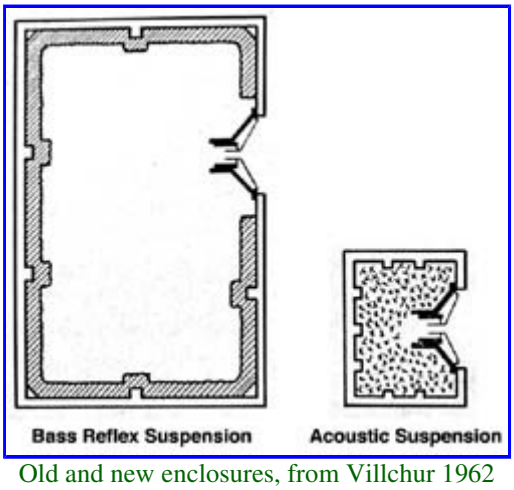
Edgar Villchur and the Acoustic Suspension Loudspeaker

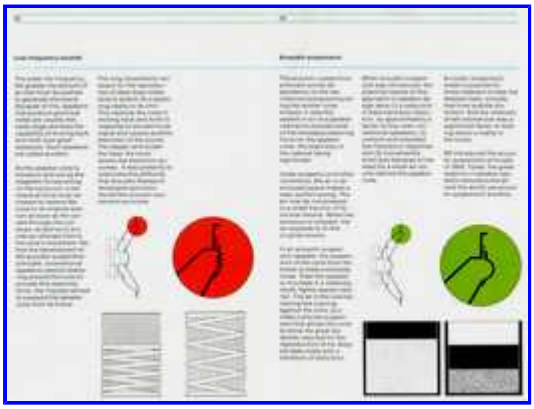
The AR-3 on display in the Smithsonian Information Age exhibit

Edgar M. Villchur earned his Masters in Education degree at The City College of New York and was a writer and teacher at NYU in 1954 when he discovered a new design for loudspeakers. After the Rice-Kellogg specifications of 1925, dynamic speakers had become large and boxy in order to reproduce low frequencies. A bass speaker capable of a 40 Hz tone was very large, more suitable for motion picture theaters than for home phonograph systems. The hi-fi market was starting to expand in the early 1950s, with new sensitive pickups and amplifiers capable of reproducing the full dynamic range of the new LP record. But speaker designers were still struggling with the problem of extended, low-distortion bass. Villchur decided to try a radical new approach: "Instead of making one more attempt to unravel the Gordian knot, I cut it. I used a different kind of elastic restoring force, one derived from an air spring, instead of the mechanical springs of the suspensions. This turned out to be not too difficult - after all, the speaker has a cabinet which encloses a cushion of elastic air. All I needed to do was to decimate the springy stiffness of the speaker suspensions, and reduce the size of the enclosure until the air spring was strong enough to replace the mechanical springs that we threw away. It also turned out that within the compressions and rarefactions that this air spring would undergo, the response was almost perfectly linear. Thus, the acoustic suspension loudspeaker is an obvious and simple system. You are merely substituting an essentially linear air spring for a nonlinear set of mechanical springs." (Birchall 1993)

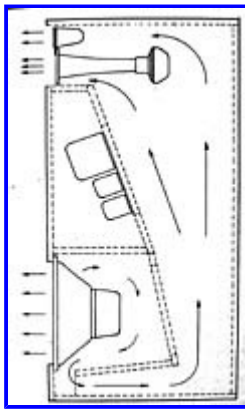
Edgar Villchur in lab ca. 1965



Old and new enclosures, from Villchur 1962



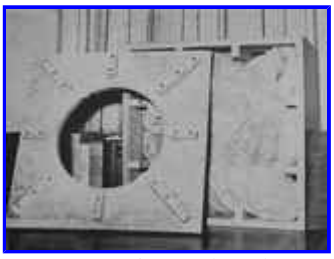
AR catalog 1974 explaining acoustic suspension



"A Laboratory Reference Standard Loudspeaker System" by Plach and Williams, old-style speaker was 52 inches high, from *Audio,* Oct. 1954, p. 84 and p. 85

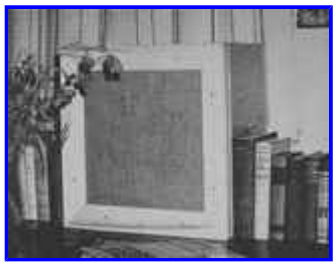
Villchur used two standard 12-inch Western Electric loudspeakers in designing his new enclosure. "I cut away part of the spider of one of them, making it more compliant. I also cut away the entire rim suspension and replaced it with a suspension made of mattress cover material (bacause it is very compliant, and adequately impervious to air). My wife, Rosemary, had worked as a draftsperson

during WWII. With those skills, she was able to project my sketch of the three dimensional suspension to the correct pattern on the mattress material so that I could cut it out and form it to the shape I needed. I mounted the second Western Electric speaker on a baffle at the head of an enclosed stairway, so I could compare the performance of my acoustic suspension system with an enclosure volume of two cubic feet against and infinite baffle system with well over 100 cubic feet. The acoustic suspension system was substantially superior in fulness of bass, and especially in lack of distortion." (Birchall 1993)



AR-1 "experimental enclosure, showing Fiberglas made up in cheesecloth-covered 'pillows.' The enclosed volume of air rather than mechanical suspensions, supplies elastic restoring force to the special 12-inch speaker.", in *Audio,* Oct. 1954

AR-1 ad on page 85 of *Audio,* Oct. 1954 emphasizing small dimenstions and ability to reproduce organ tones, for $185



AR-1 "assembled experimental speaker and enclosure", in *Audio,* Oct. 1954

Villchur took his new design to two speak manufacturers but they were not interested. One of his former students, Henry Kloss, was interested. Previously, Villchur believed that creating a commercial product would require the resources of a major loudspeaker manufacturer. "After these two rebuffs, and in particular the nature of the rebuffs, I changed my mind," said Villchur. In the spring of 1954, Villchur drove Kloss up to his lab in Woodstock, describing the theory of his new design along the way. After they arrived, Villchur played some recordings, including an E. Power Biggs LP with copious low-frequency content. After hearing it, Kloss exclaimed, "That's it!" and offered the use of his Cambridge loft to manufacture acoustic suspension loudspeakers. "And thus, AR was born," observed Villchur." (Birchall 1993)

Earliest known AR-1 from 1954, serial number 0074

AR ad ca. 1957

AR-3 from 1963

Acoustic Research in Cambridge started with $4000 that Kloss raised from his friends, plus $2000 from Villchur. Since they didn't have the capitalization to hire a production engineer to convert the prototype into a production model, Kloss worked out the details. "Henry was responsible for at least 75 percent of the production design of the AR-1. The rest was done by me and by Tony Hoffman, a physicist friend of Henry." They assembled several AR-1 loudspeakers in time for the New York Audio Show in September 1954. Although the critics were impressed with the clean 32-Hz organ pedal tones that the AR-1 could reproduce, they did not quite get the point. "One critic commented,'

If your space is limited and you're looking for a small speaker, you should consider the AR-1 very seriously. It's a fine speaker - for its size.' Julian Hirsch, who at the time published the Audio League Report, wrote that 'the AR-1 had the lowest electroacoustic efficiency of any loudspeaker on the market - but at 25 Hz and below, it was more efficient that the Klipschorn, which had the highest efficiency of any speaker on the market.' Hirsch also said that the AR-1 'established a new industry standard for low distortion bass.' Eventually, the industry began to realize that the smaller size of the cabinet was only a secondary advantage of the extended bass response." (Birchall 1993)

The acoustic suspension speaker of Edgar Villchur has been considered one of the five most important speaker designs since the Rice-Kellog dynamic speaker of 1925. "What really caught the public fancy, however, was the fact that the original Acoustic Research AR-1 was a small loudspeaker system having essentially flat low-frequency response to below the 40-Hz region. Other manufacturers were quick to point out that the AR-1 gobbled up about 10 times the electrical power needed by larger, more efficient systems. With 50- and 60-watt amplifiers becoming available, this turned out not to be a major drawback, and the trend toward smaller, less-efficient home loudspeaker systems was firmly established." (Augspurger 1987)

AR-2 loudspeaker ad with press comments, from *Audio,* Oct. 1958

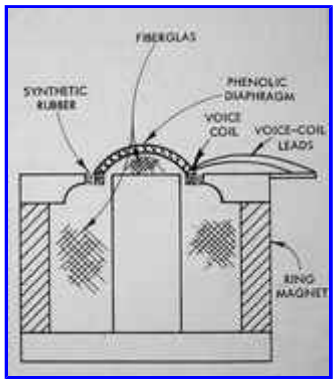

AR-2 loudspeaker ad, from *Audio,* Oct. 1958

AR-2 loudspeaker ad with picture of "Louis Armstrong in his den, editing tape (Note his AR-2 loudspeaker at the left)" from *Audio,* Oct. 1958

Villchur lowered the cost of his speaker with the $89 AR-2 model introduced in 1956. The use of this small inexpensive speaker by such notables as Louis Armstrong was featured in AR's advertising. By 1958, Villchur added a new tweeter to the AR-3. "The dome tweeter was Villchur's answer to the problems of high frequency dispersion. 'When you are listening to a loudspeaker in a normally reverberant room, and that loudspeaker has excellent on-axis high-frequency response but depressed off-axis response, the loudspeaker will sound dull in any listening position in the room, including one directly on-axis, because the major part of the sound you hear is that reflected from the walls, floor and ceiling. Putting a dispersing lens in front of the driver doesn't help much because there isn't enough high-frequency energy to disperse. The secret of high-frequency dispersion can be stated in two words: small size. Shrinking a cone tweeter to a small size doesn't help because the voice coil becomes too small to handle any appreciable amount of power. I placed my voice coil at the large diameter of the diaphragm. When you do that, the shape of the diaphragm emerges almost naturally as a dome. That has the further advantage of making unnecessary a second suspension, and it also greatly facilitates solution of the other problems (irregular frequency response and response at the extreme high frequencies). Some years later, Roy Allison improved the dome tweeter by making one with a pulsating motion.'" (Birchall 1993)

AR-3 loudspeaker "2-inch and 1-3/8 inch tweeters, unmounted," from *Audio,* Oct. 1958

"Prototype of AR-3 speaker system, including AR-1 acoustic suspension woofer and the two tweeters described in this article," from *Audio,* Oct. 1958



AR-3 loudspeaker drawing of dome tweeter, from *Audio,* Oct. 1958

Villchur himself wrote most of the advertising copy and brochures for the company in the 1950s and 1960s, emphasizing facts and performance. This style of the 1960s ads continued in the 1970s ads. Villchur sponsored "live vs. recorded" concerts to demonstrate the accuracy and low distortion of his speakers. "He placed the musicians (the Fine Arts String Quartet, among others) on the stage, with a pair of AR-3 loudspeakers behind them. At various points, they would stop playing and the taped performance would take over. Most reviewers of the day could not tell the difference between the live and recorded sound. 'I thought these concerts defined what we meant by high fidelity,' commented Villchur. He took care to use the best equipment possible at the time, including an Ampex tape deck, two 60-watt Dynakit amplifiers, and number 18 zip cord." (Birchall 1993)

The Fine Arts Quartet preparing outdoors in Woodstock NY in 1963 for the landmark Live vs. Recorded sessions. Seated are Leonard Sorkin and Abram Loft, violins; Irving Ulmer, viola; George Sopkia, cello. Standing from the left are Eduardo Chavez, friend; Edgar Villchur; Roy Allison; Sunny Trankler, secretary to Villchur.

live vs recorded press

Fine Arts Quartet

Connoisseur Society

New York's Town Hall

Villchur left AR in 1967 to establish the Foundation for Hearing Aid Research where he developed hearing aids with a system combining compression and equalization that were manufactured by the Resound Corporation. He was appointed a Visiting Scientist at the Massachusetts Institute of Technology and would write numerous articles and books on acoustics that would be published by professional journals of the ASA, IEEE and AES and reprinted by university presses. He continues

to live and work at his Foundation in Woodstock NY.

Edgar Villchur in Woodstock Aug. 1997

Villchur in Woodstock lab Aug. 1997

Tom Tyson, left, and Roy Allison 1997

Allison Acoustics was founded in 1974 after Rc Allison, Villchur's associa for many years, left AR 1972 upon completion of a year contract when Teledy purchased AR in 1967.

Sources:

- Augspurger, George L. "Theory, Ingenuity, and Wizadry in Speaker Design," *Audio,* April 1987 p. 51-55, originally published in *Journal of the Acoustical Society of America* 77, No. 4, April 1985, p. 1303-1308.
- Birchall, Steve. "Acoustic Suspension," *Journal of the Audio Engineering Society* 41, November 1993, p. 970-971.
- Rice, Chester W. and Edward W. Kellogg, "Notes on the Development of a New Type of Hornless Loudspeaker," *Transactions of the American Institute of Electrical Engineers* 44, 1925, p. 461-475.
- Villchur, Edgar M. "Revolutionary Loudspeaker and Enclosure," *Audio* 38, October 1954, p. 25-27, 100.
- Villchur, Edgar M. "New High-Frequency Speaker," *Audio* 42, October 1958, p. 38.
- Villchur, Edgar M. ***Reproduction of Sound in High-Fidelity and Stereo Phonographs,*** rev. ed. New York: Dover Publications, 1965; 1st published in Cambridge, Mass.: Acoustic Research, 1962.
- Villchur, Edgar M. "A Short History of the Dynamic Loudspeaker," *Voice Coil,* July 2000, p. 26-32, paper presented at the 133rd meeting, Acoustical Society of America, June 1997.
- Photos courtesy of Tom Tyson, unless otherwise credited.

Return to Recording Technology History | AR ads 1960s-1970s| Loudspeaker History| this page revised 4/12/08