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Some Experiments on Sound Propagation in Damped Air Ducts with Flow Velocities up to 80 m/sec FREE

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arrangement in the air stream. Methods are discussed for measuring acoustic attenuation in relation to air-flow resistance. Attenuation measurements without air flow permit detailed examination of acoustic effectiveness of attenuator components and their arrangement. Subsequent attenuation measurements under rated air-flow conditions are used to determine any potential source of self-noise from turbulence.

I7. Measurement of Noise Inside Ducts. IRA DYER, *Bolt Beranek and Newman Inc., Cambridge, Massachusetts.*—Recently Kerka, and earlier Beranek, Reynolds, and Wilson, discussed the measurement of sound power radiated by a fan in a straight duct, by measurements of the sound pressure inside the duct. One of the difficulties associated with this technique is that above the first cutoff frequency the sound pressure varies markedly across a transverse section of the duct and the relation between mean square pressure and power is not simple. The transverse variation can be understood by application of mode theory to propagation of noise in the duct; this theory is in good agreement with measurements reported by others. Furthermore, in given frequency ranges, it is possible to select a measurement position inside the duct such that the mean square pressure is related to the power flow by the usual free-field equation.

I8. Some Experiments on Sound Propagation in Damped Air Ducts with Flow Velocities up to 80 m/sec. ERWIN MEYER, F. MECHEL, AND G. KURTZE, *III. Physikalisches Institut der Universität Göttingen, Göttingen, Germany.*—In a rectangular duct with the cross section 35×100 mm² one larger side is lined with sound absorbing devices. The used absorbers are rock wool (layer-thickness 6 cm) with and without perforated coverings, and undamped as well as damped resonators of the Helmholtz type. The flow velocities have been varied between 0 and 80 m/sec. The microphone used in the measurements has a probe tube with a front opening in the form of a slot around the tube in a distance of 5 tube diameters from the front end. The opening is covered by copper gauze. Measurements have been made with respect to sound attenuation and sound velocity as functions of frequency for different flow velocities, the signal to noise ratio being about 30 db. In general the sound attenuation in the duct decreases with increasing flow velocity. For absorbers without résonance character this is observed over a comparatively large frequency range. In the case of resonance absorbers the resonant frequency is shifted towards higher frequencies with increasing flow velocity. The attenuation decreases for the resonant frequency but above this frequency reaches higher values than without flow. Between these frequencies we have a range with largely decreased attenuation which latter even may reach negative values so that an amplification is observed.

I9. Attenuation of Sound in Lined Air Ducts. A. J. KING, *Metropolitan Vickers Electrical Co. Ltd., Manchester, England.*—Theoretical predictions of the performance of silencers are apt to be difficult and unreliable so experimental results are often very valuable. A previous paper contained curves giving the attenuation of sound with frequency in lined ducts of various widths and thicknesses of lining of rock wool. Subsequent experience has shown the need for an extension of these curves to cover thicker linings and splitters and advantage has been taken of an opportunity to obtain further data on 16-in. splitters and air channels. New curves including these data are given for 50% space factor, together with an extrapolation to 32-in. splitters. Thicknesses greater than 16 in. are unlikely to be used unless frequencies lower than 100 cps are important. For covering very wide frequency bands two stage filters are recommended.

Session J. Electroacoustics

RICHARD K. COOK, *Chairman*

Invited Papers

J1. Some Observations on Reproduced Sound in an Automobile. B. A. SCHWARZ AND D. E. BRINKERHOFF, *Delco Radio Division, General Motors Corporation, Kokomo, Indiana.*—Some of the physical and psychological factors of reproduced sound in an automobile, are discussed. The environmental conditions, such as: ambient noise as it affects audible frequency and dynamic range; "listening room" size, audience seating arrangement, and acoustical properties, are compared with these conditions in a living room or concert hall. The transducer efficiency, size, loadings, required power handling, frequency balance, frequency and dynamic range, and the effects of its location on the distribution and delivery to the listeners are considered. Psychological factors affecting the desirability of many experimental loudspeaker locations tested, are presented.

Contributed Papers

J2. Stereophonic Sound Reproduction in the Home. HARRY F. OLSON, *RCA Laboratories, Princeton, New Jersey.*—To achieve realism in a sound reproducing system three fundamental conditions must be satisfied, namely: first, the frequency range must be such as to include all the audible components of the various sounds to be reproduced; second, the volume range must be such as to permit noiseless and distortionless reproduction of the entire range of intensity associated with the sounds; third, the reverberation and spatial characteristic of the original sound must be preserved. This paper describes experiments and tests conducted over a period of a decade with the object of determining the factors which play a major role in establishing realism in reproduced sound under practical operating conditions in the home. The subjects investigated include the following: acoustic frequency preference; nonlinear distortion; stereophonic frequency preference; noise; localization (lateral and depth); reverberation.

J3. Bigradient Uniaxial Microphone. HARRY F. OLSON, JOHN PRESTON, AND JOHN C. BLEAZEY, *RCA Laboratories, Princeton, New Jersey.*—A second-order unidirectional microphone has been developed consisting of two uniaxial microphones connected in series opposition. This system has been termed the bigradient uniaxial microphone. The directional efficiency, that is, the energy response to random sounds is one-ninth. The high discrimination which this microphone exhibits to sounds which originate from the sides and rear makes it particularly suitable for long distance sound pickup in radio, television, sound motion pictures, phonograph recording, and sound reinforcing systems.