Sound Reproducing Systems—

Monaural, Binaural, Monophonic, and Stereophonic

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A clarification of the definitions of the various types of systems encountered currently, as presented by a recognized authority in both acoustics and sound reproduction.

THE REPRODUCTION OF SOUND is the process of picking up sound at one point and reproducing it either at the same point or some other point either at the same time or some subsequent time. There are many different types of systems employed for the reproduction of sound. In this connection, sound reproducing systems in use today may be classified as follows: monaural, binaural, monophonic, and stereophonic. There appears to be considerable confusion in the proper use of these terms in designating the four fundamental types of sound reproducing systems. The result is an almost indiscriminate application of the terms to unrelated systems. For this reason it appears desirable to define and describe the use of the four terms. Therefore, it is the purpose of this paper to define and describe the characteristics of monaural, binaural, monophonic, and stereophonic sound systems.

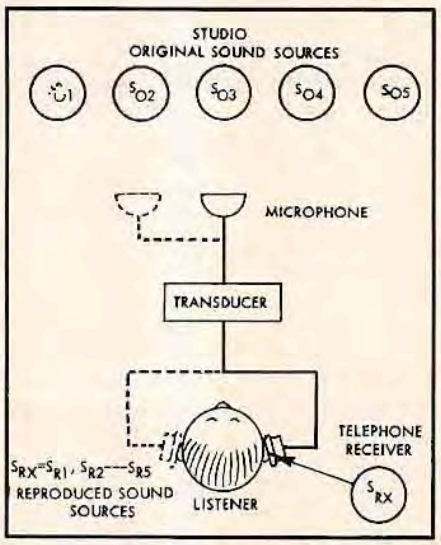

Fig. 1. Monaural.

Monaural

A monaural sound reproducing system is a closed circuit type of sound reproducing system in which one or more microphones are connected to a single transducing channel which in turn is coupled to one or two telephone receivers worn by the listener, as in *Fig.* 1.

Binaural

A binaural sound reproducing system is a closed circuit type of sound reproducing system in which two microphones, used to pick up the original sound, are each connected to two independent corresponding transducing channels which in turn are coupled to two independent corresponding telephone receivers worn by the listener, as in *Fig.* 2.

Monophonic

A monophonic sound reproducing system is a field type sound reproducing system in which one or more microphones, used to pick up the original sound, are coupled to a single transducing channel which in turn is coupled to one or more loudspeakers in reproduction, as in *Fig.* 3.

Stereophonic

A stereophonic sound reproducing sys-

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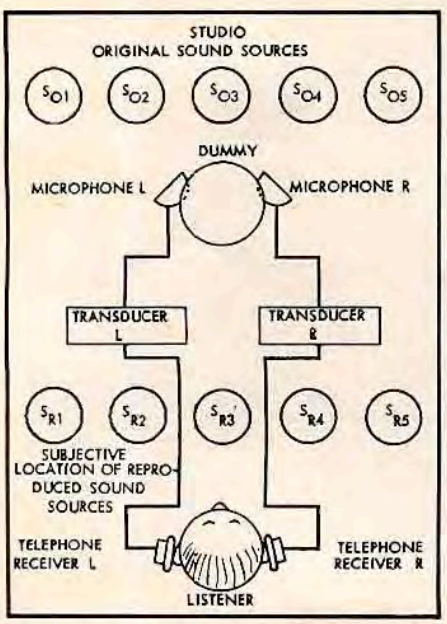

Fig. 2. Binaural.

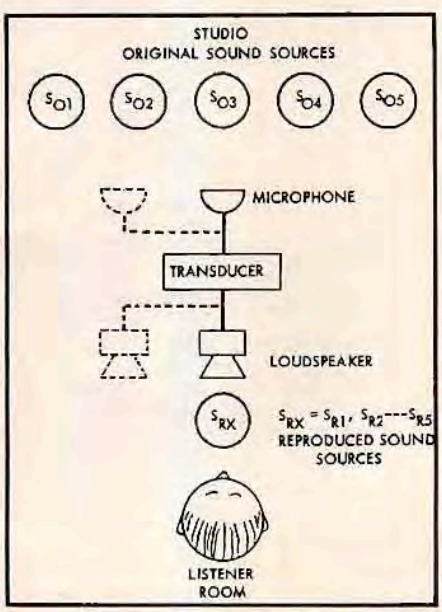

Fig. 3. Monophonic.

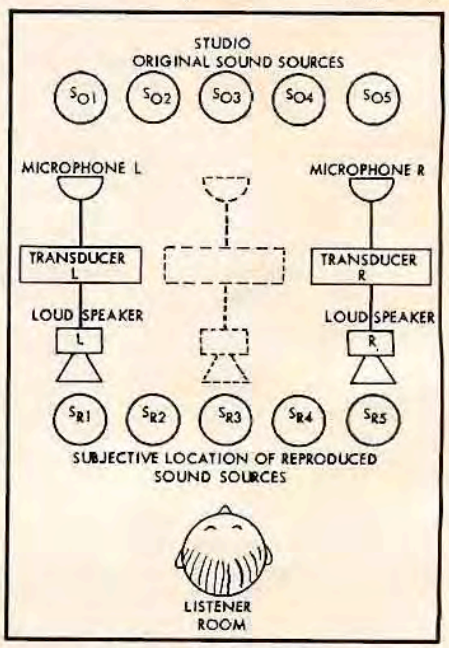

Fig. 4. Stereophonic.

STEREO

(*from page 28*)

tem is a field type sound reproducing system in which two or more microphones, used to pick up the original sound, are each coupled to a corresponding number of independent transducing channels which in turn are each coupled to a corresponding number of loudspeakers arranged in substantial geometrical correspondence to that of the microphones, as in *Fig.* 4.

Description of Systems

Following the definitions[1] of monaural, binaural, monophonic, and stereophonic sound the next consideration will be a description of some of the characteristics of the four systems.

To achieve realism in a sound reproducing system, four fundamental conditions must be satisfied, as follows:

1. The frequency range must be such as to include without frequency discrimination all of the audible components of the various sounds to be reproduced.

2. The volume range must be such as to permit noiseless and distortionless reproduction of the entire range of intensity associated with the sounds.

3. The reverberation characteristics of the original sound should be approximated in the reproduced sound.

4. The spatial sound pattern of the original sound should be preserved in the reproduced sound.

A diagram of a monaural sound reproducing system is shown in *Fig.* 1. The most common example of a monaural sound reproducing system is the telephone in which there is, in general, a single source of sound, one microphone, a transducer, and one telephone receiver coupled to one ear of the listener. In most local applications, the carbon microphone is coupled directly to the telephone receiver. In long distance telephony vacuum tube and transistor amplifiers may be used between the microphone and loudspeaker. For other more limited applications, as for example, monitoring purposes, the transducer may be a radio transmitter and receiver, a television sound transmitter and receiver, a disc phonograph recorder and reproducer, a sound motion picture recorder and a reproducer and/or a magnetic tape recorder and reproducer. In some applications, there may be more than one sound source. One or more microphones may be used. In some applications two telephone receivers may be

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[1] The definitions of the terms monaural, binaural, monophonic, and stereophonic, agree substantially with those of modern dictionaries. In addition, the terms binaural and stereophonic as defined in this paper have been standardized. As a result, the incorrect usage of binaural to designate a stereophonic system is disappearing. Monaural is still incorrectly used to designate a single-channel field-type sound reproducing system. Monophonic is a relatively new term, which has been introduced to supply a void in terms to describe the four fundamental sound systems. Monophonic and stereophonic are harmonious and congruent terms which complement each other and have a common relationship in describing field-type sound systems. Monaural and binaural are also harmonious and congruent terms which complement each other and have a common relationship in describing closed-circuit sound systems.

used transmitting the same program to each of the ears of the listener. The monaural sound reproducing system is of the closed-circuit type in which the ear of the listener is transferred to a microphone location by means of the microphone, transducer, and telephone receiver combination. The acoustics of a single room are involved in the reproduction of the sound, namely, the studio in which the microphone is located. The monaural sound reproducing system may be constructed so as to satisfy conditions 1, 2, and 3 on realism of sound reproduction. It cannot, under any conditions, satisfy condition 4.

A diagram of a binaural sound reproducing system is shown in *Fig.* 2. There is no widespread use of the binaural sound reproducing system. The use is limited to specific applications. The binaural sound reproducing system consists of two separate channels. Each channel consists of a microphone, transducer, and telephone receiver. The microphones are mounted in a dummy simulating the human head in shape and dimensions and at the locations corresponding to the ears of the human head. The transducer may be an amplifier, a radio transmitter and receiver, a phonograph recorder and reproducer, a motion picture recorder and reproducer, or a magnetic tape recorder and reproducer. The binaural sound reproducing system is of the closed-circuit type. The listener is transferred to the location of the dummy by means of a two-channel sound reproducing system. The binaural sound reproducing system may be constructed so as to satisfy all four conditions on realism of sound reproduction.

A diagram of a monophonic sound reproducing system is shown in *Fig.* 3. It is the most widely employed of all sound reproducing systems. Examples are the disc phonograph, radio, sound motion picture, television, magnetic tape reproducer and sound systems. The monophonic sound reproducing system is of the field type, in which the sound is picked up by a microphone and reproduced by means of a loudspeaker into a field. The sound at the microphone is reproduced at the loudspeaker. The transducer may be an amplifier, radio transmitter and receiver, a phonograph recorder and reproducer, a sound motion picture recorder and reproducer, a television transmitter and receiver, a magnetic tape recorder and reproducer. The monophonic sound reproducer may be constructed to satisfy conditions 1, 2 and 3 on realism of sound reproduction. It cannot under any conditions satisfy condition 4.

A diagram of a stereophonic sound reproducing system is shown in *Fig.* 4. The stereophonic sound reproducing system is of the field type, in which the

sound is picked up by two or more microphones which are coupled to a corresponding number of independent transducing channels which in turn are coupled to corresponding number of loudspeakers arranged in substantial geometrical correspondence to that of the microphones. The transducer may be an amplifier, radio transmitter and receiver, a phonograph recorder and reproducer, a sound motion picture recorder and reproducer, a television transmitter and receiver, or a magnetic tape recorder and reproducer. Two channels are used in the disc phonograph and radio. Two and three channels are used in the magnetic tape reproducer. Two, three and more channels are used in motion picture reproducers. The stereophonic sound reproducer may be constructed to satisfy conditions 1, 2 and 3 on realism of sound reproduction. It can be constructed to provide auditory perspective of the reproduced sound and in this sense the stereophonic sound reproducer satisfies condition 4 on realism of sound reproduction. Stereophonic sound is being rapidly commercialized. The first wide scale use was in sound motion pictures. This was followed by the magnetic tape reproducer. The stereophonic disc phonograph is being commercialized this year. Experiments are now being conducted in the transmission and reproduction of stereophonic sound by means of a radio system. In one arrangement, the two channels are transmitted on two separate radio links, one by a frequency modulation system and the other by an amplitude modulation system. In another arrangement, the two channels are transmitted and reproduced by means of a multiplex frequency modulation system.

Summary

The four fundamental types of sound reproducing systems—namely, monaural, binaural, monophonic, and stereophonic—have been defined and described in this paper. The terms monaural and binaural are used to designate closed circuit sound reproducing systems. The terms monophonic and stereophonic are terms used to designate field-type sound reproducing systems. Monaural and binaural (or monophonic and stereophonic) are mutually harmonious and congruent terms which complement each other in describing closed-circuit type (or field type) sound reproducing systems. The definitions as presented in this paper agree substantially with modern dictionaries. The terms binaural and stereophonic have been standardized. In view of this and the logic presented in this paper it is only a question of time until all four terms, monaural, binaural, monophonic, and stereophonic are standardized. Æ