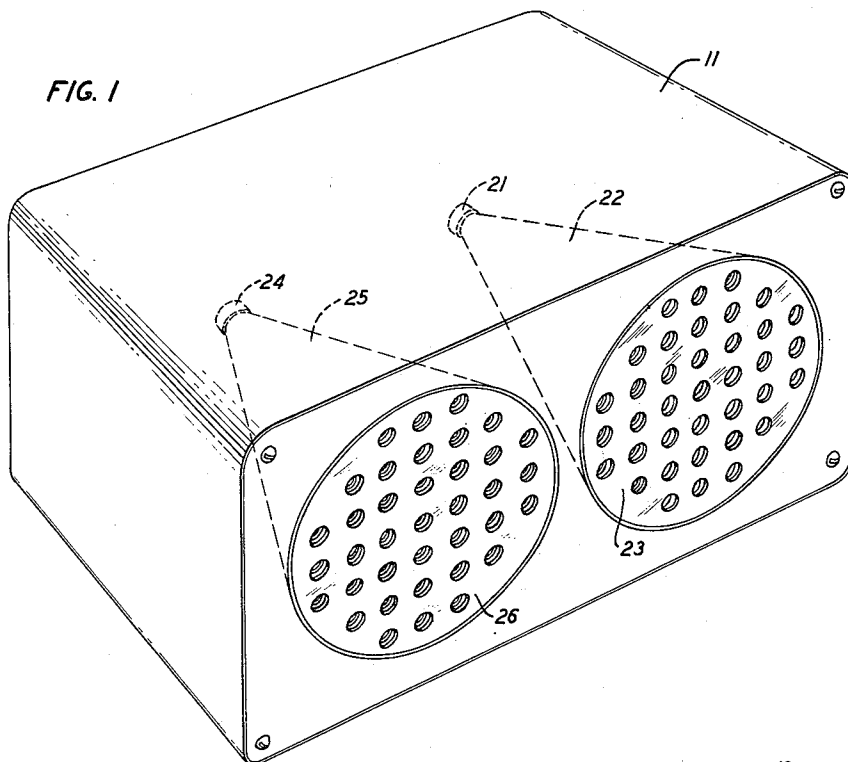


FIG. 2

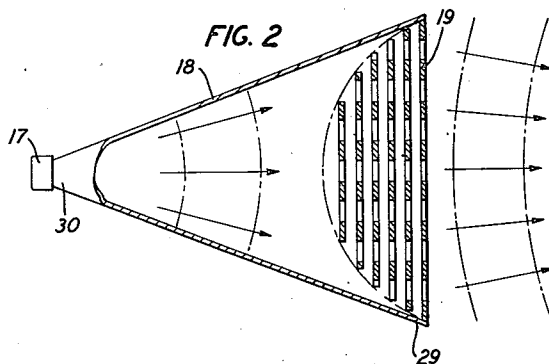
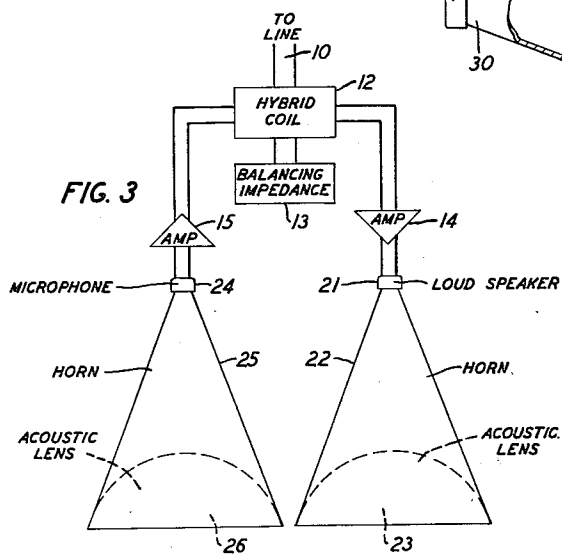


FIG. 3



INVENTOR
W. E. KOCK
BY
[Signature]
ATTORNEY

UNITED STATES PATENT OFFICE

2,580,439

DIRECTIONAL ACOUSTIC SYSTEM

Winston E. Koek, Basking Ridge, N. J., assignor
to Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application September 7, 1949, Serial No. 114,319

7 Claims. (Cl. 179-1)

1

This invention relates to directional acoustic systems and more particularly to directional transmitters, receivers, microphone-receivers, and combinations thereof for distant talking telephones.

It has long been recognized as desirable to provide means for concentrating or focussing compressional waves, for example in directional microphones, receivers, and distant talking telephones, to avoid the production and reception of waves outside of the area of interest and to utilize the energy of the waves in that area to a maximum. Various devices have been suggested for attaining these results including devices for both reflecting and refracting the waves in combination with wave transducers. The reflecting devices have taken several forms including single horns and horns with various reflecting devices mounted therein. The major difficulties with or disadvantages of these devices are their bulk and their poor transmission efficiency due to the spreading of the waves from a single horn, and in the case of a horn employing supplementary reflecting elements, due to the internal reflections set up by the reflectors and their supports.

The wave refracting devices or lenses disclosed in my application Serial No. 52,350, filed October 1, 1948, have high efficiencies in focusing compressional waves. However, when these devices are used with present types of wave transducers, spreading of the wave energy occurs between the lens and the instrument with a resultant loss in over-all efficiency and, in the case of distant talking telephones employing separate transmitters and receivers cross-talk may be so great as to make the system inoperative.

One object of this invention is to prevent the loss of wave energy between wave transducers and associated wave refractors.

Another object is to prevent audio feedback between the transmitter and receiver of a distant talking telephone.

Further objects are to reduce the size and increase the efficiency of distant talking telephones.

In accordance with one feature of this invention, a shield is provided between a compressional wave transducer and an associated compressional wave refractor so that no compressional waves enter or leave the combination by any path other than that through the refractor.

Another feature of this invention pertains to a telephone receiver and a transmitter, each associated with a wave refractor and a shield to form a distant talking telephone which may have a substantial gain without any appreciable audio feedback.

More specifically, this invention in one aspect involves the combination of a compressional wave refractor of the type comprising a plurality of rigid members mounted in spaced relationship to

2

one another and occupying substantially the whole volume of a space having the shape of an optical lens, a compressional wave transducer, and a closed horn shield extending between the refractor and the transducer. A pair of these assemblies mounted so that they have a common focus and associated with a telephone circuit by suitable couplings and amplifiers provides a distant talking telephone which permits the subscriber to effectively employ the instrument while at a distance therefrom within a limited area of focus without the signal from the loudspeaker assembly being transmitted to the sensitive microphone assembly with sufficient intensity to cause the telephone circuit to sing or howl. This combination tends to concentrate the sound emanating from the loudspeaker in a space occupied by the subscriber and likewise amplifies the sound emanating from his lips by focussing it on the microphone transmitter, thus effecting a two-fold increase in loudness which permits a reduction in the amount of amplification necessary in the microphone and receiver circuits.

Other and further objects and features of this invention will be more clearly and fully understood from the following description of an illustrative embodiment of the invention taken in connection with the appended drawing in which:

Fig. 1 is a perspective view of a distant talking telephone constructed in accordance with one feature of the invention;

Fig. 2 is a sectional view of one of the focussing assemblies of Fig. 1, including a phantom representation of the compressional waves in the region surrounding the assembly; and

Fig. 3 shows a schematic representation of the elements of the telephone instrument of Fig. 1.

Referring now to the drawing, one form of distant talking telephone according to this invention is disclosed in Fig. 1. It comprises a housing 11 containing the elements of a distant talking telephone as represented schematically in Fig. 3 and including a hybrid coil 12 with an associated balancing impedance 13 connected to the telephone line 10 and a transmitting and receiving amplifier 14 and 15 each of which is connected to an individual focussing assembly.

Each focussing assembly, as disclosed more clearly in Fig. 2, comprises an electroacoustic transducer 17, a preferred embodiment utilizing the ring armature type of transducer disclosed in application Serial No. 704,485, filed October 19, 1946, now Patent No. 2,566,850, granted September 4, 1951, of Edward E. Mott, exhibiting characteristics which permit its utilization as either a microphone or loudspeaker, a shield 18 extending from the transducer to an acoustic lens 19 made, in accordance with my above-noted application, of a plurality of rigid members mounted in spaced relationship and occu-

3

pying substantially the whole volume of a space having the shape of an optical lens. This assembly when employed in a distant talking telephone causes the sound waves emanating from the loudspeaker 21 to converge and meet at a focus F' (not shown) and acoustic waves originating at the focus F to be condensed by the receiver lens 26 and focussed on the microphone 24.

The wave focussing assembly of Fig. 2 is bidirectional permitting identical units to be used as the transmitter and receiver assemblies, the transmitter assembly comprising a loudspeaker 21, a shield or horn 22 and a transmitting lens 23, while the receiver assembly comprises a microphone 24, a shield 25, and a receiving lens 26. Preferably, the shields extending between the transducers and the lens are completely closed to eliminate the leakage of undesirable compressional or audio waves from or to the transducer, the cone form of shield being entirely satisfactory in this combination.

The shield, for example, may be a cone having a fifteen-inch diameter mouth and a fifteen-inch depth and having the transducer mounted at its throat 30 and the lens mounted at the mouth 29. Such a construction has been found to radiate a narrow beam of sound, the beam having the following dimensions at various frequencies. At 11,000 cycles, the signal radiated by this fifteen-inch combination is down twenty decibels in power at angles of 5.2 degrees off the axis, while at 1,100 cycles, this same twenty-decibel reduction occurs at 52 degrees off the axis. The fifteen-inch lens has been made exemplary for its convenient size; however, if a sharper focus is desired, such may be obtained by increasing the dimensions of the lens and the horn; thus a thirty-inch lens will have a signal down twenty decibels in power at angles of 2.6 degrees off the axis at 11,000 cycles and at 26 degrees off the axis at 1,100 cycles. At lower frequencies, the beam from the focussing combination becomes proportionally broader but since the response of telephone instruments and also the importance in intelligibility falls off at lower frequencies, tendency to howl at these still lower frequencies is less likely. Most telephone instruments are designed with a maximum transmission capability in the vicinity of 1,000 cycles and the directivity of the wave transmitted by this focussing combination at that frequency is sufficient to substantially eliminate any tendencies for audio feedback, since the sound passing through the lens, is directed and focussed and very little emerges sideways and enters the receiver assembly. The shield extending from the transducers to the lenses inhibits the radiation of the minor side lobes from transmitter 21 to microphone 24 and thus prevents direct cross-talk in that manner.

The acoustic efficiency attainable with this telephone set permits the use of greater amplification of the signal without the danger of cross-talk and howling occurring while requiring a lesser amount of amplification to obtain the same signal intensity at a given point than instruments of the prior art. Thus, the effective range of such instruments can be substantially increased without any detrimental effects.

While the embodiment disclosed in the specification is for a distant talking telephone, it is

4

to be understood that the combination of a single acoustic transducer and a rigid acoustic lens and a shield extending between the two elements, may also be effectively employed in highly directional microphones and loudspeakers as individual units.

What is claimed is:

1. A directive acoustic system comprising an acoustic refractor, an acoustic transducer positioned at one focus of said refractor, and a closed continuous shield extending from said transducer to said refractor.

2. A directive compressional wave system comprising a rigid refractor for compressional waves, a compressional wave transducer positioned at one focus of said refractor, and a closed continuous shield extending from said transducer to said refractor.

3. A directional compressional wave system comprising a horn, a compressional wave transducer in the throat of said horn, and a rigid refractor for compressional waves positioned in the mouth of said horn so that its axis coincides with the principal energy axis of said transducer, said horn being closed and continuous between said transducer and said refractor.

4. A directive compressional wave system comprising a plurality of rigid members mounted in spaced relationship to one another forming a compressional wave refractor, a compressional wave transducer positioned at one focus of said refractor, and a closed continuous shield extending from said transducer to said plurality of rigid members.

5. A directive compressional wave system comprising a compressional wave transducer, a plurality of rigid elements uniformly spaced and occupying substantially the whole of a volume of space having the shape of an optical lens and forming a refractor for compressional waves, and a shield extending from said transducer to said refractor.

6. A distant talking telephone comprising a transmitter, a receiver, an acoustic refractor having one focus at said transmitter, a second acoustic refractor having one focus at said receiver, and shields extending from said first refractor to said transmitter and from said second refractor to said receiver.

7. A distant talking telephone comprising a pair of conical horns, a transmitter enclosed in the throat of one of said horns, a receiver enclosed in the throat of the other of said horns, and a plurality of rigid members in spaced relationship to one another and occupying substantially the whole of a space having the shape of an optical lens to form an acoustic wave refractor closing the mouth of each horn.

WINSTON E. KOCK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,033,337	Harmer	Mar. 10, 1936
2,177,769	Erickson	Oct. 31, 1939
2,224,698	Roseby	Dec. 10, 1940
2,411,004	Sanial	Nov. 12, 1946
2,423,459	Mason	July 8, 1947
2,483,231	Peterson	Sept. 27, 1949