Sonderdruck Heft 5/70

HiFi Stereophonie

Zeitschrift für hochwertige Musikwiedergabe

Lautsprecherboxen im Großtest

Bose 901

Es mag für unsere Leser überraschend sein, hier einen Testbericht vorzufinden, der nur einer einzigen Lautsprecherbox gewidmet ist. Der Grund hierfür ist in der Tatsache zu suchen, daß die amerikanischen Boxen Bose 901 mittels unserer üblichen Testmethoden schwerlich mit anderen Lautsprecherboxen zu vergleichen sind. Daraus mag der Leser schließen, daß es sich dann wohl um etwas grundsätzlich Neues handeln müsse.

Nun, in gewissem Umfang ist dieser Schluß berechtigt. Schon die Form der Boxen überrascht. Von vorne betrachtet sind sie rechteckig (Bild 1, 520 x 323 mm über alles); von oben gesehen fünfeckig, wobei die Rückfrontflächen einen Winkel von 134° einschließen (Bild 2). Die größte Tiefe beträgt 326 mm. Jede Box ist mit neun dynamischen Breitbandlautsprechern ausgestattet, und zwar ist nur einer davon in die Frontseite eingebaut, jeweils vier weitere befinden sich in den abgewinkelten, nach hinten gerichteten Rückfrontflächen. Dieser Anordnung der Lautsprecher liegt die richtige Überlegung zugrunde, daß der von einem beliebigen Klangkörper ausgehende Schall im Konzertsaal oder Opernhaus nur zu einem kleinen Bruchteil den Hörer auf direktem Weg erreicht. Der weitaus größte Teil der wirksamen Schallleistung setzt sich aus indirektem Schall zusammen, der den Hörer erst erreicht, nachdem er mehr oder weniger oft von den Wänden des Konzertsaals reflektiert worden ist. Der Hersteller dieser Boxen, die amerikanische Bose Corporation, hat untersuchen lassen, in welchem Verhältnis zueinander diese Schallanteile im Mittel stehen und hat dieses der Konstruktion der Bose 901 zugrunde gelegt. Nach Angaben des Herstellers werden bei diesen Boxen 89 % der Schalleistung durch Abstrahlung nach hinten und Reflexion in den Wänden indirekt und nur 11 % direkt nach vorne abgestrahlt. Die Boxen sollen so aufgestellt werden, daß die Spitze des rückwärtigen V etwa 30 cm von der reflektierenden ebenen Wand entfernt ist. Der Einbau dieser Boxen in Regale ist demnach nicht möglich.

Die neuen akustisch gekoppelten Lautsprechersysteme haben einen Membrandurchmesser von nur 100 mm. Kräftige Dauermagnete und große Amplituden sorgen für gute Baßwiedergabe. Frequenzweichen entfallen gänzlich, was im gleichen Umfang von Vorteil ist wie die Breitbandsysteme in der Lage sind, den gesamten Frequenzbereich ohne hörbare Partialschwingungen und Verzerrungen zu verarbeiten. Zum Lieferumfang der Boxen (2590,– DM das Paar*) gehört ein aktiver Verzerrer, der entweder zwischen Vor- und Endverstärker geschaltet oder bei integrierten Verstärkern und Steuergeräten über den Tonband-Monitor-Ein- und Ausgang angeschlossen wird (Bild 3). Damit in letzterem Falle trotzdem Hinterbandkontrolle möglich ist, kann das Tonbandgerät nun seinerseits an den Verzerrer angeschlossen werden, der mit den erforderlichen Ein- und Ausgängen ausgestattet ist. Das Wort „Verzerrer", obwohl es sich um den richtigen terminus technicus handelt, klingt in diesem Zusammenhang abschreckend. In Wirklichkeit handelt es sich um ein aktives Klangregelnetzwerk mit eigener Stromversorgung, das dazu dient, den Verlauf der Schalldruckkurven der Boxen an die Erfordernisse des Hörraumes anzupassen, oder sogar, bei schlecht aufgenommenen Schallplatten, Klangkorrekturen vorzunehmen. Die Bässe unter 40 Hz können bedämpft werden. Befindet sich der mit „Treble level" bezeichnete Kippschalter in der oberen Position, können die Höhen vom Einsatzpunkt 2000 Hz an in fünf Stufen abgesenkt oder angehoben werden, wobei die Stufe 4 dem linearen Verlauf entspricht (Bild 4 a). Bringt man den erwähnten Kippschalter in die Stellung „Decrease", werden die Mitten und Höhen vom Einsatzpunkt 500 Hz an in vier verschiedenen Stufen abgesenkt (Bild 4 b). Die fünfte Stufe zeigt denselben Verlauf wie in der anderen Position des Kippschalters.

Musik-Hörtest

Die Bose-Boxen wurden zunächst im Abhörraum unseres Studios mit normalen Boxen verglichen, also mit solchen, die ihre gesamte Schalleistung nach vorne abstrahlen. Um Resonanzen im Baßbereich zu vermeiden, haben wir den Teil des Raumes, in dem die zu testenden Boxen, vom Raum körperschallisoliert, aufgestellt sind, mit Hilfe von Diolenfill und schwerem Stoff bedämpft. Genau dies aber sind Bedingungen, wie sie für die Bose 901, die auf ihrer Rückseite hart reflektierende Flächen oder Strukturen benötigen, nicht geeignet sind. Wir haben daher hinter die beiden Bose-Boxen reflektierende Wände aufgestellt. Die beiden Seiten dieser „Boxenbühne" waren aber nach wie vor bedämpft. Es ist daher auch nicht sonderlich erstaunlich, daß die Bose-Boxen unter diesen Umständen ihre wahren Vorzüge nicht in vollem Umfang offenbaren konnten. Beim Umschalten auf die zwei Braun L 810, von denen in Bälde mehr zu berichten sein wird, hatte man den Eindruck, daß nicht die Bose, sondern die Braun L 810 die breiter gestaffelte Stereoperspektive vermittelten. Das hatte zwei Gründe. Erstens strahlen die mit Kalottenmittel- und Kalottenhochtönern ausgestatteten Braun L 810 den gesamten Frequenzbereich in großem Winkel ab. Zweitens absorbierten die bedämpften Seitenwände einen Teil der von den Bose nach hinten abgestrahlten Schalleistung, dies aber nicht etwa linear, sondern selektiv, so daß sich auch noch Klangverfärbungen einstellten. Es war also klar, daß man auf diese Weise den Bose 901 nicht gerecht werden konnte und daß unser Abhörstudio in seiner derzeitigen, für konventionelle, nach vorne abstrahlende Boxen konzipierten akustischen Aufbereitung zur Beurteilung die-

© bei den Herstellern
Archiv Michael Otto
HiFi-Classic.de

ser Boxen nicht geeignet ist. Ich führe dies an, um Fachhändler und mögliche Interessenten davor zu bewahren, von diesen Boxen allein deswegen einen falschen Eindruck zu gewinnen, weil sie nicht unter geeigneten akustischen Bedingungen vorgeführt oder geprüft werden. Man kann sie in der Tat schlecht zusammen mit normalen, nach vorne abstrahlenden Boxen vorführen, weil die neben den Bose aufgestellten Boxen den Rückwurf des von den Bose nach hinten abgestrahlten Schalls stören würden.

Ein für die Bose-Boxen idealer Testraum schien mir mein privater Hörraum zu sein. Er hat die Abmessungen 6,8 x 6 m bei etwa 3,5 m Höhe. Die Boxen (Lansing Olympus) befinden sich normalerweise gegenüber einer Sitzgruppe vor der längeren Wand, bei einer Basis von rund 3,5 m, bezogen auf Boxenmitte. Der Raum ist zwar durch Polstermöbel und Teppiche bedämpft, es sind aber in ausreichendem Umfang hart reflektierende Flächen vorhanden. Ich rückte die Olympus-Boxen näher an die mit Schallplatten und Bücher gefüllten Bücherregale und installierte die Bose 901, jeweils eine auf eine Olympus-Box. Als Vorverstärker diente ein McIntosh C 24 und als Endstufe der Lansing SE 408 SE. Zwischen beide war der aktive Klangregler geschaltet. Über Rundfunk und von Schallplatten wurden über Tage hinweg die unterschiedlichsten Programm-Materialien, vom Streichquartett über symphonische Musik zu Wagner-Opern, Klavier solo, Gesangssolisten mit Orchester, Jazz und Pop-Musik abgehört. Meine Hörgewohnheiten in diesem Raum wurden geprägt vom Klangbild der Lansing Olympus-Boxen, die ja nun gewiß nicht zu den schlechtesten Lautsprecherboxen zählen.

Trotzdem muß ich zugeben, daß ich mich nach ausgiebigem Einhören in das Klangbild der Bose 901 nur ungern wieder von diesen Boxen trenne.

Tatsächlich bieten diese Boxen einige unbestreitbare Vorteile:

1.

Die Stereoperspektive ist unerhört breit. Noch mehr, als es bei anderen Boxen der Fall ist, sind sie als Schallquellen nicht mehr zu orten. Der Klang erfüllt den Raum. Trotzdem sind die beiden Kanäle einwandfrei voneinander getrennt. Die Stereohörzone ist enorm erweitert. Mit Ausnahme des direkten Umkreises einer Box erfaßt sie den gesamten Hörraum. Die Stereoperspektive ist dem Klangkörper angemessen: einerseits erhält die Opernbühne zusätzliche Breite und Tiefe, andererseits verschmelzen bei einem Streichquartett, vorausgesetzt, daß es sich um eine gute Aufnahme handelt, die Sopranstimmen besser mit Bratsche und Violoncello, ohne daß eine scheinbare Vergrößerung des reduzierten Klangkörpers die Folge ist.

2.

Die Boxen vermitteln ein ausgewogenes Klangbild bei hervorragender, sehr weit zu tiefen Frequenzen herabreichender, resonanzfreier, sauber durchgezeichneter Baßwiedergabe und freien, wohldefinierten, kräftigen Höhen, denen jegliches metallische Flirren abgeht.

3.

Eine unmittelbare Folge von 1 und 2 ist eine gesteigerte Durchsichtigkeit, gerade bei sehr dichten, großvolumigen Werken symphonischer Musik.

4.

Die Boxen sind hoch belastbar. Dementsprechend sind sie in der Lage, ein gewaltiges Klangvolumen zu erzeugen. Aber sie gehören zu den wenigen Boxen, die ich kenne, und zu denen ich auch die Olympus zähle, die auch bei leiseren Lautstärken ein hohes Maß an Durchsichtigkeit und Klangdefinition bewahren.

5.

Von einer Ausnahme abgesehen, ist das von den Bose 901 vermittelte Klangbild verfärbungsfrei.

Diese Ausnahme stellt den einzigen Nachteil dar, den ich an diesen Boxen feststellen konnte. Immer wenn vom Frequenzbereich zwischen etwa 120 und 250 Hz chorische Stimmen akkordisch das Register durchlaufen (z. B. Bratschen), glaubt man, kleinere Resonanzen zu hören, die eine Art Verfärbung hervorrufen. Der Effekt ist nicht gravierend, und bei Solostimmen offenbar nicht vorhanden. Ich vermute, daß in diesen Frequenzbereich die Eigenresonanzen der Breitbandsysteme fallen, die gewiß untereinander etwas abweichen, aber durch ein Frequenzspektrum bestimmter Breite angeregt, in ihrer Überlagerung doch hörbar werden. Das wäre der Preis, den man für die Verwendung von Breitbandsystemen und den vorteilhaften Wegfall von Frequenzweichen bezahlen muß.

© Archiv Hersteller HiFi-Classic.de

Welche Verstärkerleistungen sind erforderlich?

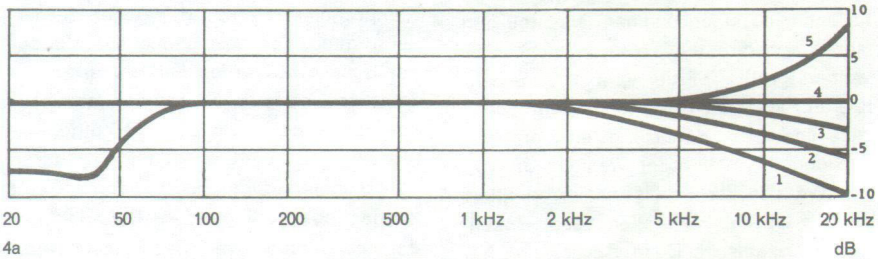
Verstärker von 2 x 20 W Dauertonleistung sind durchaus in der Lage, diese Boxen in kleineren Räumen bis zu hifi-gerechten Lautstärken zu betreiben, sofern sie an 8 Ohm ihre maximale Leistung abgeben. Wer jedoch die eminenten Fähigkeiten der Boxen im Baßbereich voll einsetzen will, muß schon etwas mehr Verstärkerleistung investieren (2 x 40 bis 2 x 60 Watt). Für hochpegelige Beschallung großer Räume können noch stärkere Endstufen eingesetzt werden. Jede Box verkraftet nach Angaben des Herstellers 270 W.

Zusammenfassung

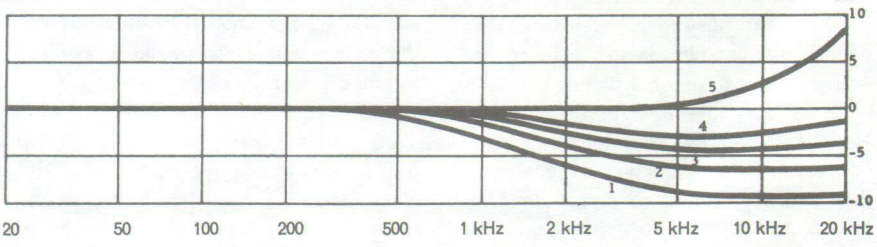
Bei den Boxen Bose 901 werden rund 90 % der Schalleistung nach hinten gegen eine reflektierende Wand abgestrahlt. In geeigneten Abhörräumen und bei sachgerechter Aufstellung erzeugen diese Boxen ein höchst ausgewogenes Klangbild mit ungewöhnlich kräftigen, bis etwa 20 Hz resonanzfrei herabreichenden Bässen und sauberen, wohldefinierten Mitten und Höhen. Bei voller Bewahrung der Stereo-Information ergeben sie eine Verbreiterung der Stereoperspektive und eine enorme Ausweitung der Stereohörzone. Noch mehr als bei anderen guten Boxen in Stereobetrieb, entfällt die Ortbarkeit der Boxen als begrenzte Schallquellen. Trotz der Verwendung von neun Breitbandsystemen überrascht die Fähigkeit dieser Boxen, Impulse sauber zu verarbeiten. Einen kleinen Nachteil sehe ich in sporadisch auftretenden Verfärbungen im engen Frequenzbereich zwischen etwa 120 und 250 Hz.

Für anspruchsvolle HiFi-Freunde, die zwar die Möglichkeit haben, Boxen in rund 30 cm vor reflektierenden Wänden aufzustellen, bei Verwendung normaler Boxen aber Schwierigkeiten mit der optimalen Stereohörzone haben, könnten diese mit Sicherheit zu den besten zählenden und auf ihre Art bislang konkurrenzlosen Boxen, die Lösung ihrer Probleme bedeuten.

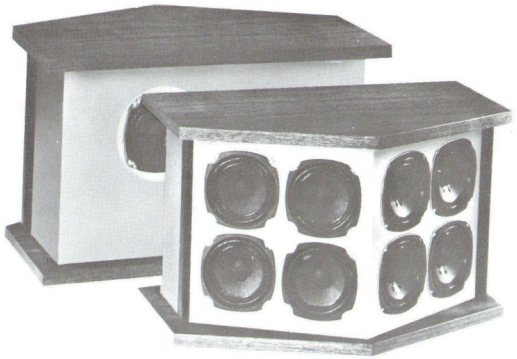
Karl Breh



4a



4b



Behind the grille cloth, each reproducer in Bose 901 system has eight speakers on its angled rear panels, one on the front panel. Equalizer has controls for shaping contour of response, plus tape monitor substitute if patched into amplifier or receiver tape jacks.

14 kHz was audible closer on axis; and from here the response sloped off towards inaudibility. White noise response was exceptionally smooth and well distributed throughout the listening area.

To test the equalizer and Bose's claim that the 901 system responds with alacrity to differences in program sources, I played the same recordings with different pickups, and different recordings with the same pickup. Details of this extended listening occupied several of us for days; what it comes to is this: the equalizer not only serves generally to contour the amplifier response with respect to the 901 speakers, but it can (indeed, should, for the most accurate playback) also be used to vary this contour —subtly, but to critical ears effectively—at both the extreme high and low ends of a system's total response. In this way all the elements involved (program source, amplifier, room acoustics) can be brought into suitable or integrated acoustic focus. In this sense, the 901 system is the closest approach to the concept of "sound conditioning" of a listening room yet encountered in a commercially available, competitively priced product. And it is all the more commendable for its ease in use: the equalizer is a small walnut box that you can install next to or on top of your main control panel, whether it's part of a separate amplifier or a stereo receiver. After some experiment you will find the best positions for its controls for various recordings and/or different cartridges used in playing those recordings. For instance, using the Ortofon to play some Columbia records of the New York Philharmonic under Bernstein, I found it more agreeable to cut back on the high end a few steps; with the Shure V-15 II I cut back only one step. For Vanguard's recent Dolbyized releases I cut back one step with the Ortofon, but ran the system flat for the Shure. In discussing these adjustments with the manufacturer I was told that the exact degree of adjustment is bound to vary in different listening rooms but that the general pattern I had hit on seemed valid: recordings and pickups—even those that may be termed high quality—do vary in acoustic tone, and Bose's aim is to provide the keen-eared listener with a means (if he opts to use it) of compensating for those variations.

Yet another area of compensation—this one primarily with regard to individual room acoustics and relative location of the speakers—is offered by the 901 system. The accompanying diagrams illustrate this point, and again the effects represented are definitely audible. If you toe the speakers *inward*, more sound will come from the sides of the room; this effect increases the apparent stereo spread and may be desirable if the speakers have to be located fairly close to each other, say about three feet apart. If you toe the speakers *outward*, less sound will come from the sides and there will be more of a centre-fill effect—useful if the speakers are installed very far apart, say about fifteen feet from each other. In any location, you must leave about a foot of space behind the speaker and any amount of space at its side in order to allow the "bounce-and-reflect" effect to develop. Correctly installed along these lines, the pair of 901 systems provides full stereo from just about any listening position in the room. Combined with the sense of front-to-rear depth they project, the sound never seems to be emanating from boxes; rather you feel that the sound is "just there," and fairly well spread about you too. The acoustic perspective thus provided comes surprisingly close to simulating the sort of ambience you normally would get only by using "surround" and center-fill speakers in addition to the normal stereo pair.

Add to these virtues the utterly clean wide-range response of a 901, its neutral, well-balanced, transparent quality on all program material, and you feel you've made some sort of stereo discovery. And it doesn't pall, either: you can listen to this system for hours on end without getting listener fatigue—if your own response to it is like ours, you'll be reluctant to turn it off and go to bed.

BOSE 901, compact full-range speaker system in enclosure; supplied in stereo pairs with model 901 Active Equalizer. Dimensions: each speaker system, 20 9/16 by 12¾ by 12⅞ inches; equalizer, 9¼ by 6¾ by 2 3/16 inches. Price, two speaker systems and equalizer, $476. Manufacturer: The Bose Corp., 17 Erie Drive, Natick, Mass. 01760.

© beim Hersteller
Archiv Michael Otto

HIGH FIDELITY/musical america

VOL. 18 NO. 8

MUSIC AND MUSICIANS

AUDIO AND VIDEO

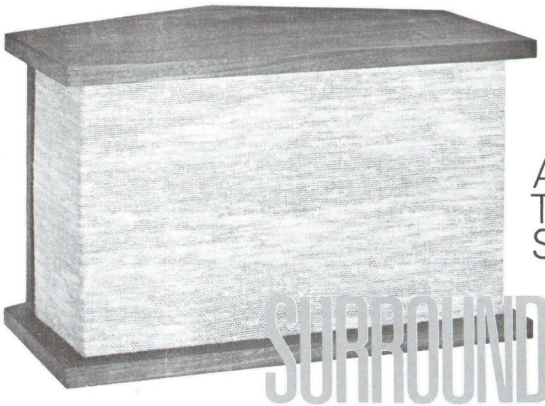
RECORDINGS

MUSICAL AMERICA *(Following page 118)*

Musician of the Month: André Previn, now conductor of the Houston and London symphony orchestras . . . Interviews with Sir John Barbirolli and Marie Collier . . . Music on campus at Michigan State University . . . Sena Jurinac's New York debut . . . "The Electric Ear" at Manhattan's Electric Circus . . . U. S. premiere of Henze's *A Country Doctor* in Evanston . . . Cleveland's new Blossom Music Center . . . Jazzfest in New Orleans . . . Festivals in Kansas City and Cincinnati . . . The Maggio musicale . . . Music in Baltimore, Muncie, Alaska, Israel.

Published at Great Barrington, Mass. 01230 by Billboard Publications, Inc. Copyright © 1968 by Billboard Publications, Inc. The design and contents of High Fidelity Magazine are fully protected by copyright and must not be reproduced in any manner. Second-class postage paid at Great Barrington and at additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa and for payment of postage in cash. High Fidelity/Musical America Edition is published monthly. Subscription in the U.S.A. and its Possessions, $12; elsewhere, $13. Subscription including Concert Artist Directory published in December, $17, in the U.S.A. and its Possessions; elsewhere, $18. Regular issues $1.00 a copy. National and other editions published monthly. Subscription in the U.S.A. and its Possessions, $7; elsewhere, $8. Regular issues 60¢ a copy. Indexed in the Reader's Guide to Periodical Literature. **Change of address notices and undelivered copies (Form 3579) should be addressed to High Fidelity, Subscription Department, 2160 Patterson Street, Cincinnati, Ohio 45214. Please state both old and new addresses when requesting a change.**

By Norman Eisenberg



A REPORT ON THE BOSE 901 SPEAKER SYSTEM

SURROUND and CONQUER

DESPITE THE PREVALENCE of look-alikes and sound-alikes in audio, every now and then the maverick spirit asserts itself and produces something that turns out to be as good from a performance standpoint as it is interesting from a design standpoint. So it is with the new Bose 901 speaker system, which—while an obvious departure from the familiar two-cubic-foot-walnut-box approach to speaker design—strikes us as one of the best sound reproducers we have ever heard.

Basically, the Bose 901 is a speaker system whose acoustic response is influenced by the electrical response of an equalizer unit inserted in the amplification chain. One equalizer serves to control two stereo channels. Each speaker system itself consists of nine specially designed four-inch drivers installed in a five-sided enclosure so that one driver faces into the listening room while the other eight radiate against a wall or other surface behind the enclosure. The nine speakers in each enclosure are identical, and no crossover network is used.

A question that immediately comes to mind is: can several small speakers match the bass performance of one large woofer? Let's see. It is apparent that the Bose system is based on certain specific design concepts, not all of which are completely accepted in audio circles. To wit: a relatively high amount of reflected sound, vis-à-vis direct radiated sound, is very desirable in playback; what one hears out of the speaker system is more important than what can be measured going into the system (the acoustic response should be flat even though the electrical signal itself is not); in creating a wide-range, high-quality speaker system the woofer-tweeter-with-crossover-network approach can be successfully ignored if suitable design steps are taken in the use of several identical drivers; nonparallel sides for an enclosure are more desirable than parallel sides; a speaker system ought to incorporate provisions—instead of or in addition to those normally found on an amplifier—for specific forms and degrees of tonal compensation related to input program material, speaker system characteristics, and loading to the acoustics of the listening room.

If all this sounds complex, it is. Briefly, here's how it works: the spatial presentation of sonic information, particularly germane to stereo, is accomplished by deliberately introducing a high ratio (eight-to-one, approximately) of indirect-to-direct sound. The sound reflecting off the walls blends with the sound from the lone driver in front to enhance the ambience and spatiality of the reproduction. At the same time the total area of speaker diaphragms improves the radiation resistance of the system in loading or transferring sound into the listening area. At low frequencies all nine speakers respond in phase to move fairly large amounts of air, thus radiating bass power. At high frequencies the small diaphragm of each speaker naturally behaves like a tweeter. Differences in individual resonances are overcome by the close internal coupling of the drivers, with the result that the response of the total array becomes fairly smooth, as compared to the characteristic response of any single driver.

To extend the range of this smooth response and also to shape it to suit both program material and room acoustics, Bose employs an "active equalizer," a solid-state device that boosts the very low and very high ends of the spectrum. By using its controls, you can vary the degree of boost at either end (twenty frequency contours are available), but some lift always remains effective. The equalizer comes before the power amplification section of whatever equipment you're using; its connections permit you to patch it into a separate preamp and power amp, into an integrated amplifier, or into a receiver. Electronically speaking, the equalizer is a fairly sophisticated device—one of its functions, for instance, is to compensate for the acoustical character of the grille cloth over the speaker enclosure.

If this sounds like electronic hocus-pocus, consider that it is really no more so than the equalization (i.e., frequency gimmicking) used on records and tapes, which is compensated for by reciprocal circuits in every modern amplifier and receiver. Analysis of the Bose approach and—more important—many hours of listening to the system certainly justify and validate it in my opinion. Indeed, after comparing its various frequency contours, playing a number of recordings, I'd go so far as to say that you can use the Bose equalizer as a "trimmer" adjustment to further refine the existing RIAA characteristic during playback, thereby cleaning up both the very low and high ends of the audible response of many recordings. It also helps the tonal balance of FM broadcasts and of prerecorded tapes (though the latter generally strike me as better balanced to begin with) played through your system.

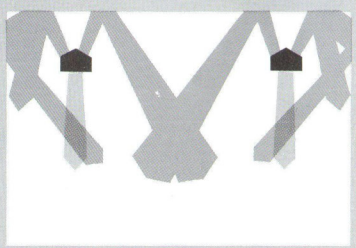
Because the equalization comes before the power amplifier, it can make demands of the latter that may exceed its capabilities. For this reason the Bose 901 is not recommended for use with puny amplifiers unless you're willing to settle for less than the full response capabilities of the system. Amplifiers (or amplifier sections of receivers) that can deliver at least 20 watts RMS power per channel into an 8-ohm load are recommended. At the same time, the power-handling ability of the combined nine drivers is prodigious, and permits using amplifiers that can deliver over 100 watts RMS per channel.

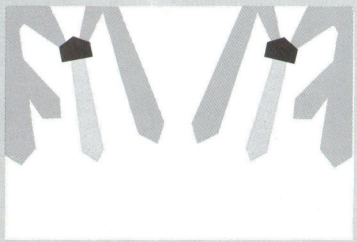
AWARE THAT MY verdict is in part subjective (and allowing too for the protean nature of the audio field, in which some future development may cause me to modify this opinion), I will say that as of now the Bose 901 strikes me as the best-sounding speaker system in its size and price class I have yet auditioned. Indeed, it rivals many systems built to larger dimensions and/or costing considerably more. In its midrange and highs—for clarity, full range, wide dispersion, open and natural sound—it is unsurpassed by anything I've heard. In its bass it is easily a match for the best of the air-suspension systems, and is outperformed only by the costliest and biggest of the top giants and horn systems. You actually have to think in terms of systems about double its cost, or more, to find speakers that surpass it at the low end—and then, they do so only by a few notes around the 20 Hz to 25 Hz region, or by what may be called an almost "subsonic feel" that is perceptible only on some program material. As for stereo spread and depth, no pair of speaker systems I've yet installed managed to create a more convincing and pleasing panorama of sound without the aid of center-fill or surround speakers to augment the presentation.

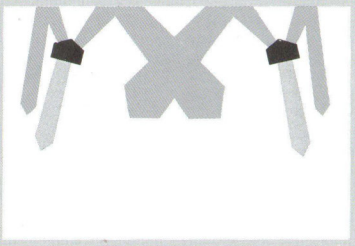
I did not attempt to push the 901 to its theoretical limit of 270 watts power-handling capacity (this figure is based on a 30-watt rating for each of the nine drivers in one enclosure), but I did run it from a 50-watt-per-channel amp. At louder than normal levels and with the equalizer contour set to deliver flat response, I found that the bass line held up firmly and cleanly to 40 Hz. Then—with some slight doubling that was considerably less than on most speaker systems and which did not increase as frequency was lowered—it continued strongly and with remarkable linearity to 26 Hz. By reducing the input level just slightly, to a more normal listening level, I found the 901 responded down to 23 Hz. The middles and highs were exceptionally smooth, clean, and strong, showing virtually no directional effects. A 10-kHz tone could be heard in another room; 13 kHz was audible fairly well off axis;

© beim Hersteller Archiv Michael Otto

The Bose speaker system uses sound coming off the walls to help create superior stereo out front. First diagram shows normal amount of left and right channel sound with center mix. Next, angling speakers inward throws more sound to sides, emphasizes separation. Last sketch shows how more mix and less separation result when speakers are toed outward.

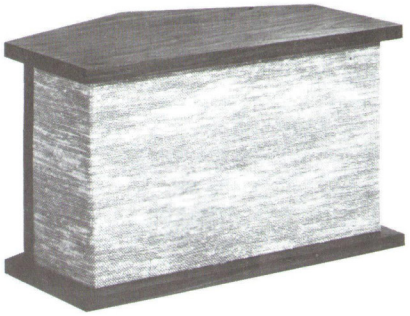






© beim Hersteller
Archiv Michael Otto

Reprinted from ELEMENTARY ELECTRONICS, Sept. '69



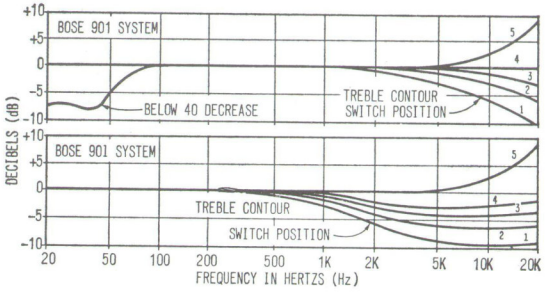
BOSE Model 901 Direct/Reflecting Speaker System

Audio engineers generally acknowledge that speaker systems are the weak link in the chain of components encompassing hi-fi reproducing systems. Amplifiers, preamps, recordings, have all benefited from state-of-the-art developments employing solid-state devices, but speaker design has followed the same basic concept since the introduction of the dynamic reproducer.

Many design engineers have attempted to overcome the inherent weaknesses of the moving coil reproducer. By novel applications of mechanical, electrical, and acoustical principles in combination they attempt to produce a speaker system that sounds like the original vocal, solo instrument, or orchestral rendition.

Hi-fi enthusiasts spend hours, even weeks or months in selecting a speaker system that pleases them. As a result, they are convinced that there really is little possibility that a new system will be developed that can provide cleaner, more realistic reproduction of sound. To correct for the deficiencies in speaker systems, amplifiers have been provided with unique compensating circuits that provide boost and/or cut at both high and low ends and sometimes in the mid-range of the audio spectrum. All of these circuits add to the cost of the amplifier.

Design Considerations. The recently introduced Bose 901 speaker system appears to have met the challenge. The Bose 901 is a product resulting from extensive research that disclosed many basic considerations to be taken in designing a speaker system. Among them are: a) correct balance between reflected and direct sound radiation: b) a means to overcome conflicts created by inherent resonances of speaker mechanisms and speaker housings; c) a new technique in the measurement of speakers, resulting in new standards for design, taking into account environmental conditions in which the speaker system will be operated; d) a new approach to the equalization of the signal driving the speaker to correct for deviations in frequency response created by



Curves supplied by manufacturer show various treble contours possible with Bose 901 speaker system and its equalizer. In upper graph, treble level switch is in normal position; in lower graph, switch is in decrease position.

mechanical design limitations; e) elimination of cross-over networks because of their inherent inability to effectively control amplitude and phase of the acoustic output in the crossover region, be they active or passive; f) a means to provide smooth, continuous acoustical blending of stereo channels without the necessity for a center speaker; and g) a means of eliminating standing waves that can affect frequency response.

Adapting Design Research. The Bose 901 system is comprised of two speaker enclosures, each pentagonal in shape, 12¾ x 20 9/16 x 12⅞-in. (HWD), and each containing nine 4-in. speakers. In addition, the system is furnished with an active equalizer that is inserted between the preamp and the power amp.

The form of the housing was developed for reasons other than to make a speaker having a different shape than those which are now popular. Two rear baffles are joined at an angle of 120° to establish a proper reflective angle off the wall of the room in which the speakers are operating. Because of this angular placement and the large ratio (8 to 1) of radiated sound, achieved by employing eight speakers on the rear angled baffles and one facing forward on the front baffle, there is uniform dispersion throughout the room without a "hole" in the center.

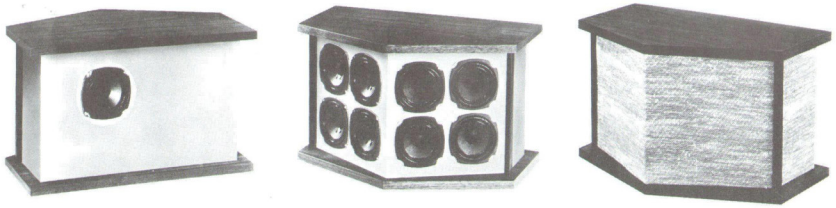
For listeners, this creates the illusion of being in a concert hall with a full orchestra spread across a stage. It removes completely the necessity of having the listener located directly on the axis of the speakers in order to enjoy the full high frequency response of the system. To create the concert hall illusion, the speaker housings must be placed 8 to 20-in. from the wall (12-in. is ideal average) to take advantage of the reflective wall surface that was calculated in the overall system design.

Also, the enclosures are shaped in pentagons to ensure that there are no surfaces parallel to the speakers, thus avoiding standing waves.

By placing eight speakers closely spaced on the rear baffles, acoustic coupling creates a resonant frequency for each speaker that will be different from that of every other speaker. The end result will be that each resonance becomes inaudible because it changes the output of just one of many speakers in the system. Thus, the distortion of sound that is caused by resonances in conventional systems is eliminated by using many speakers, each being driven by the same signal. This, in fact, is the principal reason for the improved clarity and definition of reproduction from the Bose 901, as compared to other speaker systems.

Excellent Bass Response. To solve the problem of wide response with good bass reproduction, designers have always used as large a speaker as possible for reproducing lows, along with smaller speakers to reproduce mid range and highs. In addition, they have employed a passive crossover network to route the appropriate frequency segment to a specific speaker. At best, these networks contribute appreciably to the overall distortion of the complete system. Despite the distortion effects of this combination on the response curve of such a speaker system, it appeared to be the only feasible method of covering the full audio range with dynamic speakers.

Bose, however, developed special techniques, requiring many hours of precision measurements of room characteristics along with computer analysis of taped performances, to prove that multiple small speakers can reproduce the same range as with single large speakers with no resonances or distortion. Bose employs a total of nine 4-in.



Left, view of front and (center) view of back of Bose 901 with grille cloth removed (note that unit has eight speakers in rear, only one in front). Right, view of rear of unit with grille cloth in place.

© beim Hersteller Archiv Michael Otto

Bose Lab Check
Continued

special, long excursion, high compliance cone, wide range speakers in each pentagonal housing. Arranged in an in-phase array these can move large amounts of air, which, along with the special equalizer, accounts for the spectacular bass and clean mid and high range response of the 901 system.

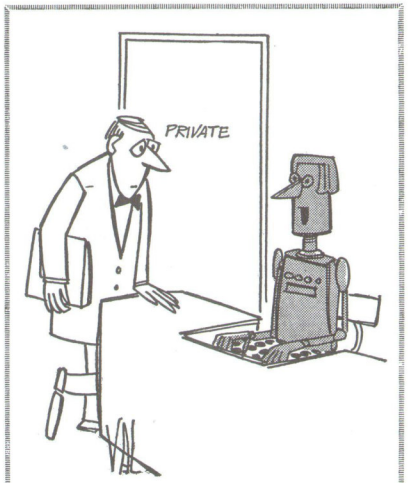
High Power Capacity. Since each of the nine speakers individually can handle 30 watts of audio power, the complete system is capable of operating at very high power levels (upwards of 270 watts), that may be required to reproduce low frequencies of sufficient loudness. Bose recommends that amplifiers having a minimum of 20 watts power output be used. This is necessary to overcome the losses created by the equalizer and still have sufficient power output to recreate the dynamic range necessary to produce the illusion of natural reproduction.

The Active Filter. Regardless of the design of any speaker system, its overall performance can be improved somewhat by the application of correctly designed electronic networks that compensate for its variations from a uniform frequency response. Because it is impractical to equalize for variations created by resonances, speaker systems have suffered. However, since the Bose 901 speaker has been designed to be virtually free of resonance effects, the active equalizer that is part of this speaker system, produces uniformity of radiated power vs frequency not attainable in other commercially available speaker systems. This equalizer is a sophisticated, transistorized, active unit that accurately compensates stereo response for the effects of speaker characteristics, enclosure dimensions, radiation impedances and even the grille cloth covering the baffles. Equalization is accomplished without introducing distortion. This is achieved by equalizing the signal between the preamp and the power amplifier which, therefore, removes the necessity of employing the iron core inducers and capacitors capable of handling high power, that introduce distortion in passive filters. Further to this, it is possible to get a greater degree of accuracy in equalization by the use of more elements in an active filter than is practical in a passive one.

Tailoring Response. Besides affording the compensation required to produce flat acoustic response, this equalizer provides a selection of nineteen additional contours, selectable from the front panel of the equalizer. This flexibility of control of equalization permits the listener to tailor the response to meet his particular tastes in compensating for room characteristics, recording techniques, and other variables. A separate switch produces steep, uniform attenuation below 40 Hz to remove turntable rumble without affecting bass response from 50 Hz on.

Conclusion. The Bose 901 speaker system delivers the most natural stereo sound, creating the illusion of being in a concert hall, with a uniformity of frequency response and freedom from distortion that is unbelievable, particularly if the listener takes into account the physical size. Considering all its advantages, the price tag of just under $500.00 for the complete system, which includes two speaker assemblies and the active equalizer, is modest. It is our opinion that this is the speaker system to own, regardless of price, if one wants the ultimate in listening pleasure.

For further information and literature, write The Bose Corp., Dept. E, Natick, Mass. 01760

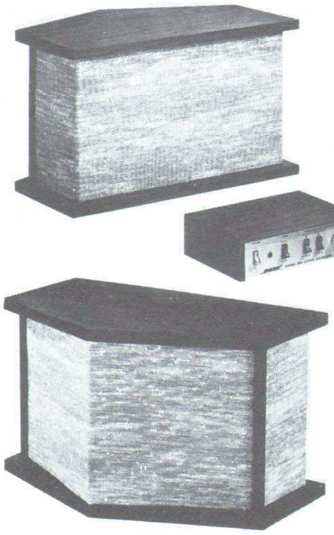


"That's very flattering, but according to our calculations you tell that to two out of three secretaries."

© beim Hersteller Archiv Michael Otto

SOUND IDEAS

An Equipment Review **By LARRY ZIDE**



Bose 901 Speaker System

THERE IS a great deal of advance interest in this report—and not without reason, as you will see.

Bose is a relatively new company, and the 901 is its one and only product. This is a "system" in every sense of the word, because the model number actually includes two speaker units plus an electronic control that goes between your preamp and amp. (It can also be hooked up to the tape monitoring circuits, and will provide switching for a tape recorder in addition to fulfilling its own primary functions. More about these presently.)

The two speaker enclosures are marked for left and right channels. At first glance you might think that they are meant for corner placement only, though this is hardly the case. They are not very large—only about 19″ wide across the flat front and 13″ deep.

Yet inside each box are nine small high-quality speakers! Eight face the rear, via the two faces of the pointed side. The ninth faces forward, in the upper left of the left speaker and upper right of the right speaker. The frequency spectrum and strength are divided among the speakers so that each gets fundamentally the same. The enclosure is intended to be free-standing, some distance from a wall. The eight rear speakers act as dispersers, serving mostly to reflect sound from the wall. Only the ninth or forward speaker localizes sound, in particular for the poorly-reflected highs. The net effect is intended to be an impression of wide sound dispersion over a broad plane (as in a concert hall) which nevertheless preserves the localizing information of stereo.

It works!

The Bose 901 is, indeed, one of the finest speaker systems it has ever been my pleasure to hear. I have lived with it now for several months, so that I am quite sure of what I say. I have long believed in the value of wide sound dispersion, and this system amply provides it.

Dispersion notwithstanding, it is the sound itself that remains paramount. The 901 is characteristically smooth. Everything is simply *there*. At high frequencies the ear indeed tells you that the frequency is there, but you do not have any "beaming" effect as with direct radiators. The bass is smooth down to my room's resonance at 34 Hz, with a smooth rolloff below. And there is useful output to about 25 Hz, which is plenty low enough.

In part the 901 achieves its excellent bass response by means of a boost circuit in the control box. This places an enormous strain on a power amplifier of marginal power. And 60 watts may prove to be marginal! I would say that to use the Bose 901 at its full potential demands an amplifier that can provide at least 50 or 60 watts *at 50 Hz and below*. Less than that will cause you to hear some audible bass distortion (caused by the amplifier clipping) *at very high listening levels in large rooms*. In any case I think that so fine a speaker would be simply wasted on amplifiers that can provide only 20-25 watts per channel.

The control box provides a useful degree of speaker *tuning*. It does serve to compensate the speaker against room acoustics, but it will do more. If you have a bright (or dull) cartridge and a tape recorder that is flat, they will not sound alike with equally good material. The high-frequency control can be used to (subtly) boost or cut highs in such a way as to equalize a bright cartridge. I have used this to compare more accurately the relative sound of cartridges, and it *is* effective.

But back to the sonic quality per se. I would have expected that all this reflected sound might have a bad effect on the sharpness of transients. Not so. The 901 is quite crisp in its attacks. When the music stops, so does the speaker.

But you really have to hear music from the best sources (such as master tapes) to appreciate all the virtues of this extraordinary system. True, at a price of $476.00 for the pair its virtues may not be for everyone. And perhaps I have failed (I suspect that I *have* failed) to give a clear picture of its special qualities. I urge that you listen for yourself. I think you will have to agree that Bose has, in a single giant step, produced one of the finest speaker systems ever made.

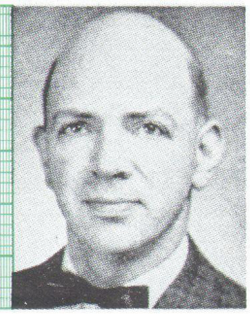
Reprinted from - the AMERICAN *record guide*

You can hear the difference now.

THE BOSE CORP.®

East Natick Industrial Park, Natick, Massachusetts 01760

TECHNICAL TALK

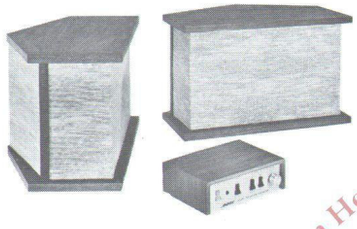


By JULIAN D. HIRSCH

EQUIPMENT TEST REPORTS

By Hirsch-Houck Laboratories

BOSE 901 STEREO SPEAKER SYSTEM



● DEPENDING on one's viewpoint, the Bose 901 speaker system might be considered a revolutionary approach to sound reproduction, or simply a workable combination of well-established (and sometimes deprecated) techniques. The Bose 901 enclosures house nine small, specially designed drivers that have 4-inch cones and powerful magnetic structures. Eight of the drivers are angled to the rear, while the ninth is mounted on the front of the enclosure facing the listening area. This arrangement is intended to achieve approximately the same ratio of direct to reflected sound that exists in the concert hall.

The 901's cabinets are quite compact, measuring 12¾ inches high by 20⁹⁄₁₆ inches wide when viewed from the front. Seen from the top, the rear of the enclosure forms a "V" of about 120 degrees. Basic to its operation is the requirement that it be mounted with the "V" facing the wall, the apex being about 12 inches from the wall. When a pair of 901's are so installed, the sound appears to be uniformly distributed across the wall between the speakers completely free of any "hole-in-the-middle" effect. Since only 11 per cent of the sound is radiated directly forward, it is almost impossible to localize the source.

An intrinsic part of the Bose 901 system is an active (ten-transistor) equalizer that handles both channels; it compensates for the high-frequency losses inherent in the reflecting process and also flattens out the bass response. (The uncompensated bass response is down because of the natural bass roll-off resulting from the very small volume of the enclosure.) Housed in a walnut cabinet 2¹³⁄₁₆ inches high by 9¼ inches wide and 6¾ inches deep, this self-powered equalizer unit is connected either between the preamplifier and power amplifier or in the tape-monitoring signal path of the amplifier or receiver. In the latter case, the amplifier's tape-monitor switch is left set to TAPE. So that the tape-monitor function would not be lost, Bose has built it into the equalizer. A tape recorder can be connected to the equalizer and the usual monitoring switching performed through it.

There are five controls on the equalizer, four rocker switches and one five-position rotary control. One rocker serves as an on-off switch, another as the tape-monitor switch, and the third as a low-cut filter that primarily affects frequencies below 40 Hz. This is intended to reduce rumble or acoustic feedback. The fourth rocker switch interacts with a rotary five-position treble-contour control. When the rocker switch is set for NORMAL, the rotary switch provides a boost position, a flat position, and three positions of decreasing high-frequency response from the speakers. When the rocker switch is set for TREBLE DECREASE, it introduces a depression in the response between 2,000 and 6,000 Hz. The five switched contours then not only affect the very-high-frequency speaker performance, but also the frequencies between 500 and 2,000 Hz that are not affected with the rocker switch in its NORMAL position. In all, ten different high-frequency/mid-range response contours are available.

For those who have well-trained hearing and musical judgment—plus the urge to tinker—it is possible to correct for poor recordings to a remarkable degree with the equalizer controls. Most people will probably prefer to leave them in their NORMAL settings.

The active equalizer introduces no perceptible distortion. We measured its distortion at less than 0.13 per cent for any output under 3 volts, which is greater than would be required with any amplifier we know of. The output signal is of approximately the same level as the input signal.

In the August, 1968 *Technical Talk* column, I commented on the difficulty of describing speaker performance in purely objective terms. The Bose 901 is a perfect illustration of this problem. After a couple of months of living with a Bose 901 system, I am convinced that it ranks with a handful of the finest home speaker systems of all time. Because of its unconventional mode of operation, I rather doubted that any frequency-response measurements I could make would account for the remarkable realism of its sound. Difficult as it is to measure the output of a single direct radiator in a normal living room, it is well-nigh impossible to measure an almost perfectly dispersed sound pattern such as that of the 901 without strong influence

© Beim Hersteller Archiv Michael Otto

from the effects of room acoustics. Nevertheless, a measurement was attempted.

We placed the speaker in the recommended position relative to the wall. We did not have the equalizer in the signal path for our frequency-response and tone-burst measurements, but measured the equalizer response separately and added it to the speaker response to obtain the final curve. Ten microphone positions were used, and their readings averaged. Harmonic distortion was measured at a 1-watt drive level with the equalizer installed.

It was no surprise to find that the final response curve was not as flat as some we have measured. There appeared to be a broad rise of about 5 or 6 dB in the 130- to 250-Hz region, although we could not detect its presence by ear. The output fell smoothly above 1,000 Hz to −7 dB at 6,000 Hz, then rose to the 1,000-Hz reference level between 10,000 and 15,000 Hz.

The low-frequency harmonic-distortion measurements were affected by the speaker and microphone placement. The distortion was 7 per cent at 20 Hz, and reached maximums of 12 per cent at 30 Hz and 10 per cent at 50 Hz. It was considerably lower at other frequencies in the bass range. (As a point of reference, the better acoustic-suspension speakers have about half as much measured distortion at similar drive levels.)

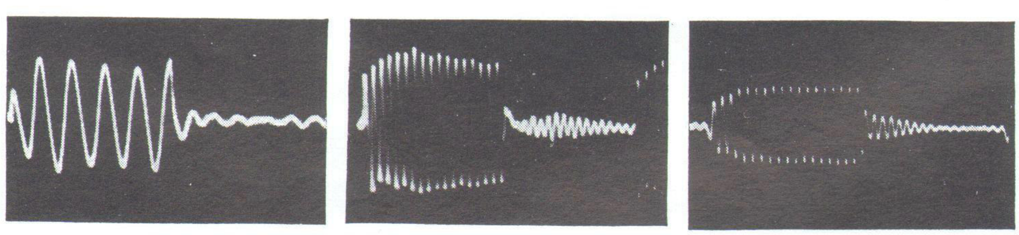
We listened to the Bose 901 in several listening rooms which ranged acoustically from extremely hard and bright to quite dull. It was compared in A-B tests with several of the better speaker systems at our disposal. The Bose 901 had an utterly clean, transparent, and effortless sound. Its clarity and definition when reproducing complex orchestral passages were, in the writer's opinion, unsurpassed by any other speaker he has heard. This impression was confirmed by its tone-burst response, which was uniformly excellent across the frequency spectrum. Its low-bass response was difficult to credit to such a compact system. It had all the room-filling potency of the best acoustic-suspension systems, combined with the tautness and clarity of a full-range electrostatic speaker. The spatial distribution, which brings an entire wall alive with sound, contributes greatly to the sense of realism.

There is, unfortunately, a serious obstacle to the universal acceptance of a speaker such as the Bose 901. The 12-inch gap necessary between the apex of the speaker and the wall places the front of the speaker about 30 inches from the wall. Bookshelf mounting is generally impractical, and it may be difficult to install the 901 in the correct location without disturbing room decor. Many potential users will be forced to decide between style and sound.

Electrically, the Bose 901 is rather inefficient, and the 18 dB of bass boost supplied by the equalizer requires huge reserves of amplifier power if loud low-frequency passages are to be played. To a lesser degree, the same problem exists at the very high frequencies. Bose recommends amplifier power ratings from 20 to 200 watts per channel, into 8 ohms. We have used it successfully with amplifiers at both ends of this range. Unlike most speakers, the 901 sounds as good at a whisper as it does at a roar, but if you are ever tempted to turn up the volume a bit, an amplifier with a continuous power rating of at least 60 watts per channel is strongly recommended. A possible compromise is to use the "below 40 Hz" roll-off in the equalizer, which reduces low-frequency peak-power requirements by 8 dB and has little audible effect. Incidentally, don't worry about overloading the 901. The individual drivers can each handle 30 watts without difficulty, and few of us are likely to be able to apply more than 270 watts to each channel.

In the final analysis, the judgment of a speaker must be subjective and personal in nature. I have, on occasion, warmly praised speakers that I considered to be outstanding performers. Everything I have said in the past is still valid. Nevertheless, at this moment, I must say that I have never heard a speaker system in my own home which could surpass, or even equal, the Bose 901 for overall "realism" of sound. My partner, Gladden Houck, concurs to the extent that he considers it a very fine system, certainly the equal of anything at or near its price. The Bose 901 system, consisting of two speaker units and the equalizer, is priced at $476.

The uniformly excellent tone-burst response of the Bose 901 is illustrated by the oscilloscope photos of tone-bursts at (left to right) 130, 1,000, and 9,500 Hz.



HiFi-LAUTSPRECHER

Musik wie noch nie

Im Sommer 1970 tauchte auf dem westdeutschen Hi Fi- und Phono-Markt erstmals eine Lautsprecheranlage auf, deren äußere Form ebenso ungewöhnlich war wie die Geschichte ihrer technischen Entwicklung: das Bose 901 Direct/Reflecting-Lautsprechersystem. Dieses Wortungetüm drückt bereits einen prinzipiellen Unterschied zu den herkömmlichen Lautsprecher-Anlagen aus: die direkte und indirekte Tonabstrahlung, wie sie auch im Konzertsaal erfolgt.

Angefangen hatte alles mit dem Mißvergnügen des US-Physikers Bose, Professor am Massachusetts Institute of Technology (MIT) in Cambridge bei Boston, an seiner eigenen Stereo-Anlage.

Bose-Lautsprecher 901 mit Equalizer

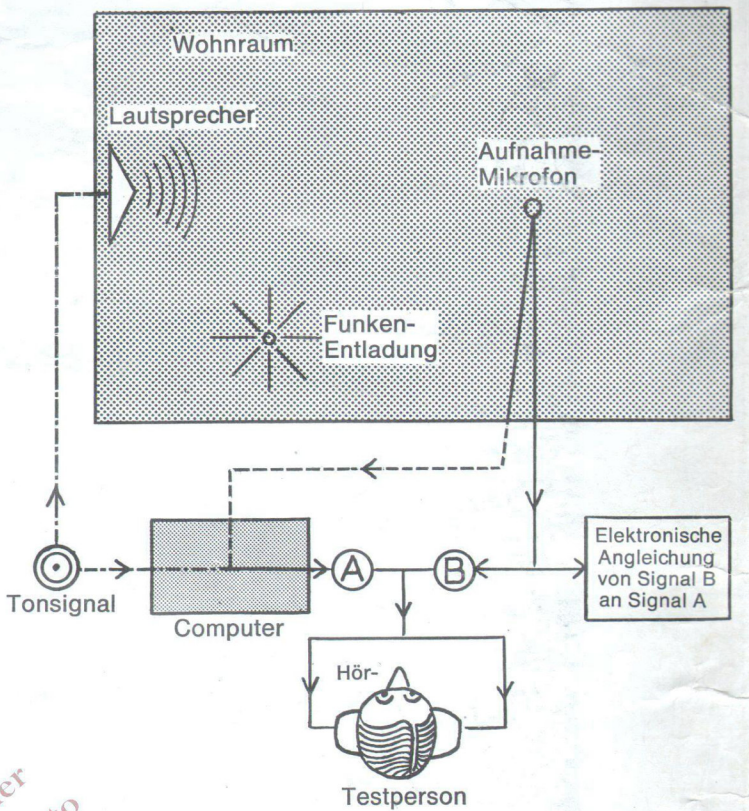
Das schwächste Glied in der akustischen Wiedergabe-Technik bilden heute die Lautsprecher. Herkömmliche Anlagen versuchen mit Tief-, Mittel- und Hochtonlautsprechern und deren Koppelung über Frequenzweichen den Frequenzgang einigermaßen zu begradigen, ohne dadurch jedoch die entscheidenden Resonanzen in den zusammengekoppelten Frequenzkurven beseitigen zu können, die die eigentlichen Verzerrungen im Klangbild und die für jedes System typische „Klangfarbe" verursachen.

Einen wesentlichen Fortschritt in der 12jährigen Forschung Prof. Boses und seines Teams bildete die Entdeckung, daß die Zusammenschaltung einer Reihe identischer Breitbandsysteme durch akustische Koppelung zu jenem glatten Frequenzgang ohne Resonanzen führt, der die Voraussetzung für eine naturgetreue Tonwiedergabe ist.

Schallmessungen in Konzertsälen ergaben weiterhin, daß der Anteil der direkt und indirekt empfangenen Schallwellen für den Hörer überall konstant ist und genau 11 direkte und 89 indirekte Anteile hat – wobei die indirekten Schallwellen nicht identisch sind mit dem Nachhall-Effekt, der in jedem Konzertsaal anders ist. Dieser Nachhall kann auf jeder Tonaufnahme mit eingefangen werden und ist sogar beliebig manipulierbar. Der eigentliche Konzertsaal-Effekt, der durch die vielfachen Brechungen der Schallsignale mit den verschiedenen Einfallswinkeln zum Zuhörer entsteht, läßt sich jedoch aufnahmetechnisch nicht reproduzieren, da Aufnahmemikrofone nur einen Ausschnitt des Energie-Spektrums einfangen können und stets eine bestimmte Richtcharakteristik aufweisen, die der Hörphysiologie des menschlichen Kopfes nicht gerecht wird. Konventionelle Lautsprecher sind aufgrund der direkten Tonabstrahlung ebenfalls nicht in der Lage, diesen hörphysiologisch wichtigen Aspekt zu reproduzieren bzw. zu simulieren. Das gelang erst mit dem Direct/Reflecting-System.

Durch entsprechende Anordnung von neun solchen akustisch gekoppelten Breitbandlautsprechern in je einem fünfseitigen Chassis und deren freie Aufstellung vor einer reflektierenden Wand gelang es, das mathematische Verhältnis der direkten und indirekten Tonabstrahlung von 11:89 des Konzertsaales wiederherzustellen und vor allem den akustischen Effekt der vollen Stereoperspektive auch voll auf jeden Hörraum zu übertragen. Es gibt also für den Zuhörer nicht mehr wie bisher eine „ideale Stereo-Position" mit anschließender Genickstarre, noch das berühmte „Loch" zwischen den beiden Boxen.

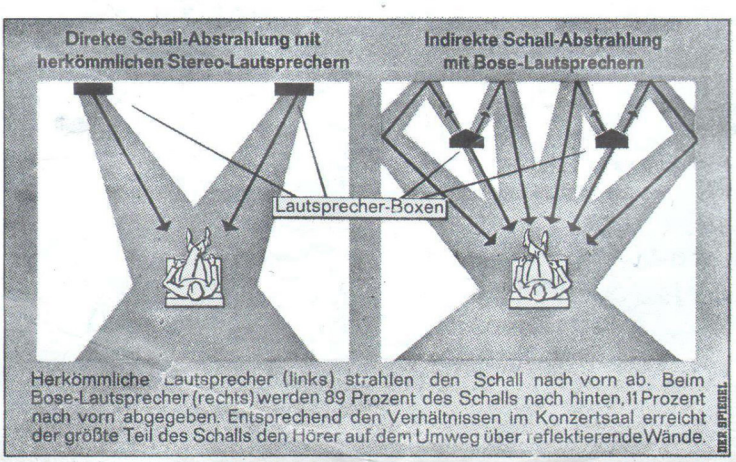
Eine weitere Quelle akustischer Verfärbungen und Verzerrungen bilden die Schall-Charakteristiken der Aufnahmebedingungen und der Wiedergabe-Charakteristik des Hörraumes. Um dieses komplexe Problem, das mit der Hörphysiologie des Menschen zusammenhängt, naturwissenschaftlich-technisch in den Griff zu bekommen, waren langwierige Hörexperimente mit zahlreichen Testpersonen erforderlich. Ziel war, alle möglichen akustischen Signal-Kombinationen so durch technisch-elektronische Eingriffe zu verändern, daß alle in der Übertragungskette von Tonquelle zum Hörer auftretenden tonverändernden Faktoren neutralisiert wurden.



Mit Hilfe des resonanzfreien Signals der elektrischen Funkentladung (zur Simulierung des idealen Lautsprechers) wurden zunächst die akustischen Veränderungen des Signals bei der Wiedergabe in einem normalen Wohn- und Hörraum in 4000 Messungen ermittelt und elektronisch gespeichert. Aufgrund dieser Meßdaten wurden nun die verschiedensten Musikprogramme so „verzerrt", daß sie genau den akustischen Eigenschaften im Raum entsprachen; zwei Millionen Rechenoperationen pro Sekunde Musikprogramm waren hierzu erforderlich. Solchermaßen korrigierte akustische Signal-Kombinationen (Signal A) waren nun von den Testpersonen zu vergleichen mit solchen Signalen ohne Programmierung, die zuvor jedoch den technischen Hindernislauf genommen hatten über Bose-Lautsprecher im Hörraum, dort Aufnahme von einem Mikrofon und dann erst als Signal B zum Ohr der Testpersonen gelangten. Diese Signale B wurden nunmehr durch elektronische „Verzerrung" in Hörvergleichen den bereinigten Signaltönen A angeglichen. Das so gewonnene neue Computer-Programm für die Musikwiedergabe ist Inhalt eines zu jedem Bose-System gehörenden elektronischen Klangreglers („Equalizer"), der zwischen Vor- und Endverstärker jeder Stereo-Anlage geschaltet wird und an jede herkömmliche Anlage paßt, die der internationalen Norm entspricht.

Das Resultat dieser wissenschaftlichen und technischen Arbeiten ist für den Hörer geradezu überwältigend. Es verbietet sich der Vergleich zu gewohnten Anlagen, den der Berichterstatter jedoch selbst anstellen konnte. Man sollte getrost alles vergessen, was man bisher als Maßstab für die Wiedergabequalität von Hi Fi-Lautsprechersystemen gewohnt war. Klassische Grenzfälle der musikalischen Klangwelt, wie etwa die Introduktion zu „Also sprach Zarathustra" von Richard Strauss, die Orgel-Sinfonie in C-Dur von Camille Saint-Saëns oder im Bereich der Pop-Musik von Emerson, Lake & Plamer repräsentiert, sonst kaum hörbar zu machen, bleiben echt und unverfälscht in ihrer natürlichen Klangcharakteristik erhalten. Eigenresonanzen gibt es selbst bei extremer Belastung nicht, die bei unglaublichen 270 Watt für Musik- und Sprachwiedergabe liegt.

So viel Forschung und Technik wäre jedoch unbezahlbar, wenn sie nicht als Nebenprodukt von Arbeiten des Bose-Teams für die US-Air Force von dieser mitfinanziert worden wäre und die Benutzung des MIT-Computers dadurch nichts kostete, weil man ihn nachts benutzte. Auf diese Weise liegt der Preis für dieses technische Musikwunder in Deutschland jetzt unter zweitausend Mark und ist damit gegenüber konventionellen Anlagen sogar als preiswert zu bezeichnen. -ra-



Herkömmliche Lautsprecher (links) strahlen den Schall nach vorn ab. Beim Bose-Lautsprecher (rechts) werden 89 Prozent des Schalls nach hinten, 11 Prozent nach vorn abgegeben. Entsprechend den Verhältnissen im Konzertsaal erreicht der größte Teil des Schalls den Hörer auf dem Umweg über reflektierende Wände.

© beim Autor/Archiv Michael Otto