AUDIO
MAY 1971 60c
The Authoritative Magazine About High Fidelity

Canby at Boston

Tuners and Receivers

Tuning With No Moving Parts
Constructing A 10-Watt Stereo System

Directory

A working musician talks about the new VM professionals.

Ron Steele's newest album is *Chicago*, for Ovation. He's a first call guitarist for artists like Ella Fitzgerald, Barbra Streisand, Nancy Wilson, Liza Minnelli, Dionne Warwick, and one of the best known behind-the-scenes musicians in films and TV.

"The sound is roomy. Good."

That's the real reason for power as big as ours. It gives sound spaciousness at normal levels.

"Man, no distortion. None!"

Less than 0.5% actually. That's because of the two new 5-pole phase linear toroidal filters in our IF stages. They achieve selectivity and distortion values far beyond crystal filters. It's permanent performance, too, because they're permanently aligned.

"You don't over-control. I like that."

Actually we have about all the controls imaginable. What professionals admire is the ability to get a "master tape" sound. It's possible because certain of our controls are cancellable—Loudness, Balance, and Treble/High filter.

"It's dead quiet. Beautiful."

Our tuner-amplifier is full of complicated electronic reasons for that. ICs in the IF and multiplex circuits, all silicon transistor and printed board circuitry, new 4-section front end with dual gate MOSFETs. We've about eliminated noise, wiped out cross modulation, and our overload characteristics are beautiful.

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If the professionals can please recording studio engineers, sound technicians, and musicians, people who make a living making and reproducing great sound, we're confident they can make you very happy, too.

Made in Benton Harbor, Michigan by

VM CORPORATION

The VM Professional 1521: Semiconductor complement: *49* transistors, *30* diodes, *3* ICs, *2* MOSFETs.

FM circuit: four ganged front end with 2 dual gate MOSFETs for lower cross modulation, greater sensitivity and overload; two 5-pole phase linear toroidal filters and 2 ICs for selectivity, sensitivity and limiting that surpasses all previous standards in this price range.

Amplifier: Power output: *40* watts RMS/channel power at less than 0.5% distortion; bandwidth *9-30* KHz. IM distortion: less than *0.5%*. Frequency response: ± *1* db *20* Hz–*20* KHz.

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Cabinet: Comes complete with cabinet of oiled walnut veneer hardwood at no extra cost. (Model *1520*, same as above except *25* watts RMS/channel power.)

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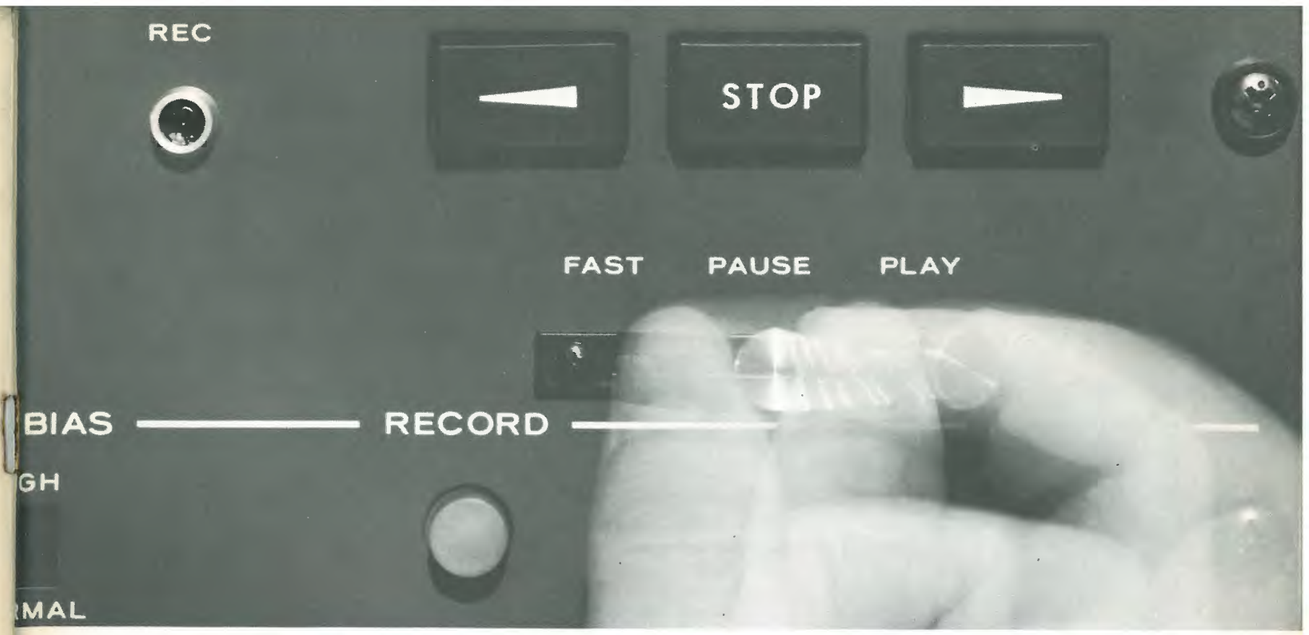

Wait till you get your pause on a TEAC A-1230

You'll be making the cleanest tapes on the new TEAC A-1230. Thanks to TEAC's unique symmetrical control system with Edi-Q. This advanced system allows you to edit while recording – instantaneously. In a flash, before that unwanted FM commercial is upon you, flick – and you're in PAUSE mode. Your tape stops silently, instantaneously. Record amps are fully fired and at standby for the first note of your recording restart. End of commercial and you toggle deftly back to "PLAY." You are off to a clean new recording start.

But Edi-Q is only one of a whole host of professional features on the A-1230. It also incorporates the same kind of advanced design and new-features engineering philosophy that established TEAC's famous Model A-1200 as the best value in various consumer tests.

There's a record bias switch for both high-output, low-noise tape and standard tape alike. So you get the fullest dynamic range with any type of tape. It also ensures the TEAC A-1230's high-performance characteristics.

So much for new refinements. Remember those other advanced A-1230 features: three-motor solenoid operation, three heads; tape/source monitoring, mic and line mixing, independent record mode switches for ¼-track stereo/mono operation, independent stereo headphone monitor, tape tension and spring-loaded automatic shutoff arms.

And the price, too, will give you pause; it's sensible.

Dust cover optional

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AUDIO

Successor to RADIO, Est. 1917

May 1971 Vol.55, No.5

DIRECTORY OF RECEIVERS AND TUNERS

FEATURE ARTICLES

EQUIPMENT REVIEWS

RECORD REVIEWS

AUDIO IN GENERAL

AUDIO (title registered U.S. Pat. OFF.) is published by North American Publishing Co., I.J. Borowsky, President; Frank Nemeyer and Roger Damio, Vice Presidents; R. Kenneth Baxter, Production Director; Nate Rosenblatt, Promotion Director; Mary Claffey, Circulation Director. Subscription rates—U.S. Possessions, Canada, and Mexico, $5.00 for one year; $9.00 for two years; all other countries, $8.00 per year. Printed in U.S.A. at Philadelphia, Pa. All rights reserved. Entire contents copyrighted 1971 by North American Publishing Co. Second class postage paid at Philadelphia, Pa., and additional mailing office.

REGIONAL SALES OFFICES: Jay L. Butler and Sanford L. Cahn, 41 East 42nd St., New York, N.Y. 10017; Telephone (212) 687-8924.
Jay Martin, 15010 Ventura Blvd., Sherman Oaks, Calif. 91403; (213) 981-7852.

REPRESENTATIVES: United Kingdom: Overseas Newspapers (Agencies) Limited. Cromwell House, Fulwood Place, London, W.C.1./Telephone: 01-242 0661/Cables: WESNEWS London PS4. **Continental Europe:** John Ashcraft, 12 Bear St., Leicester Square, London W.C.2. England. Tel. 930-0525. For Benelux & Germany; W. J. M. Sanders, Mgr. Herengracht 365, Amsterdam, Holland. Tel. 24.09.08. **Japan:** Japan Printing News Co., Ltd. No. 13, 2 Chome Ginza-Higasi, Chuo-ku Tokyo, Japan. Phone 541-5795.

AUDIO Editorial and Publishing Offices, 134 N. 13th St., Philadelphia, Pa. 19107
Postmaster: Send Form 3579 to the above address

Coming in June

Hi-Fi Outdoors—A survey of equipment by Len Feldman.

How Much Amplifier Power is Required?—Don Davis looks at public address systems and power requirements.

The Why and How of Horn Loudspeakers—Victor Brociner concludes his article.

Equipment Reviews Include:
Fisher 201 receiver
Stanton electrostatic headphones

Plus—
Record and tape reviews
and all the regular features.

About the cover: Here we show the Heath AR-17 tuner, which costs $72.95 as a kit, and the deluxe Marantz 19, which sells for $1000. The tuner is the new SAE which uses digital readout and will set you back $950—without the cabinet.

Audioclinic

JOSEPH GIOVANELLI

Preamplifiers

Q. I do not understand the basic purpose of a preamplifier. Is a preamplifier really necessary?—Dana Edwards, Edinburg, Ill.

A. In the early days of electrical sound reproduction, pickups were made from elements which produced rather high voltage as compared to more modern devices. Therefore, it required relatively small amounts of voltage gain to bring these older crystal pickups to a satisfactory level for application to the power output stage of the amplifier.

In the mid-1940's magnetic pickups made their appearance on the home market. However, their output voltage was only a fraction of that provided by the crystal pickups of that day. Therefore, in order to build up the signal of the magnetic pickups, it was necessary to use a piece of equipment termed a "preamplifier," whose output then was connected to the phono input of the existing amplifier. The preamplifier, then, was an add-on device.

Later, power amplifiers were made which had no controls on them whatsoever, with the exception of volume adjustment. The preamplifier, therefore, actually became the control center for the sound system, including the necessary gain to accommodate magnetic pickups. It also included adjustments for bass and treble, loudness, volume, and provisions for connection and selection of various external program sources. Thus, it would have perhaps been better if we had called this device a "control center" rather than a preamplifier. However, because the early add-on devices were exactly that, preamplifiers, it was easier to allow that name to remain even though the devices took on additional functions.

Now much of our sound equipment is integrated into a complete package in which both the control functions and power amplifications are included. This package includes circuitry to boost the tiny voltage produced by today's magnetic pickups. The circuit which accomplishes this task is still called a "preamplifier." It is the first amplification which takes place.

Equipment which features all the control functions, the output of which must work into a separate power amplifier, is today often called a "control center" rather than a preamplifier.

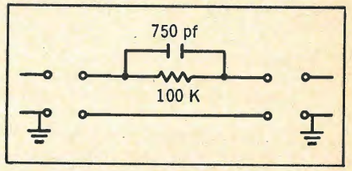
FM Wireless System

Q. I have a complete high quality stereo system in my living room. I connected it to my bedroom mono system. To accomplish this I purchased a mono FM tuner kit. Because a run of wire between the two music systems was considered impractical, I tried one of those FM WIRELESS *modules, which acted as a transmitter; the bedroom mono FM set was, of course, the receiver. It appears to be sufficiently adequate to meet my needs except for one thing, inadequate treble. I suspect that the problem is the absence of a pre-emphasis network in the module, while my tuner does have the standard de-emphasis network.*

Can you suggest a pre-emphasis circuit which will overcome this problem?—Kirk L. Thompson, St. Paul, Minn.

A. You correctly assume that the lack of treble in your system is the result of the lack of pre-emphasis in the module. These modules are made as cheaply as possible. The fact that they are even reasonably frequency stable is a miracle.

I think that an approximation of the pre-emphasis curve could be obtained by following the circuit shown. I am assuming here that the input impedance of the module is 10,000 ohms.



FM pre-emphasis network.

I can only hope that you have sufficient signal to overcome the 20 dB signal loss which will occur at mid and low frequencies. At extremely high audio frequencies the loss will be practically zero dB because of the action of the capacitor shunting the resistor. Because the reactance of this capacitor is much lower than the value of the resistor, for high audio frequencies, signal can flow more easily around the capacitor than through the resistor. The effect is that of boosting treble frequencies, which is just what is needed to correct for the lack of treble you indicated.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped self-addressed envelope.

Tape Guide

HERMAN BURSTEIN

IM DISTORTION

Q. Can you explain the following: (1) How does intermodulation occur in amplifiers? Can we hear a difference between a piece of music when reproduced by two different amplifiers, one having a rather high degree of intermodulation and the other not? If there is an audible difference, how does it sound? (2) Why do tape recorders have such a high degree of intermodulation distortion? (3) If you were to purchase a good quality stereo tape machine, and if you could choose between 2- and 4-track heads, what would be more advisable, a 2- or 4-track head? Is there any loss or difference in audio quality between 2- and 4-track playback and recording?—Christoph Keutmann, Am Wasserturm, West Germany

A. The signal coming out of a transistor or tube is supposed to be an exact facsimile of the signal coming in, except that the output is amplified in terms of voltage or current or both. If the output signal is not an exact facsimile, there will be an interaction between this signal and other signals going through the transistor (or tube), resulting in the production of new signals. These new signals are called intermodulation products, and tend to be noticeable to the ear. In very slight amount, intermodulation tends to impart a "filmy" quality to the sound. As intermodulation distortion increases, the sound tends to become successively grainy, fuzzy, coarse, and then broken. Tape recorders tend to have high intermodulation distortion because the tape is not a perfectly linear medium; that is, the magnetic record on the tape does not correspond perfectly to the signal going through the record head. While bias current helps greatly to overcome this nonlinearity, the results are not perfect. Furthermore, less bias is ordinarily used than the amount which would reduce distortion to a minimum; the reason is that less bias permits extended treble response. Also, in order to maximize signal-to-noise ratio, recording ordinarily takes place at a level that results in a significant increase in intermodulation distortion. On the other hand, for reasons not completely clear, the human ear seems to be able to tolerate larger amounts of intermodulation distortion from a tape recorder than from other audio equipment.

In today's state of the art, a 4-track stereo machine of high quality can perform very well, with little if any noticeable loss of performance compared with a 2-track machine. For home use, a quality 4-track machine is generally advisable.

High Speed Duplicating

Q. I would like to know the results of high speed dubbing of tapes. What, if anything, is lost in the process of high speed duplicating?—Avery L. Puckett, APO San Francisco, Calif.

A. So far as I know, little if anything is lost in the process of high speed tape dubbing. True, there are special mechanical and electrical problems, such as being able to drive enough bias current through the record head at elevated speed (and therefore at elevated frequency). But these have been met quite successfully. The chief problem in dubbing, unrelated to speed, is that of increasing noise with each generation of tape.

Need For Amps

Q. I'm interested in purchasing a tape recorder and a receiver; I wish to use the recorder as a music system, primarily playing back stereo music recorded from FM. My question is this: Should I obtain the recorder with output amplifiers included in the unit, to be able to record off the receiver, or would I suffer no impaired quality in recording from the receiver though it would be powering the recorder and the tuner/receiver itself at the same time, not to mention speakers or headphone? Would excessive power loss occur to mar the quality of recorded FM material?—L.T. Keith, Huntington Park, Calif.

A. If you plan to use your tape recorder in conjunction with an audio receiver, there is no need for the tape recorder to have what you call output amplifiers—presumably power amplifiers capable of driving speakers. The signal supplied by the receiver to the tape recorder is essentially voltage, with only a very minute amount of power involved. The tape recorder drains no significant amount of power from the receiver and therefore does not affect the receiver's performance. The signal supplied by the tape recorder to the receiver (for tape playback) is also essentially voltage, and hence there is no need for the tape machine to have output power amplifiers. Of course the tape machine should have record preamps; and unless you plan to use the tape playback preamps of the receiver (assuming the receiver has these), the tape machine should have playback preamps.

Left-Channel Transient

Q. I have an Ampex Micro 85 cassette recorder. I have been generally pleased with it, although I have wrestled with its limitations, but there is one problem which I can't fathom. When I make a recording (usually from a stereo record) I sometimes get great variation in the left channel. First the highs will go, then everything will fade out until it's necessary to move the balance control to the 9 o'clock position to restore balance. Balance will stay that way for a minute or so, and then the left channel level will go up. Sometimes this happens repeatedly—up and down for 5 or 10 minutes. The problem seems to happen most often on the back side of the cassette. This makes me wonder if it is not related to the physical construction of the cassette. Could the trouble be in the pressure pad? I tried one of the new Norelco cassettes with wrap-around shield and foam pad, and the left channel was way down throughout. My recorder plays prerecorded tapes without this fading problem. Please note that when the left channel is not fading, the balance is true at the 12 o'clock setting of the balance control. Generally the quality of my recordings is much better than that of the prerecorded cassettes. I would like your ideas as to whether the fault lies in my recorder, the tape, or elsewhere in the system.—Laird Brown, Dayton, O.

A. Initially your problem sounds like "left-channel dropout," due to poor contact between the upper head gap and the tape. But since you do not experience any difficulty with prerecorded tape, the trouble appears to occur in the recording process. There may be a faulty connection in the record amplifier, or there may be a faulty capacitor, resistor, or other component. Another possibility is a fault which causes the amount of bias current reaching the upper gap to vary. If this is the case, there would also be a marked variation in treble response. I think your problem calls for handling by a service technician.

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.

What's New in Audio

Richard Allen speaker

The Chaconne is a two-way speaker of bookshelf size in an infinite baffle enclosure. The 8 in. bass speaker uses a highly compliant cambric surround, and is said to achieve extended bass response in a relatively small enclosure. Power handling capacity is 20 watts rms, and rated impedance is 8 ohms. Price: $69.95. **Check No. 36 on Reader Service Card**

GC Electronics test tapes

These test tapes make possible testing and adjustment for head alignment, frequency response, equalization, sweep frequency, IM distortion, flutter, stereo balance, channel identification, and separation. Prices: open reel, $6.50; 8-track cartridge, $7.95, cassette, $5.60.

Check No. 38 on Reader Service Card

TEAC stereo tape decks

Models A-1230 and A-1250 (shown) have three motors, dual-range bias current switch, and pause control. Symmetrically-arranged, solenoid-operated controls provide smooth operation, while a turntable height adjustment allows for variation in reel dimensions. Other features include three heads, 7½ and 3¾ ips speeds and a frequency response at 7½ ips of 40 Hz to 18 kHz ± 3 dB. The A-1250 has in addition a composite head for both forward and reverse playback. Prices: A-1230, $349.00; A-1250, $449.00.

Check No. 40 on Reader Service Card

Garrard Zero 100 turntable

Zero degree tracking error is claimed for the ingenious dual-articulated arm on this new turntable from Garrard. The arm is designed so that the cartridge housing is pivoted directly over the stylus tip, with the degree of pivot controlled by an auxiliary articulating arm. The resultant tracking error is claimed

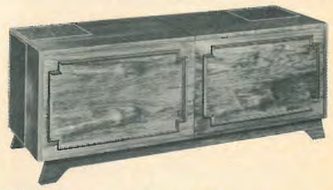
to be less than 90 seconds or approximately 160 times as small as the error of conventional tonearms. Additional features include 15 degree vertical tracking angle adjustment, sliding-weight stylus-force adjustment, cartridge overhang adjustment, magnetic anti-skating control, and illuminated stroboscope. Two speeds: 33⅓ and 45 rpm. Price: $189.50 **Check No. 42 on Reader Service Card**

Ampex tapes by mail

Some 222 selections from the more than 3000 titles in the Ampex Stereo Tapes open reel catalog are available by mail in a test marketing program. Customers pay list price for their first selection and receive a $1.00 discount on each subsequent tape ordered. No minimum orders, service or mailing charges, or membership fees are required. **Check No. 44 on Reader Service Card**

Wharfedale speakers

British Industries Corp., U.S. distributor of Wharfedale speakers, informs us that the speakers listed on page



50 in the March speaker directory are no longer offered. The current Wharfedale line is correctly listed on page 74 in the September, 1970 issue. Shown above is a pair of Wharfedale W80A's in the optional B68 base.

Check No. 46 on Reader Service Card

Quadraphonic News

The E-V (Fixler-Feldman) System

Among the many stations experimenting with this system is WDHA, in New Jersey, and they began tests as far back as February 5th. The response was so good (no pun intended) that regular programs began on March 1st and now WDHA is broadcasting discs and tapes which lend themselves to synthesized quadraphonic reproduction. Times are from 7:00 to 8:00 each evening and 3:05 to 5:00 p.m. on Sundays. The afternoon transmissions consist of tapes of the Boston Pops precoded by station WCRB in Boston. The only problem seems to be the availability of decoders, but E-V assures us that supplies should be to the dealers pretty soon. The equipment used at WDHA includes two TEAC quadraphonic decks plus a special E-V encoder. As a matter of interest, we are now testing a TEAC TCA-42 deck and a review will appear as soon as possible.

* * *

Critics of the E-V system say that the front left-right separation of 11 dB is not sufficient and that it does not meet the FCC requirements of 29.6 dB. However, E-V maintains that four-channel stereo will have all channels modulated most of the time and discrete channel directionality is not an important factor. Len Feldman also states that the 11 dB figure is not a true one and points out that normal methods of measurement do not apply.

Tele-Quadraphonics?

Quadraphonic-plus-visual broadcasts have been given recently by Pittsburgh's WDVA, WWSW and KDKA-TV as well as WDAS, WIFI with KYW-TV in Philadelphia. The latter program consisted of rock music with psychedelic light patterns and I must say it certainly made an impact!

* * *

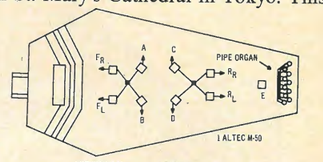
Dynaco is now marketing an adaptor called "Quadaptor" for the connection of four speakers to a stereo amplifier using the Hafler arrangement. A three-position switch disconnects the rear speakers, changes the circuit to give a null position for accurate balancing or connects all four speakers. A rear speaker level control is fitted and the price as a kit is $19.95 or $29.95 for those too lazy to assemble it.

* * *

KL has just released another record which sounds particularly good on the Hafler (Dynaquad) system. It was recorded in quadraphonic stereo and then mixed down to two channel. Title is "Riverboat Rascals Play Range Line" and according to the covernotes "the only consideration for performance by this amateur group is love of jazz, musical camaraderie and a wee dram."

* * *

From Japan comes news of a double-four-channel recording made by Sansui in St. Mary's Cathedral in Tokyo. This



Mike positions in St. Mary's Cathedral.

event was held on the 215th anniversary of Mozart's death (!) and the item selected was the "Mass in C Major." The tape was replayed from an eight-speaker setup at the Japanese Audio Fair a few weeks later. Sansui says that the object was to recreate a three-dimensional sound field and two of the microphones (A and B) were facing upwards and two (B and D) were pointed towards the floor.

ERRATA

How Many Channels? Part II
February, 1971 page 28

An unfortunate mixup of illustrations caused the Madsen system to be shown as Fig. 1, rather than the triphonic system discussed by Dr. Cooper. The correct illustration is shown here.

The caption for Fig. 2 has misled some readers. A better one might have read, "Possible quadraphonic arrangement of apparent sources as perceived for the four signal combinations. Within each square of the figure, the physical locations of the six speakers in the room are shown by the locations of the symbols, while the particular symbols used designate the signal combinations."

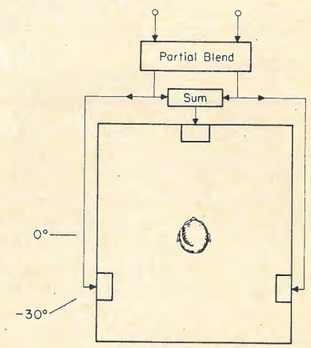


Fig. 1—The triphonic system.

BEHIND THE SCENES

BERT WHYTE

SEVERAL months ago I reported on the use of a pocket magnetometer to detect residual magnetism in the tape path of recorders. If you recall, the magnetometer was manufactured by the R.B. Annis Co. of Indianapolis. Well friends, I guess there must be a great many of you who are particularly concerned about this magnetism, because I have had a communication from Mr. Annis, who tells me he has had over 700 orders for his magnetometer and they are still pouring in, and he is temporarily *out of stock!* In addition to this information, Mr. Annis kindly sent me some notes on demagnetizing. As an expert in the field of magnetism, Mr. Annis has some interesting observations in his notes, some of which are at variance with certain commonly accepted viewpoints. In my use of the magnetometer, I reported that I found the highest values of magnetization in the capstans, guides, and rollers of my various tape machines. Mr. Annis points out that there are steels which range from magnetically "soft" to "hard." Most capstans, guides, and rollers are made of medium to hard steels for their superior mechanical strength and wear characteristics. Such magnetically "hard" steels have a lesser ability to conduct magnetism, but have a relatively good "magnetic memory." Should this "hard" steel be exposed to magnetism, even if only for a fraction of a second, it will "remember" the exposure by retaining a fair portion of the original magnetism, becoming a secondary source of magnetism in its own right. Thus the capstans, guides, and rollers are among the major offenders in retaining magnetism and tend to degrade the recorded signal every time a tape is played.

Mr. Annis made a statement which really made me flip! "Fairly long iron or steel members, oriented somewhat parallel with the direction of the earth's magnetic field, will become magnetized due to the fact that their high magnetic "conductivity" tends to concentrate the earth's magnetic field in that area. Rather strong magnetic poles will appear at either end of such iron or steel members. Steel components brought near such poles will become magnetized in turn due to this concentration of the earth's field. Very little consideration is usually given to such a possibility. In other words, don't place your recorders too close to the ends of long steel pipes, bars or structures oriented either vertically or in a generally north and south direction." Now who would have thunk about that? The usual demagnetizing tool operating on 60 cycle a.c. exposes steel components to a magnetic field of cyclically reversing polarity with a minimum initial intensity higher than a certain fraction of the original magnetizing field. As we know, such cyclically alternating demagnetizing fields can be reduced to essentially zero by slowly withdrawing the tool from the steel components a certain distance and then shutting off the current. What is not very well known, says Mr. Annis, is that *actual demagnetizing* is accomplished *only* during the incremental reduction of successive half-cycles of the demagnetizing field or *only during that time when the steel component and the demagnetizer are being separated.*

The most important thing in demagnetization, states Mr. Annis, is the intensity of the field. He has investigated a number of the common probe-type demagnetizing tools and found that their field intensity averaged around 70 to 80 Oersteds (gauss in air) when measured at a standard quarter-inch distance from the end of the probe. This field intensity is far too low in value for the important initial phase in the cyclical demagnetizing of magnetically "hard" steel capstans, etc. Mr. Annis has developed a prototype hand demagnetizer of the probe variety which measures in excess of 400 Oersteds. With such a powerful unit, it is not necessary that the probe touch the components to be demagnetized. Bringing the probe within a quarter or half-inch and then withdrawing it in the standard fashion and turning off the power is sufficient. There is a possibility that the unit described may become a production item, although it would be relatively expensive. The hand bulk tape eraser I mentioned in my previous article has a fairly high field intensity, but this field is not concentrated as in the probe-type units. How far the field extends around the periphery of these bulk erasers is at the moment an unknown factor. Because of this, if your recorder has its VU meters fairly close to the heads, capstan or other parts you may want to demagnetize, there is a possibility you may damage the meters.

I pointed out that in using the Annis magnetometer, it might be necessary to fashion an "extension probe" to reach the part to be measured. Mr. Annis says that the best material for such a probe is Permalloy or other high quality steel lamination material. A typical probe would be 5/16 inch wide by 1⅞ inch long, with a right angle bent about 5/16 inch from one end, which would allow the bent end to be taped or clipped to the test edge of the magnetometer case. The ends should be vinyl or plastic taped to avoid scratching of heads, etc. Just in case you don't want to go to that bother, such "clip-on" probes are now available as an accessory for the magnetometers.

* * *

Recently, within two days time, I was the happy recipient of 10 Dolbyized cassettes. There are quite a few more in the works. This is progress, and it looks like a good start has been made on the "chicken and the egg" problem. There is also a very strong possibility that we will get some Dolbyized open reel tapes before the fall, maybe even by the Consumer Electronic Show in June. Things are looking dandy for Dolby, right? Well, there are some sour notes being sounded in certain quarters. There has been resistance to Dolby licensing terms on the part of some cassette recorder manufacturers, who have promptly announced their own "noise reduction systems." Some extravagant claims have been made for these systems. From what can be observed thus far, most of these systems are simple expansion circuits working on playback, which either cut high frequency response or reduce the gain of the playback amplifiers in the recorder during low level passages. On a dynamic basis, there are the characteristic "breathing" and "swishing" sounds which have been typical of these circuits for many years. However, just for the hell of it, let us assume that one of these companies comes up with a workable system free of the usual problems. I still maintain that the area of principal interest in Dolby, as far as most people are concerned, is in prerecorded cassettes. These Dolbyized cassettes will be made from masters supplied by the record companies of the world, which almost without exception have adopted the Dolby system. At last count, London/Decca had over 70 Dolby A301 units, Columbia over 140. Most record companies count their A301 units in multiples. In a word the Dolby system is thoroughly entrenched, and it is highly unlikely that the record companies would embrace another type of noise reduction system. Nor are they likely to issue any cassettes with noise reduction characteristics other than Dolby.

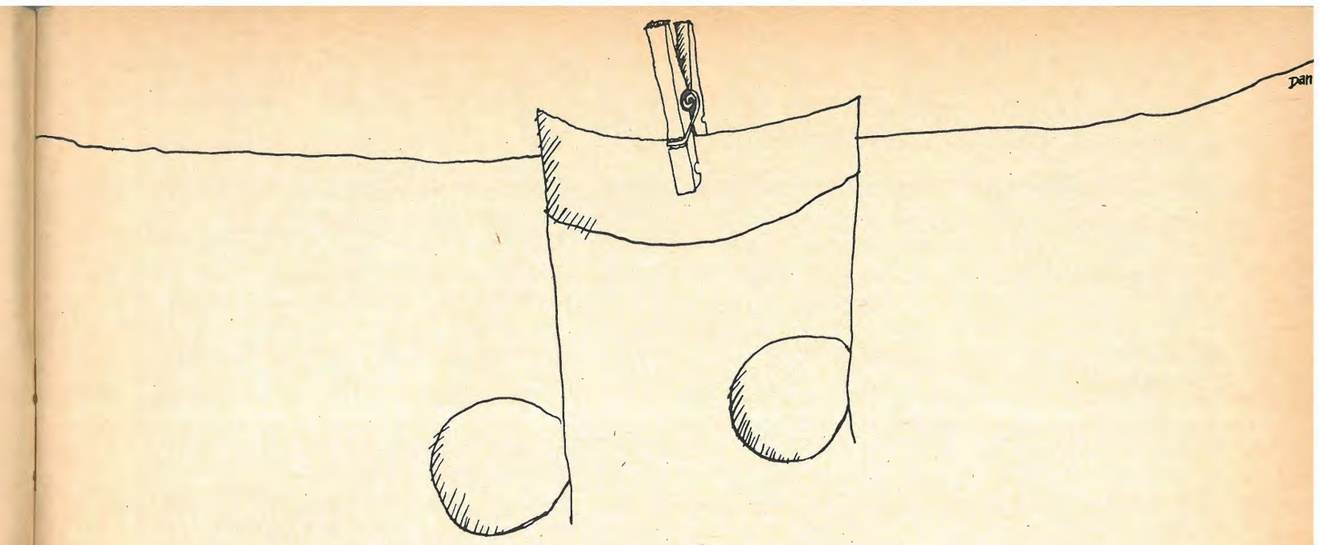
(Continued on page 14)

Behind the Scenes

So where does this leave our manufacturer with the hypothetically workable non-Dolby noise reduction system? Sure his cassette unit can play the Dolbyized cassettes and impose its technical restrictions on the sound. But without the correct Dolby playback circuitry his unit simply can't give his customer the benefits of this kind of noise reduction. Most of these manufacturers are well aware of these problems, so their next move was to raise a great hue and cry about compatibility. That is the great crutch these days. They loudly proclaim that the Dolby System is incompatible with any cassette recorder not equipped with Dolby circuitry. A lot of dimwits go along with these notions and express themselves in print. Now let's stop kidding around, use some common sense and expose this nonsense about compatibility. There is nothing wrong with compatibility per se, providing that in the pursuit of it, the quality of sound is not subverted and made a secondary consideration. Let's take a look at the cassette recorder market as presently constituted. The *vast majority* of the machines in the hands of the public are cheap jack, portable *monophonic* units. Ranging in price from 15 to 50 dollars, they are almost a form of electronic Kleenex; what with present service charges, they are cheaper to replace than to repair. Up the line a bit in price is a fair-sized group, made up mostly of monophonic units with a few stereo units at about 100 dollars. A very small part of the market are stereo units up to 150 dollars, and a still smaller percentage are the Dolby and non-Dolby machines at still higher prices.

Now a look at the prerecorded cassette market. This has been a major disappointment for the record companies. Sales are a dismal flop . . . and for the most elemental of reasons. All those owners of the cheapie machines simply can't afford to pay $5.95 and $6.95 for a cassette. Even with discounts, they can get the same music on a disc still cheaper (and from their viewpoint) better than the cassette. For the affluent group with the better cassette machines, they have not been buying prerecorded cassettes because of generally inferior sound quality, especially the awful tape hiss.

Now for the compatibility bit. Opponents of Dolby say that Dolbyized cassettes played on non-Dolby machines sound screetchy and over bright. Tests by Ampex and others, including yours truly, have shown that on the cheapie machines, the Dolby cassettes sound *better* and that on most better quality machines a reduction in the treble control can put the sound in order.



Editor's Review

OUR DIRECTORY on pages 36 to 46 lists receivers ranging from the Heath AR-17 at $72.95 to the Marantz 19 with built-in scope at $1000.00! Between these two extremes are receivers with preset station selection, slide controls, multi-position tone controls, varactor tuning, remote control, reverb amplifier, automatic tuning, FETs, ICs, and many other features. We have certainly come a long way since the days of Armstrong. . . . Most receivers have an AM broadcast band but this facility is not included in some of the more inexpensive models—or some of the most elaborate, though for different reasons. Cheapest tuner is the Heath AJ-14 at $57.95 and prize for the most expensive goes to the new SAE Mk VI which costs $950.00.

E. T. Canby has described the DGG Boston recording session with the Boston Symphony in his article this month, but I would like to quote from an impromptu speech made by Tom Mowrey on that occasion. Said Tom, "There can't be anyone here today who hasn't read about or written about the imminently expected demise of the classical music recording industry. It's heard from every side. The repertoire is exhausted. Musical tastes have shifted, and the young people want something more "relevant." Of course, "relevance" is such a subjective term that, if you'll pardon me saying so, it has lost *its* relevance. The coffin has been prepared and there's no lack of hands willing to give the corpse a final push. . . . You may be wondering why we've gathered you all together today. To hear a splendid orchestra in a magnificent hall—sure. To see a recording session from the inside; yes, we all know that's exciting. There's something else, though. The room next door, the equipment in it, our contract with this orchestra, made at a time when recording costs are out of sight and rapidly driving many record companies out of the classical business, all of those things are impressive enough in themselves. But what they symbolize is really the point, and that is DGG's absolute commitment to the strange mixture of art and business which we call the classical record industry."

The New York Audio Society announces that the next meeting will take place on May 19 at the Mercury Studios, 110 West 57th St., New York. The speaker will be John Eargle, and the time will be 7:30. John will deal with the processing of four-channel material from two- and three-channel masters.

* * *

I am very pleased to welcome a newcomer to our columns. This is Martha Gilmore, who will be reviewing jazz and blues. Martha has a B.A. from Duke University, with a major in English. Her interests include early eighteenth century music as well as jazz and blues, flute and piano, art, literature, and natural history. She has had articles published in such journals as Down Beat, International Musician, Music Journal, Jazz Journal, and Jazz Report. To forestall inquiries, I must tell you that Martha is married.

* * *

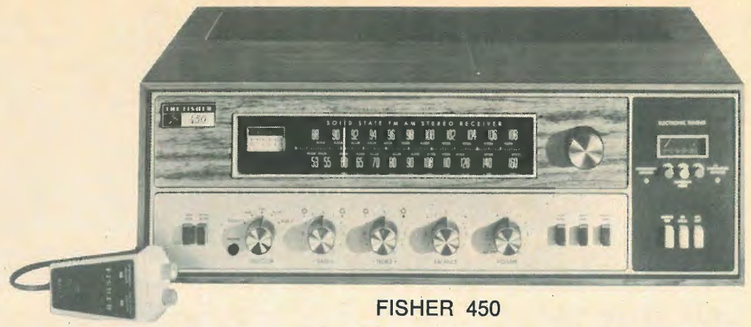
The Bose Corporation is suing Consumers Union for a cool half million dollars, charging them with falsely reporting on the Bose 901 speaker system. The report stated that the system needed "gigantic amounts of power" and that the sound was characterized by "wandering violins" and "pianos extending from wall to wall." The Bose Corporation claims that the speakers were not positioned correctly, that the reviewer was "incompetent in the evaluation of speakers" and that misleading and sarcastic comments were made in the interests of entertaining the readers and promoting the circulation.

* * *

Albert Jourdan will be very pleased to hear from anyone interested in disc recording. His address is 438 Wall Street, Meriden, Conn. 06450 *G.W.T.*

LATE FLASH---Dolby Laboratories demonstrated their B system for noise reduction as applied to FM broadcasting recently. Implications for broadcasters and listeners are of extreme importance. Tests with station WFMT in Chicago have shown noise reduction of 10 dB in fringe areas, and the system is fully compatible although a Dolby B decoder is necessary for optimum results. It is expected that the first FM receivers incorporating the Dolby B system will be on sale this year.

Tuning with no moving parts



FISHER 450

Leonard Feldman

DURING THE past few years, FM tuners and Stereo FM tuners designed for high fidelity component use have reached levels of perfection undreamed of barely a decade ago. Sensitivity figures have approached theoretical noise limits and are not likely to get significantly better because such limits, dictated by physical constants, do exist. Selectivity recently has undergone significant improvements thanks to crystal and ceramic filters which yield band-pass (or i.f. "response") curves which were once described as "text-book ideals." Proper use of FET's (Field Effect Transistors) in "front-ends" of tuners have enabled designers to reduce spurious responses and cross-modulation products which once plagued solid-state tuner designs to levels which are as low or even lower than even the best cascode-triode designs of yesteryear. Stereo FM separation is often *better* over the entire audible range than the FCC station performance requirements.

It is therefore not surprising to find that engineering efforts are now being devoted to areas of performance not directly related to "specifications," but of great importance and convenience to the ultimate consumer. One of the most interesting innovations in this area is the transition to "electronic" tuning of both AM and FM frequencies in recent tuner and receiver designs of forward-looking manufacturers in the high fidelity component field and even some manufacturers in the "not-so-high-fidelity" table-radio and car-radio segments of the industry. To clarify, all tuning of frequencies in AM and FM radios or tuners is, of course, "electronic." By way of a quick review for those who have forgotten the principles involved in "tuning in" a station using "superheterodyne" circuitry, let's refer to the block diagram of Fig. 1. The elements or blocks apply whether we're talking about AM or FM—only the frequencies are different—and an example of a station frequency received in each medium is illustrated numerically in the diagram. The first block, labeled "r.f." is an amplifier, which both amplifies and *selects* the desired signal from amongst the myriad of radio waves present in the vicinity of the receiving antenna. The "selection" part of the process is accomplished by the use of one or more (sometimes as many as five or even six) "tuned circuits," sometimes called resonant circuits which, regardless of their "schematic diagram" complexity, can always be resolved into a combination of L (inductance), C (capacitance) and (R) resistance as shown in Fig. 2. Once the sections of the tuned circuit have been resolved down to these simple elements, the formula for the incoming frequency at which this circuit will resonate (or tend to be "selective") is $F = \frac{1}{2}\pi\sqrt{LC}$, in which L stands for inductance (measured in Henrys) and C stands for capacitance (measured in Farads). The value of R simply determines *how* selective the circuit will be, and therefore does not appear in the formula for frequency.

The second block of Fig. 1 also contains a tuned circuit, but it is tuned to a frequency *above* the desired station frequency. Its function is not to "select" but to oscillate, or produce a signal of its own, always removed in frequency from the desired incoming signal by the same amount (10.7 MHz in the case of FM tuners, 455kHz in the case of AM tuners). In block 3 of Fig. 1, the amplified "selected" incoming signal is "mixed" or "heterodyned" with the locally produced oscillating signal to produce a "difference" signal known as the i.f. frequency. (A "sum" signal is also produced in the process, but it is summarily rejected by *more* tuned circuits in the i.f. stages which choose the desired "difference" frequency only.)

From the formula shown earlier, you can rightly deduce that to change the frequency of any of the tuned circuits

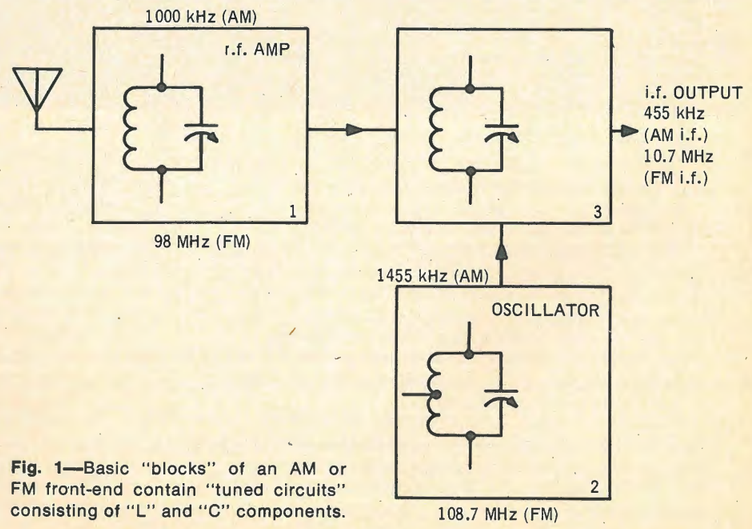


Fig. 1—Basic "blocks" of an AM or FM front-end contain "tuned circuits" consisting of "L" and "C" components.

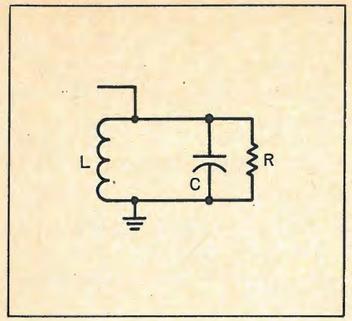


Fig. 2—Equivalent circuit of any parallel resonant tuned circuit. The frequency of resonance is determined by values of "L" and "C" while "Q" is a function of the equivalent resistance of "R."

present in a tuner "front end," you need only change either the inductance or the capacitance, and since both of these terms are in the denominator of the formula, an increase in either one of their values will cause a decrease in resonant frequency and vice versa. While some tuners utilized a variable inductance to change frequency of the various tuned circuits (this practice was quite popular in many automobile radios and even in some FM tuners years ago), by far the greater number have used *variable capacitors* to accomplish the "tuning" or change-of-frequency function. A photo of this familiar object is shown in Fig. 3. A variable capacitor is represented symbolically in Fig. 4, and the representation is quite accurate, since the device really is a pair of plates (or 2 groups of plates), insulated from each other electrically and capable of being spaced at varying distances from each other (by rotating one group in and out of an interleaved position with respect to the other stationary group). It is the change in the

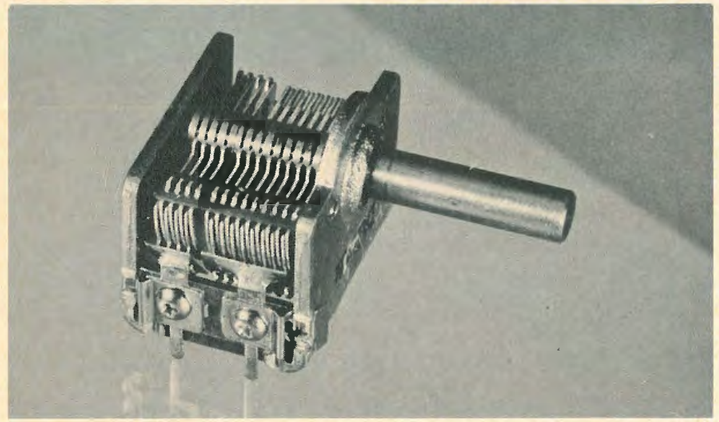


Fig. 3—An AM variable tuning capacitor.

Fig. 4—Schematic representation of a variable capacitor suggests its actual construction.

relative positions of the sets of plates with respect to each other that changes the value of "C." Usually the rotating group of plates is in some way coupled to a shaft which is in turn coupled to a dial string, dial pointer, and a tuning knob. Thus, when you tune your tuning knob in variable-capacitor equipped tuners, you are simply changing the relative position of the movable sets of plates with respect to the stationary sets.

Diodes as Capacitors

The elimination of the variable capacitor as the main means for tuning to desired radio frequencies was made possible by the development of a very special kind of diode, usually called a "varactor" diode. Actually, these diodes, which behave like capacitors of a specific value when some "reverse bias" voltage is applied, have been used in consumer circuitry for many years. Figure 5 represents a simple FM converter stage, in which one transistor serves the dual purpose of local oscillator and mixer. The local oscillator resonant circuit constants consist of L-4 and C-3C in parallel with C-13 (a trimmer capacitor used to "fine tune" the main variable capacitor C-3C) and C-14 (a fixed capacitor required to establish the minimum and maximum values of total capacitance as C-3C is rotated from its closed to its open position). Notice however that there is another network, consisting of C-17 in series with diode D-1 in parallel with all of the foregoing components. One end of this diode has positive or "reverse bias" voltage applied to it because of the voltage divider action of R-6 and R-7. Since the diode is biased in the reverse or nonconducting mode and no d.c. current is flowing, this reverse voltage is easily calculated as 180 ÷ 680 x 9 V., or approximately 2.4 volts d.c. At this reverse voltage, the diode has a certain amount of junction capacitance. Let us presume that it is 4 pF, for argument sake. The effective additional capacitance in the resonant circuit arising from the series combination of C-17 and D-1 is therefore 2 more pF.

Notice however, that the lower end of the diode is connected to "AFC Voltage"—a voltage which is *zero* when stations are perfectly tuned in, but which goes slightly *positive* if the tuner is tuned a bit too *high* in frequency. With a slight positive voltage at the lower end of the diode (let us say 1 volt), the *net* potential across the diode will now be only 1.4 volts. The effective junction capacitance will be *greater*—perhaps rising to 6 pF. Now the extra capacitance contribution of C-17 and D-1 in series amounts to 2.4pF (4.6 ÷ 10). The *total* capacitance in the overall resonant circuit is therefore *greater,* which means that the local oscillator will tend to oscillate at a somewhat *lower* frequency, tending to compensate for our having tuned the tuner off frequency on the "high side" in the first place. This is, of course, exactly what AFC is supposed to do. Had we been detuned *below* the correct frequency, the AFC voltage would have been slightly *negative* at the lower end of D-1, resulting in a *greater* reverse bias across the diode, a lower junction capacitance, a lower overall resonant circuit capacitance and a resultant *higher* local oscillator frequency required to "pull" the desired station back towards proper tuning.

The case illustrated is typical of AFC circuits that have been used for many years. The varying voltage supplied

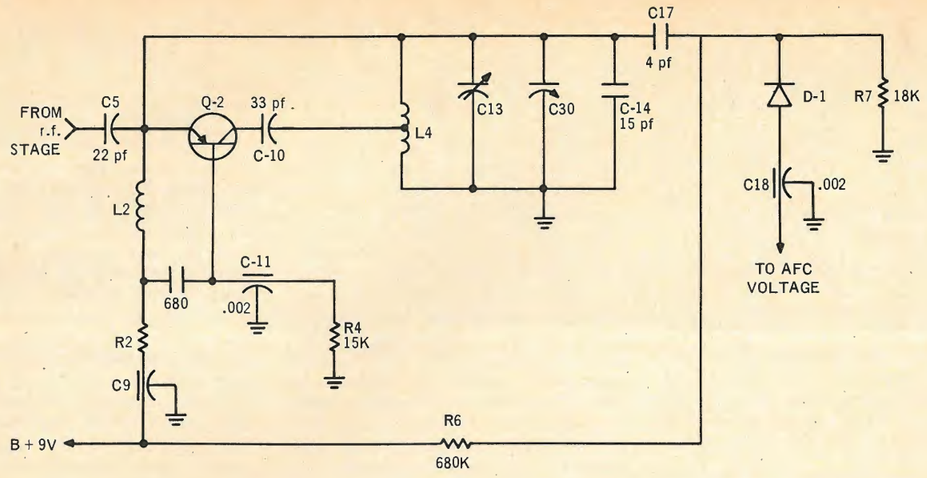


Fig. 5—Convertor stage utilizing a regular variable capacitor, as well as fixed values of "C" to tune the local oscillator.

across the diode to help "pull" the frequency of the local oscillator back where it belongs is derived from the d.c. output of the ratio-detector or discriminator circuit of the FM i.f. section, which has exactly the right kind of "plus and minus" excursion about a zero-center point to work quite nicely in this arrangement, as shown in Fig. 6. Remember, that 10.7 MHz is the desired center i.f. frequency. Incorrect tuning of the dial (and hence the local oscillator) leads to frequencies either above or below that number, as shown on the diagram of Fig. 6, and such departures from center frequency cause either positive or negative voltages at the detector output which are then used as AFC voltages in the manner just described. In a very minimal way, then, tuners have been "tuned" by a varying d.c. voltage for a long time. It would seem a very simple transition to go from this "minimal" amount of tuning to *full* tuning of the entire set, just by varying the voltage applied to a diode. In order to understand why the transition was *not so simple*, let's consider the size of the change of capacitance required for covering the FM band (88 to 108 MHz) and then, the more difficult AM band (535 kHz to 1605 kHz). In the former case, the ratio of highest to lowest frequency (allowing for no overlap) is 1.35. Referring back to the formula for resonance, however, we see that this involves a change of capacitance of $(1.35)^2$, since the "C" term in the formula is inside the radical, or "square root" sign. Thus, the required change of capacitance to tune the FM band must be a ratio of at least 1.82 to 1. Since we usually want some overlap at the ends of the band, a ratio of 2:1 in capacitance would be more realistic. Now, consider the situation with the AM band. Here we are dealing with the ratio of 1605/535, or 3:1. Again, squaring this ratio leads to a capacitance change ratio of 9:1.

Wide Range Diodes

As finally developed for wide range tuning applications, varactor diodes are p-n junction diodes, generally constructed of silicon, although gallium arsenide may be used for higher frequency response. Additional impurities may be introduced to increase capacitance variation as a function of reverse voltage applied. Figures of merit (Q), which determine the selectivity of the ultimate tuned circuit, can run higher than 100—often as high as 200 or more. Two examples of available varactor diodes for use in FM applications are the Siemens BB-104 and the Motorola 1N5142A. The former has a typical capacitance (with 30 volts of reverse d.c. applied) of 14 pF and a capacitance ratio (if one varies the reverse voltage from 3 volts to 30 volts) of 2.65—more than enough to cover the FM band. The unit is, by the way, a double diode, having a common cathode and as such can be used in two tuning stages or in a push-pull application when extreme linearity and symmetry is desired. The Motorola unit has a capacitance (with 4 volts of d.c. applied) of about 15 pF. Its ratio of capacitances (from 4 to 60 volts of reverse bias) is about 3.0—again, more than sufficient for the FM band.

In 1966 Matsushita Company of Japan (Panasonic is the name used in the U.S.A.) introduced an automatic tuning AM radio which used no moving parts for tuning. They developed a form of varactor diode which they called the "Capistor." The device is produced by an alloy-diffusion process and is of a hyperabrupt silicon junction. The ratios of capacitance obtained with a change of voltage from -1 V to -10 V is no less than 16! With maximum capacitance at about 250 pF, the device is quite suitable for covering the entire AM band, and that is how this radio was able to be tuned with "no moving parts." For whatever reason, not too many AM radio manufacturers have followed Panasonic's lead in this area, but an ever increasing number of FM tuner and receiver manufacturers in this country

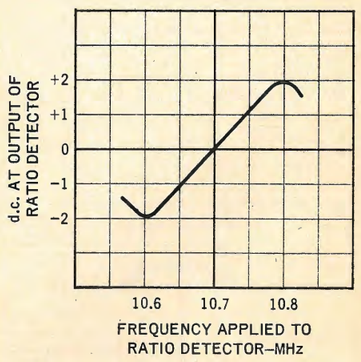


Fig. 6—Varying d.c. voltage at the output of the FM detector is used to automatically correct for improper tuning of stations.

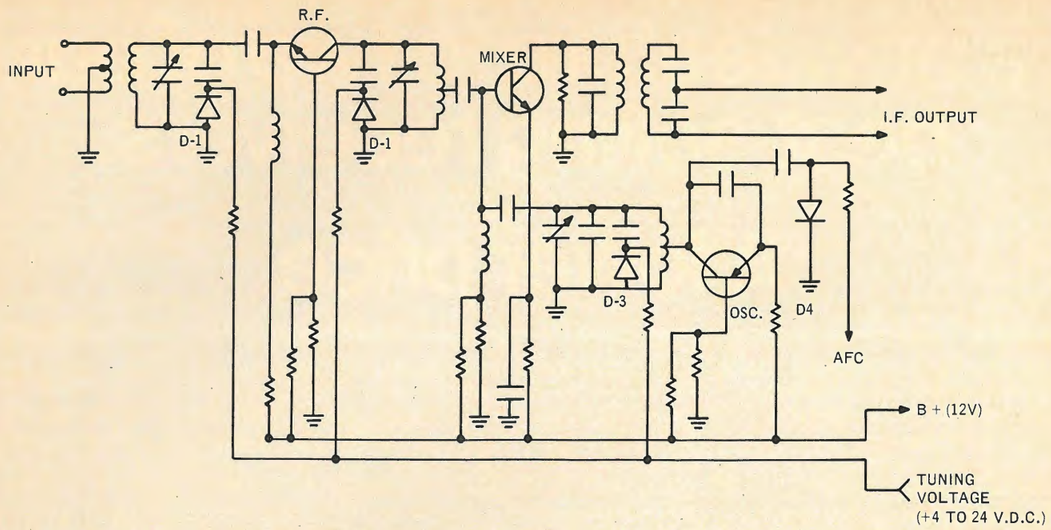


Fig. 7—Basic FM front-end by Görler, using three varactor diodes instead of the usual variable capacitor.

and abroad have realized the niceties of "tuning with a d.c. voltage" and a number of designs have come forth—each taking better advantage of the inherent possibilities than the one before it.

As an example, consider the schematic of Fig. 7. It is a complete FM "front-end" developed by the Görler company of West Germany. Three tuned stages are used, each equipped with a varactor diode in place of the familiar variable capacitor symbol. (The capacitor symbol with the arrow though it is a trimmer capacitor, set once during alignment, to help the varactor diodes "track" over the entire FM band. It is *not* moved during the actual station-to-station tuning process.). Diode D-4, by the way, is the old familiar "AFC" diode, still being used in its minimal capacitance-changing mode along with its more sophisticated "first cousins," D-1 through D-3. Tuning voltage required ranges from 4 to 24 volts, with the 4-volt bias corresponding to 87.5 MHz and the 24-volt point providing coverage up to 108.5 MHz. (See Fig. 8.) Obviously, a simple potentiometer or variable resistance hooked up as in Fig. 9 is all that is needed to tune this front-end. Equally obvious is the fact that if the simplest of power supplies were used to provide this variable voltage, any slight variation in a.c. line voltage would cause a rather substantial shift in frequency—more than the compensating AFC circuits could possibly cope with. Again, diodes come to the rescue—this time Zener diodes which exhibit the remarkable characteristic of "breaking

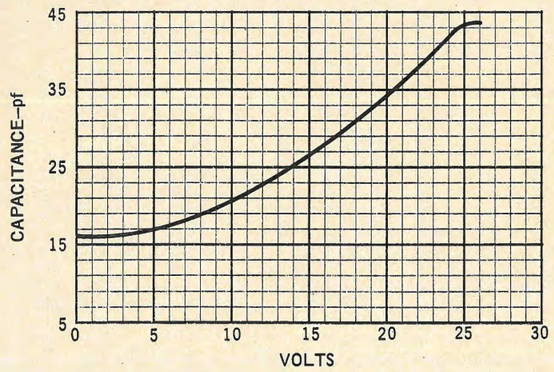


Fig. 8—Change in capacitance with applied voltage of a typical varactor diode.

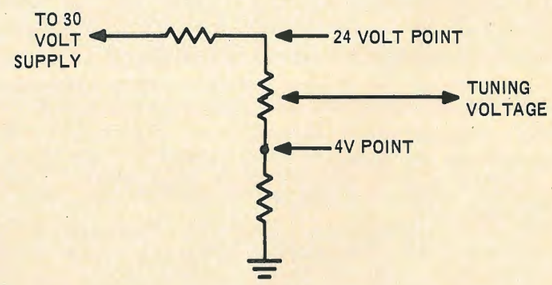


Fig. 9—A potentiometer acting as a voltage divider could easily serve as the "tuning control" for the circuit of Fig. 8.

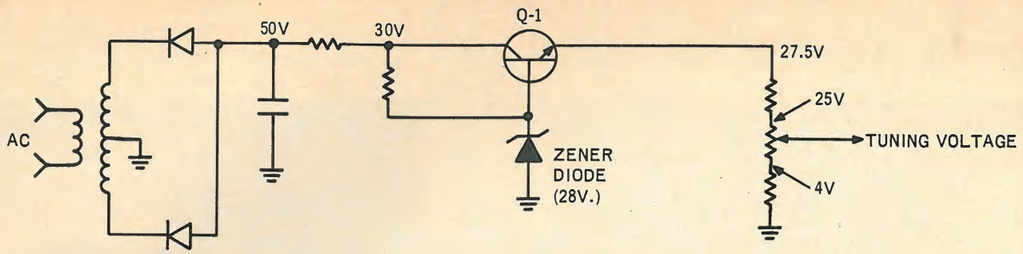


Fig. 10—A Zener-diode regulated power supply provides tuning voltage. Transistor Q-1 improves temperature stability of the system.

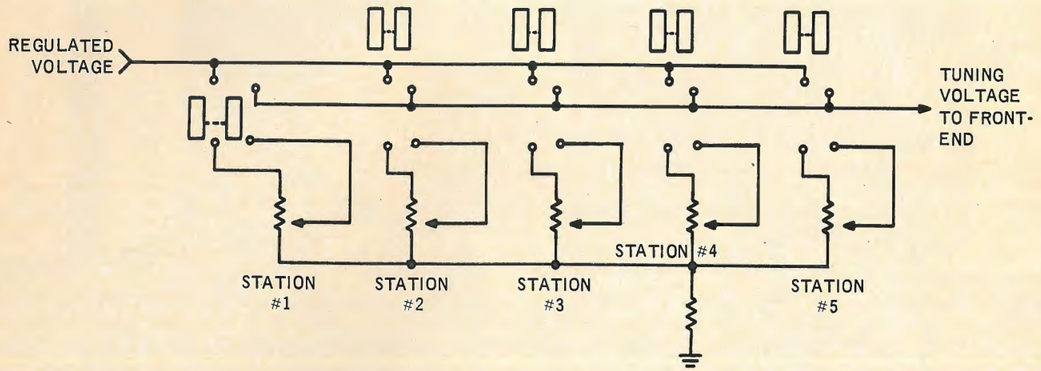


Fig. 11—Five individual potentiometers, singly selected by pushbuttons, tune the varactor-diode front-end to preselected station frequencies.

down" at specific reverse voltages and changing their internal impedance with current flow in such a manner that the voltage appearing across the diode is very nearly constant over a wide range of current flow. A suggested power supply for use with the varactor front-end of Fig. 8 is shown in Fig. 10. Now, with an available accurate source of variable voltage, accurate, stable tuning using just this variable voltage is assured.

Tuning Innovations

Given the "new freedom" of no mechanical linkages and no moving parts, engineers let their imaginations go and came up with a variety of ever more sophisticated tuning aids. The first one to suggest itself was the "push button" radio, in which several favorite FM stations may be "pre-set" by turning individual potentiometers, connected to the source of voltage and the "tuning voltage" point of the front-end by means of individual switches in the form of push buttons. This is so much simpler in execution than the horrendous mechanical marvels we still find in automobile AM radios in which the pushing of a button creates all sorts of mechanical "happenings" too terrible to behold! The push-button arrangement necessary for our varactor front-end is shown in the partial schematic of Fig. 11 and its operation is so obvious that we won't dwell upon it.

Automatic Tuning and Signal Seeking

To Fisher Radio Corp. must go the credit for really carrying the varactor-tuning concept to its ultimate level of sophistication in United States designs. Not content with just a few preselectable stations, Fisher engineers devised two more forms of tuning. Dubbed Autoscan, one form of the circuit "scans" the dial from low end (88 MHz) to high end (108 MHz) in a slow sweep, automatically stopping along the way when stations are properly tuned in. When 108.0 MHz is reached, the tuning voltage instantly lowers to the 88 MHz setting and the process starts again, always in the up-scale direction. In the other version of Autoscan, buttons are available enabling the user to tune down-scale or up-scale, depending upon which button is depressed. The former circuit is used in Fisher's 450-T while the latter appears in Fisher's 500-TX and their new four-channel Model 701. A complete schematic of the somewhat simpler circuit is reproduced with their kind permission in Fig. 12, and the explanation of the workings of the circuit, as contained in their service manual, is so clear an exposition that we have taken the liberty of quoting it, almost verbatim, for the benefit of those of our more technical readers who can follow this rather sophisticated, but beautifully logical circuit arrangement.

How 450-T Autoscan Works

Transistor Q-902 provides the constant-current source to charge capacitor C-906 which actually determines the d.c. tuning voltage for the varactor front-end. As voltage on C-906 rises, the front-end tunes higher in frequency, towards 108 MHz. Q-903 is a unijunction transistor. When the voltage across C-906 reaches approximately 25 V. d.c., which corresponds to the emitter peak-point of Q-903, and C-906 is discharged through Q-903 to approximately 3 volts d.c. As soon as C-906 is thus discharged, Q-903 resumes its normal, essentially open-circuit condition and the charge cycle begins to repeat.

Field-Effect Transistor Q-901 is a variable shunt across the constant-current charging source. Its gate is d.c.

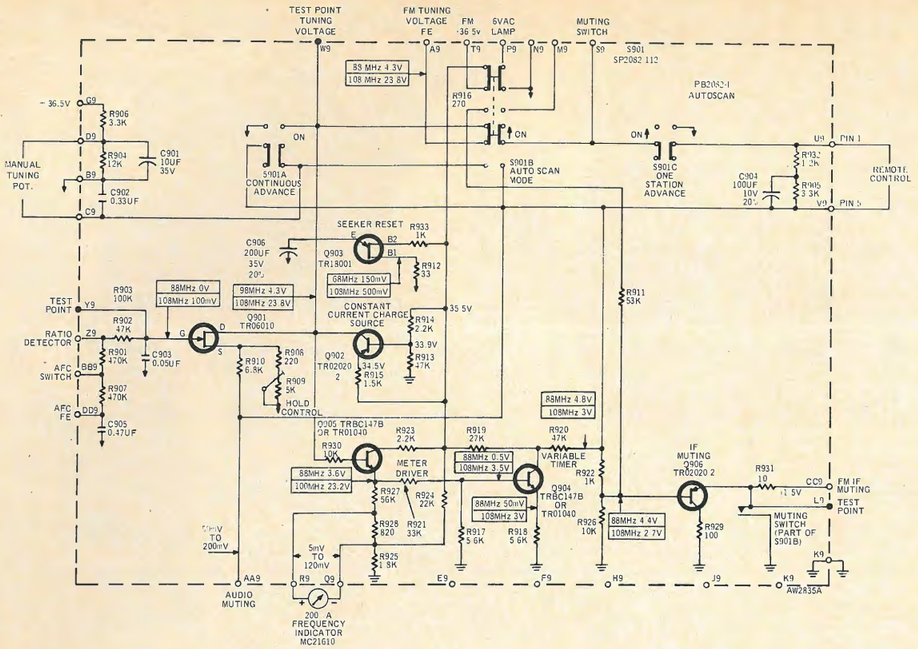


Fig. 12—Complete circuit diagram of Fisher Radio's "Autoscan" as used in the Model 450-T.

coupled to the output of the ratio-detector. When the output voltage of the ratio detector sweeps through zero (which corresponds to exact center of station tuning), Q-901 loads the charging source so as to maintain a constant tuning voltage across C-906. The hold control adjustment, R-909, is used to set the load current equal to the charge current (constant tuning voltage) when the gate voltage is zero. The source of Q-901 is d.c. coupled to the audio muting circuit. When the receiver is tuned to center-station, the muting output voltage is approximately zero. As the receiver is tuned off-station, however, the muting voltage applied to the source of Q-901 through R-910 rises to +15 V. d.c., allowing the tuning voltage to rise once more. When the receiver scans upwards in frequency to the next desired station, muting and detector voltages both swing through zero once more, and Q-901 loads the charging source Q-902 to establish and hold the new correct tuning voltage.

The emitter of Q-906 is d.c. coupled to the i.f. amplifier. With the receiver tuned to a station, Q-906 is reverse biased and operation of the i.f. amplifier is unaffected. When either the continuous advance or the one-station advance button is pressed, the grounding of C-904 temporarily drops the base voltage, forward biasing Q-906 and shorting out the i.f. amplifier. The drop in output of the i.f. amplifier releases the hold on the tuning voltage across C-906 and the receiver begins to scan. As the voltage across C-904 rises, Q-906 resumes reverse biased operation and the i.f. amplifier becomes operative once more. The release time during which the i.f. amplifier is muted by Q-906 must be long enough to allow the receiver to tune off its previous station setting, but short enough to prevent station skipping. Variable timer transistor Q-904 progressively loads the base of Q-906 to lengthen the release time at 108 MHz, compared to the release time at 88 MHz, since the varactor diodes are not completely linear in frequency vs. voltage relationship. To sweep the receiver 1 MHz at 88 MHz requires approximately ½ volt change of d.c. tuning voltage, whereas at 108 MHz, approximately 1½ volts change of d.c. tuning voltage is required.

Remote Control Operation

From the foregoing, it is obvious that a simple duplication of the "advance" switches on the end of a long cable would constitute an excellent means of providing remote control tuning for such a receiver and, of course, Fisher provides just such a "remote control" attachment. Manual tuning is also easily accomplished, by simply including a continuously variable potentiometer to which is fed the highest d.c. tuning voltage required. The "arm" of the potentiometer then supplies tuning voltage depending upon its setting or point of rotation.

The more advanced form of Autoscan featured in Fisher's 500 TX makes provision for an ascending as well as a descending d.c. tuning voltage, enabling the user to scan up-scale or down-scale in frequency by means of *two* separate push buttons, but the basic principles of operation are the same and will not be detailed here.

Conclusion

All of the refinements embodied in these automatic tuning methods depend upon the fact that specially fabricated diodes can now be produced with controlled values of junction capacitance accurately determined by the d.c. voltage applied as reverse bias to them. Whether this development will lead to the complete abandonment of mechanical, variable-capacitor tuning of AM and FM tuners by all manufacturers of tuners and receivers in the future depends upon cost factors and the engineering ingenuity of each manufacturer. But it's nice to know that the choice is there and we can foresee a variety of interesting and novel tuning schemes based upon this simple component as more and more manufacturers begin to experiment with it. Æ

AUDIO ENGINEERING SOCIETY

Fortieth Technical Meeting and Exhibition
April 27-30, at the Hilton Hotel, Los Angeles

Here are some of the papers to be presented

TUESDAY, APRIL 27

Session A, commencing 9:30 a.m.

On the processing of two- and three-channel program material for four-channel playback—*John Eargle, Mercury Records.* Dual-triphonic matrix stereo system—*Takeo Shiga, Michio Okamato of Nippon Columbia and Duane Cooper of the University of Illinois.*
At the push of a button and the flick of a switch: The design of a new studio complex—*John Mosely, Command Studios, London.*

Session B, commencing 9:30 a.m.

Airport noise management—*John Hilliard, Ramberg and Lowery, Santa Ana, Calif.*

Session C, commencing 2:00 p.m.

A new dynamic feedback cutter-head with associated solid-state driving system—*Howard Holzer, Holzer Audio Engineering, Los Angeles.*
Further improvements in performance of the Westrex 3D-II stereodisc system—*Frank Pontius and John Jarvis, Westrex, Beverly Hills, Calif.*
The education and tribulations of a precursory disc engineer—*Robert Callen, Glenn Sound, Los Angeles.*
Analysis of crosstalk in stereo discs—*Bernard Jacobs, Shure Bros., Evanston, Ill.*

Session D, commencing 2:00 p.m.

Chromium dioxide audio tape—*Klaus E. Naumann, Memorex Corp., Santa Clara, Calif.*

WEDNESDAY, APRIL 28

Session E, commencing 9:30 a.m.

A high-quality all horn-type transducer—*Raymond Newman, Electro-Voice.*
Transducers and industrial espionage—*Leo Jones, Saber Labs, San Francisco.*

Session F, commencing 2:00 p.m.

The world's most powerful sound system—*Robert Reim, Hannon Engineering, Los Angeles.*
Sound reinforcement systems for the modern high school and college complex—*Albert Huff, Hannon Engineering, Los Angeles.*
Acoustical design of Poppi Studios—two studios of 30,000 and 6,000 cubic feet respectively, plus control rooms and six reverb chambers—*Ronald McKay, Bolt, Beranek and Newman.*

Session G, commencing 2:00 p.m.

The Dorren compatible four-channel FM broadcast system—*James Gilbert, KIOI, San Francisco.*

THURSDAY, APRIL 29

Session H, commencing 9:30 a.m.

Double sound system—*Stan Horobin, CBC, Toronto.*

Session J, commencing 2:00 p.m.

The electrical design and musical application of an unconditionally stable combination filter-resonator—*Dennis Colin, Tonus, Inc., Mass.*

Session K, commencing 2:00 p.m.

A new approach for testing the hearing of new-born infants *Clinton Jorgensen, Beckman Instruments, Fullerton, Calif.*

FRIDAY, APRIL 30

Session L, commencing 9:30 a.m.

Determination of loudspeaker signal arrival times—*Richard Heyser, Calif. Inst. of Technology, Pasadena, Calif.*

Session M, commencing 2:00 p.m.

The Foster "Freqy," a new tool in audio. This is a frequency-shifting device with wide applications—*Don Foster, Amos Productions, Canoga Park, Calif.*

Session N, commencing 7:30 p.m.

A recording studio workshop—*Bill Lazerus* of Sunset Sound Recorders and *Brian Ingoldsby* of MCA Studios will present a live recording session with a mix-down from sixteen-track. A question and answer period will follow each process.

Further information can be had from the Audio Engineering Society, Room 428, The Lincoln Building, 60 E. 42nd St., New York, N.Y. 10017

Constructing A 10-Watt Stereo Amplifier

Dwight V. Jones*

Here is a 10 watt stereo amplifier which offers an excellent opportunity to get acquainted with IC's. It is ideal for the children's room as the preamplifier is matched for a ceramic cartridge—but it could have many other applications. The regulated and fully protected power supply section is mounted on a separate board, and this unit will certainly be useful around the workshop.

THE USUAL preamp used in conjunction with a ceramic cartridge attempts to have a high input impedance and utilize the amplitude response characteristics of the phono cartridge. With transistors it is difficult to achieve the desired input impedance with a simple preamp, and therefore the low frequency response often is deficient. The velocity response of a piezoelectric cartridge can be utilized by loading the cartridge sufficiently to give a rising output signal with increasing frequency of 6 dB/octave; this is similar to the response of a magnetic cartridge. The preamplifier input resistance should be low compared with the reactance of the cartridge capacitance. (See Fig. 1.)

The lower amplifier input resistance required for velocity response is easily attained with conventional bipolar transistors. The circuit in Fig. 2 gives an RIAA equalized output when used with ceramic cartridges that have 800 to 10,000 pF capacitance. The feedback equalization is from collector to base and therefore lowers the input impedance. This has the advantage of accepting a wide range of cartridge capacitance, it is also less susceptible to cable capacitance and noise pickup. The input impedance, which is about 30,000 ohms at 40 Hz, decreases with increasing frequency. This results in a velocity response from the cartridge. The higher capacitance cartridges (above 2000 pF) have a higher output when operated in the velocity-response mode. With the Astatic-137 cartridge (7800 pF) and the London PS 131 stereophonic frequency test record the output of the circuit of Fig. 2 is equalized within ±2 dB from 40 Hz to 12 kHz. The output reference level is 1¼ V, which is 14 dB below clipping and 70 dB above the unweighted noise level. The 1 kHz total harmonic distortion is less than 0.1% at 1¼ V output. Using the Astatic-17 cartridge (1000 pF), the preamp output is also equalized with ±2 dB but at about 10 dB lower output level. [1]

The cartridge loading for a velocity response provides damping and thus attenuates resonant peaks of the cartridge output. The RIAA equalized output is quite uniform without adjustments to the preamp for accommodating different cartridges—even those having different capacitance.

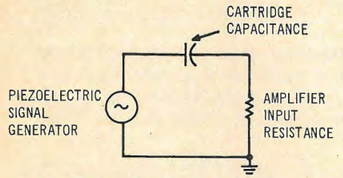


Fig. 1—Equivalent circuit of piezoelectric cartridge and load resistance.

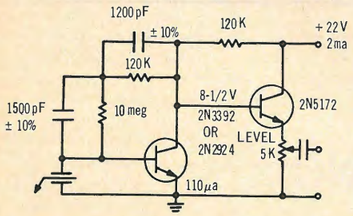


Fig. 2—Phono preamp for ceramic cartridges.

IC Power Amplifier

Linear power amplifier circuits are now available in monolithic form, and they are in plastic packages which have been designed for use on printed circuit boards. The General Electric PA246 is one of the higher power IC amplifiers and its frequency response extends well above the audio range to about 100 Hz. A pair of PA246's will give a stereo output of 10 watts continuous power (20 watts peak).

The monolithic circuit diagram of the 5 watt (PA246) amplifier is shown with a grey background in Figure 3 along with the external components used for a complete amplifier assembly. The PA246 has a quasi-complementary push-pull output circuit connection. Two transistors (Q4 and Q5) function as a composite NPN transistor while three transistors are required for the

*General Electric Co., Syracuse, N.Y.

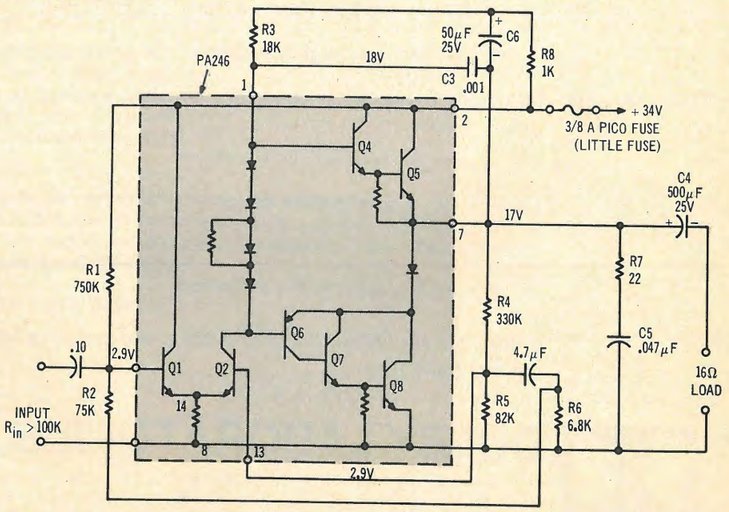


Fig. 3—Five watt IC amplifier.

composite PNP transistor since the h_{FE} of Q6 (lateral PNP) is low. This arrangement of push-pull composite transistors provides high current amplification so that R3 can be relatively large (18K) and enhance the voltage amplification. (See Reference #1 for more detailed discussion on quasi-complementary outputs and composite transistor connections, also basic IC fundamentals.)

Q1 and Q2 form a differential amplifier where Q1 operates as an emitter follower and drives Q2 as a quasi-common base stage. Q2 does operate common base when R6 is zero (i.e. feedback removed from base of Q2). This circuit has no phase inversion of the signal from input to output except within the composite PNP transistor. The differential amplifier has voltage source base bias and provides good bias stability against variations in h_{FE} for Q1 and Q2, and also against temperature variations. It is important that the d.c. bias voltage at lead #7 be stable if maximum power output at low distortion is to be maintained. The differential amplifier with d.c. feedback to the base of Q2 provides this stability.

The diode string between the bases of Q4 and Q6 provides the necessary d.c. bias voltage for the quasi-complementary push-pull output to minimize distortion at low signal levels. The quiescent power supply current is approximately 10 mA. At 5 watts sine wave output the peak current is about 800 mA and the d.c. supply current is 253 mA. This is an overall operating efficiency of 57%.

The power output diode in series with Q5 and Q8 assists in the bias stabilization of this direct-coupled circuit, and it also provides local a.c. feedback in the effective emitter of the "composite PNP transistor."

R8 and C6 in Fig. 3 provide positive feedback which increases the effective

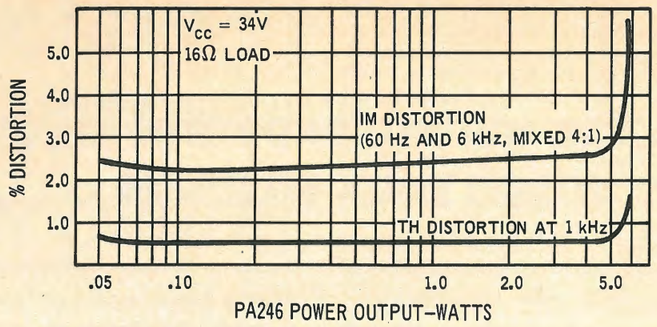


Fig. 4—Typical distortion versus power output level for PA246.

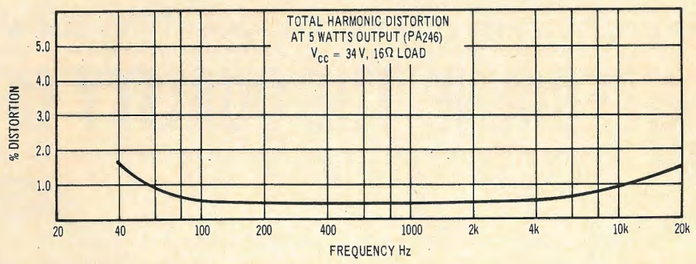


Fig. 5—Distortion versus frequency for PA246.

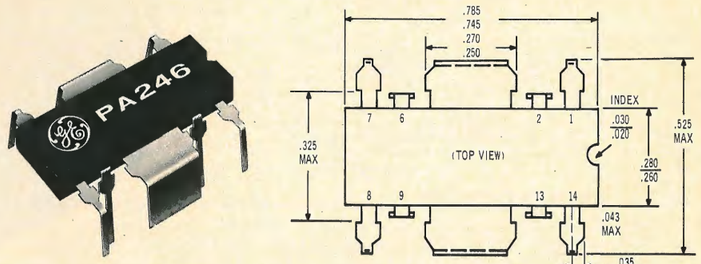


Fig. 6—Five watt IC package and outline giving lead identification.

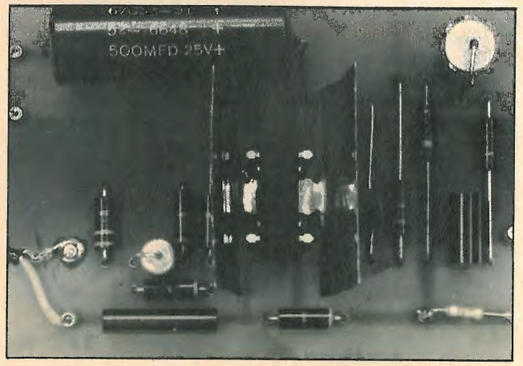


Fig. 7—Complete circuit assembly of five watt IC assembly diagramed in Fig. 3.

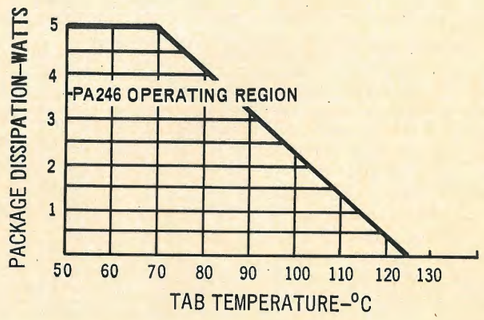


Fig. 8—Allowable PA246 package dissipation as determined by measured tab temperature.

resistance of R3 and thus increases the open loop (i.e. R6=0) voltage amplification by 16 dB for a total of 62 dB. The negative feedback with R6=6.8K is about 28 dB. An input signal level of 185 mV rms gives 5 watts power output.

The 0.001 pF capacitor, C3, decreases the open loop gain at the extreme high frequencies by decreasing the effective bootstrapping of R3. C3 provides high frequency stabilization when operating from a high impedance signal source, also with various output load conditions. Because of the high frequency capability of the monolithic transistors, more precautions are required to prevent high frequency oscillation than with discrete amplifiers. R7 and C5 are in parallel with the load and also serve to stabilize the circuit. The half power response (2½ watts output) of this circuit is -3 dB at 22 Hz and 100 kHz.

The input impedance of the PA246 is increased by bootstrapping R2 as shown in Figure 3. Since the signal at both ends of R2 is in phase, it increases the effective input impedance to over 100K ohms. The output inpedance is approximately 0.6 ohms.

Figure 4 indicates very good performance up to 5 watts with peak clipping occuring at higher power output. The distortion versus frequency is shown in Fig. 5.

The PA246 is shown in Fig. 6. It has two rows of staggered leads on each side which provide 0.140 inch lead spacing and simplify its use in printed circuit boards. The two tabs extending from each side of the PA246 are a common strip of copper to which the IC chip is attached. The tabs are to be soldered to a copper area on a printed circuit board to assist in transferring heat from the IC chip. In addition, a heat radiating fin with a tab should be soldered adjacent to each of the tabs of the PA246 to provide most of the heat transfer. This is illustrated in the complete assembly shown in Fig. 7.

The surface area of the heat fins are chosen to maintain the PA246 tab temperature within the rating as given in Fig. 8 under worst case operating conditions. The thermal properties of a printed circuit board can be improved by leaving the maximum amount of copper that is practical in the vicinity where the PA246 tabs are soldered. The copper area should include PA246 leads that are not used plus circuit ground (lead #8) so the substrate resistance between the top and bottom of the IC chip will be shorted.

The assembly shown in Fig. 7 used 0.015 inch thickness copper with an area of 2 square inches for each of the heat

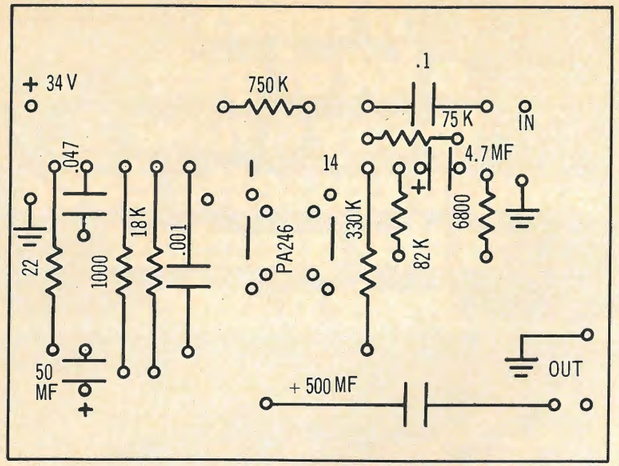


Fig. 10A—Parts layout, component side of PC board.

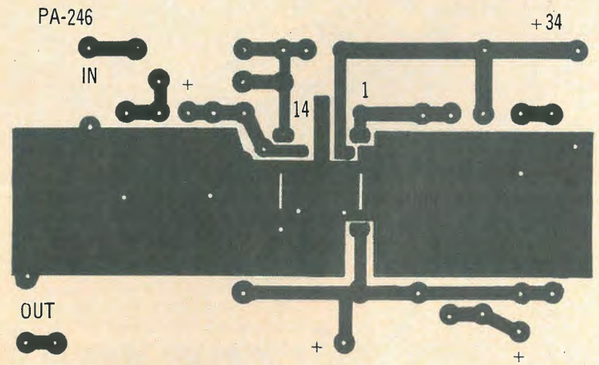


Fig. 10B—Pattern for printed circuit side of board.

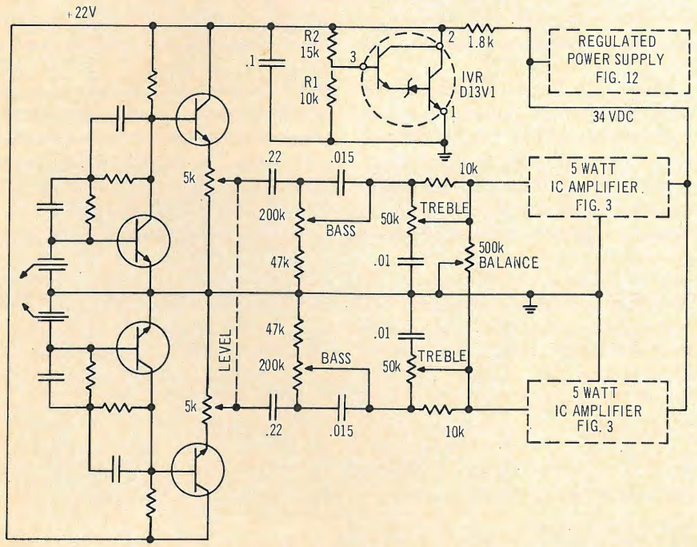


Fig. 11—Ten watt stereo phono system.

fins. This board assembly can deliver 5 watts of continuous power to a 16 ohm load (10 watts peak) in ambient temperatures up to 40 degrees Centigrade or 104 degrees Fahrenheit. Since the waveform of program material has an rms power content that is considerably less than half the peak power, this assembly is adequate up to 50 degrees C. (122 degrees F.) when used as a phonograph amplifier. Fig. 9 shows

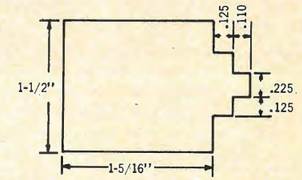


Fig. 9—Heat radiating fin of 0.015" copper.

an outline of the heat fins used in the assembly of Fig. 7. The layout of the components and the printed circuit pattern used to build the IC amplifier assembly are shown in Figs. 10A and 10B.

Preamplifier

The two-channel stereo system shown in Fig. 11 employs the preamp of Fig. 2 and the amplifier of Fig. 3. They are connected by the tone control network. Construction details have not been given for the preamp section as individual requirements may vary somewhat. For instance, some will want to use separate controls found in their "project" box, while others will want ganged units. Layout of the network is not unduly critical however, and some of the components can be mounted on the controls themselves. The volume control could be a dual-concentric type to avoid the necessity of having a balance control.

The 22 volt supply for the preamps is derived from a new low cost, integrated-voltage shunt regulator (IVR). Here the IVR is used like a programmable Zener, where the ratio of R2 to R1 programs the desired voltage (approximately 22 volts d.c.). The voltage across R1 is fixed by the IVR internal reference voltage between leads 3 and 1.

The main power supply for the system is regulated at +34 volts d.c. The luxury of a regulated power supply is now possible at a modest cost because of new semiconductors in plastic packages. The single quantity price of all the semiconductors used in the regulated supply of Fig. 12 is less than $5.00; the price is less than $20.00 for all the semiconductors in the complete stereo phono system.

Short Circuit Protection

This supply "shuts down" on overload like many laboratory supplies. Its speed is sufficient to protect the IC amplifiers when the load is directly shorted at full power output.

The supply (Fig. 12) uses a monolithic power Darlington transistor for the series regulating element, which is controlled by the integrated voltage regulator (IVR). A fraction of the regulated output voltage is compared with the reference voltage between pins 3 and 1 on the IVR. If the regulated output voltage should start to decrease, this would decrease the conductance of the IVR between pins 2 and 1, which increases the base current to the D40C4. This increases the conductance of the D40C4 which results in less voltage drop across it and thus raises the output voltage to maintain the regulated level.

The 2N5365 functions as a constant 1 mA supply to the base of the D40C4 and the IVR. The 1 mA is set by the stabistor (STB567) in conjunction with the 2N5365 and its emitter resistor, R1. The emitter-base junction of the 2N5365 plus the voltage drop across R1 equals the voltage drop across the STB567, thus the current through R1 is maintained at about 1 mA by the STB567 stabistor (forward biased diode reference). The 470 pF capacitor is used for high frequency stabilization.

R2 is the load current sensing resistor. With 0.82 ohms for R3, the current limits at 1.5 to 2.0 A by triggering the complementary SCR, C13F. When the SCR switches on it causes the emitter voltage of the 2N5365 to drop below its base voltage level, which is held two diode voltage drops below the unregulated supply. This cuts off the 2N5365, which is the source of bias current for the power Darlington, D40C4. Thus the supply is "shut-down" fast enough to protect its load which is the two 5W IC amplifiers. The supply must be reset after correcting the cause of the overload. The reset is accomplished by switching off the supply voltage with S1 until the SCR current decreases below its *"holding current"* level causing the SCR to turn off. Then S1 can be switched "on" and the supply is back in normal operation.

The dynamic output resistance of the supply is less than 0.1 ohm and the output voltage changes less than 1% with load current change from 0 to 1A peak. The ripple is less than 100 mV peak to peak. Æ

Reference

1. **Jones, D. V. and Shea, R. F.,** "Transistor Audio Amplifiers," John Wiley and Sons, New York, 1968.

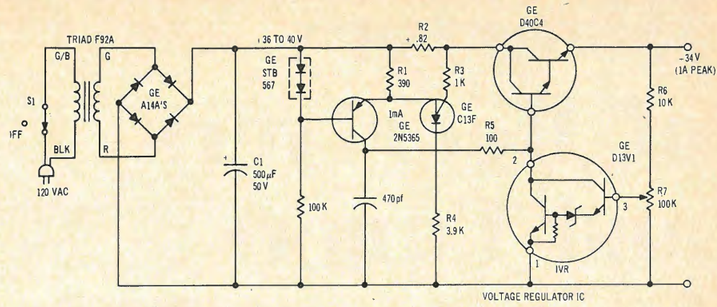


Fig. 12—Regulated power supply with electronic circuit breaker protection.

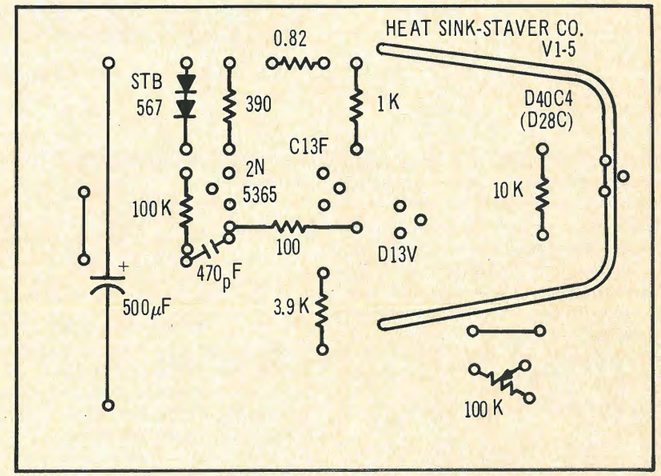


Fig. 13A—Parts layout for the component side of the PC board.

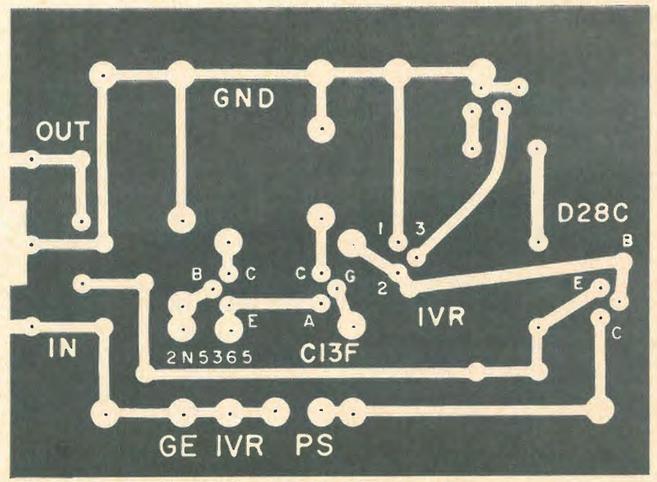


Fig. 13B—Pattern for the printed circuit side of the board.

Directory of Receivers and Tuners

BIC/LUX 71/2R

AKAI AA-6300

Readers should bear in mind that the specifications listed in the following pages are those supplied by the manufacturers—they are not the result of our tests or measurements. Note that only rms power output is shown, as this is considered to be the most accurate method of measurement. Obviously, not all products of each manufacturer are listed due to space limitations.

Glossary of Terms Used in the Charts

RMS Power—Also known as continuous power, this specification represents the most conservative rating of power output. The figures refer to the power from *each* channel driven simultaneously. Details of Music Power and other ratings were discussed at some length in the April issue.

THD at Rated Output—This is the Total Harmonic Distortion measured at 1000 Hz at full rated output. A top receiver should have less than 0.5% THD.

IM at Rated Output—IM means intermodulation and it refers to the generation of spurious sum-and-difference tones which cause very objectionable distortion. IM should be below 1% at all levels up to full rated output.

Power Bandwidth—Can be defined as the two extreme frequencies where the power output drops by half (3 dB). A good figure is 20 to 30,000 Hz.

Frequency Response—This is measured at a lower power level (1 watt) than the above figure so the response will usually be extended at both ends of the scale. The limits will depend on the design philosophy.

Phono Sensitivity—The input required to produce full rated output. Usually 2 to 4 millivolts.

Phono Overload—Maximum input handling capacity before overloading occurs. The safe figure will depend on the phono cartridge used but 80 mV will be adequate for the highest output cartridge generally available.

IHF Sensitivity—This is the number of microvolts of FM signal which must be applied to the antenna terminals of an FM tuner or receiver so that the program peaks will be 30 dB louder than any background noise and distortion. Anything less than 4 microvolts is good, with the best tuners and receivers measuring less than 2 microvolts.

Capture Ratio—Can be defined as the ability of an FM tuner to select the stronger of two stations when both are transmitting on the same frequency. Capture ratio is expressed in dB and anything lower than 3 dB can be considered very good.

THD Mono, 100% Mod.—Total harmonic distortion at 1000 Hz, fully modulated signal. Should be less than 1%.

THD Stereo, 100% Mod.—Usually slightly higher than the above figure.

Stereo Separation—This figure refers to channel separation at 100 Hz and is expressed in dB. The higher, the better, with 25 dB being the lowest acceptable

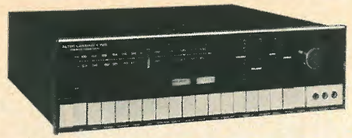
Tuning Indicator—Lists the type of tuning indicator used. Usually a single meter is employed but occasionally two are met with, one for center tune and the other for maximum signal strength. Sometimes a separate meter is used for AM.

Adjacent Channel Selectivity—Refers to the ability of a tuner to discriminate between the desired station and stations removed in frequency by two channel widths. Why two? Because stations with adjacent channels are not normally in the same geographical area. Alternate channel selectivity is expressed in dB and a good tuner would have a selectivity of 35 dB increasing to 45 or higher for a high performance unit.

AM Suppression—This refers to the tuner's ability to discriminate against amplitude modulated signals which include electrical interference. It is expressed in dB and should be at least 40.

Decibel (dB)—A unit for measuring the relative intensities of sound or the ratios between two electrical powers. Six dB represents twice the *voltage* ratio and 3 dB is twice the *power*. Thus a 54 dB noise factor (a ratio of 1:500) is twice the noise voltage of 60 dB (1:1000). A 20 watt amplifier gives 3 dB more power than a 10 watt amplifier, 6 dB more than a 5 watt unit.

More detailed information will be found in "Stereo Receiver Lexicon," which appeared in AUDIO for September and October, 1970.



Altec Lansing 725A

Bogen BR350

AR Receiver

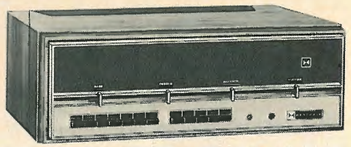
NOTES: (1) All models solid-state except when model number is preceded by (T)
(2) "K" indicates kit price; "W" indicates wired price

AMPLIFIER SECTION | TUNER SECTION

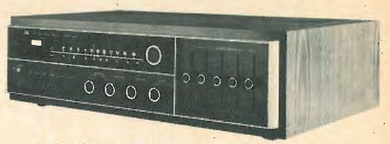
MANUFACTURER	MODEL	RMS Power/Chan., W	THD at Rated Power, %	IM at Rated Power, %	IM at 1 Watt, %	Power Bandwidth, Hz to kHz	1-Watt Freq. Response, Hz ±1 dB	Rated Output S/N, dB (phono)	Phono Sensitivity, mV	Phono Overload, mV	IHF Sensitivity, µV	Capture Ratio, dB	THD, Mono, 100% Mod., %	THD, Stereo, 100% Mod., %	Stereo Sep., 1000 Hz, dB	Tuning Indicator	Alt. Chan. Selectivity, dB	A.M. Band?	Dimensions, In. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
ACOUSTIC RESEARCH	Receiver AAU	60	0.5	0.25	0.25	14-44K	20-20K ±1db	57	2-5	100	2.0	2.0	0.5	0.5	35	Meter	>55	No	17¼ x 11¼ x 6	33	420.00	Wood case opt. $20 spkr. cables opt. $6 2 yr. guarantee.
	Univ.	Same as above except for 100, 120, 220, 240V., 50-60 Hz																				
ADC	606A		0.3	0.4	0.2	15-35K	10-60K ±1	55	3		2.5	3.0	0.5	0.5	32	Meter		Yes	17 x 5 x 9		199.50	Fits standard book shelf.
AKAI	AA6300	20 (8Ω)	0.15			20-30K		60	3		2.0	2.0	0.8	0.8	35	Meter	>50	Yes	17½ x 13½ x 5⅛	22½	229.95	
	AA8500	85 (4Ω)	0.5			20-30K	20-50K ±3	70	3		2.0	1.5	0.3	0.8	40	2 Meters	>55	Yes	19¼ x 14½ x 7	35½	389.95	
	AA6600	37.5 (8Ω)				20-30K	20-50K ±3	65	3		2.0	2.0	0.8	0.8	35	Meter	>50	Yes	17½ x 13⅜ x 5⅛	24½	269.95	
ALLIED (RADIO SHACK)	395	55	1.0				15-100K ±1.5		3		1.4	0.95	0.8	0.8	35	Meter	>50	Yes	16 x 13⅜ x 5½	30	299.95	
ALTEC LANSING	725A	60	<0.3	<0.3	<0.3	15-25K	20-20K ±0.5	60	2.0 5.0	30 60	1.8	1.3	<0.3	0.5	>40	2 Meters	70	Yes	17⅜ x 16½ x 5	48	699.00	Xtal filters; modular plug-in cctry; lin. scale slide contrs; indicator lights.
	724A	–	<.05 @1.0V	<.05 @2.5V	–	–	20-20K ±0.5	60	2.0 5.0	30 60	1.8	1.3	<0.3	<0.5	>40	2 Meters	70	Yes	17⅜ x 16½ x 5	42	550.00	Tuner-pre-amp only; otherwise as above.
	714A	44 (8Ω)	<0.5	<0.5	<0.5	15-25K	15-45K ±1	60	2.0 5.0	30 60	1.9	2.0	<0.5	<0.5	>40	2 Meters	48	Yes	16⅞ x 13⅜ x 5⅞	34	399.00	Xtal filters; ICs; fets; 4-gang tuning cap; slide contrs; fail-safe cctry.
AMPEX	ASR-100	18	0.8			20-25K	20-50K	60			3.0	4.0	0.8		35	Meter		Yes	16½ x 11¼ x 4 11/16		249.95	FET front end, muting; afc. switchable; main & rem. spkr. sws; incl. case
BIC/LUX	71/2R	75	0.2	0.4	0.4	15-30K	10-50K	60	2.0 8.0	100	1.2*	2.5	0.2	0.5	40			Yes	18½ x 13¾ x 6		580.00	*30dB S/N; 3FM pre-sets; lo & hi filters; var. turnovers;
	71/3R	50	0.2	0.4	0.4	15-30K	10-50K	60	2.0 8.0	100	2.2*	4.0	0.2	0.5	40			Yes	18½ x 13⅜ x 6		497.00	Same as above.
BSR McDONALD	McD 40	17.5	0.7	1.0	1.4	60-20K	20-20K ±1	55	3		2.2	3.5	1.0	1.5	22	Meter	31	Yes	15⅞ x 11 11/16 x 4⅞	15⅜	179.95	Auto AFC; headphone jack; stereo beacon; midnight dial.
	McD 78	7	1.5	1.3	1.5	60-10K	20-15K	50	85		10	3.9	1.5	1.5	25	Stereo Light	35	Yes	22¾ x 9⅛ x 4⅞	25 7/16 incl. spkrs.	219.95	Incl. speakers; AFC switch; A.C. conv. outlet.
	McD 20	7	1.5	1.3	1.5	60-10K	20-15K	50	85		10	3.8	1.5	1.5	25	Stereo Light	35	Yes	16 11/16 x 9 x 4⅞	16 incl. spkrs.	129.95	As above.
BOGEN	BR360	43	0.5	0.7	0.35	20-20K	20-35K ±2	60	3	60	2.7	1.9	0.3	0.4	35	Meter	60	Yes	16¼ x 14 x 4	20	299.95	Ceramic I.F.S.; ICs; FETS; slide contrs; "crescendo control"-expander compr.
	BR350	30	0.5	0.7	0.35	20-20K	20-35K ±2	58	3	60	2.7	1.9	0.3	0.4	35	Meter	60	Yes	16⅛ x 14 x 4	19	279.95	As above.
	BR340	30	0.5	0.7	0.35	20-20K	20-35K ±2	59	3	60	2.7	1.9	0.3	0.4	35	Meter	60	Yes	16¼ x 14 x 4½	19	249.95	As above, less crescendo control.
	BR320	15	0.5	0.7	0.35	20-20K	20-35K ±2	55	2.5	50	2.7	1.9	0.3	0.4	35	Meter	60	Yes	16½ x 14 x 4½	19	199.95	As above.
CONCORD	Mark 20	150 (4Ω)	0.2	0.7	0.4	5-40K	10-35K ±1	>65	3	–	1.7	1	0.6	0.7	>35	Meter	60	Yes	17½ x 14 x 5⅞	26	299.79	Slide controls; scratch filter; sep. on-off switch.
	Mark 12	90 (4Ω)	0.5	0.6	0.5	25-22K	20-25K ±1	>65	3	–	1.9	<2.0	0.6	0.7	>35	Meter	55	Yes	17½ x 12½ x 5⅞	24	239.79	Muting; 75-and 300-ohm antenna inputs.
	Mark 10	56 (4Ω)	0.5	0.6	0.5	25-20K	20-22K ±1	>65	3	–	2.0	<2.0	0.6	0.7	>35	Meter	55	Yes	17⅛ x 12¼ x 5⅞	21	199.79	Illuminated front ind-FM, Auto Stereo.

Receivers, cont.

Fisher 701



Heath AA-29



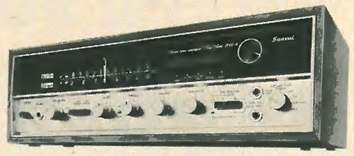
JVC 5040-2

NOTES: (1) All models solid-state except when model number is preceded by (T)
(2) "K" indicates kit price; "W" indicates wired price

MANUFACTURER	MODEL	RMS Power/Chan., W	THD at Rated Power, %	IM at Rated Power, %	IM at 1 Watt, %	Power Bandwidth, Hz to kHz	1-Watt Freq. Response, Hz ±? dB	Rated Output ±1 dB, dB (phono)	Phono Sensitivity, mV	Phono Overload, mV	IHF Sensitivity, µV	Capture Ratio, dB	THD, Mono, 1000 Mod., %	THD, Stereo, 1000 Mod., %	Stereo Sep., 1000 Hz, dB	Tuning Indicator	Alt. Chan. Selectivity, dB	A.M. Blank	Dimensions, In. W x D x H	Weight, Lbs.	Price	SPECIAL FEATURES
EICO	3770	20	0.7	2	0.6	20-30K	10-50K	70	270	90	3.5	4	0.75	0.75	40	Meter	45	Yes	16 x 9 x 4 1/16	14	189.95K 297.95W	Preassembled front end, i.f.'s, mpx; incls cab.
	3780	11	0.5	1	0.3	50-25K	20-40K ±3	60	2.7	90	3.5	4	1.75	1.75	33	Meter	20	Yes	16 x 9 x 4	10	109.95K 169.95W	FET's; pre-assembled front end, i.f.'s, mpx, incls. cab.
ELECTRO-VOICE	EV-1382	40	0.8	–	–	10-40K	10-55K ±1	70	2.5	140	2.5	3.0	0.8	–	32	Meter	40	Yes	18 x 17 x 5 1/16	23	333.00	Dual contrs; muting; main-rem. spkr. sw. incl. AM.
	EV-1282	19	0.8	–	–	20-20K	20-20K ±1.5	70	3.0	–	2.2	2.0	0.8	–	25	Meter	–	Yes	14 3/16 x 10 1/2 x 3 3/16	15	277.00	EV 1281, same less AM, $255.00.
	EV-1182	19	0.8	–	–	20-20K	20-20K	70	3.0	–	2.2	2.0	0.8	–	25	Meter	–	Yes	14 3/16 x 10 1/2 x 3 3/16	15	233.00	EV-1181, same less AM $210.00.
FISHER	701 4 Channel	(4) 40	0.57	0.87	0.15	20-25K	20-25K ±1.5	60	2.7	50	1.7	1.5	0.35	0.35	36	Meter	65	Yes	16 11/16 x 14 1/4 x 5 1/4	35	699.95	4 chan, Rcvr-Auto-scan elec. tuning; free remote control.
	500TX	65	0.5	0.8	0.15	8-35K	20-25K ±1.5	60	2.5 10	45 100	1.7	1.5	0.4	0.4	38	Meter	70	Yes	16 7/8 x 14 1/2 x 4 15/16	30	499.95	Auto-scan and Tune-o-matic tuning, XTAL & cer. filt, dual gate mosfets.
	450T	55	0.5	0.8	0.15	10-30K	20-25K ±2	60	2.5 7.5	4.5 135	2.0	2.5	0.5	0.5	38	Meter	45	Yes	15 1/2 x 14 1/8 x 4 3/8	25	399.95	Auto-scan elec. tuning, free remote control.
	250TX	35	0.5	1.0	0.2	20-25K	20-20K ±2	60	2.5 7.5	45 135	2.0	2.8	0.5	0.5	38	Meter	45	Yes	15 1/2 x 12 1/8 x 4 3/8	20	349.95	Tune-o-matic tuning model 210T W/o Tune-o-matic $299.95.
	202	28	0.5	0.8	0.2	25-20K	25-20K ±2	60	2.5 8.0	50 160	2.5	3.0	0.6	0.6	35	Meter	42	Yes	15 11/32 x 14 1/8 x 4 3/8	18 1/2	249.95	2 aux. imputs; muting; model 201 with 25 w/ch $199.95.
GROMES	503A	30	0.5	0.5	0.1	20-20K	15-50K ±1	75	2	60	2.0	3.0	0.5	0.5	35	Meter	45	Yes	16 x 13 x 5 1/2	–	349.95	
GRUNDIG	RTV 650	30 (4Ω)	0.3			10-30K	10-40K	60	3		2.0	2.0	0.5	0.5	40	Meter	50	Yes +SW	24 x 12 3/8 x 6		520.00	5 Preselec. Stns. Includes 2 SW bands.
KARMAN-KARDON	330	18	0.6	0.4	0.1		7-70K ±1	80	2.5	90	2.5	3.0	0.5	0.6	30	Meter		Yes	15 5/16 x 13 x 4 13/16	20	199.95	Function ind lts; tape mon:
	230	10.5	0.8	0.6	0.2		15-70K ±1.5	70	2.5	85	2.7	4.0	0.8	0.8	30	Meter		Yes	14 13/16 x 7 9/16 x 3 7/8	14	159.95	AM and FM dial scales separately lighted; tape mon.
HEATH	AR-15	50	0.5	0.5	0.2	6-30K	8-40K ±1dB	60	2.2	155	1.8	1.5	0.5	1.0	40	2 Meters	70	Yes	16 7/8 x 14 1/2 x 4 3/8	27	349.95 K	FETs; IC i.f., ldness & spkr. sws; stereo-only sw; stereo thresh. & mute-level contrs;
	AR-29	35	0.25	0.2	0.1	5-30K	7-60K ±1	65	2.2	155	1.8	1.5	0.5	0.5	40	2 Meters	70	Yes	16 3/4 x 14 1/2 x 5 1/16	26.5	285.00 K	FETS; IC i.f.; LC filters; spkr. 1 & 2 sws; AM tuner; input level controls, ldness contl.
	AR-19	20	0.25	0.25	0.1	5-30K	6-35K ±1	65	2.4	155	2.0	2.5	1.5	1.5	35	2 Meters	35	Yes	16 3/4 x 14 1/2 x 5 7/8	26.5	225.00 K	FETs; IC i.f.; spkr 1 & 2 sws; AM tuner; input level contrs; ldness & tone-flat sws.
	AR-14	10	1.0	1.0		15-50K	12-60K ±1	60	4.5		5.0	3.0	1.0		30			No	15 1/4 x 12 x 3 7/8	14	119.95 K	Afc; phone jack; stereo indicator; stereo phase adj.
	AR-17	5	1.0	2.0		25-35K	25-35K ±1	45	5.0		5.0	3.0	1.0		30			No	12 x 10 3/8 x 3	7	72.95 K	Compl-sym output; stereo phase adj; stereo indicator.
JVC	5040-2	83 (4Ω)	<0.5	<0.8	0.1	18-30K	20-55K +0,–2	70	1.5	75	1.8	1.2	<0.5	0.2	40	Meter	60	Yes	20 3/4 x 15 1/2 x 5 7/8	36	449.95	Snd. effect ampl (SEA) divides range into 5 sep. ±12dB contr. bands.
	5030-3	50 (4Ω)	0.5	0.8	0.15	25-30K	20-40K +0,–2	70	1.5	75	1.8	2.0	0.5	0.3	35	Meter	50	Yes	20 x 13 x 4 3/8	30.8	399.95	As above. Linear FM dial scal.
	5020	28 (4Ω)	0.5	0.8	0.2	30-30K	25-40K +0,–2	65	1.5	70	2.5	3.0	0.8	0.35	35	Meter	45	Yes	20 x 13 x 4 3/8	28.6	299.95	As above.
	5010	16 (4Ω)	1.0	1.0	0.2	30-30K	25-25K +0,–2	65	2.0	70	2.5	4.0	0.8	0.5	33	Meter	45	Yes	16 11/16 x 13 x 4 1/2	17.2	229.95	As above.

Receivers, cont.

Marantz 22



Sansui 5000A

Harman-Kardon 230

NOTES: (1) All models solid-state except when model number is preceded by (T)
(2) "K" indicates kit price; "W" indicates wired price

MANUFACTURER	MODEL	AMPLIFIER SECTION: RMS Power/Chan., W	THD at Rated Power, %	IM at Rated Power, %	IM at 1 Watt, %	Power Bandwidth, Hz to kHz	1-Watt Freq. Response, Hz +-1 dB	Rated Output S/N, dB	Phone Sensitivity, mV	Phone Overload, mV	TUNER SECTION: IHF Sensitivity, µV	Capture Ratio, dB	THD, Mono, 100% Mod., %	THD, Stereo, ±50% Mod., %	Stereo Sep., 1000 Hz, dB	Tuning Indicator	Alt. Chan. Selectivity, dB	A.M. Band ?	Dimensions, in. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
KENWOOD	KR-7070	90 110*	0.5	0.5	0.1	10-30K	12-40K ±1.5	65	0.06 0.6 2.5	100	1.5	1.5	0.4	0.6	35	Meter	75	Yes	17 x 15 x 6½	40	549.95	*4-ohms; 3-way tuning-auto, remote, man.
	KR-6160	70 90*	0.5	0.5	0.1	12-30K	15-40K ±1.5	65	2.5	100	1.6	1.5	0.5	0.7	35	2 Meters	55	Yes	16½ x 12¼ x 5½	30	379.95	FET's, IC, mic mixing w mic, 3-set spkr output, 3 tone cont.
	KR-5150	40 50*	0.5	0.5	0.1	17-30K	20-40K ±1.5	62	2.5	100	1.7	2.0	0.5	0.7	35	2 Meters	55	Yes	16½ x 12¼ x 5½	26	329.95	FET's, IC's 2-mtrs for FM, 3-sets spkr output, step tone control.
	KR-4140	24 33*	0.5	0.5	0.1	18-30K	20-40K ±1.5	60	2.5	100	1.8	2.5	0.5	0.7	35	Meter	55	Yes	16½ x 12½ x 5½	23	259.95	FET's, IC's; 2-pair phone input, mic input; lo and hi filters.
KLH	27	30	<0.5	<0.5	<0.25	17-20K	6-25K	65	1.5	105	2.0	3	0.5	0.8	35	Meter	35	Yes	13½ x 14¾ x 4½	18	319.95	Sep. planetary tuning; FETs; 5 stg. IF; MX noise filt.
LAFAYETTE	LR-1500TA	70	0.8			18-55K		60	1.8, 4.5, 12.0		1.5	1.25		0.3	40	Meter	50	Yes	16⅜ x 4⅝ x 14¼	35	299.95	Auto o'load prot; muting; "Acritune"; auto stereo sw.
	LR-775		0.8			15-30K		60	2.3, 80, 250		1.7	1.5		.07	40	Meter		Yes	14½ x 4 x 10¼	15	199.95	Fused outputs; auto stereo switching.
	LR-100		0.8			35-30K		60	2.3, 80, 250		2.5	5		0.1	35	Meter	35	Yes	14½ x 4½ x 10½	15	129.95	As above.
	LR-75		0.7			20-20K		55			3.5	5			30	Meter	35	Yes	13 x 4½ x 9⅞	14	109.95	As above.
MARANTZ	19	50	0.15	0.15	0.2	7-40K	20-20K ±0.5	75	1.0		1.8	3.5	0.15	0.15	45	Scope	50	No	18¼ x 16 x 5¾	46	1,000.00	Built-in scope.
	22	40	0.3	0.3		20-30K	20-20K ±0.5	70	2.0		2.4	2.5	0.3	0.5	40	2 Meters	40	Yes	16⅞ x 14 x 5	30	449.00	Var. overlap drive.
	27	30	0.3	0.3		20-30K	20-20K ±0.5	70	2.0		2.8	3.0	0.3	0.5	34	2 Meters	40	Yes	14⅞ x 15 3/16 x 5 7/8	35	319.00	
	26	10	1.0	<1.0		20-30K	20-20K ±0.5	65	2.0		3.0	3.0	0.5	0.7	30	1 Meter	40	Yes	15½ x 12½ x 3 13/16	22	219.00	Auto. circuit bkr.
	28	20	0.5	<1.0		20-30K	20-20K	67	2.0		2.8	2.5	0.4	0.4	35	1 Meter	40	Yes	18⅛ x 16½ x 6⅞		229.00	
MIKADO	2470	19	0.5				20-20K		3.0		2.0	2.5		0.6	38	Meter		Yes	19¼ x 15 x 5⅛	21	199.95	Blackout dial, FET's.
	2230	10	<1.0	–	–	–	–	55	3.0	–	2.5	–	–	–	30	Meter	–	Yes	15¾ x 10½ x 4⅛	22½	139.95	
	2420	10	1.0				20-40K		2.0 6.0		3.5	5.0		2.0	25	Meter		Yes	15 x 11 x 4½	13	129.95	
	2210	7	<1.0	–	–	–	30-20K ±2	50	2.2	–	3.0	–	–	–	30	Meter	–	Yes	14½ x 10⅝ x 4¾	21	109.95	
NIKKO	STA-1101	40	0.3	0.6		20-30K		75	2		1.5	1.5	0.6	1.0	40	Meter	60	Yes	18½ x 14⅜ x 6½	33	399.95	6 FETs; 12 ICs; 2 xtal filtrs; 2 mic inputs; 2 phone jacks; sep. vol contr for rem spkrs.
	STA-701B	25	0.8	1.0		20-20K		65	2.8		1.8	3.0			40	Meter		Yes	14¼ x 12⅞ x 4½	17	239.95	2 FETs, 3 ICs; AFC; muting; dual tone contrs; cct bkrs protection; tape-head input.
	STA-501S	18	0.8	1.0		20-20K		65	2.8		1.8	3.0			40	Meter		Yes	15¼ x 12⅞ x 4½	17	189.95	2 FETs, 3 ICs; AFC; muting; dual tone contrs; scratch and tumble filters; cct bkr prot.
	STA-301	10	0.8	1.0		30-20K		65	28		2.5	4.5			32	Meter		Yes	14¼ x 12⅞ x 4½	14	159.95	FETs in front end; 2 ICs in pre-amp sect; cct. brkr prot.

Receivers, cont.

Scott 387

Pioneer SX-990

Panasonic SA-70

MANUFACTURER	MODEL	AMPLIFIER SECTION: RMS Power/Chan., W	THD at Rated Power, %	IM at Rated Power, %	IM at 1 Watt, %	Power Bandwidth, Hz to kHz	1-Watt Freq. Response, Hz ±2 dB	Rated Output/5 M dB (Phono)	Phono Sensitivity, mV	Phono Overload, mV	TUNER SECTION: IHF Sensitivity, µV	Capture Ratio, dB	THD, Mono, 100% Mod., %	THD, Stereo, 100% Mod., %	Stereo Sep., 1000 Hz, dB	Tuning Indicator	Alt. Chan. Selectivity, dB	A.M. Band?	Dimensions, In. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
PANASONIC	SA6500	60	0.5	1.0		15-60K			3 3		1.8	1.5	0.5		40	2 Meters		Yes	16⅞ x 15¼ x 5⅞	34	399.95	Dual tuning mtr. blackout front direct coupling.
	SA70	32	0.8	1.0		15-70K			4 18		2.0	2	0.5		37	Meter		Yes	19⅛ x 14 x 5¼	29	349.95	
	SA60	22.5	0.8	1.0		20-50K			3.5 10		2.2	2.5	0.6		35	Meter		Yes	19¾ x 14 x 5¼	25	279.95	
	SA40	12	0.8	1.2		20-50K			3.5 10		2.8	3	0.7		35	Meter		Yes	18 x 14 x 5	20	219.95	
PIONEER	SX9000	85 (4Ω)	0.5	1.0	0.2	15-40K	10-100K ±3	65	2.5		1.6	1.0	0.8	0.8	42	Meter	40	Yes	20 5/16 x 7⅝ x 13 9/16	35	499.95	Built-in reverb.
	SX-1500TD	70 (4Ω)	0.5	0.5	0.2	15-40K	10-100K ±3	60	3.3	80	1.7	0.7	0.8	0.8	42	Meter	40	Yes	18 1/16 x 14½ x 5 11/16	25	399.95	FET & ICs; pre-amp out and main-amp-in jks; incls wd. cab.
	SX-990	35 (4Ω)	0.5	0.5	0.2	15-40K	10-100K ±3	62	3.3	80	1.7	0.7	0.8	0.8	42	Meter	40	Yes	18 1/16 x 14½ x 5 11/16	25	299.95	As above.
	SX-770	20 (4Ω)	0.8	0.5	0.3	15-35K	20-40K ±3	70	2.5	75	1.8	2.0	0.8	0.8	40	Meter	40	Yes	16 15/16 x 13¾ x 5 13/16	21	249.95	FETs and ICs; incls wood cab.
	SX-440	15 (4Ω)	0.8	0.8	0.3	30-20K	20-70K ±3	60	3.6	80	2.5	2.5	0.8	0.8	35	Meter	40	Yes	15 5/16 x 13⅜ x 5 7/16	18	199.95	FET front end; incls wood cab.
SANSUI	5000A	75	<0.8	<0.8		15-30K	10-50K ±1	>65	2.5		1.8	1.5		<0.5	>35	Dual Meter	>50	Yes	17¼ x 14½ x 5	29	399.95	Linear tuning, 3 spk. systems.
	4000	65	<0.8	<0.8		20-30K	10-50K ±1	>70	2.5		1.8	1.0		<0.5	>35	Dual Meter	>50	Yes	17¾ x 13¼ x 5¼	31	349.95	As above plus wide dial.
	2000A	43	<0.8	<0.8		20-40K	10-50K ±1	>60	2.5		1.8	1.0		<0.8	>35	Meter	>40	Yes	18 x 13½ x 5	27	299.95	As above, except 2 spk. syst. sel. switch.
	1000X	35	<0.8	<0.8		20-30K	15-40K ±1	>60	2.5		2.0	2.5		<0.8	>35	Meter	>40	Yes	16½ x 12 x 5⅛	23	269.95	As above.
SCOTT	636	26	<0.8	0.5	0.3	20-20K	15-15K	65	3.0		2.2	2.0	0.6	0.8	35	Meter	40	Yes	17¾ x 11 x 4⅜		259.95	
	387	100 (4Ω)	0.5	0.5	0.3	10-38K	20-15K ±1	65	4.2H 8.5L		1.9	2.5	0.6	0.8	35	Mtr. perf. tune	40	Yes	17½ x 15 x 6		399.95	
	386	42 (4Ω)	0.5	0.5	0.3	15-25K	15-30K ±1.5	65	3H 6L		1.9	2.5	0.6	0.8	35	Mtr. perf. tune	40	Yes	17½ x 14¾ x 5⅜	22	329.95	
	382-C	30 36 (4Ω)	0.6	0.5	0.3	20-20K	15-15K	65	3		1.9	2.5	0.6	0.8	35	Mtr. perf. tune	40	Yes	15⅜ x 11½ x 5	17	170.00	
	342-C	36 (4Ω)	0.6	0.5	0.3	20-20K	15-15K	65	3		1.9	2.5	0.6	0.8	35	Mtr. perf. tune	40	No	15⅜ x 11½ x 5	17	163.00	
	631	23 (4Ω)	0.5	0.5	0.3	25-20K	20-15K	65	4.5		2.5	2.5	0.7	0.8	35	Meter		Yes	14⅛ x 14⅛ x 4⅞		199.95	
SHERWOOD	SEL-200	85	0.2	0.6	0.1	8-35K	20-20K ±0.5	68	1.6	100	1.5	1.7	0.15	0.3	40	2 Meters	70	No	18¼ x 13 x 5⅜	33	599.00	Excl. "Legendre" toroid FM i.f. filt; FET hush circuit.
	S 8900	70	0.35	0.6	0.15	12-30K	20-20K ±0.5	65	1.6	120	1.7	1.9	0.15	0.3	40	Mtr. zero	65	No	16¼ x 14 x 5¾	28	399.95	Ceramic filt; FET hush cir.; avail. w. AM - 439.95.
	S 8500	60	0.6	0.8	0.2	18-25K	20-20K ±1.0	65	2	65	1.8	2.0	0.15	0.3	40	Mtr. zero	60	No	16¼ x 12 x 5¾	23	299.95	Ceramic FM IF filt. avail. w. AM - 339.95.
	S 7100	30	1.0	1.0	0.3	25-20K	20-20K ±1.0	65	1.5	60	1.9	2.8	0.5	0.9	40	Meter	40	No	17½ x 13½ x 5⅜	30	199.95	Walnut case included.

Receivers, cont.

NOTES: (1) All models solid-state except when model number is preceded by (T)
(2) "K" Indicates kit price; "W" Indicates wired price

MANUFACTURER	MODEL	AMPLIFIER SECTION: RMS Power/Chan., W	AMP: THD at Rated Power, %	AMP: IM at Rated Power, %	AMP: IM at 1 Watt, %	AMP: Power Bandwidth, Hz to kHz	AMP: 1-Watt Freq. Response, Hz ± dB	AMP: Rated Output S/N, dB (Phono)	AMP: Phono Sensitivity, mV	AMP: Phono Overload, mV	TUNER SECTION: IHF Sensitivity, µV	TUNER: Capture Ratio, dB	TUNER: THD, Mono, 100% Mod., %	TUNER: THD, Stereo, 100% Mod., %	TUNER: Stereo Sep., 1000 Hz, dB	TUNER: Tuning Indicator	TUNER: Alt. Chan. Selectivity, dB	TUNER: A.M. Band?	Dimensions, In. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
SONY	STR-6200F	70	0.2	0.3	.05	10-40K	10-100K	70	1.5	100	1.8	1.5	0.2	0.35	40	2 Meters	80	Yes	19 x 15⅞ x 5 11/16	34	699.50	Hi & Lo filters, Blend switch.
	STR-6065	70	0.2	0.2	0.15	15-30K	20-60K ±3	65	2.1	90	2.2	2	0.3	0.5	40	Meter	80	Yes	17⅜ x 13 13/16 x 5 9/16	29	399.50	
	STR-6055	40	0.2	0.2	0.2	15-30K	30-50K ±3	65	2.5	90	2.6	2	0.4	0.5	40	Meter	70	Yes	17 5/16 x 13⅜ x 5 11/16	20	279.50	
	STR-6045	25	0.5	0.5	0.2	10-30K	10-50K ±3	60	2.5	90	2.6	1.5	0.4	0.5	35	Meter	70	Yes	15⅜ x 12¼ x 5⅜	18	229.50	
	STR-222	8	0.8	3.0	1.5	20-20K	30-50K ±3	60	3.5	80	3	2	0.4	0.5	38	Meter	60	Yes	16 9/16 x 12 5/16 x 4⅜	12.5	149.50	
STANDARD	SR-A1000S	20	0.8			15-30K	15-50K ±3	70	2.5		3.5	3.5	0.8	0.8	35	Meter	45	Yes	16¼ x 12⅝ x 5⅜	16	209.95	
VM CORPORATION	1521	40	0.5	0.5	0.5	20-20K	9-30K	65	2.0	50	1.9	3.8	0.5	0.5	40	Meter	45	Yes	18⅞ x 12 x 6 7/16	30	500.00	(2) 5-pole toroidal filters; (2) dual gate Mosfets in front end.
	1520	25	0.5	0.5	0.5	20-20K	9-30K	65	2.0	50	1.9	3.8	0.5	0.5	40	Meter	45	Yes	18 7/16 x 12 x 6 7/16	30	460.00	As above.
YAMAHA	AA-70	35* 30	0.1	0.3		30-20K	30-20K ±1	65	3.0		2.5		0.5		40	Meter		Yes	18½ x 17¼ x 5½	24	229.50	*4 ohms; loudness contr,

Tuners

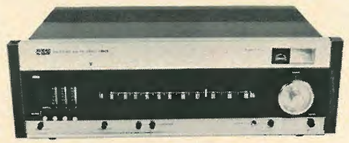
Heath AJ-15

MANUFACTURER	MODEL	IHF Sensitivity, µV	THD, Mono, 100% Mod., %	Capture Ratio, dB	Alt. Chan. Selectivity, dB	Frequency Response, Hz ± dB	AM Suppression, dB	Stereo Separation, 1000 Hz, dB	Stereo Separation, 10 kHz, dB	THD, Stereo, 100% Mod., %	Tuning Indicator	S/N, dB	Dimensions — In. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
BIC/LUX	71/5T	1.2*	0.2	2.5		20-15K ±1	80	40		0.5	Meter	60	18½ x 12½ x 6		322.00	*30 dB S/N; center-tune ind. light; 3 FM pre-sets; incls. AM
	71/7T	2.2*	0.5	4.0		20-15K ±1	70	30		0.7	Meter	50	16½ x 9 x 5		179.00	*30 dB S/N; hi & lo Z phone jack; incls. AM.
DYNACO	FM-5	1.75	0.25	1.5	65	5-15K ±1	70	40	30	0.25	Meter	65	13½ x 9 x 4¼	11	149.95K 249.95W	Automatic tuning control. uses 10 IC's.
EICO	3300	3.5	1.75	4	20	40-15K ±1	40	33	25	1.75	Meter	60	12 x 7 x 3⅛	6	69.95K 109.95W	FET; pre-assembled front end, mpx i.f.'s; incls. cab.
ELECTRO-VOICE	EV-1255	2.5	1.0	2.5		30-15K ±1		30		1.5	Meter	60	8¾ x 10¼ x 3⅜		147.60	Movable station markers; afc.
GROMMES	108A	2	0.5	3	45	20-15K ±1	45	35	25	0.5	Meter	65	13½ x 10 x 4¾		199.95	
HEATH	AJ-15	1.8	0.5	1.5	70	20-15K ±1	50	40	25	1.0	2 Meters	70	16⅞ x 12½ x 4¾	11½	189.95K	Xtal filters; IC i.f., FETS, phase adjust; stereo-only mode; auto noise operated squelch; black panel styling
	AJ-14	5.0	1.0	3.0		20-15K −3, +0	40	30				50	12 x 9¾ x 3¼	4.5	57.95K	Pre-built, pre-aligned front end; stereo/mono switch; stereo phase contr.; stereo indicator light.
KLH	18	2	0.5	3.0	35	30-15K ±1	50	35	20	0.8	Meter	55	9 x 5⅜ x 4¼	4	129.95K	FET front end; 5 i.f.'s; zero-ctr tuning mtr; planetary tuning contr., mx noise filter; incls. cab.

Tuners, cont.

Pioneer TX-700

Marantz 20



BIC/LUX 71-5T

NOTES: (1) All models solid-state except when model number is preceded by (T)
(2) "K" indicates kit price; "W" indicates wired price

MANUFACTURER	MODEL	IHF Sensitivity, μV	THD, Mono, 100% Mod., %	Capture Ratio, dB	AIL Chan. Selectivity, dB	Frequency Response, Hz ±1 dB	AM Suppression, dB	Stereo Separation, 1000 Hz, dB	Stereo Separation, 10 kHz, dB	THD, Stereo, 100% Mod., %	Tuning Indicator	S/N, dB	Dimensions–in. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
KENWOOD	KT-5000	1.7	0.6	2.5	50	20-15K −2, +0	55	35	25	0.9	2 Meters	60	16 7/16 x 11 x 5¼		179.95	2 FET's, muting, AM.
	KT-7000	1.5	0.3	1.5	60	20-15K +0, −2	60	35	25	0.6	2 Meters	70	16½ x 11 x 5	18	249.95	Xtal filters, IC's. FET's. S-mtr and zero-ctr tuning mtr, multipath output, muting, noise filter, output level control; incls. AM.
	KT-2001	2.0	0.5	4.0	45	20-15K +0, −2	50	30	20	0.7	Meter	60	13 x 9½ x 5	9.5	99.95	FET front-end, IC i.f. stage, stereo noise filter; incls. AM.
LAFAYETTE	LT-725	1.7	0.25	1.5	50			40		0.25	Meter	75	12 x 9⅛ x 3⅜	10	99.95	Auto stereo sw; int. FM ant; Flex. AM loopstick.
	LT-670	3.5		5	30			30			Lit.	50	10¾ x 8⅛ x 3½	9	69.95	Auto FM station lock; front panel tape output; int. AM and FM ants.
LEAK	Stereofetic	2		3.5	55	40-15K ±1	50	30	20	0.25	Meter	60	11½ x 7⅜ x 4¼	6⅝	225.00	"Quasi-stereo" sw reduces noise on dist. stas; tuning ind. acts as tuning meter and stereo indicator. FM only.
MARANTZ	20	1.8	0.15	3.5	73	20-15K ±0.5	40	45	35	0.15	Scope	73	15¾ x 14⅛ x 5¾	24	595.00	FM only.
	23	2.4	0.3	2.5	80	20-15K ±1.0	50	40		0.5	2 Meters	70	15¾ x 12½ x 5¼	16	259.00	Incls. AM.
NIKKO	FAM-14	1.8		1.5	60	50-15K ±1	60	40	30	1	Meter	60	13 x 9½ x 3¾	8.8	139.95	Dual-gate FET: cer. filters; muting cct; dial light contr also contrs vol for head-phone ampl; plug-in modules; cct brkrs, inc. AM.
	FAM-12	1.8		3.0	55	50-15K ±1	50	40	30	1	Meter	60	12 x 10 x 3½	7.7	119.95	FET's in FM and AM front end; noise filter; A.F.C.; muting circuit.
NORELCO	697	3.0	1.0	4	46	20-15K ±2		30	28	1.5	Meter	58	14 x 10 x 3½	7.5	179.95	2 shortwave bands 2.2–7.3 and 9.5 to 22 MHz, includes AM broadcast band.
PIONEER	TX-900	1.7	0.3	1.5	65	50-15K ±2		38	20	0.5	2 Meters	67	15 15/16 x 14 x 5½	17	259.95	3-FET front end; 2 crys. filtrs. and 4 ICs in i.f. unit; mpx filtr; muting sw; sep level contrs for AM and FM; incls AM.
	TX-700	2.2	0.5	2.0	35	50-15K ±2		42	20	0.8	Meter	52	13¼ x 10 9/16 x 4 5/8	12	199.95	FET front end; 2 ICs in i.f. unit; push-button preset; muting and mpx filter sw; incls AM.
	TX-500	2.5	0.5	2.5	40	50-15K ±2		35	17	0.8	Meter	50	13 x 13⅛ x 5	11	109.95	FET front end; incls. AM.
SAE	Mk. VI	1.6	<0.1	1.9	75		>60	40		<0.1			17 x 10½ x 5¾		950.00	Digital tuning, built-in scope, Digital readout 14 pole, Butterworth filter. FM only.
SANSUI	TU-999	1.8	<0.3	1.5	>70		>80	>38		<0.5	2 Meters	>65	17 x 13 x 6	22	279.95	FETs, ICs, crys filtrs; sig. str mtr; zero ctr tng mtr; muting; noise filtr; 300- and 75-ohm ant. input; incls AM.
SHERWOOD	S2300	1.8	0.15	2.0	55	20-20K ±1	45	40	40	0.15	Zero Meter	70	14 x 10¼ x 4	11	199.95	Available mounted on 19" commercial rack panel. Includes AM.
	S3300	1.8	0.15	2.0	55	20-20K ±1	45	40	40	0.15	Zero Meter	70	14 x 10¼ x 4	11	169.95	Available mounted on 19" commercial rack panel.
	S2500	1.8	0.15	2.0	55	20-20K ±1	45	–	–	–	Zero Meter	70	14 x 10¼ x 4	11	159.95	Same as above. Mono. FM. Includes AM.
SINCLAIR (Audionics)	Project 60	2.0	0.15	1.5		10-15K ±1				0.15	Light	>65	8⅞ x 3½ x 1½		74.95	Uses P.L.L. circuit. No cabinet supplied, 30 v d.c. supply PZ-5, 513.395. FM only.
SONY	ST-5000F	1.8	0.2	1.5	90	20-15K ±0.5	65	40	30	0.35	2 Meters	70	15⅜ x 12⅛ x 5⅜	21	449.50	FET front end; 8 element s/s i.f. filtrs. FM only.
	ST-5100	2.6	0.3	1.5	80	20-15K ±1	65	40		0.5	2 Meters	70	16 9/16 x 12⅝ x 5 11/16	15.4	219.50	AM included.
	ST-5600	3	0.3	2	50	30-15K ±1	60	38		0.7	Meter	65	16 19/32 x 10½ x 4 7/8	9	119.50	AM included.

Construction of a Madsen-System Delay Tube

This wide-range, time-delay unit adds ambience to a stereo system

Part II

Duane H. Cooper

Equalization

When the equalization requirements posed by the dashed curve of Fig. 6 are compared with a measured response curve, shown solid, it is seen that the R-50 cartridge functions rather well as a tube driver. For the measured curve of Fig. 6, no cavities had been applied to either one, no equalization networks had been used, and the sharp dip at about 9 kHz was still present. In this experimental setup, straight tubing, including a terminating tube of 5-foot length, was used, and the ripples in the response indicate that the reverberation level is some 25 dB weaker than the direct propagation for bass frequencies, and essentially unobservable at treble.

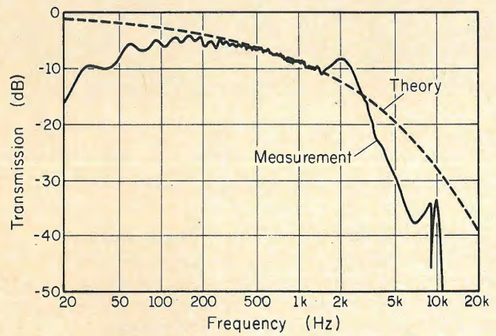


Fig. 6—Equalization requirements. The dashed curve shows the theoretical transmission response of the tube, and the solid curve shows the transmission with the transducers used, but without any of the equalization devices ultimately employed.

For this service, the R-50 departs from the ideal mostly in presenting a peak between 1.5 kHz and 3 kHz and in showing a treble roll-off of 12 dB per octave, from there up to 6 kHz, in excess of the 6-dB-per-octave slope of the loss curve in this vicinity. It was planned at once to use two 6-dB-per-octave boost networks, one at each cartridge, similar to those of Fig. 5, but with break frequencies of 3 kHz and 6 kHz. Thus, the theoretical loss curve would be reasonably well fulfilled. Then, the plan would be to try to discover further means of equalization.

This plan was to exploit only passive equalization devices, reserving tone-control equalization as a last step. Moreover, no modification of the internal structures of the cartridges was to be undertaken, so that only home-workshop methods need be used. The result is a rather inelegant patchwork equalization design, including patches upon patches, as will be seen. However, it is a design that works and one that can be easily realized.

In the course of trying various possibilities, the cause of the sharp dip at about 9 kHz was discovered and eliminated by adding the mass to the R-50 cover. Next, it was discovered that a flatter response in the range from 100 Hz to 1 kHz could be obtained by wrapping damping material around the back framing of the R-50, and that this provided some much-needed treble boost. See Fig. 7. The difficulty was that the connection

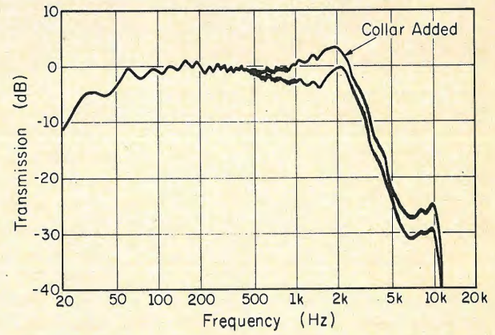


Fig. 7—Effect of the damping collar. The actual amount of high-frequency boost product by this means was adjusted to match the peak-supressing effect of the cavity to be placed in front of the R-50, for the peak of 2 kHz. More than 5 dB of boost was obtained. Here, and in Fig. 6 also, the response above 6 kHz was not very accurately measured. This test setup used straight tubing.

of the equalization circuits then resulted in a high, broad peak centered on about 2 kHz, although the lifting of the response above 3 kHz was gratifying. Arguing that every 5 dB helps, it was resolved to keep the damping wrap.

The means found to suppress the peak at 2 kHz was the 1¼-inch cavity inserted in front of the R-50 driver. This same cavity elevated the response somewhat, near 4 kHz and 9 kHz, but depressed the response in the neighborhood of 6 kHz. The result, including the original electrical equalization, was the response curve shown in Fig. 8, taken with coiled tubing, and using the 4.5-foot terminating section.

The critical element in matching the cavity against the peak at 2 kHz proved to be the damping. An error of ⅛ inch in cavity length had a slighter effect than a change in the damping material. The latter directly affects the height of the peak, but, on the other hand, the magnitude of the dip provided by the cavity (its Q value) is not adjustable. The material specified for

this damping is almost exactly right, but it was found that its removal and reinsertion after a period of service resulted in a change in performance. The orignal performance was restored when a fresh specimen was inserted.

Two systems with the response of Fig. 8 were used for a long time with considerable pleasure, but the dip at 6 kHz was a source of annoyance—intellectual, really, since the tube sounded rather good. Finally, it was resolved to try inserting a cavity in front of the R-70 microphone. The result was the response plotted in Fig. 9, in which the 0.22-inch cavity did largely fill the hole at 6 kHz, besides making a dip at 11 kHz, and a peak at 12 kHz. the second tube, made to the same mechanical specifications, demonstrates that the response was fairly reproducible, as shown in the curve plotted 10 dB lower. In overall sensitivity, the two tubes agree within about 1 dB.

At last, it was felt that the remaining equalization could be obtained with tone controls, but this proved not to be the case with the intended preamplifier (Dynaco PAT-4). Consequently, the passive equalization circuits were changed to agree with those shown in Fig. 5. Up to 3 kHz, the response was hardly changed, but some 5 dB of further boost was evident by 12 kHz. In the final installation, the response was measured with tone-control equalization with the results shown in Fig. 10.

It is not clear that tone-control equalization is really needed. Indeed, there well may be very little ambiance information above 5 kHz, and the response of Fig. 9 may suffice. If so, a simpler preamplifier could be used (such as the previously discussed Shure M-64 but with the manufacturers suggested connection for high gain), together with a low-cost power amplifier and cheap, if clear-sounding, loudspeakers. The decrease in bass response, which appeared when the impedance of the R-70 network was increased, is probably also not serious, since bass below 100 Hz is nonlocalizeable, anyway. This may be a second reason for choosing inexpensive side speakers.

To test these ideas, ambiance-generation trials were made with the finished tubes for which the PAT-4 tone controls were set to the "flat" position, but the low-cut and the 7-kHz-cut filters were turned on. Listening to the tubes, the restriction in bandwidth was evident. In ambiance generation, however, the change was much more subtle, and the level of the delayed sound could be increased somewhat. It was also found that only one tube does rather well in supplying a delayed sum-channel signal to the pair of side speakers, except that there is some loss in ambiance if that component had been badly phased in the recording.

If inexpensive side speakers are used, it seems important for them to have a smooth response. Irregular peaks in the response can cause the side speakers to attract attention more often than desired. Some of the peaks in the delay tube may have this effect also, but not the regular ripples in the response (equally spaced on a linear frequency scale), since these represent reverberation on an inaudible level. If the spacing were irregular, or if the peak-to-peak ripple amplitude were as much as 5 dB, the ear might not be so tolerant.

Before placing the tube in service, checks of its performance were made with the many joints temporarily sealed with plastic electrician's tape. In this condition, the tube is unwieldy and fragile, and the tape eventually creeps and comes undone, especially with much handling. After the performance checks, it was time to consign many of the joints to nondemountable status and seal them with epoxy. The only joints that were to be retained as demountable were those that allow the R-50 and R-70 elements to be removed (these are sealed with O rings) and those that allow their housings to be disassembled (these need not be sealed). All of these demountable joints may be secured with set screws, and two or three set screws, equally-spaced around the circumference, are recommended for the O-ring-sealed joints. The 4-40-size screw seems satisfactory.

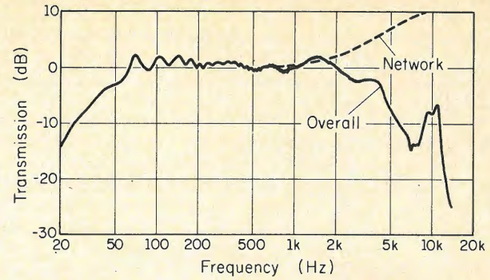


Fig. 8—Equalization obtained with the R-50 collar and cavity and passive networks. The setup used coiled tubing. The two passive networks embodied in the overall response has the joint response shown in the dashed curve.

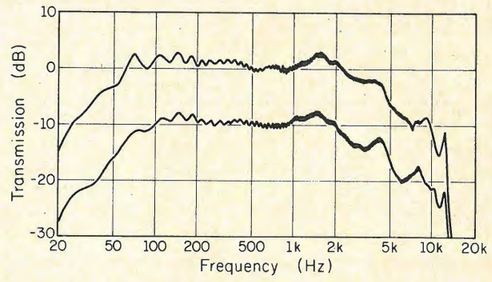


Fig. 9—Effect of the R-70 cavity. The upper-curve response is for the same conditions as in Fig. 8, except for the added 0.22-inch cavity in front of the R-70 pickup. The lower curve is for a duplicate tube made to the same mechanical specifications and using other specimens of the same transducers. The 10 dB displacement is a plotting artifice.

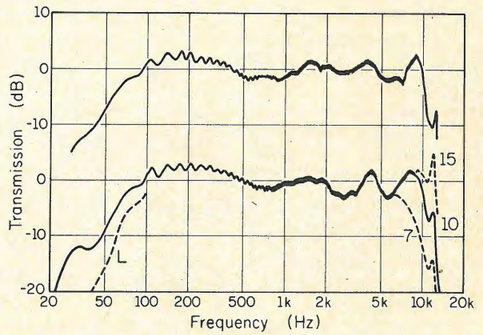


Fig. 10—Final equalized response. The conditions are the same as for Fig. 9, except that the passive-network time constants are those of Fig. 5, and the tone-control adjustments of the Dynaco PAT-4 preamplifier were used—maximum treble boost, slight bass boost, 10 kHz roll-off filter. The effects of a low cut (L) and 15-kHz or 7-kHz cuts are shown near one of the curves in dashed line. When the R-70 network is replaced by a preamplifier modification (Table 1), the bass response is more like that shown in Fig. 8.

The loose coil was still not ready for installation. Standing in a corner or lying flat on a carpet, it proved susceptible to many modes of low-frequency flexural vibrations that were very sensitive to airborne and structure-borne excitation. Even the internal propagation excited them, once the tube was lifted off the test bench, and many new frequency-response anomalies were traceable to them. One anomaly, at about 200 Hz, was traceable to propagation within the wall of the tube.

The damping of these spurious modes of vibration was done by packing the tube in plasticene (or other mastic-like material that will not age harden) and making an overall binding with self-adhesive textile-based tape (such as supplied by Johns-Manville in 1-inch widths). First, the coil was strapped at 6-inch intervals with masking tape to make a flat spiral with a close fit between turns. Then, rolls of plasticene were packed in the little space remaining between turns, building the hollows up to make a nearly level surface. Over that, a neat helical wrap of the textile tape was made, covering all parts except the demountable driver and pickup housings and their immediate couplings.

So prepared, the tube is very clean sounding and resistant to acoustic pickup. In the author's installation, the tubes hang on a hook on the back of the equipment cabinet, less than 4 feet from one of the speakers served by them. Some 20 dB of gain margin against feedback oscillation seems to remain relative to the gain setting normally used. In that location, there is an abundant opportunity for hum pickup, but it is a simple matter to loosen a set screw and twist the pickup housing to find a minimum-hum orientation for the microphone transformer, one sufficient to bring the hum level below the already-low hiss level.

It is also a simple matter to complete the installation with checks for left-right connections, balance, and phasing. With the front speakers silent, the left-right phasing check may be made in the usual manner, since it is easy to make the two tubes agree in length to within an inch or less. Then, since the side speakers had already been phased for another purpose, the author found it convenient to adjust the tube phase by interchanging connections on one of the R-70 cartridges.

A front-side phasing check is also easily made. With the ear close to the delayed loudspeaker, and for nearly equal apparent loudness from each separately, switching on the undelayed speaker shows it to augment the loudness, when the phasing is correct. Otherwise, for incorrect phasing, level balances are easily found for which the undelayed speaker causes a diminution in loudness. For this test, the distance between speakers should match the delay, tones near 100 Hz should be used, and only one delayed-undelayed pair should be tested at a time.

In ambiance presentation, improper phasing causes the side speakers to attract undue attention and makes it difficult to find a level setting for satisfactory ambiance that does not disturb the direct-sound image. With correct phasing, however, this image is less easily disturbed, the level setting for the side speakers is less critical, and the most natural-sounding effects are obtained when that level equals the one for the front.

With experience, it is found that a certain degree of awareness of the side speakers is normal and acceptable. With discrete four-channel reproduction, this awareness is also observed, even when the side speakers carry pure ambiance information. Evidently, the nonlocalizeability of ambiance (Damaske effect) is not absolute, but depends to some extent upon the recording acoustics and the program content. In those brief instances in which the awareness of the side speakers seems to be almost of a direct-sound character, it is noted that the frontal direct-sound image is nevertheless as stable as it would be found to be in the original acoustical environment. In tests comparing four-channel ambiance reproduction against Madsen-system ambiance extraction (from a two-channel mix down of the four-channel material) the Madsen-system side speakers seemed somewhat less noticeable, although the subjective impression of ambiance was identical in the two cases.

Operation(a)	Shure M-64	Dynaco PAT-4(b)	Dynaco SCA-80(b)
Remove capacitors.	330 pf at inputs, C6, C7, C10, C11	C5, C6	C21, C22
Replace named resistors by ones of value shown.	R7, R8, R9, R10 by 15 kohms	R7 by 3.9 kohms R8 by 3.3 kohms	R29 by 3.3 kohms R30 by 3.9 kohms
Install resistor(c) of value shown bridging across series combination of resistors named.(d)	82 kohms across R7', R9'; 82 kohms across R8', R10'	18 kohms across R7', R8'	18 kohms across R29', R30'
Install capacitor(c) of value shown from common point of resistors named to capacitor terminal named.	5 nF from R7', R9' to + end of C8' 5 nF from R8', R10' to + end of C9	20 nF from R7', R8' to -end of C3	20 nF from R29', R30' to -end of C23

(a). Converts PHONO inputs. (b). Operations shown for only one channel—repeat for other channel. Once effect is seen for the PHONO input, use of alternative circuit-board locations to modify the SPECIAL input, instead, will be understood. (c). Insulate leads. (d). Previous step converts R7 to R7', etc. (Note: these operations entail some risk of circuit-board damage and may void manufacturer's guarantees.)

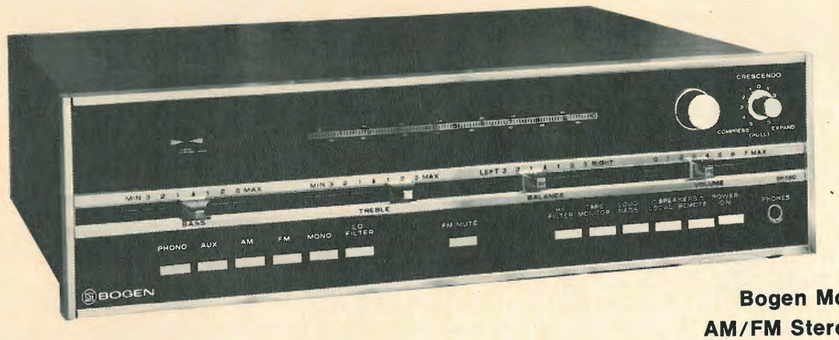
Table 1. Modification of low-level preamplifiers to provide treble-boost TUBE input as replacement for R-70 network. Feedback network becomes resistor-bridged, shunt-capacitor "T" section that fits existing circuit-board layout.

Long Tubes

The treble-equalization reserve obtained by replacing the R-70 network by a preamplifier modification (Table 1) appears to make the present design suitable for tube lengths up to 20 feet. Beyond that length, the transducer equalizations (R-50 network and treble-boost preamplifier of Table 1) would remain satisfactory, but the tone-control equalization of the tube loss would eventually require (at 32 feet) twice as many decibels per octave than ordinarily provided, so that two such stages of equalization would be needed. Also, the signal-to-noise ratio would begin to become unacceptable, so that a less-conservative driver network should be considered, despite the risk of greater tube distortion. For lengths beyond 32 feet, a larger-diameter tube, and possibly a more powerful driver would be needed, so that a whole new design approach would be indicated.

The author is grateful to James H. Kogen and William R. Bevan of Shure Brothers, Inc. for suggestions as to the devices of Shure manufacture that might be tried.

Equipment Profiles



Bogen Model BR-360
AM/FM Stereo Receiver

MANUFACTURER'S SPECIFICATIONS:

TUNER SECTION. IHF Sensitivity: 2.7 μV. **THD** (Mono): 0.35%. **Capture Ratio:** 1.9 dB. **S/N Ratio:** 70 dB. **Alternate Channel Selectivity:** 60 dB. **Frequency Response:** 30 to 15 kHz ± 2 dB. **Stereo Separation:** 38 dB @ 1 kHz. **AM Loop Sensitivity:** 100 μV/meter. **AM Adjacent Channel Selectivity:** 40 dB. **Amplifier Section. Power Output:** 100 watts (IHF); 40 watts/channel rms (both for 4-ohm load). **Power Bandwidth:** 20 to 20,000 Hz. THD at rated output: 0.5%. **Frequency Response** (at 1 watt): 20 to 35,000 Hz ± 2 dB. **IM** at rated output: 0.7%. **Input Sensitivity:** Phono, 3.0 mV; AUX, 250 mV. **Hum and Noise** (below rated output): Phono, -58 dB; AUX, -66 dB. **Tone Control Range:** Treble, +12, -10 dB @ 12 kHz; Bass, +12, -15 dB @ 60 Hz.

GENERAL SPECIFICATIONS. Dimensions: 16⅛" w. x 4⅝" h. x 14½" d. **Weight:** 19 pounds. **Price:** $299.95.

From one of the oldest high fidelity component manufacturers comes a receiver which is as modern in front panel layout and internal engineering and design as anything we've seen from any of the newcomers to the field. Starting in 1932 as the David Bogen Co., Bogen manufactured professional public address and intercommunication equipment and pioneered in the development of the first high fidelity amplifiers and receivers. Today, the firm continues in these fields as a division of Lear Siegler, Inc. The new Bogen Model BR-360 falls into the "under $300.00" price category, which seems to be increasingly important and popular these days, with new entries coming in almost daily.

The first observation that we made regarding the external appearance of the receiver was the almost complete absence of rotary knobs and controls. Only the tuning knob and the "crescendo control" are equipped with the familiar round knob. All other controls are either of the push-button type (for selectable or switchable circuitry) or of the slide-lever type (for continuously variable controls). Interlocking push-buttons are used for source selection (AM, FM, PHONO and AUX), while press-to-connect/press-to-release matching buttons are used to introduce such features as low and high filters, FM mute, mono/stereo mode, loudness, tape monitor, speaker selection (local or remote pairs), and power on/off. All of these buttons occupy the lower portion of the panel, along with a stereo headphone jack, located at the extreme right. Just above these controls are four horizontal-moving slide controls used for bass, treble, balance, and loudness. The upper portion of the panel includes a well illuminated dial scale, a tuning meter (which acts as a zero-center indicator on FM and a peak reading meter for AM tuning), a stereo indicator light, the tuning knob, and the crescendo control, consisting of a rotating control as well as a pull-out switch (the same shaft does both jobs) which introduces the "crescendo" feature.

The rear panel of the Bogen BR-360 is equipped with speaker terminal strips for local and remote pairs of speakers. Although closely spaced screw terminals are used the "grounds" for all four speakers are located on one strip, while the "hot" terminals for left and right local and remote speakers are all on the other strip. A pair of covered fuses are located below these strips. These fuses are speaker line protection devices, and as such carry no dangerous voltages and are easily popped in and out for replacement. The power line fuse is in a conventional closed fuseholder. Tape input and output jacks, as well as inputs for PHONO and AUX, a convenience a.c. outlet, a screw terminal strip for external AM and FM (either 75-ohm or 300-ohm impedance) antennas, and a ground post terminal complete the rear panel layout. This is one of the few component high fidelity sets we have seen that features a "line" antenna for FM. This single-wire antenna is loosely coupled to the power line cord, thereby taking advantage of the power line cord's length (and in some cases, the continuation of that length in the house wiring).

The Bogen instruction manual notes that for the best possible FM reception, any tuner or receiver should be equipped with a good quality outdoor antenna, and we concur with that statement. In our experience, power-line antennas cannot truly take the place of properly cut and correctly oriented outdoor antennas, though they can often provide excellent local station reception.

A look at the inside of the Bogen BR-360 chassis discloses a combination of vertically and horizontally mounted chassis boards. Mechanically, however, the mounts are all solid and seem impervious to damage from vibration of shipping.

Circuitry

As for circuitry, the FM front-end has a Field-Effect Transistor r.f. amplifier. The i.f. section includes ceramic band-pass filters as well as integrated circuit limiting stages. Multiplex decoding circuitry is conventional and is of the switching or time-division type. AM circuitry includes a mechanical i.f. filter (in place of conventional interstage tranformers) as well, for improved selectivity and less interference from adjacent frequencies. We did find, by the way, that nighttime AM listening (usually impossible in our area) was noticeably better using the Bogen BR-360, and since other sets were on hand to check for the possibility of changing atmospheric differences from month to month, part of the improvement must certainly be attributed to the extra emphasis Bogen engineers have placed on the AM circuit design.

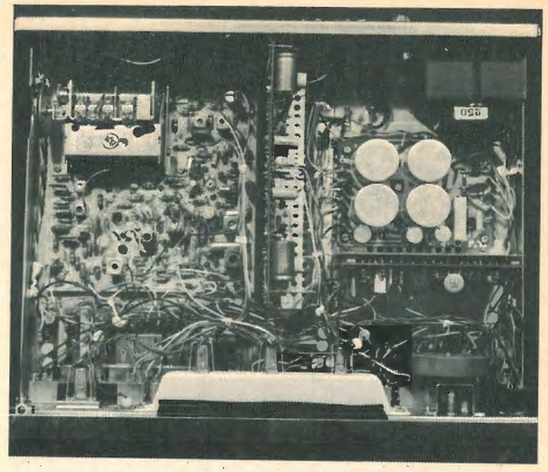


Fig. 1—Internal view.

Crescendo Control

At first glance (and use), the Bogen crescendo control incorporated in this group of receivers appears to be a compressor-expander circuit. Actually, it's more sophisticated than that, in that expansion or compression has a definite threshhold point. The curves, plotted in Fig. 2 during our audio measurements of the receiver, will help to explain this action. The setting of the volume control is completely independent of the crescendo control, which is located ahead of it in the circuit. Thus, compression or expansion becomes strictly a function of signal source level. Action of the circuit is insignificant at signal inputs below 0.1 volt to the AUX input. Referring to the manufacturer's specifications above, you will note that full output is attainable at this input by application of a signal of 0.250 volts. Thus, if such a signal is available at the AUX input, only the upper 8 dB of its dynamic range would be subject to expansion and compression and the effect might be very slight. In actual practice, however, most signal sources (including its own AM, FM and Stereo FM detected signals) have peaks of the order of 1.0 volt or so. Under these conditions, the upper-most 20 dB of dynamic range (from 0.1 to 1.0 volts) is subjected to compression or expansion. The curves illustrate the amount of compression or expansion possible at various *input* signal levels with the crescendo control set completely towards compress (lower curve) or expand (upper curve). All amounts of compression or expansion contained within the shaded areas are achievable, either by backing off on the crescendo control an appropriate amount *or* adjusting the input signal level of the program source (possible with external sources such as a tape deck having its own volume control, etc.). We have heard many versions of "home" expanders and compressors

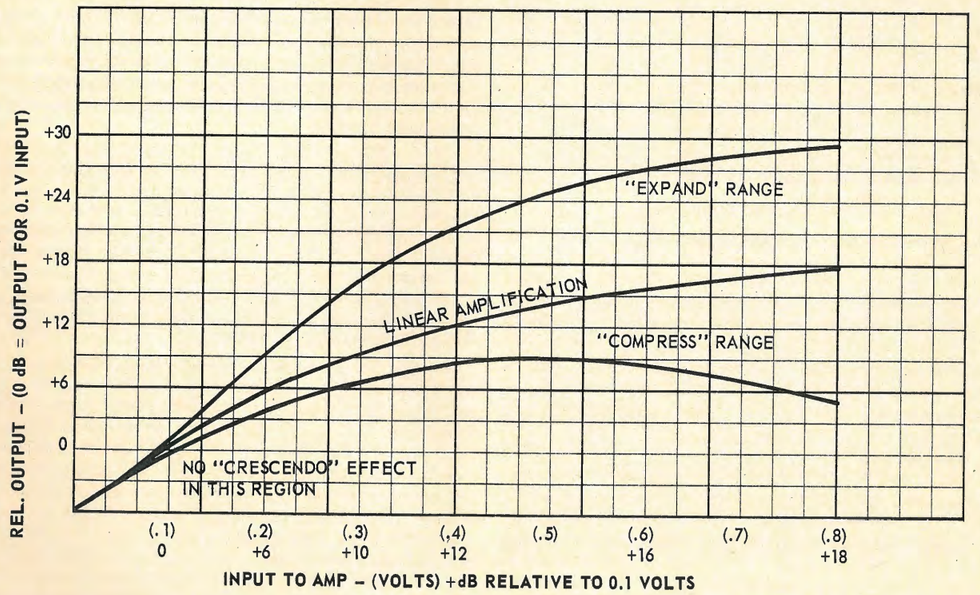


Fig. 2—Range of crescendo control in expand and compress modes.

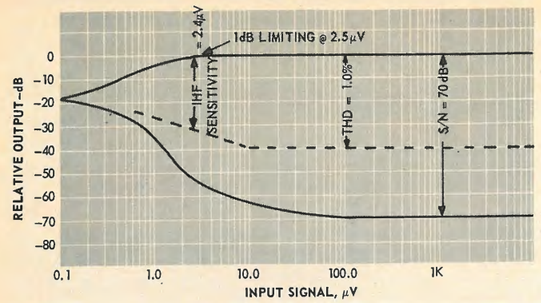


Fig. 3—FM characteristics.

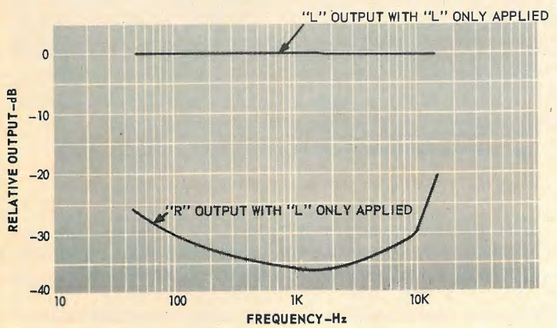


Fig. 4—Stereo FM separation characteristics.

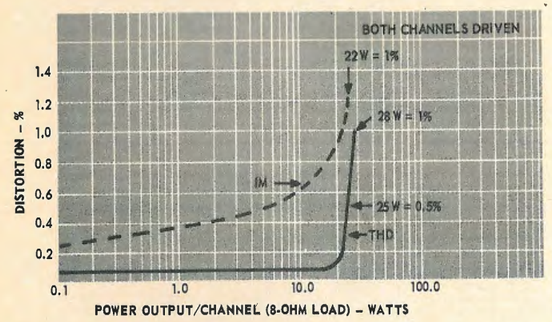


Fig. 5—THD and IM distortion characteristics.

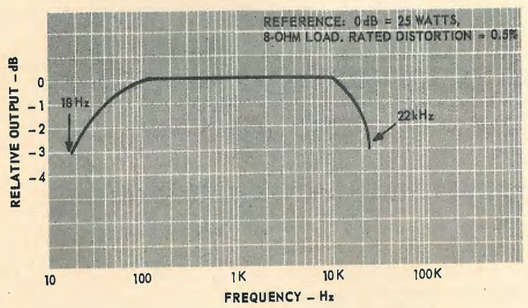


Fig. 6—Power bandwidth.

over the years, and generally, our chief objection to these devices was that you could hear them "breathe" (for want of a better term). That is, you would be conscious of an "opening and closing" of the gain of the amplifier as the circuits performed their compression or expansion role. The nice thing about this latest version of such circuits is that this "breathing" effect is not discernible at a variety of input levels and the volume levels at which we listened. Of course, the device can be "overused." There are some modern disc recordings (and certainly reel-to-reel prerecorded tapes) that have plenty of dynamic range, and the application of additional expansion, even in moderate degree, throws things out of proportion quite noticeably. On the other hand, some older recordings (and a great deal of the FM material broadcast these days) is certainly enhanced by the application of moderate amounts of expansion. The compression feature will probably find great favor with amateur recordists who, either because of inadequate or inaccurate metering facilities, end up with tapes which are distorted because of "over-recording." Making recordings via the Bogen BR-360's record output jack and with the compression mode in effect on the "crescendo control" will certainly help here, and of course, upon playback, the control can be moved to the "expand" position so as to restore original dynamic range. Of course, tapes recorded in this fashion will *sound* compressed and lacking in dynamic range when played back through any other amplifier which lacks the expansion facilities needed to restore this dynamic range. If all this causes the "purist" to cast a doubting look, remember that a simple "push" on the crescendo control knob takes it out of the circuit completely.

FM Measurements

We measured an IHF FM sensitivity of 2.4 μV, a bit better than claimed, as shown in Fig. 3. Ultimate S/N reached exactly the 70 dB claimed but THD (mono) reached just under 1.0% at full modulation.

Full (1 dB) limiting was reached at about 3 μV. Muting is fully effective at about the same input signal which yields IHF sensitivity—around 2.5 μV. Because it is effective at such a very *low* threshhold level, there is really no point in ever *not* using the mute feature, since stations of lower signal strength than 2.5 μV would be impossible to listen to in any case, because of inadequate quieting.

Fig. 4 shows the stereo FM separation capabilities of the receiver. While we measured 36 dB at mid-band (a bit less than claimed), we got 30 dB of separation all the way up to 10 kHz and down to 50 Hz, which is remarkable and must be due, at least in part, to the excellent i.f. filters which permit greater phase linearity in that portion of the circuit—a vital "ingredient" of good low and high frequency stereo FM separation.

Amplifier Measurements

Note that we measure amplifier power at 8-ohm load, so that the figures obtained for the Bogen BR-360's amplifier section cannot be directly related to their published specifications, which refer to 4-ohm loads. In order to be fair and so that you can compare results against other products in the same price category, we must publish our findings in a consistent manner—the one recommended by the IHF. In any case, with both channels driven, the amplifier reaches an output of 28 watts per channel at 1.0% THD. The rated distortion of 0.5%, referred back to 8 ohms, occurs at an output of just over 25 watts per channel which, for our purposes, becomes the 8-ohm rated output upon which we base our power bandwidth curves and IM measurements. Both THD and IM are shown in Fig. 5, while

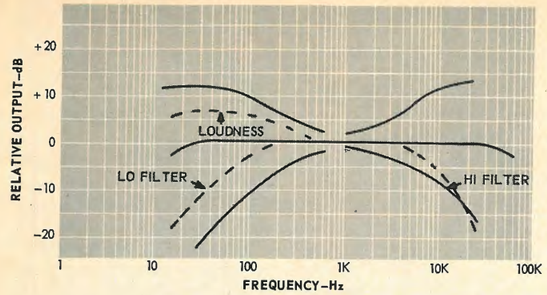


Fig. 7—Frequency response, tone control range, filter characteristics, and loudness control response (at -30 dB).

power bandwidth (based on these new references) is plotted in Fig. 6. IM reaches a figure of 1.0% at an output of 22 watts (no published claim is made by the manufacturer against which this can be compared), while power bandwidth extends from 18 Hz to 22,000 Hz, a bit better than claimed.

Fig. 7 shows tone control range, loudness control action (at -30 dB setting of volume control), and low frequency and high frequency filter characteristics. The tone controls are of the variable crossover (Baxandall) type and are quite effective. Filter crossover points are set just about where we like to see them (100 Hz and about 7 kHz for the -3dB points), but their slope is only 6 dB per octave and so they are not much more effective than tone controls used in moderation. Low level frequency response is down only 1.5 dB at 35 kHz and is down less than 1 dB at 20 Hz. Mechanical center of tone control settings (much more easily set with the slide controls than with ordinary rotary controls) corresponded very well with electrically "flat" position for both bass and treble controls.

Listening Tests

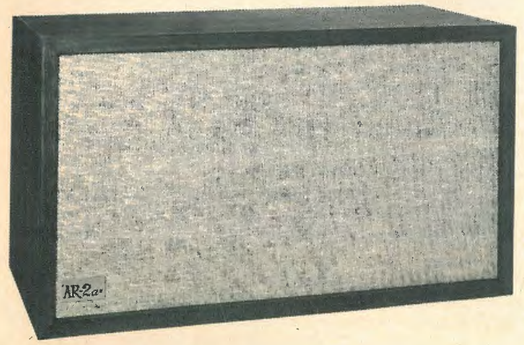
In using the Bogen BR-360, it takes no more than about two minutes to become familiar with the slide controls which replace so many conventional rotary controls. Actually, they are much easier to use and, more importantly, it is much easier to restore a predetermined setting with them. Their action is extremely smooth, and one feels like a professional recording engineer or mixer (most recording studio consoles feature slide attenuators, rather than rotary controls these days) and somehow, the sense of control is greater. We like this innovation and expect to see it emulated in years to come. The tuning knob is unique in its own way too. We have seen it before on other Bogen equipment, but in case you haven't twirled a Bogen tuning knob lately, it differs in "feel" from other flywheel controls. Instead of a shaft directly coupled to a heavy flywheel, Bogen has a geared arrangement from the actual tuning shaft to the separately mounted flywheel. The arrangement almost gives the tuning knob a motion of its own, once you give it a good twist.

FM reception was excellent with the BR-360. In one or two instances in our crowded signal area we did wish that the selectivity had been just a bit better, but we are talking about trying to receive signals 200 kHz removed from each other—a condition not likely to occur in most listening areas. Audio response was good, and power seemed adequate for our low efficiency speaker systems. However, high efficiency speakers are in order if your system includes extension speakers. We wondered if in the "expand" mode of the crescendo control, the several "db" of expansion might not drive the amplifier into distortion at fairly loud listening levels. This did not occur, and in order to find out why we returned to the test instruments. Sure enough, the Bogen engineers realized that this problem could occur, and so they limited the expand action of the crescendo control to frequencies above 100 Hz. In this way, the higher-energy ultra-low bass tones are *not* expanded and cannot cause premature overload of either the amplifier or the speaker cones it is trying to move. This low end cut-off of the crescendo action did not audibly diminish the effectiveness of the circuit with the recordings we tried, since the sense of increased dynamic range comes primarily from the mid-frequency region in any case.

In all, the Bogen BR-360 receiver is a thoughtfully designed piece of equipment that utilizes well-accepted and tested circuitry concepts and limits innovations to the excellent front panel layout and the interesting and useful "crescendo control." The latter feature alone, if purchased separately, would account for about 40% of the total price of the BR-360. Since the BR-360 is well worth its price even without this new feature, the receiver's value is further enhanced by its inclusion. *L.F.*

Check No. 54 on Reader Service Card

Acoustic Research Model AR-2ax Loudspeaker System



MANUFACTURER'S SPECIFICATIONS:
Impedance: 8 ohms. **Dimensions:** 13½" x 24" x 11½". **Weight:** 36½ pounds. **Price:** $109 to $128, depending on finish.

The new AR-2ax is a major improvement over its predecessor (prior to serial number 125000), even though its dimensions, price tag, and model designation are the same. To begin at the bottom, the new woofer, which is the same as the AR-5's, employs a new cone molding technique resulting in better internal damping combined with greater structural rigidity. The benefits are an audible improvement in the 500 Hz to 1500 Hz range. The new voice coil and magnet design achieve better control of low frequency Q and hence give flatter response at resonance and the octave above.

Crossover to the 3½" cone-type midrange has been changed from 2000 Hz down to 1400 Hz. This, incidentally, is the only

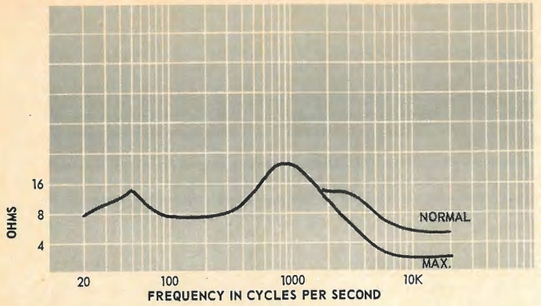


Fig. 1—Impedance of the AR-2ax with tweeter level controls at normal and maximum positions.

driver remaining from the older speaker. At 5000 Hz, changed from the previous 7000 Hz crossover, the ¾" dome tweeter takes over to beyond audibility. Input terminals and individual midrange and tweeter potentiometer controls are still recessed in the rear panel.

The loudspeaker is available in a variety of wood veneers and is finished on all four sides. It is also available unfinished. Since the radiation pattern of all three drivers is symmetrical about their axes, the enclosure may be positioned horizontally as well as vertically without degrading or changing dispersion characteristics.

Rated impedance is 8 ohms and except for the 100 Hz region is remarkably level, making it safe for any amplifier. See Fig. 1. A 25 watt amplifier is quite adequate; a 50 to 60 watt amplifier is better and is safe to use. AR's own amplifier comes to mind as a fitting companion.

Performance

Our measuring technique, as before, puts the speaker flat against the wall at ear level, with microphone at one meter (40 inches) away. We sample the loudspeaker's response with one-third octave pink noise on axis and from several points off-axis. With the addition of a half-inch calibrated H.P. condenser microphone to our armory, we've extended our frequency response measurement capability to 30 Hz and 16,000 Hz at the low and high ends respectively.

The three curves of Figure 2 show the AR-2ax's response to one-third octave pink noise. Curve C is the most indicative of the loudspeaker's spectral balance and subjective impression in a normal room. The response irregularities below 200 Hz are

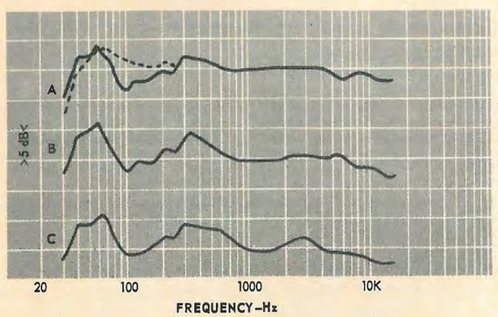


Fig. 2—Frequency response, (A) on-axis, (B) 45 degrees off-axis, and (C) average of six curves at different points about the speaker's axis.

room effects and vary with room dimensions as well as speaker placement in a given room. If large bookshelves are available, we recommend placing this or any other bookshelf loudspeaker on them, surrounded by books. We can vouch for the efficacy of this procedure from presonal experience. It will get rid of a minor flaw and at the same time reduce speaker visibility, thus adding to the realism of the reproduction.

Smoothness, as evidenced by the curves, is very good and dispersion is outstanding. In our experience, few loudspeakers have equalled, let alone surpassed, the performance of this tweeter. The terrific performance of the tweeter has been accomplished simply by applying the laws of physics, or so it seems, (the smaller the radiator, the better the dispersion), without resorting to reflecting or deflecting devices which can introduce coloration.

While we expected good bass response coupled with low distortion, 3.5% at 40 Hz at an SPL of 100 dB is not exactly commonplace. At 400 Hz, THD is 1.1% and at 2500 Hz, distortion rises briefly to 1.5%, all with 11-volt input giving 100 dB SPL. At the more normal level of 90 dB, 40 Hz THD drops to 1.6% and becomes completely inconsequential at higher frequencies. Tone burst response is equally good. See Figure 3.

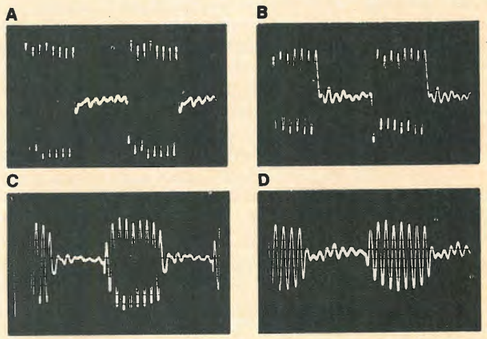


Fig. 3—Toneburst response at (A) 500 Hz, (B) 1000 Hz, (C) 5000 Hz, and (D) 10,000 Hz.

Listening Evaluation

With measurements out of the way, we came to the more enjoyable part of our work and started playing some favorite recordings. After some fiddling with the midrange and the treble balance controls (improper balance can ruin the sound of the best speaker), we settled down to some extended listening sessions. It quickly became apparent that this is indeed a superior loudspeaker, with as little or less coloration as anything in its price range.

Bass, low midrange, and highs were about as good as anything we remembered hearing in the recent past; only the upper midrange betrays some departure from the overall excellence, and this of course is what makes the $45 savings vis-à-vis AR-5 possible. In sum, we were highly impressed by the natural, spacious reproduction the AR-2ax's afforded.

Better speakers are available but at a price, and the law of diminishing returns sets in rather rapidly. Lastly, we wish to commend Acoustic Research on their advertisements, calling the design an evolutionary one, which it patently is.

If we may have one wish in 1971, it is for Madison Avenue to declare a one-year moratorium on the term "revolutionary breakthrough." To paraphrase Professor Einstein, good design as well as genius is 10% inspiration and 90% perspiration. Let's leave revolution to the politicians, and instead, apply scientific thinking to the betterment of audio. *A.R.*

Check No. 55 on Reader Service Card

Sharpe "Stereo Central" Headphone Control Units

Model SC-1 With Model 7 Headphones

Model SC-3

MANUFACTURER'S SPECIFICATIONS: Impedance: 4 ohms. **Maximum input voltage:** 10 volts rms. **Prices:** SC-3, $39.95; SC-1, $19.95.

This is an interesting device which serves as a remote control for stereo listening as well as for a place to put your phones when they're not on your head. Available in two types, they perform different functions, but both offer remote volume control for the phones, as well as the ability to hold the phones in readiness for use whenever you want them.

The simpler of the two types—SC-1—consists of the housing, a 10-foot, three-wire cord, and separate volume controls for left and right channels, along with a single 3-circuit jack for your stereo headphones. It has a molded plastic base, topped by a 2¾" spacer between the base and the control head, the latter 2⅜" wide, 3⅜" deep, and 4½" high. In the front of this section is a gold-finished panel with the left and right level controls, while on the side of the spacer is a 3-circuit stereo phone jack. The gold-finished rear panel mounts two fuses, one in each phone circuit.

The device incorporates 100-ohm series resistors in each circuit, and volume is controlled by a variable resistor across the phone outputs. A walnut-finished plastic case 7½" wide, 4¼" deep, and 10½" high covers the entire unit when not in use, including the phones which are placed on the sides of the control housing in the same way you would put them on your head.

The more-complete model, SC-3, has the same dimensions and functions, plus greater control facility. The connecting cable is 25 feet long and has five wires to provide the additional ability to switch speakers on and off at the control center. Three of the wires are connected to the amplifier output terminals and the other two are connected to the speakers. In the control head are two rocker switches in addition to the level controls for two sets of phones and the necessary two output jacks for them. One of the rocker switches turns the speakers on or off, while the other adds a phase-blending control similar to the Bauer circuit to give more realism to stereo listening with phones. Both units are similar in appearance, but the SC-3 offers much greater flexibility both in control and in the distance it can be located from the amplifier.

For those who do considerable headphone listening, either of these Stereo Central units can add an enjoyable measure of control and flexibility to listening pleasure. *C. G. McP.*

Check No. 56 on Reader Service Card

Annis Pocket Magnetometer

MANUFACTURER'S SPECIFICATIONS:
Scales: Standard No. 20: 5-0-5, 20-0-20; Special No. 25: 0.5-0-0.5, 1-0-1, 2-0-2, 5-0-5, 10-0-10, 20-0-20, 50-0-50. **Scale Units:** Standard Models, 0.5 Gauss; Special Models, 1.0 gauss. **Dimensions:** Standard Model, Dia. 2"; Special Model, Dia. 2½" **Prices:** Standard, 5-0-5, $6.80; 20-0-20; $5.45; Special Models, $29.75 to $34.75, depending on sensitivity. R. B. Annis Company, 1101 N. Delaware St., Indianapolis, Indiana, 46202.

We first received two of the standard models, and after wondering what to do with them, even after reading the instructions, we read Bert Whyte's BEHIND THE SCENES column in the January issue and realized what a handy device each of these items could be to the home recordist.

All of us have seen a watch repairman use a small compass—usually about ½" in diameter and soldered to a wire for handy placement near the balance wheel of a watch to determine if it is magnetized. Maybe some more enterprising recordists have thought to do the same thing with heads and other steel parts on their tape recorders. However, such a method provides no quantitative information. It only gives an idea of the possibility of some magnetization of the parts, and furthermore the compass is not likely to be as sensitive as the magnetometer, which is shown disassembled in the illustrations accompanying this profile.

The moving part of the magnetometer consists of a small round disc magnet slightly smaller than a dime, and affixed to it is a vane and a pointer. In the standard model, the pin through the magnet and vane is pivoted in an adjustable brass fitting to which is attached the scale plate, together with a small magnetized strip which is used to approximate the zero setting while the unit is out of its case. Inside the cover is a horseshoe-shaped magnet which is adjustable by a screw accessible through the front of the case for accurate zero adjustment after assembly, just as in a conventional d'Arsonval meter movement. A red plastic circle is affixed to the outside of the case to indicate what part of the case should be exposed to the surface suspected of being magnetized.

The special models are larger, measuring 2½" in diameter, and the pivot pin rests in jeweled bearings.

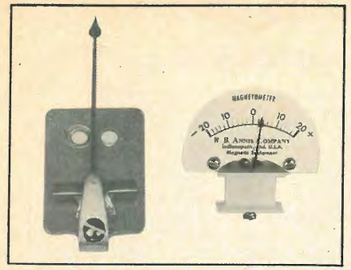


Fig. 1—Moving element of the magnetometer consists of a small disc magnet (seen under the horizontal vane) and the pointer, all mounted in the brass fixture with adjustable bearings.

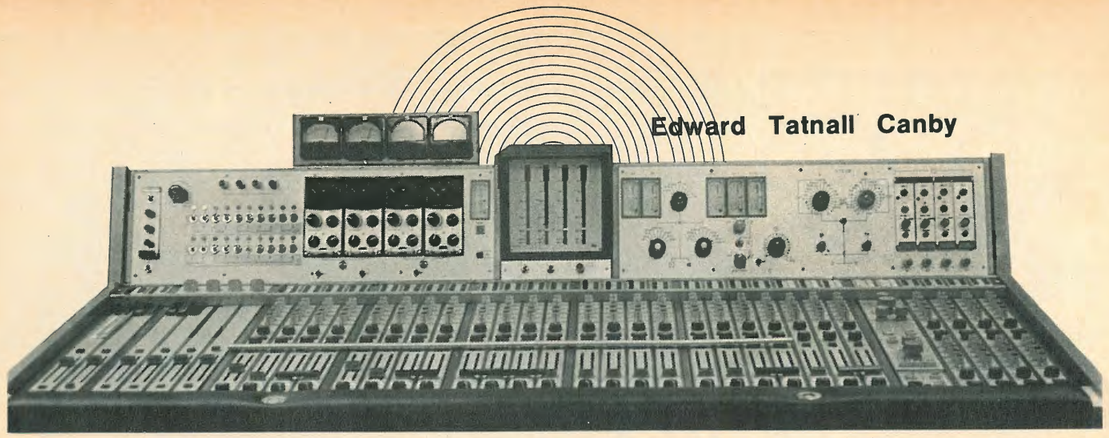
Fig. 2—The inside view of the cover of the magnetometer case shows the zero-adjusting magnet which is rotated by a screw head accessible from the front. The complete movement is shown at the right.

The scale carries two sets of graduations, with the black upper scale indicating directly in Gauss the strength of a uniform magnetic field oriented parallel with the centerline of the instrument, while the lower red scale is used in determining the magnitude and direction of an unknown magnetic field by merely orienting the instrument for maximum indication, at which time the direction of the measured field is parallel with the pointer, and the magnitude, in Gauss, is shown on the red scale.

We tried the magnetometers out on our workbench first and were surprised at the magnetism exhibited by the ordinary run of screwdrivers, pliers, and so on. Then we explored several tape recorders and found that some did have magnetized heads and some didn't. We also observed that those which were magnetized had more tape hiss in their output than did those which were free of magnetism. So we demagnetized the heads, and the hiss level was more consistent between the machines.

In this day and age of having everything necessary to keep our equipment in good operating condition, it appears that the Annis magnetometers are almost indispensable if we expect to keep head—and capstan and tape-guides and anything else that comes into close proximity to the tape path—in the correct non-magnetic condition for optimum operation. And $6.80 for the more-sensitive 5-0-5 unit of the Standard Model 20 is a reasonable figure. Not a bad post-Christmas—or birthday or Easter—gift, either. *C.G.McP.*

Check No. 53 on Reader Service Card



Edward Tatnall Canby

Canby at Boston

ONCE IN A silver moon a reviewer like myself, who normally operates at the far end of the recording chain, judging the end product, gets a "behind the scenes" chance to witness the front end—a genuine, live symphony orchestra, pianist, or chamber group in the act of recording in real time. Once in an electric-blue moon it is a great symphony orchestra. Such opportunities don't come often.

It takes an ultraviolet lunar cataclysm to involve that same reviewer in a correspondingly top rank pop music production ("live" is not a very useful word here). In most pop sessions, much of the music is already recorded, or will be recorded in the future. All you ever see are engineers and producers. And headphones. The other performers are in the headphones.

A while back, I managed to hit both of these extremes, classical and pop, within a week. Lovely contrast! Instructive comparison too. A conjunction of astrological moons at least. First, it was the Boston Symphony Orchestra recording Tchaikovsky in Symphony Hall for its new label, Polydor, better known by the parent name of Deutsche Grammophon or DGG. Can you go higher than that? I do not think so. Then it was best-selling folk singer Tim Hardin. Believe it or not, I helped lay down several tracks of the 16 that eventually went into a pair of songs for his latest LP, "Bird on a Wire." My Canby Singers, who normally specialize in highbrow a cappella stuff like motets and madrigals, did the choral background for the title song and one other. (It was my fault; I *wanted* to do it.) Some recording! We all sang with earphones on our heads, one ear in and the other out.

The Boston Symphony, of course, was present in entirety, for its recording. All of the music was put down at once, simultaneously, on a mere four tracks. Everybody played together. (Strange that we must explain this today.) The music was "real-timed" in the horizontal or layer sense, though real time vertically will not be preserved in the final editing, if you see what I mean. (Sometimes the introduction is played after the end. That's the way classical tape is edited.)

Not so in pop music. With sixteen tracks, mostly made at different times (and in different climes, L.A., Georgia, who knows where), there is no editing of the main tape. On its two-inch span, however, you may add or subtract ad infinitum, one element at a time. But you must always start over again at the beginning and go right through. We laid down three tracks, but we must have done it a couple of dozen times. No good—erase it! Nobody *ever* erases classical music. They just go on and on, adding new tape, keeping everything for the final editing. A startling difference in technique. But let me go on to the Boston.

The world of classical recording really rocked a bit, if I may use that term, when the elegant German firm of Deutsche Grammophone stole the Boston Symphony away from its long-time American recording company. I myself found it startling to hear German fluently in use in the new Symphony Hall control room, built by DGG in the bottom of that Boston landmark. But the "show" that the Symphony people and the Germans and the Americans in Polydor put on for us, built around the recording session which went on as though we were not there, very quickly reassured us. These people, it was clear, were in deadly earnest; they were aware that classical music of the Boston's sort is in increasing economic difficulty today but they are determined that the very best of it shall be preserved and *can* be preserved by such a company as theirs without sinking the mother ship at home. I was really impressed by the short speech to this effect by Thomas Mowrer, the young classical director of DGG's American operations. This, one felt, was an enlightened operation, dedicated and intelligent. In a way, it is sad to see so much of our own music taken over by enterprising outsiders. But it is heartening to know that if in classical music we cannot save ourselves, then DGG, and Angel and Philips and all the rest, will save us in spite of ourselves.

The Boston DGG party kept up for more useful hours than I ever remember remaining at a press "show." It fell into three complementary parts, not counting the excellent luncheon in the basement (with monitor TV and the stereo sound of the rehearsal going on upstairs in the hall). First, we found ourselves on the great stage, looking out into one of the world's finest acoustic structures. Memories! In my college days, I had sat at precisely the same spot as a member of the Harvard Glee Club, singing the Beethoven Ninth Symphony under Koussevitzky. It is a lovely hall, the first ever to be designed specifically with acoustics in mind, and it was a pleasure to hear a man from Bolt, Beranek describe its features. The ceiling is plaster on a metal screen with 15 percent open grill work into the loft above; the walls are 30 percent plaster on metal lathe, with wood panels. Very little carpeting, and the original seats, bound in leather, still improve the sound. There are no deep balcony "pockets," as in too many more-utilitarian halls. Instead, the balconies extend around the sides, as in an opera house. Splendid view.

CANBY

(Continued from page 60)

What really matters, though, is the "break up" of surfaces, everywhere, in a fashion that was mercifully easy in 1900 and stylistically almost impossible today. Style runs the world! There are niches, statues, wreaths and curliques, a crisscross of deeply recessed squares over the entire ceiling, a million irregular curved surfaces and scarcely a flat plane anywhere.

Yet Symphony Hall is dignity itself, absolutely without date, a harmonious whole that is as pleasing to the eye as to the ear. Amazing. True, the design takes after earlier European models; the architects had the famed Leipzig *Gewandhaus* in mind, though Symphony Hall is bigger. But in the 1900s one always modeled American buildings on European styles, sometimes rather dreadfully. Not so in this case. Even a mishmash can be beautiful, given the right intelligence! Out of all the borrowings, the plaster and the grillwork, comes a harmony of sight and sound still unmatched in any other hall. Would that we could do as well today.

Next we went in one of three groups, with the other two frequenting the handy bar, into the new DGG control room, which is totally isolated, exactly matching the acoustics of similar rooms in Germany so that DGG engineers will always hear their tapes in the same way. Double walls, fiberglass in between, a suspended ceiling, specially soundproofed double doors—no sound gets in or out. All via Bolt, Beranek. The inside acoustics are neutral in color, approximately as live as an average living room. The former recording tenants apparently just used a handy room upstairs somewhere for their tape playback. Not DGG.

The specially-made DGG console has everything you've ever seen on one of those monsters and even more, including the now-common slider controls, gangable (to coin a word) in fours for the four channels, with an incredible wealth of equalizations, pan pots, transfer switches for 33 inputs and four outputs and so on, all in a new miniaturized form, jammed close together. Most interesting item: The four light-beam meters, with four lighted vertical columns, the lower part white, the danger zone red, all four together so that four channels can be "read" without moving the eyes.

A splendid discussion ensued at this point between one of the German officials and Victor Campos of KLH concerning the old bugbear question of matching. I knew enough to play dumb, but I did gather that the German line level is plus 6 in reference to 200 ohms (1.5 volts), that all outputs are low impedance and inputs high—only an ohm or two out and some thousands in—that being the Continental philosophy, even in the basement of Symphony Hall. Strange! All this exotic foreign equipment, piloted by two ardent German technicians (one at the board and the other conducting the music madly from the score and marking mistakes as they occurred), was fed out (and matched) first to Dolby, then prosaically to American equipment, a pair of Ampex half-inch, four-channel recorders (a German model stood by for emergencies) and two large American monitor speaker boxes, the sound of which was only too familiar to me after these many years. (Frankly, I think the Germans could have done better there, but one does get used to familiar equipment, and maybe a little politics might be involved, who knows?)

Straight through Tchaikovsky's "Romeo and Juliet" without a break. Take One. TV monitor of the conductor, who had long hair and a phone next to his stand. Then, on the same reel of tape, back to the beginning; the whole slow introduction, a difficult segment to get down with precision. Five takes, still on the same reel of tape, and finally—oops! The tape runs out while the music continues. It stops, but mainly because somebody played a sour note. I was slightly mystified, but mainly they seemed to know what they were doing. Quick change of reels, then more of the slow beginning, take after take. As the session continued, the retakes became shorter and shorter, clearly to be used as inserts here and there, if and when needed in the editing.

I was fascinated by those light-beam meters. Over at the Ampexes, on one side, I noted that regular VU levels ran quite low, the loudest peaks (and Tchaikovsky can be loud) hitting no higher then -4 dB. But on the light-beam meters all four channels ran continuously into the dangerous-looking red areas at the top. The man in charge scarcely moved a muscle; he obviously knew his equipment. I surmised that these non-VU meters are essentially unweighted and therefore show instantaneous peaks in the red which with VU monitoring would average out much lower. As with the slow-blow fuse, this is the intention of the VU-type indicator.

One of the German engineers gave a lucid accounting of the DGG philosophy of recording in which he used my favorite term for that art—*translate.* Good! One does in fact translate the communication we call live music into the different communication, the different language, which is recorded music. It is, as he put it, "a delightful and difficult job."

Break. Upstairs we go for Part Three of our party, this time the same music continued, but now heard from the live vantage, up in the overhanging first balcony directly above the orchestra, which was playing on the front segment of the floor. (The stage is acoustically too "narrow" for good recording.) What a marvelous sound! Hearing the music first in the control room, stereo, then in the flesh only a few moments later, was a revelation with such a superb orchestra.

Is live music better? Of course! Not only in the smooth, velvety sound, the superb spread in space, the enormous power of the kettle drums, brass, cymbals, the total background silence (except for one distant fire engine siren, faintly in a *ppp* passage) but even more important, in the sight of the playing orchestra, live and in color, spread out over a visual 3-D "screen" hundreds of feet across. How could any TV picture or any other mere reproduction compare with such a sound-sight? But even beyond all this was the ineffable quality of life—these were real people, actually living, breathing, playing down there below our balcony. Could anything ever substitute for that?

Suddenly a halt. The harpist, placed abnormally, far up front and facing the orchestra (with his own special miking), has been playing unnaturally *ff* in a solo passage. Deliberately. He explodes. He is Bernard Zighera, who joined the orchestra in 1926 and is allowed to explode.

How can he play up there in front, where nothing sounds right? He can't hear a thing, everything is crazy, outrageous, etc. There is a long silence; he has talked himself out. The young conductor smiles and shrugs. Letter G, please.

Then comes a musician's sorest trial. Not a word had been said. They simply go straight back and approach the same long solo harp passage once again, no change. Mr. Zighera, still very red in the face, plays again. Absolutely flawlessly, while the tapes roll on. The musician's discipline, let me tell you, is the highest in any of the world's professions. Next to such a man, an astronaut is a child.

For that matter, the discipline of the orchestra as a whole is unbelievable, even without special strains. What an admirable art is symphonic playing and how terribly jeopardized today! No finer sense of skilled cooperation has ever been developed by our civilization. I noted with astonishment that the Boston Symphony is full of youngsters.

(Continued on page 69)

Classical Record Reviews

Edward Tatnall Canby

The Jacques Loussier Trio Plays Bach's Brandenburg Concerto No. 5 with the Royal Philharmonic Orchestra. (Also: Air on the G String, Prelude No. 2 in C Minor). London Phase 4 SPC 21044 stereo ($5.98).

A French jazz trio plays inside a Bach concerto adding jazzy extras, and I find it mostly very annoying, though there are some interesting moments.

Jazz people, expecially modern jazzists, can be terribly pretentious, as well as terribly out of date! When Freddy Martin "jazzed the classics" back in the 1940s it was a novelty, and it was the same when Gershwin wrote his symphonic jazz in the twenties. But there's just no shock value left in the idea nowadays. Even the rock boys understand that. Their classic borrowing is mostly matter of fact and often quite beautiful. Not so in jazz.

The Trio actually amounts to a jazz solo by the leader, Loussier. His bassist mostly plays an impeccable Bach bass line, right with the music, and the percussion is moderately self-effacing. Everything else, *everything,* is note-for-note original Bach. So what does the piano do as a replacement for the solo harpsichord? Bang, bang; he pounds syncopations against the opening *tutti.* So what! Just an unstyled disruption. He puts in jazzy twiddles, then plays Bach straight (he's fluent), then takes off in jazzy flights. He can't settle down to one thing or the other and seems incapable of really amalgamating the two elements. Since that is presumably what he is there to do, the performance is mostly a floundering failure, for my ear at least. It could be good, it could be fascinating, but it isn't.

The slow movement goes better (a better rapport between Bach and jazz), and the final furious little high-speed Prelude goes very well indeed. It is done in three versions, more in the jazz variation style that would seem right for such music, and the bassist does a wonderfully musical job with his part, the piano plays the original notes with fluent passion—very good. You may like the "G String" too, even if that is not its proper name and never was. (Shades of Music Appreciation. I can still hear my snickering students when *that* title came up in class.)

A bit more of a modern outlook, a lot less of self-conscious pretention, and this combo might be really good.

Performance: ? Sound: B-

Entremont Conducts Satie. Gymnopédies Nos. 1 and 3, Parade, Relâche. Royal Philharmonic Orchestra. Columbia M 30294 Stereo ($5.98).

Unexpected disappointment. Philippe Entremont is a lively, winning pianist and as French as they come, but for reasons not easy to guess this performance of the wily old satirist's orchestral music (and the Debussy arrangements of the two little Gymnopédies for piano) just plods. The tempi are all wrong, the orchestra seems listless and inaccurate, the whole crackling spirit of naughtiness in the big scores of 1918 and 1924 respectively is unaccountably missing. Don't ask me why. I'm only listening.

Even odder, then, to read Entremont's engaging annotations for the album; they are delightful and make you *want* to hear the music. But it remains a disappointment. If you are in a comparing mood, you'll find no less than five other versions of "Parade" and three of "Relâche" in the LP catalog. Haven't heard them all, but between them they do the music a lot better justice.

Performamce: C+ Sound: B

Beethoven: Egmont (complete incidental music). Pilar Lorengar; Vienna Philharmonic, Szell. Klausjürgen Wussow, narrator. London CS 6675 stereo ($5.98).

When in a couple of hundred years our scholars begin to untangle the sense of our present lightshows, television, audiotapes, and staged extravaganzas, their problem will be much like ours currently is with the curious polydramas of the early 19th century, to which the celebrated composers often lent their musical talents.

"Incidental music"—the term sounds so simple! Frankly, I can make neither head nor tail of this one's factual history, except that it began as a play by Goethe and ended up many years later as a half-spoken "oratorio"—more or less as on this recording—with narration in German. The hero of the title is represented in spoken words only though a soprano sings the heroine's part. The work is rounded out with considerable orchestral music, including the familiar overture and its partial return at the end.

In recorded form, it all fits together nicely. The narration is persuasive enough to carry you in mood (and sense, if you can figure out the translation) from one Beethoven item to the next, thereby knitting back into shape a collection of musical items that otherwise would be fragmentary. Definitely, the recorded medium is useful!

Musical productions of this mixed sort abounded in the German tradition, leaving a trail of fragments from Mozart through Beethoven and Schubert and on through Schumann. Even the German-language operas of the day incorporated the spoken word extensively, making problems for our multinational singers today. But the incidental category goes further and is harder to put back together; sometimes it is impossible to figure out what actually took place, in concert hall, opera house, or on the stage. It's not even certain just when Beethoven's music first got a hearing in the midst of the Goethe play, but it was around 1810.

Even at that time the audiences for spoken drama and for music were drifting apart and one element or the other usually suffered. Beethoven's contribution at first came off badly, it is said. Nobody much cared. The play was the thing. But the present "oratorio" came along almost a dozen years later, merely grafting inspiring passages from Goethe on a spoken plot framework put together by the well-known Grillparzer, and at last the music became the important element, the drama the backup force.

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Canby's Capsules...

TITLE	CONTENT	SOUND
George Szell on Angel **Beethoven: The Five Piano Concerti; solo piano variations.** Gilels; Cleveland Orch., Szell. Angel S 36027-31 stereo ($5.98 each). **Brahms: Violin Concerto; Double Concerto, Violin and Cello.** Oistrakh, Rostropovitch; same. Angel SFO 36032-3 stereo ($5.98 each). **Dvořak: Symphony No. 8 in G; Two Slavonic Dances.** Angel S 36043 stereo ($5.98). **Schubert: Symphony No. 9 (The Great C Major).** Angel S36044 stereo ($5.98).	Szell ranked with two utterly different conductors, Reiner and Toscanini, as a supreme orchestral builder and disciplinarian; his taut control, always stylized with Central-European knowhow, mellowed in the last years—it often happens. The big 3 Russians' breadth and grandeur go perfectly with Szell's economy and discipline. Good for all concerned. Szell's Schubert, Dvořak are massive, never rushed, yet full of high tension—Bruno Walter at double voltage. (The tension is also typically U.S., out of our own players and our own tensions.)	Technically interesting—the Beethovens were recorded for Angel by Columbia, whereas the later Brahms, Schubert, Dvořak are by Angel itself (EMI). Astonishing difference in the sound. The Columbia Beethoven is close, sharply defined and separated in the U.S. style; the Angel-made jobs (with the orchestra massed inside a reflecting shell) are more distant, with little close-up edge, a big golden liveness—very much a European (and EMI-type) job, perceptively conservative. Excellent illustration of the two wings of current recording technique in stereo—same orchestra, same conductor, same hall, same label.
	(Dr. Szell died in July, 1970, after Angel had taken over his Cleveland Orchestra from Columbia-Epic to launch a "big classics" series featuring the big three Russians, Gilels, Oistrakh, and Rostropovitch. E.T.C.)	
Harpsichords, Clavichord **The "Now" Music of the Old Harpsichord (Bach, Handel, Rameau).** William Read. RCA LSC 3157 stereo ($5.98). **The Sound of the Early Harpsichord.** (J.J. Froberger). Gustav Leonhardt. RCA Victrola VICS 1494 stereo ($2.98).	Two-to-one price difference—crazy! (Read is domestic RCA; Leonhardt an imported tape.) Read's "now" music is the old sound of a new harpsichord (Rutkowski). Standard fare with elaborations: Italian Concerto (Bach), improvised paraphrase of "Harmonious Blacksmith" (Handel), a Rameau Suite. He is brilliant but nervous, high-strung in the faster movements, best in the slow, and in the quiet Rameau, its ornaments well done. Leonhardt's harpsichord is very early (1640 Ruckert) and mellow, his Froberger (a pre-Bach Austrian) full of dignity and poetry; I enjoyed it. In comparison, Read's music needs a tranquilizer. Okay if you want jumpy harpsichord brilliance. Lots do.	
Austrian Music for Harpsichord and Clavichord (Froberger, Poglietti, Fux, Mozart, Haydn, Beethoven). Igor Kipnis. Odyssey Y 30289 stereo ($2.98).	Kipnis, literary-inclined (a critic, he wrote notes for the Leonhardt album above), is becoming the most literate and persuasive harpsichordist on discs, always with interesting ideas. His modern harpsichord (also a Rutkowski) is beautifully recorded, his playing smooth, well phrased, communicative. Nice idea to include Mozart, Haydn, Beethoven! (Beethoven's earlier piano still had much harpsichord in it.) The clavichord on side 2, Froberger, Mozart, Haydn, is the best job to date of recording that tiny instrument, almost inaudible across a room. Good for Mozart and Haydn too.	
Golden Broom and The Green Apple, Harlem, New World a'Coming. Duke Ellington, Cincinnati Symphony Orchestra, Erich Kunzel. Decca DL 710176 stereo ($5.98).	Same old Duke, still a lively pianist, in his ineffable super-mood pieces for symphony orchestra, styled to the *n*th, all spit and polish—"New World a'Coming" 1943, "Harlem" 1950 (the NBC Symphony), "The Golden Broom and the Green Apple" 1965. Slick and beautifully orchestrated, with bits of everything from Gershwin to Hindemith and blues to hollars, it goes down easy, but harder listeners will be bored if they listen too hard. Just let it roll.	
The Four Elements (Hill, Earth; Rose, Fire; White, Air; Lake, Water.) London Gabrieli Brass Ensemble. Deutsche Grammophon 2530 032 stereo ($5.98).	Big, fat British brass music from four brassy composers, all spread-eagled in style from serial dissonance to sort of Brahmsy with elephantine pop in between. Very competent (the composers play brass too) but an awful lot of sound about not very much, I thought. What you might call musical professionalese.	
Five Bridges. The Nice. Keith Emerson, keyboard. Mercury SR 61295 stereo ($5.98).	Some bridges! (Pop/classical.) *This* "so-called-critic" isn't going to spit on them (see notes) but Keith Emerson (pop) and Joseph Eger (classical) did put down an awful dose of heavy symphony stuff here. I like the pop; you can have the symphony orchestra. But I liked side 2 (it's a live concert) where "Karelia" (Sibelius), the "Pathetique" scherzo and the Bach Brandenburg No. 6 get incredibly entangled with the rock group's frenetic funky stuff. You guessed it—the Bach is best, if rockiest. Combined with "Country Pie" (including vocal), it is a whiz-bang—really *one* piece, unified. That's good.	

(Continued from page 64)

That was in 1821, but the play has since been readapted to Beethoven's music at various times. A risky venture in the live media, what with out current emphatic split between the theater world and that of concert music.

The late George Szell's direction of the Viennese musicians is superb. Once again, we hear that uncanny precision, the taut, meaningful shaping of every idea, that came so much to the fore in his grand last recordings (though it was there all the time in the earlier years). Pilar Lorengar, name or no, offers a dramatic German-style soprano voice for the solo songs, in spite of a rather heavy vibrato. Herr Wissow, our narrator, speaks beautifully and not too loud (in terms of recorded level) so that the music is always properly in the forefront, full-bodied. For Egmont's words in the melodrama (speech against musical background), the voice moves into a reverb surround, the hero becoming disembodied yet potent.

No matter that the fiercely joyous climax, full of military flourishes and rallying calls to freedom, brotherhood, victory in death, sounds uncomfortably like a Hitlerian rally of around 1934. That is merely an anachronism and should not be blamed on Beethoven, Goethe or on the present producers. Just goes to show that great forces can be used for nefarious ends.

Performance: A- Sound: A-

Delius: Appalachia, Brigg Fair. Hallé Orchestra, Ambrosian Singers, Barbirolli. Angel S 36756 stereo ($5.98).

It's good to have "Appalachia" brought up to date in stereo. I first got to know this early Delius, about the only Delius I can musically swallow without gagging, via an early recording a good many years back. It's American, a reminiscence of Delius' two years in the U.S., beginning in Florida where he was sent to manage his father's orange grove and didn't. The piece is based on a couple of turn-of-the-century plantation-type tunes (like the Dvorak "New World" Symphony in spirit), and it sounds like a combination of all the Suth'un movie music you ever heard, with Virgil Thomson's "Louisiana Story" out in front. Delius however wrote his film music long before there was any such thing. Baritone solo ("Oh, Honey, I'm goin' down the river in the morning. . . .") and lush chorus round out the longish work.

"Brigg Fair," the more orthodox sort of later British Delius, is another story. Most Americans simply will find this unctuous idiom too sickly-sweet, with its piled-up melodramatic harmonies, though the British seem still to love it. Perfectly good British folk tune, but the icky treatment is relentlessly plastered on top, like marzipan and whipped cream and maybe almonds as a topping for roast beef! (Well, almost.) My apologies to our British editor, but I can't help it. Just too thick.

If anyone after Sir Thomas Beecham could keep Delius afloat, it was the late Sir John Barbirolli. He and his orchestra and chorus have exactly the right ideas.

Performance: B+ Sound: B

JAZZ & BLUES

Martha Sanders Gilmore

JELLY ROLL MORTON: The Complete Piano Works of Jelly Roll Morton. Played by John W. "Knocky" Parker. **Audiophile 102-105,** 4 Vols. $19.95. John W. "Knocky" Parker, Piano; Ruth and Dick Brightwell, drums and bass; Marvin Montgomery, banjo; George Pryor, bass, and Harvey Kindervater, drums.

Jazz purists, devotees of the "real" jazz, the serious student of the idiom, and the more casual listener alike are in store for an invaluable treat in this four volume set of unadulterated Jelly Roll Morton. Spanning some 34 years of musical growth, this chronological compilation of the complete works of Jelly Roll contains no less than 48 Morton originals, embracing some 2½ hours of rags, blues, barrelhouse, and stomps which bear his immortal touch.

John W. "Knocky" Parker deserves considerable praise for his supreme competence at the keyboard in his masterful interpolations and close adherence to the Morton mystique. The undertaking by Parker as well as Audiophile, that San Antonio-based recording company which made it all happen, is nothing short of phenomenal. Plaudits must also be extended the rhythm section and Marvin Montgomery on banjo.

Dr. Parker seemingly sidesteps nothing in this pure rendition, extrapolating clear, incisive chords and frills from the keys. No notes are slurred; the lacey trim is easily discernible, markedly defined. The one drawback is that Parker's approach is so highly polished that it at times resembles a mechanical player piano. He does not effervesce that same Morton vitality in his interpretations and does not achieve that *carefree* yet controlled quality so inherent in Morton's work.

Jelly Roll Morton wore many musical hats in his day—1885-1941. He was at one time or another a pianist, composer, bandleader, lecturer, arranger, and vocalist, spreading his musical talent among cities from coast to coast—to the south in New Orleans and Memphis; to the midwest in Kansas City and St. Louis; to the west in Los Angeles; and to the east in Washington, D.C.

Morton's approach is one of unequivocal joy which one cannot avoid absorbing while listening to these records. He is simultaneously tender, melodic, joyful, lyrical, humorous, and complex. A bittersweet quality pervades his blues. He even manages to make blues bright!

When one considers the vast impetus of the Victorian era, it is understandable that its filigree and assorted configurations would infiltrate Morton's music, softening otherwise sharp edges. Commendations again to Parker's transcription since many of these solos were never, in fact, put on paper.

Morton's music, as heard here, achieves a fusion of the classicism and melodies of New Orleans as coupled with the earthiness of the French Quarter, the rhythms of St. Louis, and the polyrhythms of Chicago. His chord progressions gave rise to bop, his riffs led to the Kansas City school of swing.

Each of the four volumes here represent a period of Morton's accomplishment, dividing the tunes date-wise. They run to rags and blues, 1915-1924; Spanish rhythms, 1924-1926; barrelhouse and stomps, 1926-1938, and memoirs and recollections, 1938-1949.

The majority of the rags, which incidentally are composed, are in three or four parts, the last part imparting a singing, melodic quality in and stark contrast to the lead statement, a back and forth bass chording which underlies the honky-tonk notes of the treble. At times, as in "Frog-i-more Rag," 1918, one's thoughts range from the 2/4 cadence of a Sousa march to music accompanying a silent movie.

A strict, even syncopated time is the trademark of much of this early ragtime, executed by an ornamental right hand and a left which races to and fro, fortifying the entire creation with an oom-pah-pah—much like a tuba in a Dixieland jam session. Thus, here is a bold caricature of treble and bass roles.

A harpischord as well as a piano meets Morton's demands in fine, rinky-tink fashion. A crisp snare and punctual bass contribute further to the effort as well as the previously mentioned banjo. However, "Fingerbreaker," 1938, is so spectacular in its pyrotechnics and breathtaking pace that one wishes for piano alone.

The "Superior Rag," 1915, reflects the rather academic approach of Parker who is obviously a perfectionist. A carousel-like celeste provides a light and lyrical ending.

"Crazy Chord Rag," 1932, is intriguing for its dissonance, containing an adagio refrain which sounds like tinkling bells. In "Dead Man Blues," 1926, "jelly rolls" come alive after a funereal introduction. Morton's imagination and wit speak through his music.

The interesting fact remains that all of these compositions possess similar traits but never bore or tire. Each has a different cast and is brimming with riffs, cross rhythms, and generally happy motifs.

It is apparent that "Sweet Peter," 1933, and "Sweet Substitute," 1938, were forerunners of popular songs of the 40's. Strains of "Peg 'O My Heart" come quickly to mind. "The Crave," 1939, a tango, breathes a Spanish air while "The Naked Dance," 1938, reveals Morton's propensity to infectious rhythmic ideas, betraying an insight into harmonics and dynamics that defies comparison.

In Morton's later work, one is not so aware of strict time; the pieces become more modern. "Metamorphosis," 1949, suggests a theme and variations and appears less busy than his earlier material. And what more fitting end than "Tiger Rag," 1949, with rolls!

This magnus opus released by Audiophile embodies refreshingly sweet, happy, and, above all, intricate music. As an additional dividend, the engineers have balanced it well. Mighty Morton has withstood the test of time!

Performance: Very Good
Sound: Very Good

CANBY

(Continued from page 63)

The youngest cellist looked to be about 16; a number seemed no older than 19 or 20.

As you may guess, I hardly noticed the microphones. This was live music for me. But there were pairs of Schoeps; some ancient mics, over the violins (all violins on the left, an old Boston Symphony tradition), over the celli and basses, plus that special setup for the harp solo. Neumann K-84, SM-69 stereo pairs, I noted down.

But what interested me more was the young conductor, Claudio Abbado. One expects pyrotechnics from a conductor, in particular a youthful one who is still on the make. This man was the epitome of calm control and economy. He had a score, a miniature, down in front of him. He never looked at it, except to indicate measure numbers for retakes and the like. He could start (and the orchestra with him) on a dime, at exactly the right tempo, anywhere in the piece. He hardly opened his mouth, yet the things he wanted were entirely clear even to us. At one stopping point he turned casually towards the violas and pointed, offhand, to one player. "The G," he said. That was all. The man nodded. Indeed he had played one tiny wrong note. I didn't hear it nor would you have heard it.

They say he is a great favorite of the musicians and I can see why, though he is not the main conductor, Steinberg, nor the main assistant, Michael Tilson Thomas, who is even younger.

It was almost six o'clock on that wet evening when I finally left Symphony Hall, after a stirrup cup and a chat with some of the musicians themselves while they listened to the TV-stereo playback of the music they had just recorded. Could any forthcoming record, I thought, match that afternoon's total experience or its near equivalent, the concert that would be presented in the Hall? Never. But then, how many of us have the choice? Recorded music still has its own values in the altogether different plane of living room listening.

Perhaps the strangest thing that happened in our subsequent pop session was the unexpected appearance of Tim Hardin himself, in the flesh. Unheard of! He had long ago put down his part of the music on the tape and the producer was now working out the musical surround being added to the prerecorded Hardin voice. He just happened in, unannounced. After a quick listen, he took over my singers to make some changes, a word-echo effect, something about "everyone," which he wanted to come after he sang the same word (on the tapes, of course, not live).

The producer was silent. Like the harp player in Boston, the performer had the floor. It was his record after all. Hardin worked away for a good 15 minutes with my singers, while I retired to the control room to eavesdrop. Tough going, because he wanted them just to "harmonize" and they didn't know how. (How many classical musicians do?) But he got the effect he wanted, more or less.

Guess who won that argument? The pop singer may be the main performer, but his production people have a very large hand in the shaping of the final product, just as do the recording people and the conductor in the classical recording situation. Bernard Zighera played precisely as had been planned by the Boston experts. He had to, and he knew it. So too, we went ahead according to the prior plan. If you will listen, you will hear our choir along with Tim Hardin, triple-tracked and huge (all three of our recordings simultaneously). But there is no "everyone" echo from us, not even a trace. AE

Weingarten Looks At...

Don McLean

GUILT! That's what I feel for having overlooked a superb album from a newcomer, Don McLean. And the fact that almost everyone else also has missed TAPESTRY (Mediarts, 41-4) doesn't salve my professional conscience at all.

McLean, a tunesmith-singer in his early 20s, is on one hand a throwback to the folk era of the late '50s and on the other a latter-day Bob Dylan, filling the other-directed void left by Dylan's turning first to introspection and then to country.

Of the 11 cuts, it is likely that you have heard only "Castles in the Air," a slow-starting item that belatedly made a mini-splash in the recording biz puddle. Sings McLean:

"I'm city born but I love the country life
"For I will not be part of the cocktail generation
"Partners waltz devoid of all romance
"The music plays and everyone must dance
"I'm bowing out, I need a second chance."

But the young man, who plays lead guitar and banjo in addition to singing, has much more to say. "General Store," as an example, is a tone poem dealing with insensitivity, bigotry, and fear. And "Magdalene Lane" knocks California in general, Hollywood and its carbon-copies in particular, for its focus on bright lights and other tinsel-type glitter instead of on people. The attack is soft yet bitter.

A disciple of living-legend Pete Seeger, McLean, who writes his own material, also is into the ecology thing, witness the title tune, which contains both musical and lyrical beauty.

"All the flowers that grow on this colorful tapestry
"Somehow they know that if man is allowed to destroy all we need
"He will soon have to pay with his life for his greed."

In contrast, "Respectable" is a ballad about injustice, a tune portraying adroitly the idea that the rich and powerful can buy freedom in our system of jurisprudence while the poor often are incarcerated even though innocent because of their financial plight.

"Orphans of Wealth," however, tends to sum his feelings about money and its application in the United States:

". . .they're African Mexican Caucasian Indian
"Hungry and hopeless Americans
"The orphans of wealth and of adequate health
"Disowned by this country they live in
"And with weather-worn hands on bread lines they stand
"Yet but one more degradation
"And they're treated like tramps while we sell them food stamps
"This thriving and prosperous nation . . ."

The balladeer-troubadour also offers, on the flip side, "Three Flights Up," a tale of loneliness; "And I Love You So," a song of love and happiness chasing the shadows of past aloneness; "Circus Song," a sardonic tune about phoniness ("Everyone's juggling and everyone's acting With smiles of grease-paint three feet wide . . ."), and "No Reason for Your Dreams," another love song, this time touching on the notion of being free.

"Bad Girl," however, is a contrast, musically-speaking, to the rest of the Folkish LP. Featuring a rinky-tink, old-time jazz sound (sandwiching melancholy strains), it is a tune with a punch at its tail. Essentially, it is the story of a girl who thinks she's alone but really isn't because there's at least one person who loves her (and, symbolically, all the downtrodden)—the singer.

What is McLean? According to the liner notes by Lee Hays of The Weavers, "The poetry of earth is never dead. It's a theme in Don's music and in his life."

And Seeger is quoted thusly: "Don is . . . a normal, talented, unpretentious, nervous, relaxed musician trying to use his songs to help people survive in these perilous times."

Besides all that, he's damned good.

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