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World Radio History

IRE PROFESSIONAL GROUP ON AUDIO

The Professional Group on Audio is an organization, within the framework of the IRE, of members with principal professional interest in Audio Technology. All members of the IRE are eligible for membership in the Group and will receive all Group publications upon payment of an annual fee of \$2.00.

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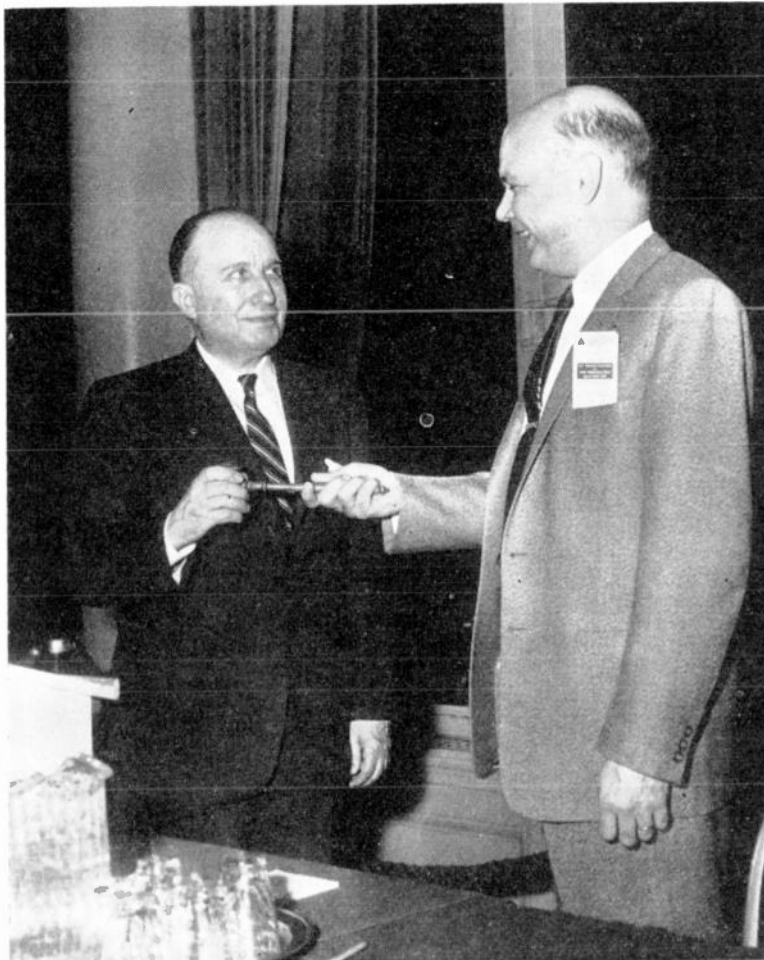
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Frank H. Slaymaker (right), Chairman for 1958-1959, receives gavel from Retiring Chairman H. F. Olson, at Annual PGA meeting on March 25, 1958.

From Our New Chairman

The responsibility of being Chairman of the largest professional group is a big one and I hope I will be able to live up to the high traditions set by the men who have held this office in past years. The responsibility is great and it is a flattering honor to follow such people as Harry Olson, Dan Martin, Win Koch, Vince Salmon, Ben Bauer, and Leo Beranek. If I have omitted some, blame my faulty memory since there may have been some early PGA activity that preceded my connection with the group. Dr. Olson said last year many things that I would like to repeat this year, but there isn't time and I don't want to keep you here too long.

Our beginnings in PGA have been in the reproduction of sound, that is, Hi-Fi. Hi-Fi is a major interest to a large proportion of our members and the PGA atmosphere should remain friendly and hospitable to this activity so our members will be kept abreast of the latest scientific developments in Hi-Fi. Closely allied to Hi-Fi is the field of musical electronics. I hope we can bring you more in this field as time goes on. Also, there is a rapidly growing field of audio electronics based on

speech studies and information processing methods which is peculiarly suited to a Professional Group on Audio. I hope PGA can become the home environment for those working in this branch of audio. The stature of the papers published in our TRANSACTIONS has been growing. Many of them are first sources of basically important developments. I hope this trend will continue.

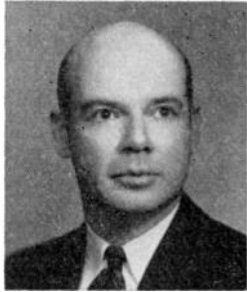
Now before closing, I would like you to know that Alexander Bereskin is retiring as the very able editor of the TRANSACTIONS and in his place will be Marvin Camaras, whom you all know through his work in magnetic recording and as Editor of *The PGA Chapter Newsletter*. Benjamin Bauer continues as Secretary-Treasurer. Joe Begun will be our new Program Chairman. On these three rests the biggest load of the PGA Administration and I know with their help, the help of the rest of the Administration Committee, that of the other committees, and your help, PGA will continue to grow both in size and effectiveness.

FRANK H. SLAYMAKER

PGA News

NEWLY ELECTED NATIONAL OFFICERS OF PGA, 1958-1959

Frank H. Slaymaker (M'45) was born on April 22, 1914, in Lincoln, Neb. He received the B.S. degree in electrical engineering in 1941, and the E.E. degree in 1946, both from the University of Nebraska, Lincoln.



F. H. SLAYMAKER,
Chairman, 1958-1959

He became affiliated with the Stromberg-Carlson Company in 1941, in the Research Department, where he was engaged in the development of noise reducing microphones, electronic carillons, ultrasonic devices, loudspeakers, etc. He joined the Sound Equipment Division, Engineering Department, in 1950, to work on electronic carillons, and acoustical problems associated with loudspeakers and sound distributing systems in large arenas. Later he was made chief engineer. In 1956 he rejoined the Research and Advanced Development Department as manager of the Electroacoustics Laboratory. He is a registered Professional Engineer in the State of New York.

He is the author or co-author of numerous papers on acoustical or electronic subjects published in the *Journal of the Acoustical Society of America*, *Electronics*, *IRE TRANSACTIONS ON AUDIO*, and *Audio Engineering*. He is also the holder of numerous patents in the fields of telephone switching, noise reducing microphones, ultrasonic transducers, ultrasonic echo ranging systems, and electronic carillons.

Mr. Slaymaker is a Fellow of the Acoustical Society of America, a member of Sigma Xi, the Audio Techniques Committee of the IRE, 1955-1957, the Administrative Committee of IRE-PGA, and the 1957 National Convention Program Committee representing PGA. He was also Chairman of the PGA Awards Committee, 1957, and is Vice-Chairman of the PGA.



Murlan S. Corrington (SM'49-F'54) was born on May 26, 1913 in Bristol, S. D. He received the B.S. degree in electrical engineering in 1934 from the South Dakota School of Mines and Technology, Rapid City, and the M.S. degree in 1936 from Ohio State University, Columbus.



M. S. CORRINGTON,
Vice-Chairman,
1958-1959

In 1937 he joined the Rochester Institute of Technology, where he taught mathematics, mechanics, and related subjects. Since 1942 he has been engaged in mathematical engineering in the Advanced Development Section of the RCA Victor Television Division, Camden, N. J. He is manager of audio, acoustics, antennas, theoretical studies, and the measurements laboratory for the Division.

He has written a large number of technical papers on frequency modulation, circuit theory, transients and cone motion in loudspeakers, distortion in phonograph records, etc., and is the author of textbooks on mathematics and machine shop practice.

Mr. Corrington is a member of Sigma Pi Sigma, the Society for Industrial and Applied Mathematics, and a Fellow of the Acoustical Society of America. He is Chairman of the Bylaws Committee for PGA and PGCT, and Past Chairman of the Philadelphia Section. He has been a member of several IRE Technical Committees and has held many other local and national offices.



John K. Hilliard (A'25-M'29-SM'43-F'52) was born in Windemere, N. D., on October 22, 1901. He graduated from Hamline University, St. Paul, Minn., in 1925 and was awarded the honorary Doctor of Science degree in 1951.



J. K. HILLIARD,
Administrative
Committee, 1958-1961

Until 1942 he was engaged in motion picture sound engineering with Metro-Goldwyn-Mayer Studios. He joined the staff of M.I.T. and worked on radar design during 1942-1943. From 1943 to the present time, he has been with the Altec Lansing Corporation and is now staff vice-president and in charge of advanced engineering. For several years he has been developing high intensity sonic measurement and generation equipment for the jet engine and missile fields which includes a series of small condenser microphones capable of operating in high temperature, high altitude, and high sound pressure levels. He also is engaged in the design of new telephone industry products which Altec Lansing is now manufacturing.

Mr. Hilliard is a member of the Acoustical Society of America, SMPTE, and the Audio Society. He has served the IRE and the PGA in numerous capacities; he was a member of the Editorial Committee from 1953-1955; Chairman of the Awards Committee, 1954; West Coast Program Committee, 1955-1956; National Vice-Chairman, 1951-1953, and served on various committees.



Marvin Camras (S'41-A'42-SM'48-F'52) was born on January 1, 1916, in Chicago, Ill. He received the M.S. degree from the Illinois Institute of Technology, Chicago, in 1942. He has done considerable



M. CAMRAS
Administrative
Committee, 1958-1961

research work in magnetic recording as staff member of the Armour Research Foundation. He is connected with the development of the stainless steel recording media, supersonic bias, improved recording heads, high-coercive coated tapes, magnetic sound-on-film, stereophonic magnetic recording, and magnetic duplicating by contact printing.

Mr. Camras is a member of Sigma Xi, Tau Beta Pi, Eta Kappa Nu, Past Secretary-Treasurer and Past Chairman of the IRE Professional Group on Audio.

ADMINISTRATIVE COMMITTEE MEETING MINUTES

New York, N. Y.—March 24, 1958

Members Present

B. B. Bauer, Secretary-Treasurer
A. B. Bereskin
S. J. Begun
M. S. Corrington
H. F. Olson, Chairman
F. H. Slaymaker
P. B. Williams

Members Absent

A. B. Jacobsen
W. E. Kock
W. T. Selsted

Guests Present

M. Camras
M. Copel
J. K. Hilliard
L. C. VanAtta

The meeting was held at the Waldorf Astoria and was called to order at 8:00 p.m.

1) The Secretary read the results of the election: Frank H. Slaymaker has been elected Chairman for 1958-1959, and M. S. Corrington has been elected Vice-Chairman.

New members of the Administrative Committee are M. Camras and J. Hilliard.

2) *The Editorial Committee:* Professor Bereskin reported continuing problems in the procurement of suitable papers. However, six issues of TRANSACTIONS were published and several papers are available for the succeeding issue. Chairman Olson confirmed the appointment and acceptance of Chairmanship of the Editorial Committee by Marvin Camras. Members of the Administrative Committee expressed their appreciation to Professor Bereskin for the fine handling of the editorial work during the past two years.

3) *Awards Committee:* Frank Slaymaker, Chairman of the Awards Committee, reported on the awards made during the year 1957-1958. These are described in the appended letter.

This report of the Awards Committee has been approved by the Administrative Committee by letter ballot and the Secretary-Treasurer was directed to proceed with the implementation of the awards.

4) *Program Committee:* P. Williams reported on the activities of the Program Committee. Three programs were held, namely at WESCON, NEC, and the IRE National Convention.

5) *Tapescripts Committee:* Andrew Jacobsen, Chairman of the Tapescripts Committee, sent a letter report which is appended to these minutes.

6) *Ways and Means Committee:* Michel Copel read the report of the activities of the Ways and Means Committee, which is appended hereto.

7) *Constitution and Bylaws:* M. Corrington reported that the approved draft of the constitution will be published in December TRANSACTIONS and if not objected to by 10 per cent of the members, then it will be in full force and effect.

The Bylaws were rewritten on December 8, 1957, and adopted by the Administrative Committee and are currently in full force.

8) *Publication Review Committee:* Walter Selsted was unable to attend, but he sent a letter about the activities of this committee. The letter is appended.

9) *Chapter Committee:* Marvin Camras read a report of activities for 1956-1957, which is appended. It was agreed that the work of this committee had shown excellent progress during the past year, and further agreed that the organization and work of this committee would be called to the attention of other professional groups.

10) *Papers Procurement Committee:* J. Begun, Committee Chairman, outlined the difficult problems in procurement of papers stemming from the fact that so many papers are absorbed by the IRE NATIONAL CONVENTION RECORD. L. C. VanAtta offered to discuss this matter with headquarters.

11) *Convention Records Committee:* A report by Michel Copel, Acting Chairman of this committee, is appended herewith.

12) Upon motion of M. Corrington, seconded by A. Bereskin, it was unanimously resolved to approve the reports of the committees.

13) Frank Slaymaker raised the point about the procedure to be followed when a nonmember joins a member in contributing an outstanding paper to an IRE publication. By motion of M. Corrington, seconded by J. Begun, it was resolved to modify the procedure of the Awards Committee whereby nonmembers would be eligible equally with the members for PGA awards, so long as other requirements have been met.

14) M. Corrington noticed that the last two sets of minutes issued by the Secretary have not been subject to formal approval. By motion of A. Bereskin, seconded by M. Corrington, it was unanimously voted that the last two sets of minutes be approved.

15) The Secretary-Treasurer read the latest report of the financial status issued by headquarters on January 1, 1957. This report had been circulated to all members previously and is appended herewith. Furthermore, the Secretary had been notified by headquarters that the total membership has increased to 4519, and the balance in the treasury has increased to \$17,325.26. The Secretary-Treasurer recommended no change in financial policy.

It was moved by P. Williams, seconded by F. Slaymaker, and unanimously approved to accept the report of the Secretary-Treasurer and to distribute it with the minutes.

At this point the meeting was turned over to the

newly elected Chairman, Frank Slaymaker, and he announced the appointment of the following committees:

Ways and Means—M. Copel
 Constitution and Bylaws—M. Corrington
 Editorial—M. Camras
 Chapter Committee—J. R. MacDonald
 Program—S. J. Begun
 Tapescripts—A. B. Jacobsen
 Finance—B. B. Bauer
 Awards—P. B. Williams
 Nominations—H. F. Olson
 Membership—W. T. Selsted.

The newly elected Chairman announced the re-appointment of B. B. Bauer as Secretary-Treasurer for the year 1958-1959.

The meeting adjourned at 11:00 P.M.

B. B. BAUER
Secretary-Treasurer

REPORT OF THE AWARDS COMMITTEE

The Awards Committee of the Professional Group on Audio has proposed the following awards for the year 1956-1957.

PGA Award

James J. Davidson, "Low Noise Transistor Microphone Amplifier," 1957 IRE NATIONAL CONVENTION RECORD, PGA Part 7, pp. 162-168.

PGA Senior Award

D. W. Martin, A. Meyer, R. K. Duncan, and E. C. Broxon, "An Experimental Nine Thousand Watt Airborne System," IRE TRANSACTIONS ON AUDIO, Vol. AU-4, pp. 146-155; November-December, 1956.

Achievement Award

Marvin Camras.

FRANK H. SLAYMAKER
Chairman

REPORT OF THE CHAPTERS COMMITTEE

Organization of New Chapters

A list obtained from headquarters showed members-at-large of PGA for each of the IRE Sections. A letter was written to the Chairman of every Section which did not have a PGA Chapter, but where there were more than twenty-five unaffiliated PGA members. The following eighteen Sections qualified:

Atlanta.....	52	Montreal.....	39
Buffalo Niagara.....	27	New York.....	287
Conn. Valley.....	87	Los Angeles.....	305
Dallas.....	29	N. New Jersey.....	168
Denver.....	29	N. Carolina-Va.....	39
Detroit.....	55	Pittsburgh.....	44
Ft. Wayne.....	25	Rochester.....	39
Indianapolis.....	45	Toronto.....	51
Kansas City.....	36	Twin Cities.....	53

The Chairman was asked to designate someone who was interested and capable of forming a PGA Chapter.

A list of local PGA members was sent to those who responded. Areas of interest and those who are following through are:

Dallas—Mark W. Bullock
 Northern New Jersey—R. MacVeety
 Twin Cities—Ed Harding
 Montreal—H. H. Schwartz
 Denver—Robert H. Kirby
 Portland—Will Marsh.

Most of these had initial meetings, surveys, etc., during the year. Robert H. Kirby reported negative results for Denver, but the rest are active.

During our next term the men listed above should be encouraged to continue. September of 1958 is the best time to contact new Chairmen of Sections, who are usually enthusiastic and optimistic at the start of their fall programs. We ought to make a special effort in New York and in Los Angeles, who are in first and second place, respectively, as to the number of unaffiliated PGA members.

Newsletter

Three issues of *The PGA Chapter* were sent out. This newsletter for chapter officers has been useful in keeping chapter officers informed about activities of others, sources of program material, names and addresses for interchapter correspondence, etc. Attached to each copy is a green sheet convenient for reporting chapter meetings to the Committee on Chapters.

We recommend continuing and expanding this newsletter.

MARVIN CAMRAS
Chairman

REPORT OF CONVENTION RECORD COMMITTEE

At the request of Dr. Olson, Chairman of the Administrative Committee of PGA, the undersigned represented our Group at the 1958 IRE NATIONAL CONVENTION RECORD Committee meeting which was held on January 9, 1958, at the IRE headquarters.

The main business of the meeting was the assignment of sessions to the various Parts of the CONVENTION RECORD, business which sometimes results in strange bed-fellows. I suggested that Audio be combined with Broadcast and Television Receivers and Broadcast Transmission Systems. This seemed to be a reasonable combination, further supported by the fact that this year PGA has a joint session with PGBTR. PGBTR and PGBTS readily agreed to the arrangement, which was accepted by the Committee.

One noteworthy item which came out at the meeting was that the 1958 CONVENTION RECORD expects to incur a slight deficit (a few hundred dollars at most), but since the Committee has on hand a very substantial surplus from past years, the over-all financial picture is excellent.

MICHEL COPEL
PGA Delegate

REPORT OF THE TAPESCRIPTS COMMITTEE

In the last few years IRE Student Chapters have made best use of tapescripts. Student groups have nearly 100 per cent turnover each year so that they can use the same material year after year. This, of course, is not true of the IRE Chapters and Sections.

There has been a considerable reduction in the use of tapescripts owing to a lack of advertising. No new tapescripts are available. Only a fraction of the requested budget for the last year was spent. A budget for the forthcoming year of \$200 would allow for two or three new tapescripts. Suggested sources of material for new tapescripts would be appreciated.

ANDREW B. JACOBSEN
Chairman

REPORT OF THE TREASURER

FINANCIAL STATEMENT

IRE PROFESSIONAL GROUP ON AUDIO

For the Period from January 1, 1957, to December 31, 1957

Balance from January 1, 1957.....	\$11,159.27
Receipts during period:	
IRE matched funds.....	\$3,788.00
Assessments.....	\$7,894.62
Advertising.....	\$ 300.00
Sale of publications.....	\$1,067.09
Surplus from meetings.....	
Other sources.....	\$ 200.00
Total receipts.....	\$13,249.71
Total balance and receipts.....	\$24,408.98
Expenses during period:	
Publications.....	\$7,328.07
Membership service charges.....	\$ 245.33
Others.....	\$ 858.79
Total expenses.....	\$ 8,432.19
Balance as of December 31, 1957.....	\$15,976.79
Balance as of March 10, 1958.....	\$17,325.26

	December 31, 1957	March 10, 1958
Membership		
Paid.....	3754	3892
Paid Students.....	570	608
Affiliates.....	2	3
Unpaid.....	16	16
Total.....	4342	4519

B. B. BAUER
Secretary-Treasurer

REPORT OF THE WAYS AND MEANS COMMITTEE

This report covers the period from March 1, 1957, to February 28, 1958.

1) Seventeen institutional listings which expired during this period were disposed of as follows:

- 7 renewals paid for,
- 4 were dropped (Altec, Ampex, Freed Transformer, Shure Bros.),
- 1 past due (Audiophile),
- 5 just became due.

17

2) Total receipts up to date \$525.00.

3) In last year's annual report, the Committee reported that the Technical Secretary of IRE had requested that renewal notifications for listings in the PGA TRANSACTIONS be handled by them for PGA as they did for all other Professional Groups. This arrangement was in effect this past year and saved this Committee a great deal of work. However, the Committee believes that the system is not satisfactory because of the lack of communication between the IRE and the Committee, and the loss of personal contact with subscribers. The Committee therefore recommends that, if possible, we revert to the old system.

4) The records of the Committee are in good order.

MICHEL COPEL
Chairman

ANNOUNCEMENTS



B. B. BAUER

Benjamin B. Bauer Named Vice-President of CBS Laboratories

The appointment of Benjamin B. Bauer as a Vice-President of CBS Laboratories was announced by Dr. Peter C. Goldmark, Director of Research and President of CBS Laboratories.

He will be in charge of the Acoustics and Magnetics Department of the Laboratories. This department is concerned with advanced research and development in the broad areas of sound recording and reproduction.

Mr. Bauer has been responsible for the development of a great many electroacoustical devices and inventions, and has contributed to many publications in the field.

Mr. Bauer is a Fellow of the Institute of Radio Engineers, the Acoustical Society of America and the Audio Engineering Society. He is also Associate Editor of the Acoustical Society of America and in 1955, as co-founder and past National Chairman of the IRE Professional Group on Audio, was recipient of the "Achievement Award." He is a member and recipient of the "Recognition Award" of Eta Kappa Nu and a member of Tau Beta Pi and Sigma Xi. As an active member of the American Management Association, he has conducted seminars on various phases of research administration.

Before joining CBS Laboratories, Mr. Bauer was Chief Engineer and Vice-President of Shure Bros. Inc., manufacturers of electroacoustical devices in Chicago.

Mr. Bauer and his family reside in Stamford, Conn.

NEC

Five papers on Audio and Acoustics will be presented at the Fall National Electronics Conference in Chicago under joint sponsorship of NEC and PGA. They are tentatively scheduled for Wednesday morning, October 15.

- 1) "The Electro-Acoustic Transducer and Its Application to Sonar Systems" by George Rand and John Devine, Surface Armament Division, Sperry Gyroscope Company, Division of Sperry-Rand Corporation, Great Neck, N. Y.
- 2) "An Improved Method for the Measurement of Nonlinear Audio Distortion" by James S. Aagaard, Department of Electrical Engineering, Northwestern University, Evanston, Ill.
- 3) "The Design of Electronic Musical Instruments" by Richard H. Peterson, Peterson Electro-Musical Products, 10108 Harnew Road East, Oak Lawn, Ill.
- 4) "Effects of Practical Transformers on Output-Tube Performance in Hi-Fi Amplifiers" by Leonard Kaplan, Electron Tube Division, Radio Corporation of America, Harrison, N. J.
- 5) "A Two Way Stereophonic Amplifier" by Benjamin B. Bauer, John Hollywood, and George Maerkle, CBS Laboratories, 485 Madison Avenue, New York, N. Y.

In addition, a sixth paper of interest in the audio field will be presented at the computer sessions of NEC by David, Mathews, and McDonald, all of Bell Laboratories, on "Description and Results of Experiments with Speech Using Digital Computer Simulation."

Acoustics Congress, Stuttgart, 1959

The Third International Congress on Acoustics will be held from September 1 to September 8, 1959, in Stuttgart, Germany. It is sponsored by the International Commission on Acoustics according to the resolutions of the Second ICA Congress 1956 in Cambridge, Mass., and is arranged by the "Verband Deutscher Physikalischer Gesellschaften" together with the "Nachrichtentechnische Gesellschaft des Verbandes Deutscher Elektrotechniker" and the "Verein Deutscher Ingenieure."

The technical sessions will be held in Stuttgart's "Liederhalle" and in the lecture theaters of the "Technische Hochschule Stuttgart."

The program will cover the entire field of physical and technical acoustics with some preference to noise and vibration control, electroacoustics, architectural acoustics and physical acoustics.

Invited papers are planned on the following subjects: Acoustical methods in solid state physics; Sound propagation in gases under low pressure; Turbulence and sound; Cavitation; Investigation of molecular structure by ultrasonics; Physiological acoustics; Psychological acoustics; Stereophony; Room acoustics; Building

acoustics; Noise control; Information theory; and Speech.

In addition to the technical program, Congress participants will enjoy a combined technical and sightseeing excursion to Munich as well as bus trips to nice places in the environs of Stuttgart (Schwarzwald, Bodensee).

Modern acoustical and electrical measuring devices will be shown in a special industrial exhibition in connection with the Congress.

Alien Congress participants, especially those from overseas, will be given the opportunity to visit German research institutes before or after the Congress.

Further announcements will follow as soon as more details are fixed. All this further information will be mailed to you if you give your address to the Congress Secretary

Dr.-Ing. Eberhard Zwicker
Stuttgart N
Breitscheidstr. 3.

Announcements of contributed papers, which are accepted until May 15, 1959, must be sent to the same address.

CHAPTER NEWS

Baltimore, Md.

The Professional Group on Audio sponsored a "Local Papers" meeting on April 17, 1958, at the Hecht Co. restaurant in the Northwood Shopping Center. Two talks were given. The first, "Transistorized Aircraft Audio Amplifier," was presented by John Tewksbury and the second, "Design of a Horn-Loaded Speaker Enclosure," by John Markwalter.

One of the features covered by Mr. Tewksbury (of the Aviation Engineering Dept. of Bendix Radio) was a four transistor bridge power amplifier that delivered 10 watts to an 8-ohm loudspeaker without the use of an output transformer. The actual amplifier chassis contained five of these channels—with separate gain controls—giving a combined power output of 50 watts.

John Markwalter (of Aircraft Armaments) described the design calculations, construction, and performance of a four-way, front loading speaker system suitable for the home builder. This system was intended to be in the class of the more elaborate commercial units but featured a basically simple design that could be constructed with hand tools if necessary. The cabinet was rectangular in shape in all views and did not have to be placed in a corner. Nearly flat response was obtained down to 40 cycles with substantial output at 30 cycles. Basic theory of operation was discussed and illustrated with slides.

The meeting took place at 7:30 P.M. in the Hecht Co. employees' cafeteria adjoining the restaurant, and was preceded by a dinner at the restaurant at 6:30.

For May 22, 1958, the Baltimore Chapter scheduled a talk and demonstration on "The Dynamic Speaker—Can We Improve It?" by Saul J. White of the Racon Electric Co.

Boston, Mass.

"Modern Techniques in Multi-Channel Recording" including a demonstration of stereophonic sound was presented at a meeting of the Boston Chapter on March 20, 1958. An audience of 75 listened to Harold J. Bresson of Ampex, who presented this paper. Richard S. Burwen reported that a bad snowstorm on that evening reduced the expected attendance of 250.

Cleveland, Ohio

Joseph Chernof, Jr., project engineer of Bell Aircraft Corp., gave a "Qualitative Discussion on the Present Day Techniques Used in Obtaining Low Frequency Sound Reproduction from Loudspeakers" at the May 15, 1958, meeting of the Cleveland PGA Chapter. The meeting, attended by 26 members and guests, was rated excellent according to a report by Jack Goldfarb, Chairman.

Dayton, Ohio

According to Dayton Section's April *Wave Guide*:

"Those who attended the March 6 Section meeting probably still have a ringing in their ears from the demonstration, and a buzzing in their brains from contemplating what the telephone companies have in store for the American public.

"Sponsored by the PGA, the meeting presented Ralph T. Riefenstahl of the Bell Telephone Co., whose dynamic story of Bell systems operations today, and their future, kept an interested audience slightly bug-eyed and certainly fascinated.

"His statement that there are 214 separate telephone companies in Ohio and 4000 such companies in the United States was a surprise to many. With so many independent operations, the problems of a country-wide system for direct dialing could become a Frankenstein or BELLa Lugosi-type monster.

"Mr. Riefenstahl explained the new system of seven-digit numbers which recently went into effect in the Dayton area. With the aid of a demonstration panel and equipment which simulated a telephone exchange and two subscriber stations, he demonstrated direct dialing from Dayton to Zanesville, Dayton to Toledo and several other widely separated cities.

"He pointed out the fact that today's telephone exchanges employ computers and electronic circuitry which employ logic factors in the switching of phone call inputs as well as other built-in use safety factors. These include 'tuning out of operation' to prevent unwarranted use of phones by children.

"The United States, he explained, is divided into 108 areas and in the immediate future when complete conversion to direct long distance dialing is completed, it will be possible for any subscriber to call any other subscriber in the nation by first dialing the area number and then the seven-digit phone number."

"The head of the Acoustical Engineering Department,

Stromberg-Carlson—Richard E. Liebich—is the PGA Chapter meeting speaker on April 3.

"Mr. Liebich's topic is 'Current High Intensity Sound Systems Developments.' Program begins at 9 P.M. at the Engineers Club.

"The chapter's speaker is no stranger to the Dayton Section, having spent three years in the Physical Acoustic Section, Bioacoustics Branch, Aeromedical Laboratory, WADC.

"In 1956, Mr. Liebich joined the division of General Dynamics Corporation to organize the Acoustical Engineering Department for Stromberg-Carlson.

"The department, now numbering 25 people, currently is working in the fields of acoustical transducer design, acoustical systems design, acoustical measurements and production model construction.

"He is responsible for all aspects of engineering development and design of electroacoustic transducers manufactured and used by the Special Products Division, including automobile radio loudspeakers, commercial sound system microphones and loudspeakers and high fidelity sound system components.

"In addition, he is responsible for work performance on various Government contract programs for development and evaluation of acoustical components and systems for the Army, Navy and Air Force. Included in the latter is the standardization of loudspeakers catalogued by the Federal Government.

"While at WADC, Mr. Liebich served as assistant chief of the above named group. In this capacity, he was responsible for the development of turbojet engine ground run-up muffling systems for turbojet aircraft of the Air Force.

"He assisted in the design of acoustical instrumentation facilities for the new Air Force Bioacoustical Research Laboratory at WADC and acted as consultant to air base planning groups to relieve aircraft noise problems at Air Force installations.

"Mr. Liebich's hobbies are music and motion picture photography. He has had many years of amateur experience with disk sound recording and has played piano, trombone and bassoon with amateur music groups.

"He is married, has one son, a home in the suburbs of Rochester, N. Y., and is only five minutes drive from Exit 45 of the New York State Thruway.

"Mr. Liebich also reports that he has a spare bedroom and bath for overnight accommodation of any engineer or scientist who will argue 'hi-fi' over a glass of Wurtzburger.

"Here's the synopsis of his talk:

"The advent of extremely high thrust turbojet and rocket engines as operational military power plants has created many severe acoustical problems due to the relative efficiency with which such power plants produce acoustic energy.

"One of the many areas of concern for aircraft and related industries is the problem of simulating the

acoustic environments under which airframe components and control equipment must operate.”

San Francisco, Calif.

For 8:00 P.M. on Tuesday, May 20, 1958, PGA announced the following meeting in the San Francisco Grid:

Panel Discussion: Second of a series to examine critically the present state of the art in music reproduction from both the engineers' and the musicians' point of view.

Panel Moderator: Ross H. Snyder, video products manager, Ampex Corp.

Panel Members: Jerry Walters, Gateway Singers; Dr. John Zuckerman, psychologist and amateur musician; Walter Selsted, director of research, Ampex Corp.; and Jimmy Lyons, jazz musicologist, Radio Station KIDD, Monterey, Calif.

Place: Conference Room, Hewlett-Packard Co., 1501 Page Mill Road, Stanford Industrial Park.

Dinner: 6:00 P.M., El Rancho, 3901 El Camino Way, Palo Alto.

WITH OTHER ACOUSTICAL AND AUDIO SOCIETIES

The February, 1958, issue of the *Journal of the Acoustical Society of America* contains a number of contributions which may interest the members of PGA.

Richard V. Waterhouse and Raymond D. Berendt of the National Bureau of Standards have reported on "Reverberation Chamber Study of the Sound Power Output of Subsonic Air Jets." In this study, the reverberation chamber technique was used to determine the sound spectra and acoustic power radiated by air jets over a range of subsonic velocities. Different air jets were used with round and square velocity profiles; nozzles of circular cross section, and nozzles with saw-tooth and corrugated ends were also used. Of these nozzles only the latter type gave a significant (9 db) reduction in sound power output for a given exit-pressure ratio.

"Masking of Speech by Noise at High Sound Levels" is described by Irwin Pollack and J. M. Pickett of the Operational Applications Laboratory, Air Force Cambridge Research Center. Speech intelligibility was examined at high noise levels for a range of speech and noise spectra. Over a wide range of conditions, deterioration of speech intelligibility was observed for over-all speech levels to 130 db in the absence of background noise. Control tests ruled out distortion within the equipment as the factor associated with the loss of speech intelligibility.

Another interesting study by the same authors is "Stereophonic Listening and Speech Intelligibility against Voice Babble." It has long been felt that directional information of a talker may improve the intelligibility of his speech heard against the voice babble of

other talkers. This effect has sometimes been referred to as "the cocktail party effect." This study examines the role of binaural directional information in listening to speech against a background of voice babble. The authors examine a situation which appears extreme in direct person-to-person communication, but is entirely feasible in an interphone system utilizing binaural information. The utilization of a particular form of stereophonic information was studied with respect to the intelligibility of a single speech source heard in the presence of a voice babble of other speakers. The reception of monosyllabic words, presented against a babble of 1, 2, 4, or 7 talkers, was compared under two listening conditions. 1) In the stereophonic listening condition, one set of background talkers was presented to one earphone, another set of background talkers was presented to the other earphone, and the test words were presented binaurally, in phase. 2) In the control listening condition, only a single set of background talkers, and the test words, were presented to a single ear. The stereophonic advantage, for 50 per cent word intelligibility, ranged from 12 db with 1 background voice per channel to 5.5 db with 7 background voices per channel.

A "New Technique for Measuring Transducer Blocked Impedance" is described by Gerald A. Sabin of the U. S. Navy Underwater Sound Reference Laboratory, Orlando, Fla. A pulsing technique for measuring the blocked impedance of an electroacoustic underwater sound transducer is described. The method permits measuring the blocked impedance under free-field acoustic loading conditions without resorting to clamping the transducer or to the usual interpolation method. Both theory and measurements are discussed. A means of readily identifying the natural resonance frequency from either an impedance or an admittance plot is also presented.

In a letter to the Editor, Wallace G. Clay and William S. Partridge write on the "Measurement of Sonic Velocity in Wax Cylinders." The wax cylinder is driven with a transducer and phonograph pickup was used to study the standing wave pattern on the cylinder.

Julius G. Baron, Iowa City, Iowa, writes on "Physical Basis of Piano Touch." The question whether the quality of a single piano tune can be influenced by touch without changing the loudness or without use of any of the pedals has been often discussed. Most musicians have assumed such a possibility. A number of physicists have denied it. They argue that the hammer is never in contact with the key at the instant when the hammer strikes the strings; therefore, both intensity and quality of tone depend on a single variable, the velocity of the hammer at the instant of contact. Mr. Baron points out that the former thesis becomes plausible if one considers the influence of noise elements of the piano action on the tone perceived by the listener.

The issue contains the usual "Review of Acoustical Patents" by Robert W. Young of the U. S. Navy Electronics Laboratory, San Diego, Calif.

The March, 1958, issue of the *Journal of the Acoustical Society of America* also featured several noteworthy articles on subjects related to the field of audio engineering.

Of interest to those who may deal with studio acoustics is a contribution by Prof. Erwin Meyer in collaboration with Fridolin Mechel, and Gunther Kurtze of the Physics Institute of the University of Gottingen on "Experiments on the Influence of Flow on Sound Attenuation in Absorbing Ducts." The influence of a turbulent air stream on the sound attenuation in ducts, lined with sound absorbing materials or structures of different kinds, has been experimentally investigated. For linings consisting either of porous materials or sufficiently damped Helmholtz resonators, a decrease of absorption with increasing flow velocity has been observed, together with an increase of the frequency of maximum absorption in the case of the resonators. Somewhat surprising results have been obtained for undamped or weakly damped Helmholtz resonators, where an attenuation minimum is observed above the resonant frequency, the frequency of which increases linearly with increasing flow velocity, and which—for undamped resonators—even reaches negative attenuation values.

Another interesting piece of research dealing with studio acoustics is described by Ladislav O. Dolansky of Northeastern University, Boston, Mass., in "Studio for Listening Tests." In this paper the design, construction, acoustical testing, and articulation testing of a listening studio are described. The author gives a good survey of various reverberation measuring methods. The reverberation time of the studio has been measured by several methods, and was found to be equal to about 0.5 second. A comparison of the individual results is presented.

A noise shield for microphones used in noisy locations is described by Mones E. Hawley of RCA, Moorestown, N. J. A rubber noise shield was developed which significantly improves the speech-to-noise ratio at a military microphone. The construction and evaluation techniques are described, and the advantage of introducing acoustic damping material is shown.

The question of communication under noisy conditions has had considerable attention during World War II, principally from the point of view of instrumentation. Irwin Pollack of the Bolling Air Force Base Research Center has been studying this problem from the point of view of presenting information in a manner which would result in considerable improvement of intelligibility. In his study "Message Procedures for Unfavorable Communication Conditions" Pollack describes several message procedures, designed to improve speech communications under extremely unfavorable speech-to-noise ratios. (The speech-to-noise ratios used in this study are of the order of -12 to -22 db.) A message procedure based upon the principle of successive selections among a reduced number of alternative was found to improve intelligibility.

With the current interest in stereophonic sound two letters to the Editor are noted; one by Leakey, Sayers, and Cherry of the University of London, and the other by Winston E. Kock of Bendix Systems Division, Ann Arbor, Mich., on binaural fusion of low and high frequency sounds, and binaural localization.

The issue contains the "References to Contemporary Papers on Acoustics" by Walter Koidan and Earl D. Schubert and the "Reviews of Acoustical Patents" by Robert W. Young.

The January, 1958, issue of the *Journal of the Audio Engineering Society* contains a number of articles stemming from the 1957 AES Convention.

Some of the problems in transistorizing motion picture projection are described by Stephen F. Bushman of Bell & Howell Co., Chicago, Ill., in an interesting article describing the use of a photo-transistor as a combined photocell and magnetic head signal amplifier.

A transistor power amplifier in which all the transformers and interstage coupling capacitors have been eliminated is described by Richard S. Burwen of Minneapolis-Honeywell, Boston Division, in an article entitled "Portable Transistor Music System." The amplifier is capable of delivering 20 watts, with a standard 45 volt battery and 4 mercury flashlight cells. It uses 13 transistors.

In "Techniques for Measuring and Evaluating Noise" J. J. Hamrick of IBM, Endicott, N. Y., discusses instrumentation and annoyance evaluation of noise produced by office equipment. The continually increasing public awareness and concern over noise has required the development of improved techniques and procedures to measure and evaluate the noise environment created by new products. Modifications of existing instruments and improved operational procedures have been developed using stereo tape recorders and reproducing systems, audio spectrum analyzers, graphic level recorders, and frequency analyzers.

The "Variable-Speed Scanning of Recorded Magnetic Tapes" by W. S. Latham of the U. S. Navy Underwater Sound Laboratory, New London, Conn., describes a device for critical examination of recorded data on moving or stationary magnetic tapes by means of variable-speed rotating magnetic reproduce-head assemblies. Several types of interchangeable assemblies, both single and dual-track, are discussed, together with certain operative phenomena peculiar to each. Problems arising from the use of variable speed scanning as a means of analyzing recorded analog data are illustrated. The effect of rotating-head design on wow and flutter is described in detail, as well as the ability of current magnetic tapes to withstand physically high-speed scanning for prolonged periods of time.

Robert E. Glendon, of the U. S. Navy Underwater Sound Laboratory, New London, presents "An Analysis of Tape Noise in a 100-KC Bandwidth." The noise of

various kinds of commercially available tape was measured in logit filter bands from 100 cps to 100 kc by means of standard and readily available equipment, with the exception of the filters. The corrections necessary because of the use of the logit filters and the various electrical and physical characteristics of the head and the reproduce process are described and considered. The results of the measurements are presented in terms of noise spectra as a function of the type of erasure, backing, thickness, orientation of the magnetic coating, and tape speed. The actual noise voltages encountered are also shown.

Other papers in this issue deal with high power transistor audio amplifiers, magnetic loop tape cartridges, and problems of reproducing sound in an automobile.

The paper on "Reproduction of Sound in Automob-

biles" deals with a number of interesting problems. B. A. Schwarz and D. E. Brinkerhoff of Delco Radio Division, General Motors Corp., Kokomo, Ind., treat some of the physical and psychological factors of reproduced sound in an automobile. 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, loading, 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 the experimental loudspeaker locations tested are presented.

BENJAMIN B. BAUER

Procedures for Loudspeaker Measurements*

P. J. A. H. CHAVASSE† AND R. LEHMANN‡

TRANSLATED BY MICHEL COPEL‡

Summary—In this study the authors try to define the instrumentation and measurement procedures for the acoustic calibration of loudspeakers. They give some indication of the characteristics of the instrumentation and then specify the measurements to be taken in order to determine the acoustic (performance) quality of a loudspeaker.

They review successively the following problems: frequency response characteristic, directivity, harmonic and intermodulation distortion, impedance characteristic, efficiency, and transient response. For each they propose a method of measurement and give some practical examples of results obtained.

I. GENERAL

LOUDSPEAKERS essentially are transducers which produce acoustical energy from electrical energy. This transformation is accomplished usually through mechanical vibration, although in a model recently developed in France (ionophone) there is no mechanical motion. No matter what the type of transducer is, the measurement procedures which permit the determination of the (performance) acoustic quality are the same and should be specified precisely.

In the radio broadcasting field, in the motion picture technology, or in the ordinary usage of electroacoustic equipment, the essential thing, to reproduce sound

faithfully, is always relegated to the loudspeaker. However, it seems that it is the one thing which is the least known and controlled from the acoustical point of view, and therefore, its quality does not always reach the level which should be assured to it by the developments in electroacoustics and the technical progress achieved in its fabrication. The aim of this paper is to specify the measurements which should be made to control that quality in accordance with the definition of the characteristics which have been given, and to establish the technical requirements for the equipment as well as the condition of measurement for a systematic evaluation.

II. INSTRUMENTATION AND CONDITIONS OF MEASUREMENT

In order to make possible the comparison of measurements taken by different specialized laboratories or manufacturers, it is necessary to define with precision the conditions under which measurements are taken, and also the electrical and acoustical characteristics that the instrumentation must possess. These factors are analyzed below.

A. Conditions of Measurement

1) *The Acoustic Environment, the Room:* Although the conditions of normal usage of a loudspeaker in most cases do not correspond to free field, it seems that all the laboratories perform their measurements under that condition (of theoretical performance). Free-field meas-

* Translated manuscript received by the PGA, December 23, 1957. Original manuscript appeared in *Annales des Télécommunications*, vol. 8, pp. 226-237; July, 1953.

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‡ Naval Material Lab., Brooklyn 1, N. Y.

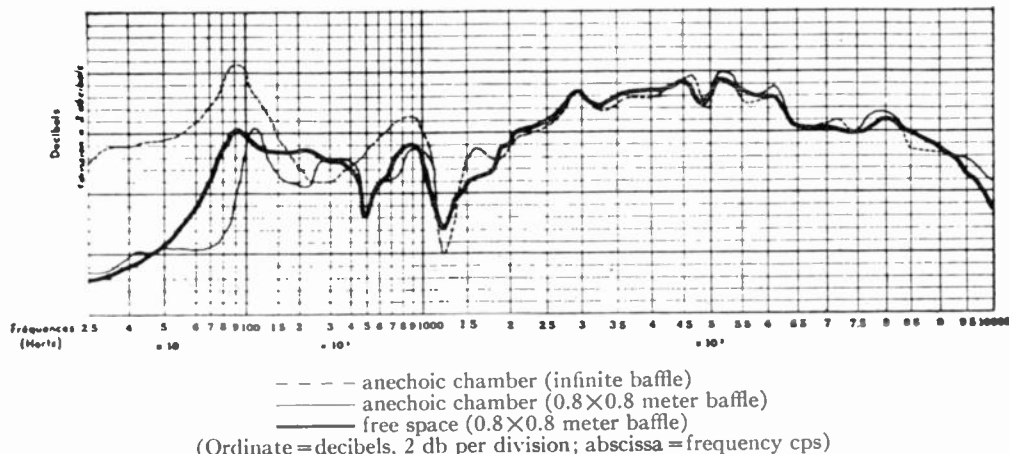


Fig. 1—Response curves of an electrodynamic loudspeaker: microphone at 1 meter from the reference plane, constant voice coil voltage.

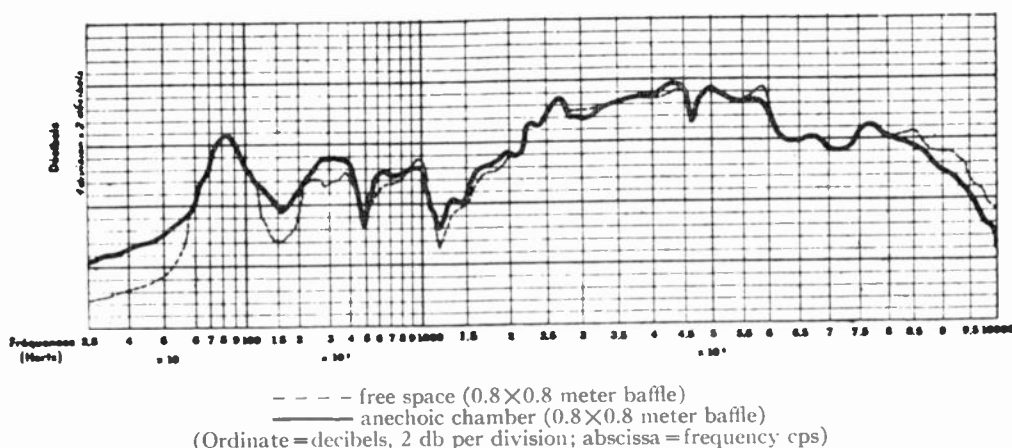


Fig. 2—Response curve of a dynamic loudspeaker with field coil: microphone at 3 meters from the reference plane, constant voice coil voltage.

urements have the advantage of being well defined, repeatable, and allow the comparison of results with relative ease. However, the major difficulty rests with realizing a free-field as closely as possible. All the acoustics laboratories now have anechoic chambers which enable them to artificially fulfill the condition of free-field with an approximation which is sufficient for all practical purposes. The problem, however, complicates itself when low-frequency measurements (below 100 cps) must be made, since one should then utilize very large rooms (at least 6 to 7 meters or 19.7 to 23 feet for all dimensions) so that these dimensions remain larger than the longest wavelength.

The anechoic chamber of the Acoustic Department of the CNET,¹ though of smaller size^{2,3} yields satisfactory results in this respect, as shown in Figs. 1 and 2.

It would be naturally preferable to perform the tests

in a room similar to those that many American laboratories have⁴⁻⁶ where the absorption is better than 90 per cent for frequencies below 100 cps, and where the dimensions (of the rooms) are around 10 meters (about 33 feet). Therefore, we recommend taking all the measurements, which are described in detail in the following section, under natural conditions of free propagation, which permits the theoretical interpretation of the measured results.

The second condition of measurement, which is very important to specify, relates to the method of mounting of the loudspeakers. Two cases are then to be considered.

- a) Cone loudspeakers, of circular or elliptical shape, which are usually mounted either on baffles of various size and shape, or in cabinets.
- b) Horn loudspeakers, with horns of various types (often exponential).

¹ A more substantial chamber has just been constructed.
² P. Chavasse, "La salle muette du Centre National d'Études des Télécommunications," *C. R. Acad. Sci., Paris*, vol. 224, pp. 1341-1343; May 12, 1947, and *Atomes*, vol. 4, pp. 308-312; September, 1949.
³ R. Lehmann, "La salle sourde du département acoustique du C.N.E.T.," *Ann. Télécommun.*, vol. 2, pp. 177-188; May, 1947.

⁴ P. J. Mills, "Construction and design of Parly sound laboratory and anechoic chamber," *J. Acoust. Soc. Amer.*, vol. 19, pp. 988-992; November, 1947.

⁵ L. L. Beranek and H. P. Sleeper, "The design and construction of anechoic sound chambers," *J. Acoust. Soc. Amer.*, vol. 18, pp. 140-150; July, 1946.

⁶ H. F. Olson, "Acoustic laboratory in the new R.C.A. Laboratories," *J. Acoust. Soc. Amer.*, vol. 15, pp. 96-102; October, 1943.

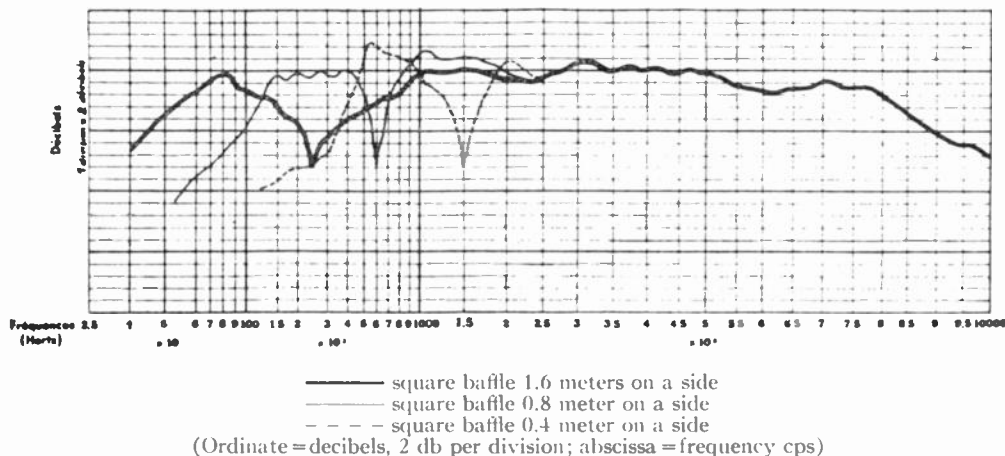


Fig. 3—Change in the response of an electrodynamic loudspeaker as a function of the baffle dimensions: microphone at 3 meters from the reference plane, constant voice coil voltage.

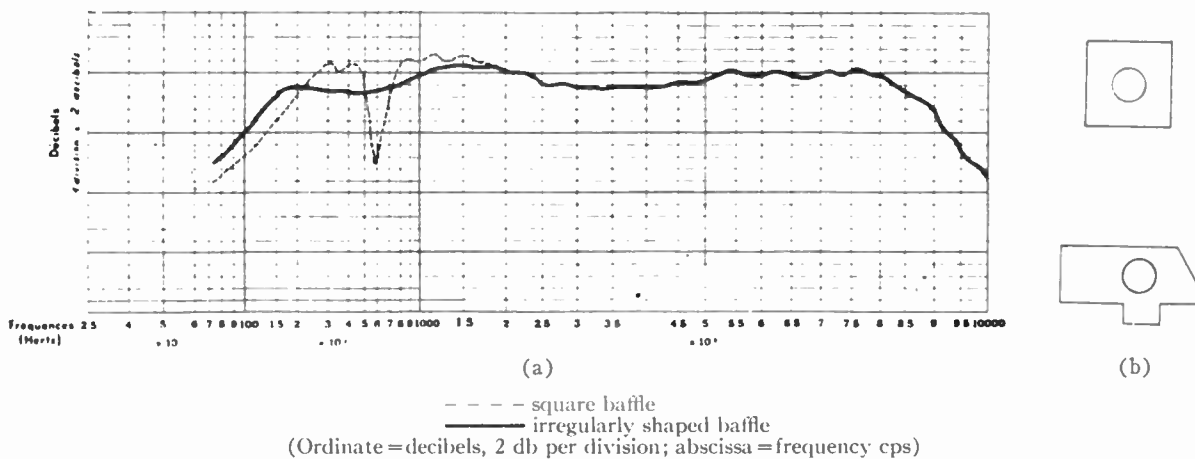


Fig. 4—Change in the response of an electrodynamic loudspeaker as a function of the shape of the baffle: microphone at 3 meters from the reference plane, constant voice coil voltage.

With respect to the second category, one must naturally utilize the horns which are an integral part of the loudspeakers under test. As far as the loudspeakers of the first category are concerned, their usages are many, so it is necessary to specify the test conditions.

It is preferable to mount the loudspeaker under test on a baffle of large size (in the order of 4 meters at least, 13 feet) so as to eliminate, at all frequencies, the effect of the back wave (the ideal would be evidently an infinite baffle). In this respect, Fig. 3 shows the variation of the response curve of a cone loudspeaker mounted in a square baffle of various dimensions. For practical reasons, the use of a baffle of very large dimensions is naturally difficult, so it is necessary to use a standardized baffle of given shape, and of lesser dimensions.

Opinions on this subject still seem quite divided, and if some authors propose circular baffles with the loudspeaker mounted at the center, others advocate square or irregular baffles (U. S.), or rectangular (Germany), with the loudspeaker mounted either at the center, or in a dissymmetrical manner. Fig. 4 shows, after Olson and

Massa,⁷ the influence of the baffle form upon the frequency of response characteristic of a loudspeaker. It appears difficult, technically, to make a definite choice between these arrangements, but our own experience incites us to think that a 2-meter square baffle, with the loudspeaker mounted at the center, can give satisfaction. Therefore it is this type of baffle that we shall adopt. It is necessary, naturally, that the baffle be sufficiently heavy and rigid, so as not to generate any audible parasitic radiations by exciting it into vibration.

2) *The Position of the Microphone*: Another parameter which is important to determine is the position of the measuring microphone in relation to the loudspeaker under study. In principle, all the tests will be performed on the axis of the loudspeaker or the horn with which it is associated and, in some cases, for other azimuths (directivity). One must, however, fix and specify the distance between the microphone and the loudspeaker, and it seems that very many authors are in accord to give it a

⁷ H. F. Olson and F. Massa, "Applied Acoustics," 430 pp.; 1934.

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