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AUDIO

NOVEMBER
1970
60¢

Crowhurst Function Generators

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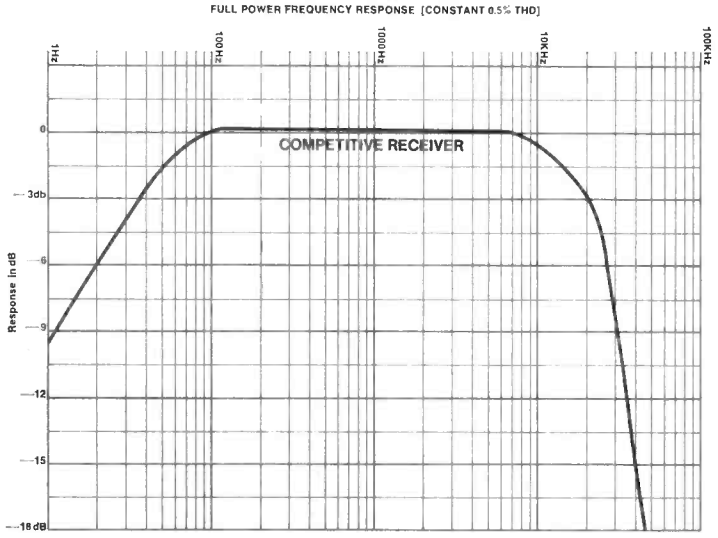
An FM Adapter

Sound & Decor

Any high-power receiver gives you good midrange response,



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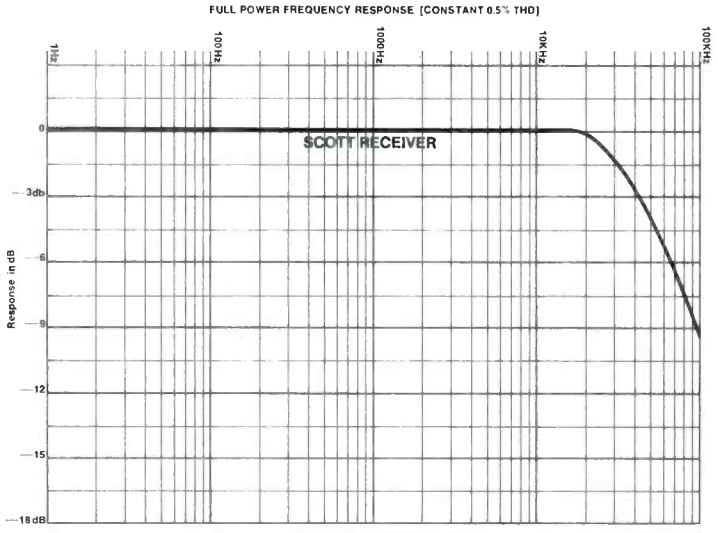

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NOVEMBER 1970 Vol. 54, No. 11

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About the cover: This rather Patriotic cover shows a Conn Mellophonium which was specially designed by Stan Kenton. It is monophonic and if you wanted to buy one, it would set you back about $400. . . . Keen-eyed readers will have noticed an AR receiver reflected in the bell. The distortion is purely visual. . . .

Audioclinic

JOSEPH GIOVANELLI

Connecting a TV set to a Home Music System

Q. How do I obtain audio output from my television receiver which can be fed to the auxiliary input of my music system?—Charles Reibeling, Brooklyn, New York

A. Without having a schematic of your television set here as I write this, it is impossible to give you a concrete answer. All I can do here is give you some general guidelines to follow.

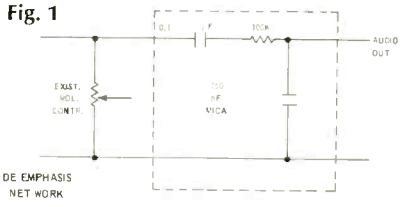
Many television receivers are of the series-heater-string variety, having no power transformer. If yours is one of these sets, do not attempt to connect it to your audio system without first obtaining an isolation transformer. Such a transformer is connected between the a.c. power line and the set. It does exactly what its name implies: it isolates the power line from the television set's ground system. The voltage appearing across the output socket of the transformer is the same as that supplied by the power line. The purpose of the transformer in this application is to ensure that the ground system of the set is not connected directly to the power line. Without the transformer, the television set's ground system could either be at true ground potential or might be "hot" with respect to ground, depending upon the polarity of the wall plug. You can see that if the TV set's ground was actually "hot," and that if it is connected to a high fidelity system which is grounded, the full power line voltage would be shorted, blowing a fuse and possibly damaging the two pieces of equipment. Further, we must not overlook the shock hazard which exists at the time that the connection is made.

Assuming that the set is a tube-equipped unit, the signal can be taken directly across the volume control. However, if the set is of solid-state design, there will not be sufficient signal produced across this volume control to drive your high fidelity system. You should obtain your signal from the output of the stage following the volume control. This means that the setting of the volume control on your TV set will affect the volume produced by your high fidelity system. This also means that the television set's internal speaker will also operate simultaneously with the high fidelity system. Its output can be silenced by simply insering a single-pole single-throw switch in series with the speaker. If the set has a headphone jack, then a dummy plug can be inserted into it, cutting off the speaker. When sound from the high fidelity system is desired, the switch is open or the dummy is plugged in. This arrangement should be applicable to solid-state TV sets regardless of whether they use an output transformer or not.

In a tube-equipped set the amount of signal appearing across the volume control terminals is sufficient to drive the auxiliary high-level input of most home music systems. A further advantage is that the setting of volume control on the TV set will have no effect on the level of sound produced by your high fidelity system. Therefore, no switching arrangement need be provided to mute the television set's loudspeaker. Be sure that the ground side of the volume control is connected to the shield of the cable which interconnects the television set with the home music system. The "hot" side conductor of the cable is connected to the "hot" terminal of the control. The center lug is not used to provide any external connections.

If there is an overabundance of highs, this means that the de-emphasis network in your TV set is located in some portion of the circuit after the volume control.

Fig. 1



Therefore, it must be added externally. See Fig. 1. When using the TV set alone, use it in the manner to which you have become accustomed. However, if it is connected at all times to the high fidelity system, the input selector switch must be set to the proper input in order to prevent the audio of the TV set being shorted out. If this switch is set to the wrong position, nothing will be heard from the TV set's loudspeaker. When you wish to listen to the television program through the high fidelity system, the volume control of the TV set should be set to its minimum position so that no sound is produced by its built-in loudspeaker.

I have seen some instances in which the volume control of the TV set is used

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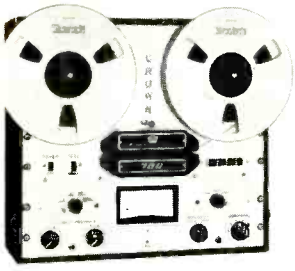

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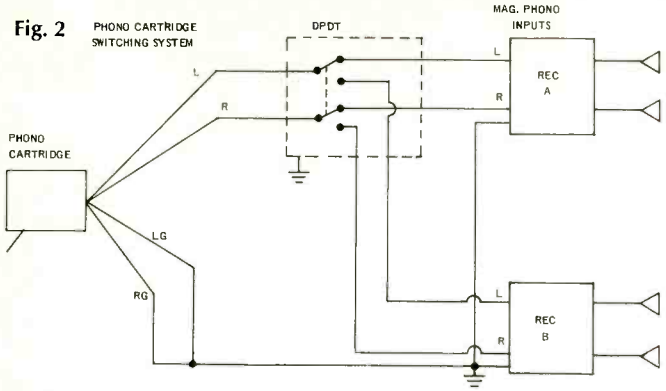

Fig. 2

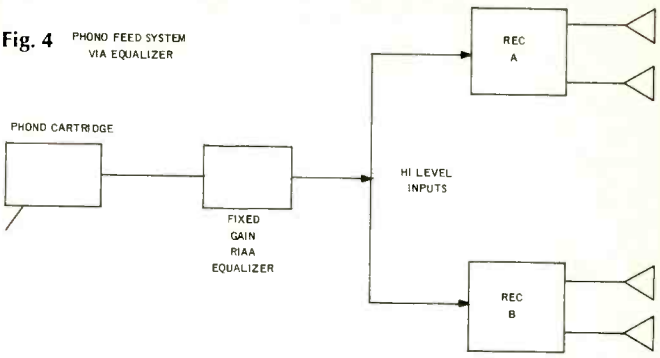

Fig. 4

as the load for the detector. Under these circumstances, use a coupling capacitor connected between the "hot" side of the volume control and the cable feeding the high fidelity system.

Going back to transistor sets, the de-emphasis network will probably be located at a point prior to the place where you are extracting output. If, however, the network is placed between this point and the following stage, you should connect your music system to the output side of this network.

You will almost certainly require a coupling capacitor between the output and your music system.

To facilitate a quick disconnect from the music system, an appropriate jack should be mounted on the rear apron of the chassis. Thus, interconnecting the TV set and the music system will simply be a matter of running a cable between the jack on the TV set and the appropriate input connector on the music system.

Impedance and Speaker Efficiency

Q. From reading several articles concerning amplifier power and speaker power requirements, I am under the impression that 8-ohm speaker systems tend to be more efficient than four-ohm speaker systems. Does speaker impedance per se have much to do with efficiency? —John J. Serocki, Whitestone, N.Y.

A. There is no way to equate speaker efficiency with speaker impedance. Efficiency depends on magnet design, cabinet design, cone mass, and other parameters.

As you know, transistor amplifiers are designed to produce maximum power at some specified impedance. If the speaker's impedance is higher than this value, the amplifier cannot supply it with as much power as would be true if the speaker had an impedance equal to that which enables the amplifier to deliver its maximum rated power. This might lead you to think that speakers with, say, 16 ohms impedance are not as efficient as others of 8 ohms. However, this is really a matter of amplifier performance.

Connecting a Pickup to Two Receivers

Q. I would like to connect my phonograph to two separate receivers by means of two Y connectors. Would this be all right or would it cause an interaction between the two receivers?—Frank L. Moore, Ogden, Utah

A. I do not suggest that you connect your phonograph to two receivers, at least not in the way you have described. There are at least four reasons why I say this.

1. The shielded cable required to interconnect the two receivers to your phonograph system will be, obviously, of greater total length than that which would have been required to connect the phonograph to a single receiver. Added length means added capacitance, which, in turn, can result in some loss of high frequencies.

2. The combined load presented to the cartridge by the two receivers will be 23.5 K ohms. Most cartridges require

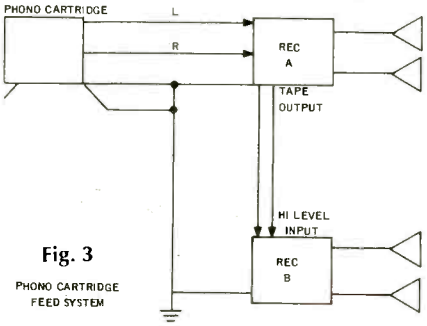

Fig. 3

47 K ohms for proper operation. Additional high-frequency losses are likely to result.

3. If you desire to use receiver A to hear a phonograph record, but receiver B is switched to some source other than phonograph, it is possible that the cartridge will be shorted out, rendering it inoperative as far as receiver A is concerned. As you know, selector switches often short out all unused inputs. Therefore, receiver A could not be fed from the cartridge except when both are switched to the "phono" position.

4. The common ground lead between the two receivers and the phono cartridge is likely to serve as a ground loop and introduce considerable hum into one or both receivers.

This hookup is better accomplished with a switching arrangement. See Fig. 2. Of course, this arrangement will not enable both receivers to obtain signal from the cartridge at the same time. If this is a requirement, another method must be devised.

One solution might be to connect receiver A directly to the phonograph pickup. Then connect the "tape out" jack of receiver A to one of the high-level inputs of receiver B. Thus, when playing a phonograph record, receiver A is switched to its "phono" position, and receiver B is switched to the position corresponding to the high-level input fed by receiver A. See block diagram of Fig. 3.

Solid-state equalizers are on the market; they have neither volume nor tone controls, but they do provide sufficient gain and equalization so that their input can be fed into the high-level input of an audio system, and they provide sufficient signal strength as well as the RIAA compensation. The phonograph cartridge could feed two receivers simultaneously by being connected as shown in Fig. 4.

This scheme has the advantage that the leads connecting the equalizer to the receivers can be rather long without producing significant loss of high frequencies. (I am assuming, of course, that the output impedance of the equalizer is rather low, as would be the case if an emitter follower stage is provided in the output of the equalizer.)

This arrangement has the disadvantage that, if the receivers are to be used for separate functions, the phonograph circuitry will be shorted by the input selector switch, as was described earlier. *Æ*

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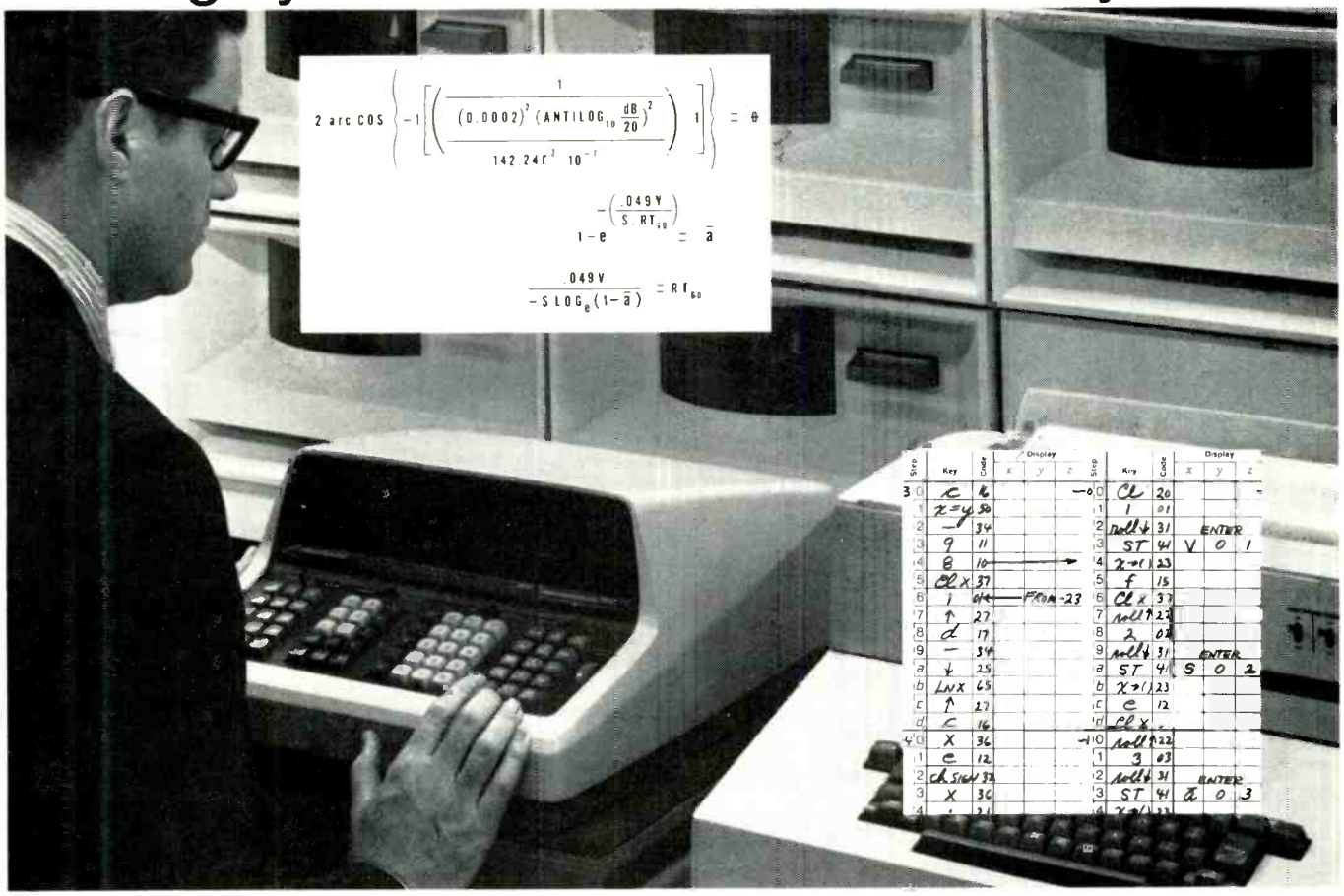

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BEHIND THE SCENES

BERT WHYTE

LAST MONTH I described the old Brooklyn Paramount theatre, which was to be the locale for a four-channel recording of its newly restored 26-rank "mighty Wurlitzer" organ. Now I'll cover the details of that recording.

It becomes quickly apparent when you decide to make a four-channel recording that it takes a lot of heavy equipment, and there is almost always a scarcity of eager, strong-bodied young men to lug the stuff. I guess over the years I've been spoiled by the superb facilities available to me on "location recording." First there was the famous Mercury recording truck, which Bob Fine had equipped to cover virtually any recording contingency, and in which, in relative comfort, I made some of the earliest stereo recordings. Then there was my Everest recording truck, which was equipped for every kind of recording including six-channel 35-mm magnetic film. This truck used to accompany me as "personal baggage" on the S.S. United States, or the Queen Elizabeth. We would disembark at Southampton, drive to London, and thence to Walthamstow Town Hall, where British Customs would open the sealed truck and in fairly short order we would be set up to record. Ah, those were the days!

Now I'm older and fatter, and definitely not kindly disposed to the more athletic side of location recording. Nevertheless, once you have been infected with "recording fever," there is no turning back, and it is astonishing in retrospect what kind of personal effort and sacrifices one will make for the sake of a recording!

To make this four-channel stereo recording I used an altogether remarkable tape machine . . . the Ampex 440-4. This is the workhorse of many professional recording studios, where they are installed in consoles. My unit had the tape transport and four-channel electronics mounted in separate portable (transportable would be a better term) cases. The 440 transport follows traditional Ampex design, considerably updated and advanced in this latest version. All elements are extremely rugged, designed for heavy duty. The transport is solenoid operated, of course, and the pushbutton controls have a reassuringly solid feel and respond instantly to your touch. The 440 I have operates at 7.5 and 15 ips, and speed change is electric at the flick of a switch. Switches also handle equalization for both tape speeds, as well as tensioning for reel size. With this unit you can use up to 10½-inch reels, but you can also mix reel sizes—7-inch on one side, and 10½ on the other and vice versa. Unlike previous Ampex professional recorders, the 440 accepts *both* quarter-inch and half-inch tape. Neat trick, and here is how they do it . . . the tape guides at the supply and take-up sides of the recorder, have an ingenious spring-loaded mechanism, which when pulled up and given a half turn, gives guidance for quarter-inch in one position and half-inch in the other position. Next, the entire head structure is interchangeable. The heads are contained in a cast housing, the base of which has been precision milled and fitted with three machined guide pins. This mates with a milled area on the heavy top plate, and the pins fit into perfectly aligned holes in the plate. The leads from the heads terminate in a flat Fiberglas board and are connected to a series of pins. The pins plug into female receptacles which are mounted at the back end of the milled area on the top plate. With this arrangement, one can choose many different mono and stereo head configurations for use with either quarter- or half-inch tape. The four record/playback amplifiers are completely independent and can be connected to the heads in a variety of ways. Currently I have a three-channel half-inch head (there are thousands of three-channel half-inch productions in the vaults, and if one has the right connections . . .) and a four-channel half-inch head. I also used a quarter-inch four-channel head for a while, one of the first of this type built by Ampex. The precision fitting of head assembly to base plate, makes possible head interchange without alignment. You can check the alignment, of course, and thus far it has been on the nose! The head assembly also contains a scrape flutter filter (with provision for a second filter if desired) and for the first time on an Ampex professional machine, automatic tape lifters. Actually the lifters come up through the top plate and into the head assembly. Now here is another clever bit . . . the lifters pull the tape away from the heads in the fast forward or rewind modes . . . but not completely. Thus a certain level of "monkey chatter" can still be heard and the trained recording engineer is able to use this sound to locate various parts of the program on the tape. The 440 electronics are all solid-state, have large, legible VU meters, the usual input and output pots, and switches to select between record, playback, and "sel sync." The sel sync feature permits totally synchronous recording, by circuit switching which changes a record head into a playback head in multiple-track "layer-on-layer" recording. Sound-on-sound and sound-with-sound recording with amateur tape machines always suffers from the approximate tenth of a second lag between the record and playback heads.

For this organ recording, I used the 440 with the four-channel half-inch heads, mainly in the interests of signal-to-noise ratio. This really came about, because the 440, in common with all professional machines, uses Cannon XLR input and output plugs. These mate splendidly with the professional Dolby A301, which is similarly equipped. Trouble is, I didn't have a pair of Dolby A301s. My Dolby "B" Type units have RCA pin jacks and I just didn't have the time to make up cables with XLR on one end and RCA pin on the other end. I have since rectified this situation, and now can do "state-of-the-art" four-channel stereo plus Dolby recording. The Ampex 440 is found mostly in professional studios and as such, are usually set up for a line input from a mixing console. Thus in the portable versions if you want to record with microphones, you must use a plug-in pre-amplifier, which goes into an accessory receptacle on the rear of the record/playback amplifiers. This is okay, but it doesn't afford the flexibility of a mixer like the Ampex AM-10, which accepts multiple mikes and can also split mikes between channels. Since I was recording four-channel stereo, two

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mixers were necessary. With this Ampex 440 unit and the mixers, one can handle almost any kind of "remote" or "location" recording.

In a huge place like this theatre, you need miles of mike cable, especially in a hall where your recording equipment is not necessarily in a place of your choosing. In surveying the theatre for mike placement, I thought I had found a good solution to this problem. As I told you last month, Long Island University uses the theatre as a gymnasium. They had ripped out about half the old orchestra seats and installed in their place a basketball court. Powerful lights are installed over the court, about 40 feet high, and strung on wires across the width of the theatre from the organ pipe chambers on each side. The chambers begin roughly 35 feet from the floor. I figured I would hang my primary left- and right-channel mikes from these lighting support wires. In order to change bulbs when they burn out, there is a "cherry picker"—an elevating platform—on the premises, and with this gizmo I thought I had it made. Alas, none of the custodians would undertake to run the "cherry picker." Now even with Star mike stands and booms, you can't get higher than about 20 feet. And they are *heavy*. And I didn't have any. Momentarily thwarted, we spotted a pile of commercial-type folding tables off to one side, and with the aid of some agile types we placed tables one on top of another, at a pre-determined spot on each side of the theatre near the pipe chambers, and when we had built up the "table platforms" as high as we dared, we gingerly put one of my lightweight PIC mike stands on top. This precarious assembly put my mikes about 30 feet high. The mikes used for the front channels were the new Electro-Voice RE-55 omni-directional dynamics. They are rugged, highly sensitive mikes with a flat wide-range response, and a particularly good bottom end. While I decry the practice of placing mikes fairly close to the pipes, which usually reduces the spatial characteristics, it is important to get your mikes level with the pipe chambers. When they are level and you adjust the closeness of the mikes to the pipes, so that you get the important high frequencies without short-changing the acoustic perspective, you've got the beginnings of a good balance. Incidentally, the reverberation time in the theatre was no more than 1.5 to 1.7 secs, but the hall has great brilliance and liveness. The left and right rear mikes were Electro-Voice RE-15 cardioid dynamics. They were placed on regular mike stands about 12 feet high and a certain width apart, and a certain distance from the front mikes. The "dead" side of the cardioids were placed to the *rear*. This four-channel stereo recording utilized a special technique, and thereby hangs a tale.

Some of you oldtimers may remember a very early stereo recording called "Sounds In The Round." It was a rather spectacular recording demonstrating the spatial and directional aspects of stereo. The recording was brilliantly engineered by Bob Jordan and Jim Cunningham. Jim has always been in the forefront of stereo experimentation, and today he is research director for the Eight Track Recording Co. of Chicago. About four years ago, after much experimentation and research in multi-dimensional recording techniques and psychoacoustics, Jim developed a unique four-channel stereo recording technique. A great deal of this technique is based on fairly complex factors, but in essence here is how it works . . . Research has shown that the human brain

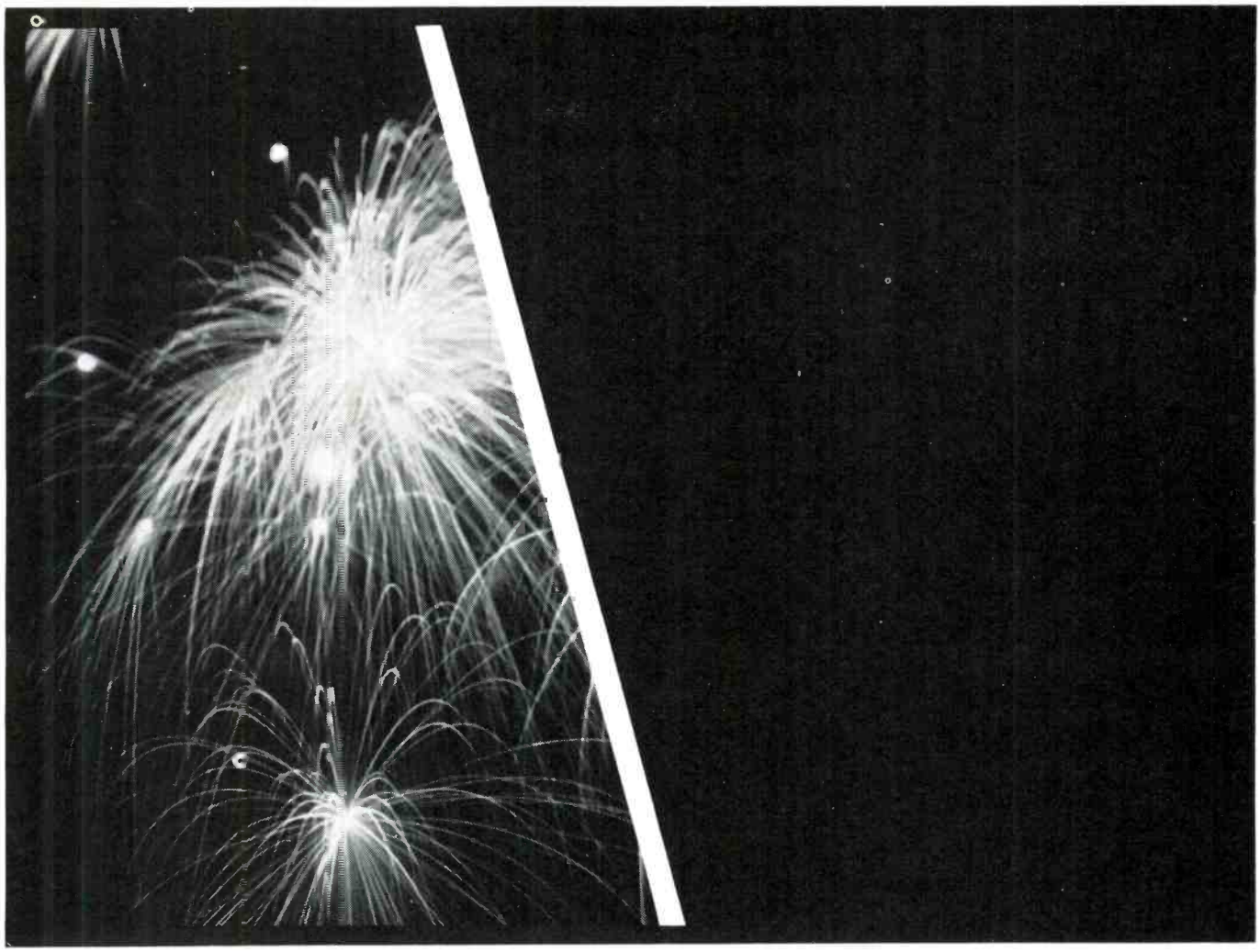
Ampex 440-4

cannot integrate sounds lasting much longer than 33 milliseconds, with possibly 50 milliseconds right on the ragged edge. Sounds longer than this confuse the brain and thus we hear various orders of reflections. Working with this information, Jim Cunningham devised a four-channel stereo set-up, in which the primary mikes are placed in more or less normal position near the orchestra, depending on the hall acoustics. The secondary mikes he places preferably at 33 feet and no more than 50 feet to the rear of the primary mikes. This distance is based on the velocity of sound—approximately 1 foot in 1 millisecond—hence 33 ms equals 33 feet. The width between the primary and secondary mikes is dependent on many factors, such as size and shape of hall, reverberation time, size of performing group, and so on. But in general, Jim's experiments have led him to conclude that whenever practicable, the width between the mikes should be kept to the 33- to 50-foot maximum. Further tests have revealed that Jim's technique doesn't work as well in a very reverberant hall. In many situations, it may be necessary to use cardioid mikes for front and rear channels, with the rear cardioids presenting their "dead" side to the rear of the hall.

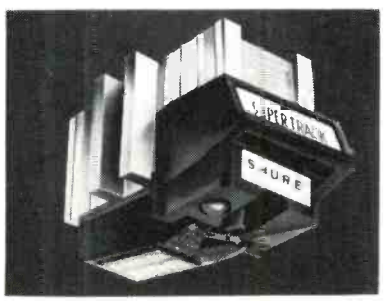
Having made his four-channel stereo recording in this fashion, Jim plays back the recording quite differently from the usual set-up of speakers in front of, and to the rear of the auditor. The front speakers remain in their normal position, but the "secondary" speakers are placed from ⅓ to ½ the distance between your seat and the front speakers, they are placed at the extreme sides of the room, and they are angled in towards you.

I made the recording of the Brooklyn Paramount organ with the Cunningham technique. The primary (front) mikes were a little less than 50 feet apart, the secondary (rear) mikes were about 30 feet to the rear of the front mikes and about 35 feet apart. The liveness of the hall, led me to use the omni-directional mikes in front and the cardioids in the rear.

How does the Cunningham recording compare with the four-channel stereo we have heard up to now? In my opinion, and the opinion of others who have heard it, this is the most convincingly natural sound yet. It is absolutely spectacular. You play the two front channels and the sound is that of a good high-quality stereo recording. You switch in the secondary channels and the effect is stunning and dramatic. The effect is not at all subtle. Your whole listening room opens up, a great stage seems to appear before you. The effect is totally natural too. Obviously, there is no danger of overbalancing rear speakers and hearing discrete instruments behind you, as is too often the case with current four-channel sound. In making the recording, the rear channels were about 6 dB lower than the front. In adjusting the playback level of the secondary speakers, you strive for a balance which complements the front speakers, and this seems to be at quite a bit higher level than you would ever use for the rear channels in the surround techniques. What about pop music with the Cunningham technique? It works well here too, providing that the recording is made properly and played back with Jim's special set-up. However, a Cunningham pop recording can be played in "surround" style if desired, and without any degradation of the sound. It is equally important to emphasize that the playback of currently available four-channel stereo music will *not* give you the Cunningham



"Perfect tone bursts"



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We quote: "Tone burst response, using the Stereo Review SR-12 test record, was perfect up to the highest frequencies . . ." That's Hirsch-Houck Labs talking about the Shure V-15 Type II Improved phono cartridge. Hirsch-Houck also said the V-15 was ". . . always unstrained, effortless, and a delight to listen to." We were enormously pleased, of course, but not surprised. After all, the cartridge that does sound better to the ear *should* also sound better to an electronic listening device. But now we feel we're ready for the *ultimate* test — on your turntable, playing your records. The incomparable V-15 Type II Improved, $67.50. Shure Brothers Incorporated, 222 Hartrey Avenue, Evanston, Illinois 60204.

SHURE

sound. To hear this fabulous new sound, it *must* be recorded and played back in accordance with his prescribed techniques.

Where can you hear Cunningham four-channel stereo? That is a bit of a problem right now. I will be demonstrating some of it at the Westbury and Newton Hi-Fi Shows, but the trouble is that by the time you read this the shows will be over. It may be that some of the more venturesome hi-fi sales rooms will want to demonstrate this sound. The overall point to remember is that a great deal of experimenting lies ahead with all types of four-channel sound. Both the Cunningham and the "surround" four-channel sound have their respective merits. Then there is the thorny problem of speaker placement in living rooms. Decor and personal taste have to be a big factor here. Fortunately, if you are contemplating the purchase of a four-channel stereo tape recorder, it is comforting to know that Cunningham, or "surround" or any other kind of four-channel stereo that is likely to appear, can be played with equal facility on the same machine.

° ° °

It has been brought to my attention that a few columns ago, I made a real goof. In writing about the RCA Quad Eight, I wondered why the time of the cartridges would be cut down from 80 to 40 minutes. I even mentioned a few sentences earlier, that in Quad Eight the first set of four channels would end and the player shift to the second set of four channels. Worse still, I recorded and sequenced the four programs on each of the first hundred or so cartridges for RCA. So I certainly know how the process works. In fact, about a year ago I wrote an elaborate article in Audio about 8-track cartridge sequencing. I'll have to attribute my boo-boo on the time aspects of Quad Eight to too many gin-and-tonics, or some such thing when I was writing the column. Sorry about that.

° ° °

Progress is being made on the Dolby front. Ampex Stereo Tapes, biggest producer of open-reel, cartridge, and cassette tapes, has announced it will be producing "Dolbyized" cassettes. First items will be some London operas, with Tosca and Norma heading the list. Ampex expects to be in production of the Dolby cassettes by October 1st of this year. The company has said it will produce "Dolbyized" cassettes "whenever practicable" from most of their production, but obviously such items as historical and childrens' tapes would be excluded. Now that the ball is rolling on cassettes, how about some "Dolbyized" open-reel tapes for all the quality conscious audiophiles who read this magazine? AE

Dear Editor...

I very much appreciated the articles by Don Davis on the use of a computer in planning a Sound installation. Articles of this caliber with the mathematics are rare these days. Keep up the good work!

J. THOMAS
Chicago

The article by Don Davis on Sound installation was far too technical. I could not understand a word of it.

P. KELLY
Indiana

What can I say?—Ed.

(Continued on page 14)

ANY NUMBER CAN PLAY.

The time is tomorrow. The name is TEAC. The machines are the Simul-trak™ Series TCA-40. And they're here today.

This series of tape decks combines the best features of high-quality quarter-track, two-channel operation with four-channel stereo capability. It's the best of two worlds, in three versions, four channels.

All three models feature four-channel playback, as well as regular two-channel playback with auto reverse. What's more, Models 40 and 41 can be modified later to the full four-channel capability of Model 42, at moderate cost. Meanwhile, any one of these machines is compatible with your present equipment; no modifications or reassembly are necessary.

So what are you waiting for?

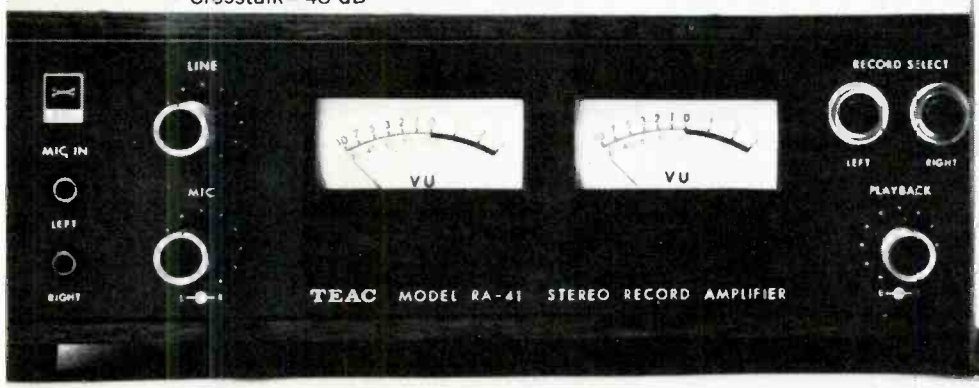
Simul-trak™ surrounds you with sound – and gives you a headstart on tomorrow.

TEAC

TEAC Corporation of America • 2000 Colorado Ave. • Santa Monica, Calif. 90404

General Specifications

- Speeds – 7½ and 3¾ ips
- Motors – 1 hyst. sync., 2 outer rotors
- Wow and Flutter – 0.12% @ 7½ ips
- Freq. Response – ±3 dB 50-15,000 Hz @ 7½ ips
- S/N Ratio – 50 dB
- Crosstalk – 48 dB



TCA-40

• ¼-track, 2-channel stereo playback, plus 4-channel stereo playback (in-line) • ¼-track, 2-channel erase and record heads for future "step-up • Automatic reverse for uninterrupted playback of conventional 2-channel tapes • Readily modified to TCA-41 or 42 • Built-in solid-state preamplifiers • Ideal for duplication master or copy deck

TCA-41 *(Illustrated)*

• ¼-track, 2-channel stereo playback, plus 4-channel stereo playback (in-line) • ¼-track, 2-channel record • Automatic reverse for uninterrupted playback of 2-channel tapes • Readily modified to future 4-channel recording capability, or TCA-42 • Solid-state playback and record preamplifiers • Off-the-tape monitoring selector

TCA-42

• ¼-track, 2-channel stereo playback, plus 4-channel stereo playback (in-line) • ¼-track 2-channel stereo record and 4-channel stereo record (in-line) • Automatic reverse for uninterrupted playback of 2-channel tapes • Total of 8 separate solid-state playback and record preamplifiers • Off-the-tape monitor selectors

Dear Editor . . .

(Continued from page 12)

Dear Sir:

After reading David Hafler's article in the July issue, I feel prompted to send you my own circuit for a derived center speaker. (Nothing to do with four-channel stereo.) This circuit solved a problem with my home stereo and does not require that you modify the amplifier as does the Dynaco circuit.

My problem was that my Fisher 500TX would not deliver 60 watts R.M.S. per channel with two 4-ohm AR-3's. With 4-ohm loads the 500TX will deliver only about 37.5 watts R.M.S. per channel. Also, the receiver would overheat at high levels and eventually trip the thermal breaker. I was connecting my center speaker—an 8-ohm AR-5—to the connection provided on the receiver. But this only made a bad situation worse as it caused the load impedance to go still lower. This power was not adequate for two AR-3's in a large room (AR recommends 60 per channel). I have determined that this is normal for a 500TX and my unit is not defective. Most people will assume that the power goes up and not down with 4-ohm loads.

With the circuit shown, my receiver now operates cool at an earsplitting level! About 25 per cent of the power is wasted in the resistor with one channel driven. However, note that on monaural no power is wasted since both leads of the resistor are at the same voltage and phase. Whatever is wasted depends on the program material. In my case the result was a very considerable increase in acoustic power. And the receiver now "sees" a much more favorable set of loads.

The purpose of the resistor is to cancel out any cross-channel leakage. I use two 3.7-ohm "fuse" resistors (designed for TV sets) and they get barely warm at maximum power. The value is not critical as long as it is somewhere near the impedance of the center speaker. The transformer is an ElectroVoice XT-1, which is a large and heavy transformer with a 1:1 ratio. Purists may object to the use of a transformer. Let me point out that this transformer does not carry d.c. and has a 1:1 ratio. It is, therefore, not subject to most of the woes of output transformers. I cannot detect (and neither can anyone else) any distortion introduced by the XT-1.

The sound with the two AR-3a's in two corners and the AR-5 in the middle of the wall is simply superb! The AR-5 is a perfect match for the AR-3's since it has similar midrange and tweeter drivers. The somewhat lesser bass is no worry since the AR-3a's handle most of the bass—and they are in the best location to handle it.

Sincerely,
Clyde E. Wade, Jr.
312 S. Cedar
Little Rock, Ark. 72205

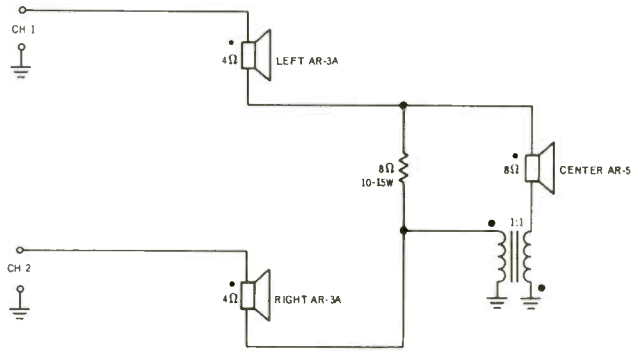
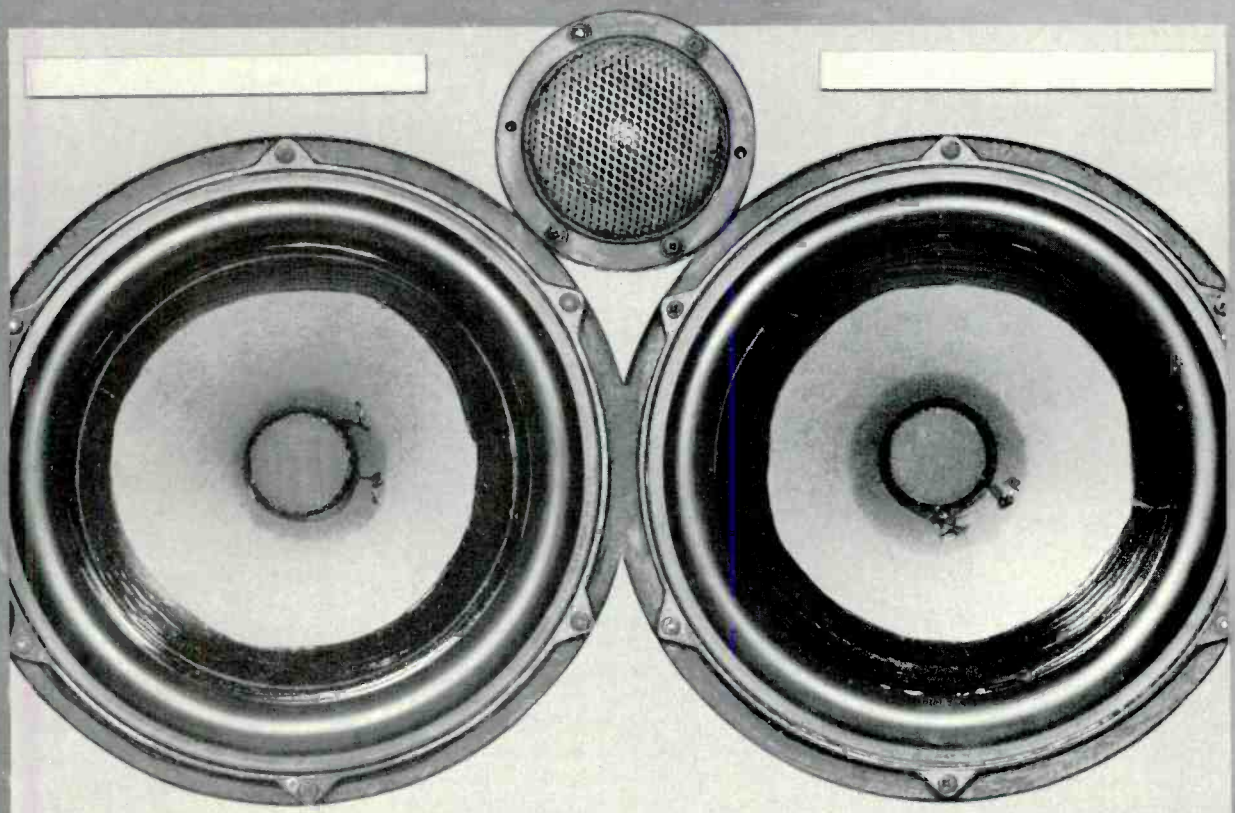


Fig. 1—The transformer must be phased as shown in the diagram or the resistor will not cancel channel leakage.

WHY SPEND $100 MORE?



Here is the new Dynaco A-50 Aperiodic loudspeaker which costs $100 more than the popular A-25 loudspeaker.

As thousands of listeners have found, the A-25 gives excellent performance throughout the musical range and satisfies at least 95% of all listening requirements. Many people will not want to spend $100 more for the last 5% that the A-50 provides . . . its lower frequency response, high power handling capabilities, and slightly more linear impedance curve. The A-50's midrange is also slightly smoother because the new dome tweeter's lower resonance permits a 1000 Hz crossover. For most listeners, these are not substantive differences, but for those striving for perfection, they are worthwhile.

Here is how they are attained in the A-50: The A-50's cabinet consists of two closed chambers, each the size of the A-25, connected through an acoustical resistance consisting of a narrow slot filled with the critical density of fiber glass. The two 10" woofers and high dispersion dome tweeter are mounted in the top half. The top enclosure provides a high degree of acoustical loading in the critical 50—150 Hz spectrum. This damping is responsible for the outstanding transient performance and flat impedance characteristic of the speaker, and explains why power transfer between an amplifier and the speaker is so efficient with an aperiodic design.

Below 50 Hz the bottom air volume is added to the top, giving a large air mass which combined with the two 10" woofers extends low frequency performance.

The A-50 and A-25 are acoustically compatible and both can be used in the same four dimensional stereo playback system. Your dealer now has both speakers available for your comparison. We know you will be satisfied with the A-25. We also know that for those of you who are seeking that last 5% of perfomance, the A-50 is worth $100 more . . . $179.95.

dynaco INC. **3060 JEFFERSON ST., PHILA., PA. 19121**

IN EUROPE WRITE: DYNACO A/S, HUMLUM, STRUER, DENMARK

Tape Guide

HERMAN BURSTEIN

MAY I PLEASE again remind readers that the basic purpose of the Tape Guide is to answer queries about the electronic and magnetic aspects of tape recorders, about the use of tape machines, and about problems of tape machines in general.

Too many letters still come in asking for recommendations or other comments bearing on specific items of tape and other audio equipment; the policy of AUDIO prohibits me from making such recommendations and comments. Readers are referred to the Equipment Profiles for such views. Also there are too many queries about the idiosyncrasies of specific models of tape machines; I am not and cannot be familiar with all makes of tape machines, and therefore cannot answer most of these questions. Finally, there are too many questions which should be addressed to manufacturers or their representatives, as for example, those on specifications or maintenance of a particular model.

* * *

Mr. Roger Odom, Engineering Manager of SPARTA Electr. Corp., Carmichael, California, has sent in a very interesting suggestion about better erasure and lower noise:

"Few, if any, home-entertainment or semi-professional recorders develop a strong enough field to erase a tape *thoroughly*. The previous recording may be wiped out well enough, but the residual tape noise will be much higher than need be due to incomplete erasure. Use of a good-quality bulk eraser can result in several dB or more of increased S/N, but only if the recorder's erase head is suitably disabled so as not to undo the good of thorough bulk erasure. Of course this won't help in a system whose performance is limited by circuit noise, but this should not be the case in any modern recorder of reasonable quality . . . My recorder has an erase-defeat switch, and I bulk-erase. I can easily detect where I have recorded-over, using the internal erase head, by the increased noise level. Please try it some time."

Tape Deck Amplifiers

Q. One thing that puzzles me about tape decks is that they have built-in amplifiers. I want to get a tape deck and run it through my audio preamp and power amplifier. Do the tape deck's built-in amplifiers have any effect on the performance of the preamp and power amp? Is it possible to obtain a tape deck that doesn't have built-in amplifiers, or are the built-in amplifiers a necessity? Also, if the built-in amplifiers are a necessity, would my audio preamp/power-amp combination improve the quality of the sound from the tape-deck amplifiers? (Curtis T. Gross, APO San Francisco, California)

A. For recording, a tape machine must have a special preamp that includes an oscillator. None of the audio preamps customarily available provides this facility, nor the equalization that is required in recording (treble boost of a specified kind). For playback, a tape machine must have a preamp to provide equalization and amplification. Many audio preamps provide this playback facility, so that output of the tape playback head, if desired, may be connected directly to the audio preamp. (However, this cable should be as short as possible to avoid treble loss; and it must be routed carefully to avoid hum pickup.)

Playback quality is governed by the amplification stage nearest to the playback head. Whether you are better off connecting the playback head directly to an external preamp, or going through the playback preamp of the tape machine, depends on the respective quality of each preamp. In your case, if you are using a very-high-quality external preamp, you might be better off bypassing the tape-deck playback preamp. On the other hand, in a good tape machine the playback preamp contains equalization adjustments to compensate for the deviation from "ideal response" of the particular head. The external preamp ordinarily provides no such adjustment, and therefore may not give as good a frequency response.

Test Tones

Q. I have some test records with 1600-Hz standard lateral test tones recorded at velocities of 5 cm. per sec. rms and 7 cm. per sec. peak, respectively, which are almost the same. Are these test tones equivalent to the standard-level tones on tape recorder alignment tapes and therefore useful for level adjustments when copying records, or does such a standard exist? These records have worked for me for copying some orchestral records, but result in level settings either too high or too low on others or on other types of music, such as classical vocal. Your comments will be appreciated. — H. Michael Lafleur, Lafayette, Louisiana.

A. There is no direct relationship between the standard lateral test tone for records and the standard level tones for tapes. The latter are related to a prescribed amount of distortion recorded on the tape at a prescribed frequency. The NAB magnetic tape standards can give you more information on this.

In setting level for recording a tape, one cannot follow a purely mechanical procedure based on a reference level tone. Much depends on the nature of the sound to be recorded; more specifically, on the extent to which peaks exceed average level. If amplitude of the sound is relatively uniform, with peaks seldom more than 10 dB above average level, one can safely record (without excessive distortion) at a higher level than if there is, say, a 20-dB distance between peaks and average level.

Faulty Playback

Q. I have a problem with my tape decks on recording. This is my second deck, and both of them have given me the same difficulty. When I am taping, the meters show that the signals are going through, but on playback I can hear only one channel. This happens off and on, which is the reason I bought a second deck. Also, on tapes I recorded a while back, I can hear a mixed up sound on one channel and the recording on the other channel. If I rewind, sometimes this problem clears up. Or if I take the tape off and play it at a later date it is okay. My amplifier plays both tapes and discs well, and there is always sound in both speakers. (Clyde M. Thomas, Paraiso, Canal Zone)

A. Your trouble might lie in a faulty cable or other poor connection between the output of your tape machine and the input of your amplifier. Interchange the left and right output cables of the tape machine to verify this. If the sound goes dead on the opposite channel than previously, the trouble is in the cable.

If the trouble is not in a cable, you can likely pick up a clue as to where the

The More Serious You Are About Tape Recording, The More You Need It.

THE ADVENT MODEL 100 NOISE REDUCTION UNIT is designed for people who own good recorders and demand a great deal of them. The more ambitious the recorder and more demanding the recordist, the more necessary an investment it is.

The basics of the Advent Model 100 are these:

- It makes the famous Dolby® System of noise reduction available for use with any tape deck.
- It reduces tape hiss at any speed by 10 db.
- It takes over the electronic control functions (such as level-setting) of a recorder and performs them more precisely and simply.
- It provides complete input mixing—allowing any combination of microphone and line source material to be "Dolbyized," and adding the mixing capability to recorders that lack it.
- It makes a striking improvement in recording quality at any speed, and can be the difference between mediocrity and high performance at lower speeds.

It is hard to do justice to the difference the Model 100 can make in recording quality. While many people know that the studio version of the Dolby System has made a dramatic improvement in professional recording and mastering, very few have ever heard tapes of their own without background noise. And not having blessed silence as a reference is something like never having seen a television picture without "snow." If you don't know it isn't supposed to be there, you simply look or listen past it and accept it as part of the medium.

But once you've seen or heard things without it, life is different. With the usual hiss removed from a good recording, there is a striking difference in overall clarity and in the definition of individual musical instruments. And quiet passages previously "lost in the soup" emerge for the first time. The difference is anything but academic.

It becomes even less academic at lower tape speeds, where the presence of noise—to the point where it competes actively with music for attention—has made wide-range recording untenable. With the usual noise gone, the potential low-speed frequency and dynamic range of many recorders can be realized for the first time. The 3¾-ips speed can become the highest needed for most critical recordings of music, enormously extending both the convenience and economy of recording. And the

The Advent Model 100 Noise Reduction Unit $250*

1⅞-ips speed, both in open-reel and cassette recording, can become as satisfactory as the 33⅓-rpm speed for records.

All of which led us both to present the Dolby System for home use and to make it the basis of as flexible and useful a "recording center" as we could devise. The Model 100 provides the kind of recording control that few home recorders do—the kind that makes for precisely repeatable results and that yields a recorder's full performance in everyday use. Its combination of four input-level controls and a single master record-level control make the fussy but critical matters of balance and final level easy to do properly.

The Model 100 uses the "B-Type" Dolby circuitry developed by Dolby Laboratories specifically for home recording and pre-recorded tape releases. It comes with complete calibration facilities (including an internal test-tone oscillator) for optimum use with any recorder, and with a standard level tape that assures a match with the universal playback characteristic for all "Dolbyized" recordings, including pre-recorded releases.

We will be happy to send further information. But we hope you will explore the Model 100 for yourself. We believe that it's the single best investment for anyone who wants the fullest enjoyment of tape.

Advent Corporation **377 Putnam Avenue, Cambridge, Massachusetts 02139**

*Slightly higher in some parts of the United States "Dolby" is a trademark of Dolby Laboratories.

TAPE GUIDE (Continued)

trouble does lie by reversing left and right connections—for example, connecting the tape left output jack of the tape machine to the right input jack of the amplifier. In such a case, if the trouble switches channels, suspicion points at the left output circuit of the tape machine. Similarly, you can make further tests to narrow down the source of difficulty to the tape machine or to the amplifier; and to either the playback or recording mode.

Sibilant Distortion

Q. *My tape deck produces a type of sound distortion which is independent of the recording level, but dependent on the tape speed. The most extreme effect of the distortion is in nearly all sung words containing "s." The fairly short, sharp sound of the "s" in the source becomes a much-lengthened "ssss" (somewhat like a hiss) on the tape. Most extreme at the slowest speed, the effect is still detectable at 7.5 ips. When a cymbal is recorded, it loses some or all of its clarity, depending on tape speed. What is the reason for this distortion?* (Conrad M. Swartz, Minneapolis, Minnesota)

A. My guess is that the "distortion" you describe may be due to a peak in treble response. Such peaks are unlikely to be severe, if they exist at all, at 7½ ips inasmuch as flat response of 15,000 Hz or higher is readily attainable today at this speed. But it still is not really easy to obtain response to 15,000 Hz at reduced speeds without giving up something in the way of noise and/or distortion. To maintain extended treble response at reduced speeds, a good deal of treble boost is employed in recording—substantially more than at 7½ ips. This treble boost may encompass a peak in response in the vicinity of 5000 to 8000 Hz, unless the equalization circuit is very carefully designed. The peaked response characteristics, frequently encountered at 3¾ ips and lower speeds in many tape recorders, could cause the "ssss" you describe.

The large amount of treble boost can also produce distortion in two ways: (1) It may overload the tape. (2) It may overload the record amp of the tape machine. Another possible cause of the "ssss" is distortion in the record amp due to a leaky capacitor, faulty resistor, and so on.

Test Tapes

Q. *I am interested in obtaining a test tape to test and align my tape deck. Can you suggest an inexpensive test tape that will fulfill the job as a good substitute for the standard test tapes?* (Laudie J. Doubrava, Fairfield, California)

A. I am sorry, but I have no substitute test tape to recommend. A great deal of ingenuity, work, and care go into the making of a good test tape; hence its expensiveness. I would be disinclined to trust an inexpensive test tape, because this would seem to reflect insufficient care in producing a product of very high precision for it to serve its intended purpose.

Head Life

Q. *Could you hazard a guess as to how long it might take before a properly installed replacement head begins to show visual signs of wear? That happened within three hours after I installed a new head in my recorder, and this leads me to believe that something must be wrong.* (Robert Pearson, Chicago, Illinois)

A. I am sure it should be much more than three hours. Are you by any chance mistaking accumulation of tape oxide for visual head wear?

Measurement Levels

Q. *Why is frequency response of a tape recorder measured well below 0 VU rather than at a higher level?*—R. B. Rose, APO San Francisco, California.

A. To measure a tape machine's frequency response, frequencies are recorded at a level typically 15 to 20 dB below 0 VU to avoid tape saturation at high frequencies. The record amplifier supplies a substantial amount of treble emphasis, and recording in the vicinity of 0 VU would therefore result in tape saturation at the high end of the audio range. Correspondingly, in playback there would be an erroneous indication of inadequate treble response. The reason I say erroneous is that natural sound generally contains high frequencies of substantially *lower* magnitude than mid-frequencies, thereby avoiding tape saturation at the high end. However, in testing record-playback response, one feeds in high frequencies of the *same* magnitude as mid-frequencies. Æ

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

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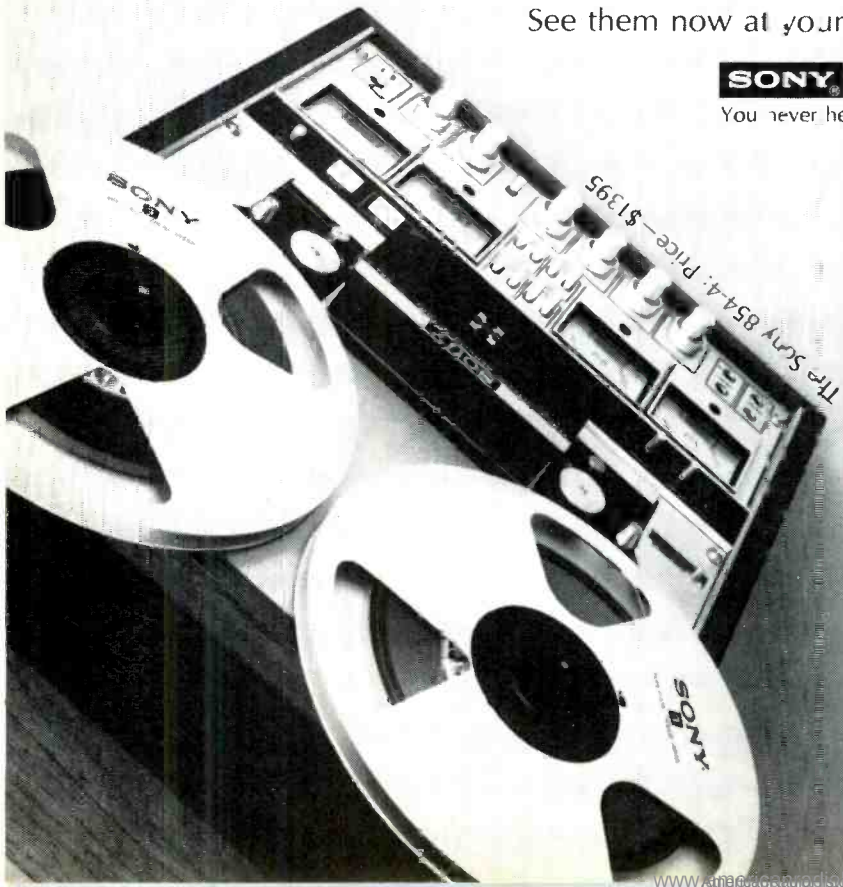


Editor's Review

Five years ago I wrote "I do not suppose anything has caused so much confusion in the audio world as this question of power output. When highly qualified engineers talk (and argue) about RMS or sine wave power, peak watts, continuous power, IHF, EIA, music power and so on, it is no wonder that the man-in-the-street scratches his head in some bewilderment. Gertrude Stein could have said 'A Watt is a Watt is a Watt' but she would have been quite wrong!" Well, the situation today is still the same—worse if anything—because we have additional ratings like the misleading ±1 dB figures to contend with. . . .

The question is, said Alice "whether you *can* make words mean so many things?"

"The question is," said Humpty Dumpty, "which is to be master—that's all."

Referring to the recent Federal Trade Commission Hearing on Amplifier Power Advertising, Acoustic Research issued a statement saying:

"Acoustic Research is firmly opposed to official recognition or sanction of so-called 'music power' ratings in advertising. This rating is not relevant to the character of many music signal waveforms, nor is it consistent with accepted physical definitions of power. Lacking any derivation from the nature of music and power, it is an entirely promotional term, fabricated to inflate the apparent performance of mediocre equipment. The term lends itself to deceptive use; it cannot clearly distinguish one amplifier from another of the same rating; it demeans the integrity of those who use it.

"Acoustic Research favors adoption and enforcement of Rule 1, with minor modifications to make it more complete. The rule would require every claim of power output, bandwidth or distortion to be accompanied by

(1) A continuous power rating.
(2) The bandwidth over which this power could be delivered in full.
(3) The maximum distortion at any frequency within this bandwidth.

"FTC pressure can finally bring sanity and order to amplifier power advertising, after nearly twenty years of confusion."

Critics say—with some justification—that amplifiers with identical RMS figures will not necessarily produce the same power output as far as music is concerned. In other words, an amplifier's power supply regulation might be such that the low-load d.c. voltage is appreciably higher, allowing a larger power output on transient peaks—so increasing the Music Power rating. The trouble is—there is no agreement as to how long these short-duration peaks shall be. The new EIA Standard speaks airily of measurements made "for a *short period of time* when measured after the sudden application of a signal." The power peak of some organ works like Bach's *Toccata and Fugue in D* is maintained for quite long periods, and then how about those tremendous climaxes in Vaughan Williams' *Sea Symphony*? Unfortunately, neither RMS nor Music Power ratings take into account the amplifier's distortion at very low levels, overload recovery characteristic, or indicate the *type* of distortion at clip point. An amplifier which generates a high percentage of odd harmonics at overload will sound much worse under those conditions than one which produces a higher proportion of second harmonics. (Some present-day speaker systems are so insensitive that transient overloading occurs more often than supposed.) Then there is the question of output loads: some amplifiers will deliver their maximum output at 6 ohms and others at 8. So it is difficult to come up with a simple set of figures that can accurately indicate what the dynamic power of an amplifier really is. Nevertheless, continuous power rating, bandwidth, and distortion figures are meaningful, repeatable measurements which should always be used in preference to mythical Music Power or dishonest ± 1 dB figures.

* * *

The 1971 Washington Hi-Fi Show will take place from February 12 to the 15th at the Hotel Washington—near the White House. Show director, Teresa Rogers, believes the attendance will surpass the 1969 figure of 22,000.

* * *

The New York Hi-Fi Show at Westbury was very successful with an attendance of over 12,000. True, some of the exhibitors were a little dissatisfied with the small rooms and the parking facilities left a lot to be desired (no pun intended) but the results were worthwhile. Walter Goodman, the IHF President, told me that attendance was double that anticipated and that he himself was impressed with enthusiasm of the great number of youngsters who were seriously interested in Hi-Fi.

* * *

Some additions to the September Products Directory will be found on pages 43 and 44. These include new products, late arrivals and one or two we just plain couldn't find room for.—GWT

A lot of people don't know that a cartridge that's great for one high fidelity system could be disastrous for another.

That's why Pickering has done something fantastically simple.

We've developed *Dynamic Coupling Factor*—henceforth known as *DCF*.

All it is is a complicated name for an uncomplicated way to select the best cartridge for your system. It is your guide to the selection of that cartridge based on its intended application in playback equipment—just as horsepower is the guide to the proper engine for a vehicle.

It works like this. You own an XYZ model record changer. What cartridge do you pick? Not the $29.95 model because it isn't designed for the capability of your XYZ player. Not the $60.00 cartridge either, for its quality cannot be realized in that unit.

Our chart—available to you free—reveals that you need our model XV-15 with a *DCF* rating of 400 for optimum performance. This means that you will get 100% of the music from your records. Not 50% or 75% but *all* of the music capable of being obtained from your particular playback unit.

Technically, what we've done is taken virtually every high fidelity record player and pre-analyzed the vital variables for you; those affecting cartridge design and those related to the engineering features of the various turntables and changers.

So now all you need to be well informed on cartridges is to send for our *DCF* application guide containing our recommendations for what cartridge you use with which record player.

And next time you walk into a high fidelity salon, tell the man: "I'd like a Pickering XV-15 with a *DCF* of 400." Or whatever.

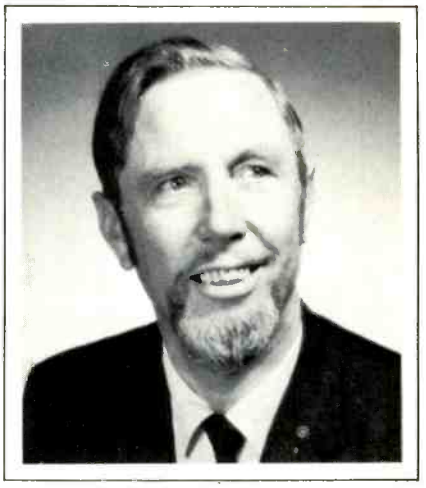
Pickering cartridges are priced from $29.95 to $60.00. For your free *DCF* chart, write *DCF*, Pickering & Co., 101 Sunnyside Blvd., Plainview, N.Y. 11803.

PICKERING

"for those who can hear the difference"

THE FUNCTION GENERATOR

NORMAN H. CROWHURST



THE FUNCTION GENERATOR is a fundamentally different oscillator from its predecessors. The nearest to it was the multivibrator. The old sine wave oscillator worked, esssentially, by using a tuned circuit or other frequency-selective network and applying gain to make it oscillate at the required frequency.

Oscillators that used a phase-shift or bridge-type feedback, or even the twin-T type, all employed the same principle. What the reactive components, of whatever combination and configuration, determined was frequency, basically of a sinusoidal signal. If it oscillated too hard, the shape departed from true sinusoid, but that was the shape with which it started, before it got big enough to distort.

And gain was the other adjustable quantity. When gain was just a whisker more than needed, the waveform built up until something stopped it. In a good oscillator, an automatic circuit would turn down the gain; in a poor one, distortion would reduce gain, because all the signal handled was not of the true frequency.

And if gain went a whisker too low, the oscillation would die away. However good a sine-wave oscillator, it has these sort of "bouncy" characteristics, of growing and dying. The function generator uses a totally different starting point. Instead of frequency and gain being the basic reference quantities, as in the sine-wave generator, the function generator uses time and amplitude as the basically inter-related quantities.

Figure 1 shows one way of starting such a design. Transistors Q1 and Q2 alternately charge and discharge capacitor C, as one or other of them is triggered into and out of action. The rate of charge or discharge is set by the voltage applied to their bases. As shown, the emitters of Q1 and Q2 have a 1-K resistor each. This converts the voltage from base to supply point into a constant current of the same number of milliamps.

Transistors Q3 and Q4 serve to switch off the transistor Q1 or Q2 that is momentarily inoperative. Suppose Q1 is momentarily charging C more positively. For this to happen, Q6 short-circuits Q3, so that the only current in the 1-K resistor between the emitters of Q1 and Q3 and supply plus is due to Q1 emitter current.

To maintain Q6 in saturation, Q4 must also be conducting. The 1.5-K collector resistor, feeding the base of Q6, sets the collector and emitter voltage of Q6, which is saturated, at plus 12 volts, due to the drop in the 1-K resistor in the emitters of Q2 and Q4. This means the emitter of Q2 is more positive than its base and thus it is cut off. Only Q1 is supplying current that affects the voltage on C.

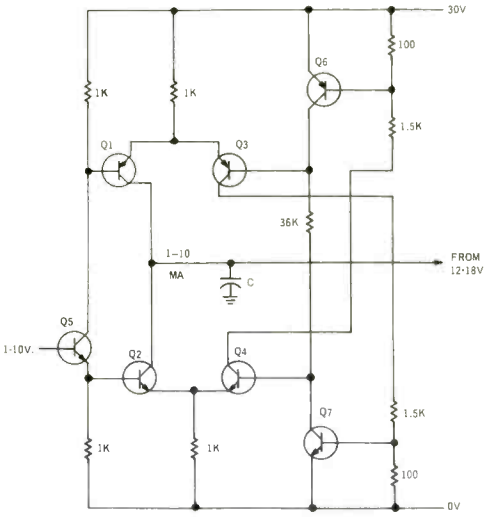


Fig. 1—The switching and charging, discharging part of a function generator.

When the current through Q1 has charged C to the point where its voltage should go the other way, a trigger circuit will reverse the cycle. Then Q3 will saturate, along with Q7, and Q4 and Q6 will be non-conducting.

When Q4 saturates Q6, Q4 in turn is saturated by the 36-K resistor between the bases of Q3 and Q4. Q7, being non-conducting, allows the current in this resistor to saturate Q4. Similarly, when Q7 saturates, Q4 is cut off, cutting off Q6, thus allowing the current in the 36-K resistor to saturate Q3 and maintain the other bistable condition.

In this circuit, the rate, or slope of both 'up' and 'down' is controlled by the input voltage applied to Q5. As this has a 1-K resistor in both emitter and collector, the voltage is duplicated, relative to the respective supply points, at the bases of Q1 and Q2. By applying from 1 to 10 volts d.c. at the base of Q5, the charge and discharge rate may be varied from 1 to 10 milliamps.

If C is made 1 microfarad, 1 milliamp will charge or discharge it at the rate of 1 volt per millisecond. Making the height of the wave 6 volts (from 12 to 18, as shown) means the 'up' slope will take 6 milliseconds and the 'down' slope will take 6 milliseconds: a period of 12 milliseconds, or a frequency of 83.3 Hz.

Pushing the control voltage up to 10 volts, the charge and discharge rate will change to 10 milliamps, resulting in charge and discharge times of 0.6 millisecond, or a 1.2 millisecond period: frequency 833 Hz. Using different values of C enables other frequency ranges to be obtained. Using a capacitor of 0.1 μF, the frequency range will be from 833 Hz to 8330 Hz, for the same control-voltage range.

Figure 2 shows the next step toward the design, by adding a suitable trigger circuit. First step is to provide the trigger voltages, which is achieved by stringing a resistor chain across the supply. The trigger circuit consists of Q8, Q9, Q10, Q11. As the bases of Q10, Q11 are at 12 and 18 volts, with the polarity of transistors shown, all four transistors are normally non-conducting.

The only time they conduct is at the moment when the voltage at the bases of Q8 and Q9 goes either more positive than 18 volts or more negative than 12 volts.

When the voltage on C is moving positive, Q1 is conducting, Q4 and Q6 are saturated, and Q7 is non-conducting. When the voltage causes Q8 to conduct, it triggers Q10 along with it, and this triggers Q7 into saturation, which short-circuits the base of Q4, cutting it off, and thus discontinuing the saturation of Q6. This allows Q3 to saturate, switching Q1 off, while Q4 being cut off allows Q2 to start conducting to reverse the charge direction.

Function Generator

When the voltage on C gets so that Q9 starts to conduct, Q11 triggers Q6 into saturation, cutting off Q3 and Q7 and allowing Q4 to saturate, again reversing the charge direction. This flipping will carry on with close precision.

This is a precise triangular waveform, with very linear sides, because the charging current is controlled entirely by the voltage on the bases of Q1 and Q2, in conjunction with the emitter resistor. For example, 5 volts across the 1-K emitter resistor sets the current at precisely 5 milliamps, and the collector current follows it. Precise choice of 1-K resistors, both in the emitter and collector of Q5 and in the bases of Q1, Q3 and Q2, Q4, is needed to effect an exactly symmetrical wave.

The next step will be to use this triangular wave as a basic form from which to generate other waveforms. A series of appropriately biased diodes and resistors can change the slope of the waveform at different points, until a very close approximation to sinusoidal is achieved.

The advantage of this method of making a sine wave is that it works down to a very low frequency. For example, by using a 1000-μF capacitor for C, the frequency range, with the same values otherwise, can go down to from one cycle every 12 seconds to one cycle every 1.2 seconds. It will trace these waveforms as precisely and as immediately as it does those of more conventional audio frequency.

A 1/12th Hz sinusoidal oscillator, using the older circuits would take minutes —perhaps half an hour—to settle to a stable amplitude, even if a good sine waveform was possible. This circuit starts to generate the perfect sine wave immediately.

But we do not have a sine wave yet. All we have is a triangular wave, with a peak-to-peak voltage of 6, using a 30-volt supply. To be able to adjust the sine waveform precisely, it will be advantageous to make the wave bigger first. And to set its limits as precisely as the 6-volt limits at 12 and 18 volts on this embryo wave.

Figure 3 shows the same circuit with 4 more transistors added that will achieve this. Q12 and Q13 take the triangular voltage, which is 6 volts peak to peak, and convert it to a triangular current waveform. The 27-K emitter resistors convert the 6 volts maximum voltage to 6/27 = 222 microamps maximum current.

The 8.2-K collector resistors again convert these currents to voltages, except that there are now two of them, located adjacent to the supply voltages, on the d.c. scale. Before determining the voltage, consider the parallel effect of the transistor bases, Q14 and Q15, which have 910-ohm emitter resistors. Assuming a beta of 50, this refers back to the base as 45.5 K. In parallel with 8.2 K, this makes 7 K.

So the voltage at the bases of Q14 and Q15 is triangular, of 0.222 × 7 = 1.56 volts peak. When C is charged to its maximum positive, Q12 current falls to zero, as does Q15 current, to which it is coupled. At the same time Q13 current reaches 222 microamps and Q14 base reaches 1.56 volts negative of supply plus.

The emitter voltage of 1.56 volts maximum, on Q14 or Q15, across 910 ohms, results in a collector current of 1.56/910 = 1.72 milliamps. The other current, at this moment, is zero.

The collector load for Q14 and Q15 is the two 15-K resistors across the supply. These provide a source voltage of half the supply, or 15 volts, and a load resistor value of 7.5 K. The maximum current of 1.72 milliamps in 7.5 K yields a voltage of almost 13 volts peak, each way, or 26 volts peak to peak.

Quite precise choice of values may be needed to effect this degree of precision.

(Continued on page 87)

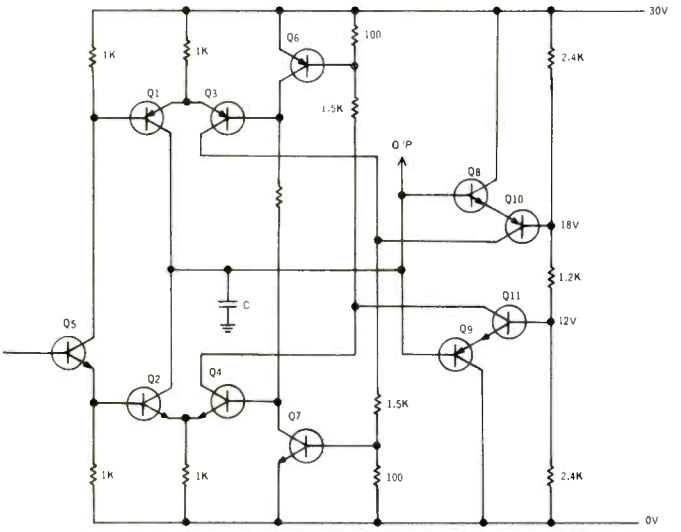


Fig. 2—The trigger elements added to the circuit of Fig. 1.

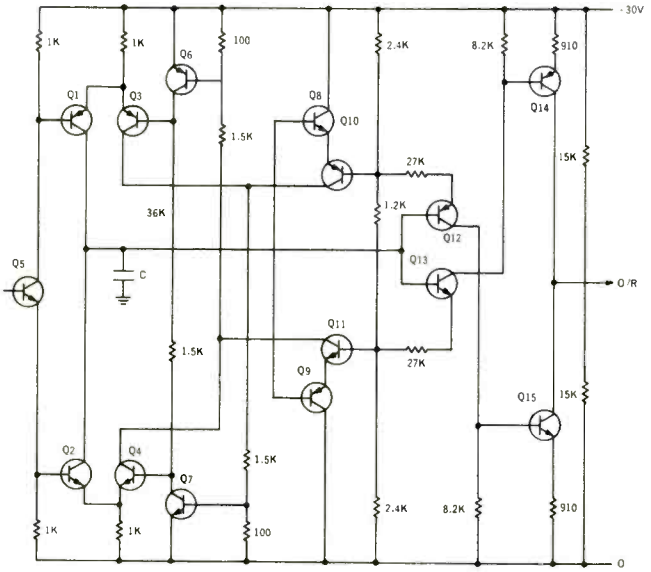


Fig. 3—The complete circuit, with amplification added, so the output can be almost as large, peak to peak, as the supply voltage. As the whole thing is direct coupled, the circuit can be used for very low, fractional frequencies.

Another Look At Parallel-Connected Loudspeakers

DICK CRAWFORD

THERE IS AN INNATE appeal in the use of multiple speakers. It is difficult to dispel the notion that many of a kind are better than one. And why not, for that's the principle of democracy, is it not? What, then, are the advantages of democratic speaker systems?

G. A. Briggs, in his 3rd edition of *Sound Reproduction* (pp. 58-61), discusses some of the characteristics of a system using nine 8-inch speakers. Both good and bad results were noted. Among the former was the ability to produce sound at 30 Hz without doubling, and among the latter was a good deal of boominess. Improvement was gained by being less democratic and replacing two of the 8-inch units with more conservative 10-inch speakers.

Of a more recent vintage is the Sweet Sixteen speaker system, in which sixteen small, low-cost speakers were used. Opinions vary, but many claim improved bass response from this array.

Even more recently we have the Bose speaker system. This unit also has nine speakers, but arranged so as to achieve a large percentage of reflected sound. The reviews of this system are generally excellent. Having listened to this system, I must say that it has much better bass than one would expect from a group of small speakers. I don't care how much the bass is boosted, it is difficult to achieve decent bass much below the resonant frequency of the speakers.

Then, too, we have the example of some speaker manufacturers who make top-of-the-line speaker systems using several of their best speakers in parallel (acoustically speaking). For example, I have always had a liking for the large Bozak systems that use four 12-inch speakers for the bass, and Bozak makes it clear that they believe these larger systems to be superior. Now why is that?

Many reasons have been given for the superiority of multiple speaker systems, but the one I wish to dwell on is the superior bass response. This is partly because I like lots of low bass and partly because of my limited test facilities. On to the experiments!

I measured the impedance characteristics of four identical low-cost ($15) 12-inch speakers. The indicated resonance was 38 Hz and varied only by 1 Hz, and the impedance at resonance varied only by a few ohms between the four speakers. The results for one of the four are plotted in Fig. 1.

The four speakers were then mounted in a simple corner enclosure (which we will discuss later) and the impedance of the single speaker was again measured. As can be seen from Fig. 1, there is some effect due to the combination of the cabinet and the corner placement. The speaker was slightly better damped, and the resonant frequency was lowered by two or three Hz.

Finally all four of the speakers were phased, and then wired in a series parallel combination, so as to achieve nominally the same impedance as the single speaker. The results (see Fig. 1) are gratifying! The resonance has been moved down to 27.5 Hz.

What has happened? Mutual coupling. When several speakers are connected in phase and not too far apart physically, the reactive and resistive components of the air loading at low frequencies are increased. Mr. Knowles has a good discussion of this effect in Keith Henney's *Radio Engineering Handbook*, 4th Ed. (pp. 741-744). For four speakers the radiation resistance, which is that part of the air loading to which the speaker can deliver acoustic power, is multiplied by four. This is somewhat offset by the increase in radiation reactance, but, as Mr. Knowles points out, a typical speaker system will gain about 5 decibels in bass response by using four similar speakers.

There is more. If we place the same four speakers in a corner we gain another factor of four in radiation resistance. So we achieve another 5 decibels bass boost, for a total of 10.

Does it really happen? A microphone and a.f. voltmeter were used to measure the bass response. With the same 100 Hz signal level the four in the corner were found to produce 5 decibels more output than the single speaker in the corner. At 40 Hz the increase was 12 decibels. That is as low as my microphone goes. I believe that at 30 Hz the increase is more like 15 decibels, but I cannot prove it.

This is mostly in agreement with the theory, although there is more bass increase at 40 Hz than would be predicted. Of course, room acoustics and microphone placement may explain the differences. Incidentally, 10 decibels is not peanuts; it is the difference between a 20-watt amplifier and a 60-watt unit.

But what about that lowering of the resonant frequency? Well, there is the increase of reactive air loading that we mentioned. The resonant frequency of the speaker is determined by the compliance of the speaker, the mass of the speaker cone and voice coil, and the equivalent mass of the reactive air loading. As the air loading increases due to mutual coupling effects, the equivalent mass of the air load also increases, and this lowers the resonant frequency. At this point we need to know more about the speakers in order to calculate the effects of the increased air loading, but we can make a few assumptions and see if the results seem reasonable. From Olson's book *Elements of Acoustical Engineering*, 2nd Ed., pp. 126, we see that the mass of the speaker cone is approximately equal to the mass of the air loading for representative speakers.

If we then assume that the air mass, due to the twin effects of four speakers and corner placement, is doubled at low frequencies (as seems reasonable from Mr. Knowles curves), we arrive at the conclusion that the total mass is increased

How we saved our new $139 speaker from medium-priced boredom and conformity.

Ordinarily, there's nothing more boring than a medium-priced speaker system.

Low-priced speakers can be exciting because a few exceptions sound better than they have the right to. And high-priced speakers are, of course, endlessly fascinating because each expresses a different designer's concept of the "state of the art."

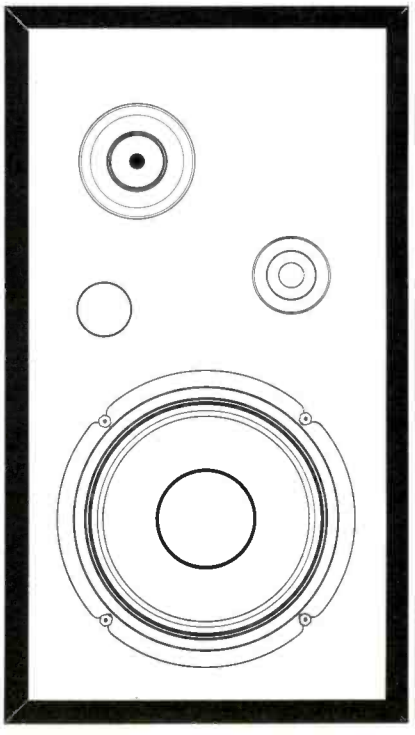
But bookshelf speakers in the $110 to $150 range? When you've heard one, you've heard them all.

That's why, having already created some of the world's finest low-priced and high-priced speakers, we decided that something distinctly new and different should be done for the music lover with a middle-sized stereo budget. The result was the **Rectilinear XII.**

First of all, we did something about efficiency. Unlike the conformist acoustic-suspension speakers in this price range, the **Rectilinear XII** is a high-efficiency tube-vented bass reflex system. All you need is 10 clean watts to drive it to ear-shattering levels. So you won't need a high-priced amplifier or receiver to enjoy your medium-priced speaker, even if you like to feel those bottom notes right in your stomach.

Then we did something about *time delay distortion*. The **Rectilinear XII** reacts faster to an input signal (it "speaks" sooner, with less time delay between electrical input and acoustical output, and with less lag between drivers) than any other cone-type speaker system except our own higher-priced models. Rectilinear seems to be the only speaker manufacturer to be concerned about this type of distortion, but the difference it makes is easily audible to any critical listener.

A nonconformist approach to crossover design is largely responsible for the superior time delay characteristics of the **Rectilinear XII.** The 10-inch high-excursion woofer is crossed over to the "fast," low-inertia 5-inch midrange driver at 350 Hz, a much lower frequency than is conventional in three-way bookshelf systems; the 3-inch tweeter takes over at 4000 Hz. To compound the unorthodoxy, we abandoned the customary parallel-type crossover network in favor of a very elegant series configuration, which gave us vastly improved phase response.



Finally, as our ultimate defiance of tradition, we listened objectively to our own speaker. Did it really sound as different as we had set out to make it? To our ears (which, after all, have a good track record), it did. The **Rectilinear XII** seems to reproduce music with a clarity and authority that few speakers, at any price, can even approximate. And certainly none at $139.

But this is something that each prospective buyer must decide for himself. So, if you're shopping in this price range, listen carefully to the **Rectilinear XII.** And, please, be cynical, jaded and hard to please.

For your $139, you're entitled not to be bored.

(For more information, including detailed literature, see your audio dealer or write to Rectilinear Research Corp., 107 Bruckner Blvd., Bronx, N.Y. 10454. Canada: H. Roy Gray Co. Ltd., Markham, Ont. Overseas: Royal Sound Co., 409 N. Main St., Freeport, N.Y. 11520.)

Rectilinear XII

Check No. 25 on Reader Service Card

(Continued from page 24)

by a factor of 1.5, giving a new resonant frequency 1/1.24 that of than the original. Since the measured new resonant frequency is 1/1.27 times the original, either we made compensating errors in our assumptions, or we are very close to being right.

What about damping? Since the resistive part of the air load at low frequencies has increased more than the reactive part, we would expect better damping. A glance at Fig. 1 shows that the impedance of the four in the corner is lower than the single unmounted speaker, so that the damping is apparently improved.

What sort of enclosure was used in these tests? Not much. Fig. 2 shows the design. The top and bottom are made of a 24-inch square piece of ¾-inch plywood sawn diagonally. The front is 32 × 48 inches, also of ¾-inch plywood. A 2 × 4 is used at the rear to space the top and bottom. All are screwed and glued together. The speakers are mounted, phased, and the whole is jammed into a corner. Foam weather-stripping is used to seal the inevitable gaps around the top. The weatherstripping also prevents rattles. There is about a 1-inch gap along both sides which becomes a port. Thus this is a bass reflex cabinet. The main purpose of this port is to avoid the necessity of achieving a seal along the edges. The area of the port is too small in relation to the total cone size to give much radiation. Furthermore, its high periphery-to-area ratio is such as to damp the port radiation rather well. However, the port undoubtedly does some radiating, and it lowers the speaker impedance as well. The volume of the cabinet is just under eight cubic feet. The cabinet does not rattle, but for those interested in making their own cabinets I recommend the advice of Mr. Briggs (cited earlier).

There you have it, a little curiosity, a simple cabinet, a few simple measurements, and a little theory. How does it sound? Clean. Good opera recordings are very clear, without boominess. Beethoven really growls.

What are the conclusions? Simply that theory and experiment both conclude that multiple speaker systems can give both lower resonant frequencies and more bass. Æ

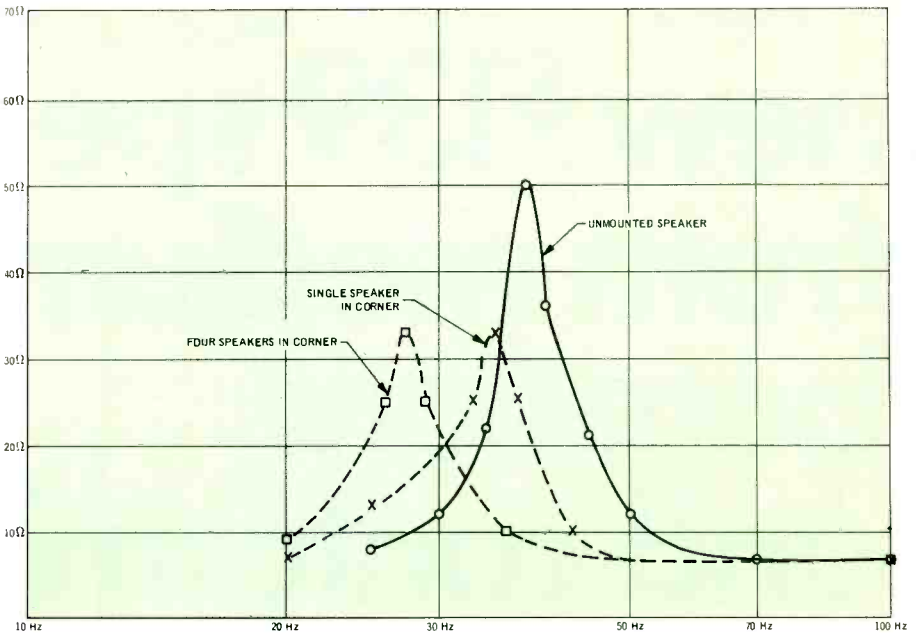


Fig. 1—Impedance Curves of Speakers.

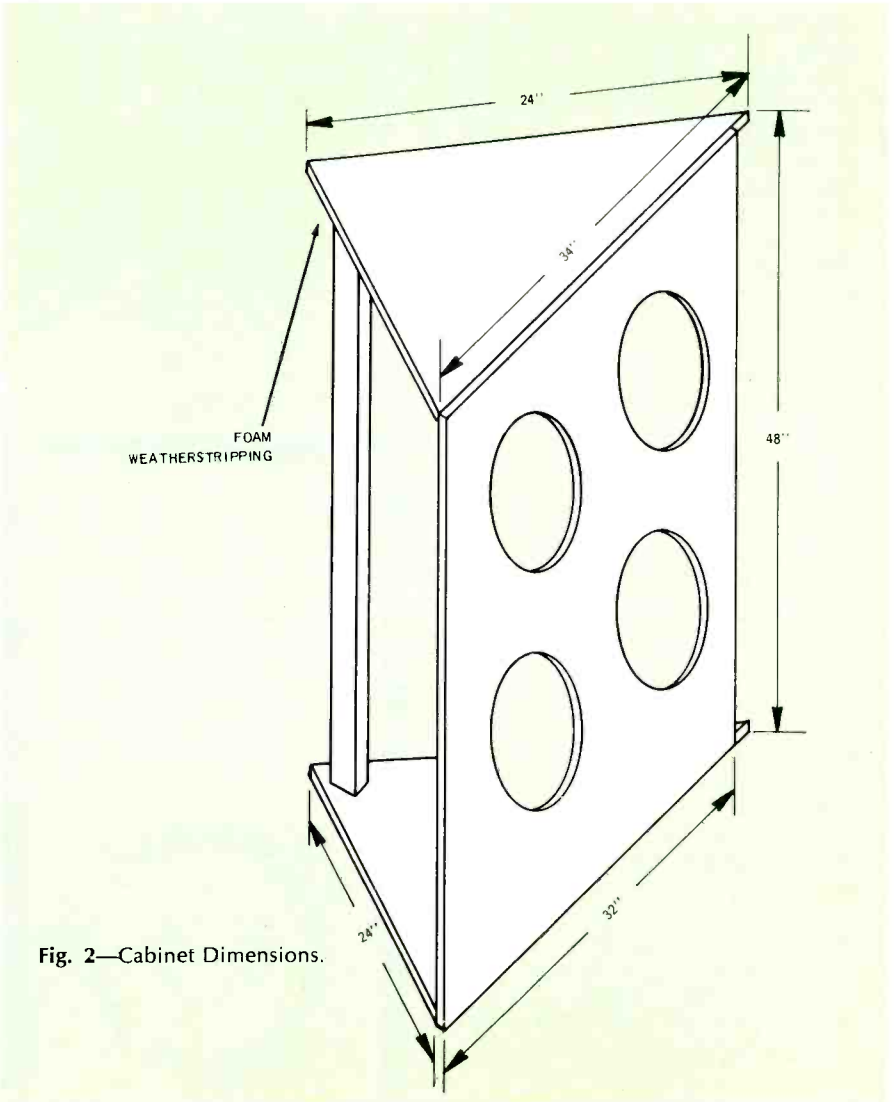


Fig. 2—Cabinet Dimensions.

See also:
"Another word on multiple speakers" by John Ward, *Audio* December, 1962
"Mutual acoustic impedance between radiators in an infinite rigid plane" by R. Pritchard, *J. Acous Soc. Am.* 32, No. 6, 1960
"An open-baffle parallel-series array" by R. Oakley, *Audio* December, 1963
Loudspeakers, by Gilbert Briggs (Cahners Publishing Co., 221 Columbus Ave., Boston, Mass. 02116)

An audio engineer talks about the new VM professionals.

Murray Allen owns one of the world's keenest ears. He played sax and clarinet with big name bands like Skitch Henderson's and Bobby Sherwood's before becoming an engineer. And has done sessions for Bobby Melton, The Hi-Lo's, Julie London and many other famous names. Murray was one of the first to experiment in multi-track recording and recently pioneered in the use of 16-track. He is now with Universal Recording Studios where he engineers records and commercials, including the Schlitz and United Air Lines television campaigns which are currently on the air. He was also Audio Consultant to Science Research Associates.

"The VM professionals are really worthy of the name. I've never seen so much professional control in home-type equipment.

"The VM 1521 receiver, for example, does a lot of things even more expensive units I've played with can't.

"The bass and treble controls really give you a lot of room. And it's got a high and low filter you can switch in and out. The separation is terrific, too.

"I mean you can take something like a bass and clarinet duo and completely isolate the bass on one channel, then completely isolate the clarinet on the other.

"Another thing, I live in an area where FM is very RFy. The VM 1521 has a new filter that handles it better than anything I've heard.

"The speakers are something else, too. VM calls them the Spiral Reflex System. Built on the twin wave theory. That's very efficient. And clean. Really clean. Especially the percussions. Even the transients don't get distorted. It even gets those low guitar sounds.

"And I really like the VM 1555 automatic turntable. The cueing. The belt-driven platter. The extra length on the tone arm. The photo-electric tripping mechanism. All of them are terrific.

"And the spindle gently lowers records all the way down to the stopped platter. Really takes good care of them.

"You know how hard it is to reproduce a clean piano or harp. Well, the 1555 does a beautiful job. Absolutely no wow.

"I listened to an album I engineered on a VM professional rig, and I can honestly say it was closer to the master tape than I'd ever heard. I could even hear tape noise which is really rare.

"I've decided to take my VM professional outfit to my office. Every day I deal with people who really know a good sound when they hear it.

"And it always pays to make a good impression."

For engineering specs on the complete VM Professional Series write:

VM CORPORATION

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(Ask for Dept. 74.)

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Rosemary Brown

EDWARD TATNALL CANBY

One is inclined to be facetious in writing about Rosemary Brown, as I know to my cost. Too easy to poke fun. This is the second version of my article. I scrapped the first. Rosemary is the plain little English housewife who takes down music by dictation from the Great Composers. The dead ones. She's already accumulated hundreds of pieces from beyond the grave. And now she has a recording of some of them.

Not that I have come around to believing. But I do feel that (a) there is nothing to be gained from ribaldry at the expense of those who may be acting in good faith; and (b) there's a lot to be gained in Rosemary Brown's case by sheer listening. That's my business and yours too. We can read all about Rosemary second hand. But when we *listen*, it's first hand. Straight from Rosemary to you and me. Or is is straight from Liszt, and Schubert?

The composers appear to her in person, she says, and have even been known to guide her hands at the piano. Liszt, above all. But also others of a familiar Music Appreciation sort—Chopin, Schumann, Beethoven, Schubert, Brahms, Rachmaninoff, Grieg, even Debussy. One by one, under Liszt's personal direction, they are still giving her their compositions from the Other Side. And she *writes them down*, note for note. That is what makes it all so interesting.

There is a Foundation now, set up expressly to provide Rosemary with enough income so that she can work full-time with these composers and learn more musicianship and better finger technique, the quicker to take down their music, which sometimes comes through pretty slowly. She is receiving what she calls "tuition" (she means tutoring) right now from Liszt himself, who has taken over and organized her working day with times for seeing the composers and for concentrated studies of various sorts.

"I find Rachmaninoff most wonderful for helping me in my actual playing," she says. "He's been giving me quite a lot of helpful hints and assistance in trying to improve my style and technique." As for Brahms, "he has given me some finger exercises to improve the stretch between my fingers and the actual span of my hands." Beethoven brings her some problems. "I would like to get one piece at a time completed . . . but instead, I find he'll give me a page of one thing and then two pages of something else—it's a little bit confusing but I must just adapt myself. He puts them together eventually."

Debussy, it seems, has been doing a lot of painting, in the Impressionist style. He showed her one called "Femme en bleu" with a blue face, which she got to like. As for Chopin, he got agitated one day and burst out in French, "Le bain va etre englouti!"—the bathtub's going to overflow. Sure enough, her daughter had left the tap running. "I think it was after that," she says, "that I began to feel more at ease with him." Schubert came to her the first time wearing his famous spectacles but "I think it was only to make sure I recognized him. Now he doesn't wear them at all." But Liszt is her favorite and he evidently decides which composers to send along each time. She just takes whoever comes.

Rosemary has heard the entire Unfinished Symphony of Schubert, including the part that wasn't finished. She hasn't got it down yet. "Whether he will get it through—written down, that is—I don't yet know. All I can say is that it was absolutely heavenly—I've never heard anything so beautiful in all my life. I thought that after I heard it I would never forget the main theme but I never wrote it down and it went—so he'll have to give it to me all over again. I find that he communicates very easily."

That tells you the Rosemary story. On her record she tells it to you in her own voice, in the same matter of fact way. Rosemary could not be faking; there is a ring of absolute conviction to her words.

Opinions on Rosemary vary. They fall into three irreconcileable categories. (A) She is harmlessly, totally looney. (B) She *is* in contact with the other world—she has ESP. (C) Her symptoms are characteristic of well known types of delusion, of which examples abound in the literature including Joan of Arc. Voices. Unconscious total recall. Cryptomnesia. These viewpoints will be argued until the printed page turns blue and you may join in if you wish. But only one thing matters, *the music*. Hundreds of pages of it and plenty more on the way.

There could, of course, be fraud, or pure hoax. I suppose Philips of Holland and even the great BBC might be hoodwinked or—less likely—knowingly produce a fake. I doubt it, but does it really matter? We now have two whole LP sides of recorded Rosemary and the sheer fact of its existence is the startling thing. *Somebody wrote down all of those notes* and, if there is honesty here, it was Rosemary herself. I accept that premise, and I believe it.

And so what do we find? I've listened. It's not bad at all—if hardly earthshaking. Rosemary's music is not amateurish. It flows easily and for the most part with good musical sense. She has a nice feel for a kind of nineteenth-century salon style, watered down and simplified but really quite authentic. Just what Grandma played in the front parlor. Her feeling for modulation is excellent; she moves easily from key to key and back again, as they used to do—an art that is mostly lost on today's pros, who don't have it and do not want it. Rosemary knows how and she seldom flubs. Nothing spectacular, mind you. Just an easy, right sound.

She has a good sense for a tune, too, in the right style. And she remembers her tunes, plays on them, brings them back very properly. They stick—and *you* remember them. Her piano writing is the same, a simplified salon style, *circa* 1875 perhaps, slanted moderately in the direction of one or another composer. Good left-hand figurations, a proper spread of right-hand melodic line, a texture and mood that is of the period, if out of its more insipid expression. Definitely, she has a knack.

What *I* hear is exactly what Rosemary Brown might actually compose, or improvise of whatever, if there were no ESP and she merely presented her "thing," say, at a party, putting on a little show of numbers done up "in the style of" various composers. Not an uncommon

It's kind of a dumb-looking thing, but the ear is still the best listening device around. Which should tell you something about the shape of a Yamaha speaker.

True, the ear receives sound and a speaker reproduces it. But the basic principles of physics and design are essentially the same. There is a place in the middle through which the sound travels. Surrounding it are planes of varying dimensions. There is no symmetry.

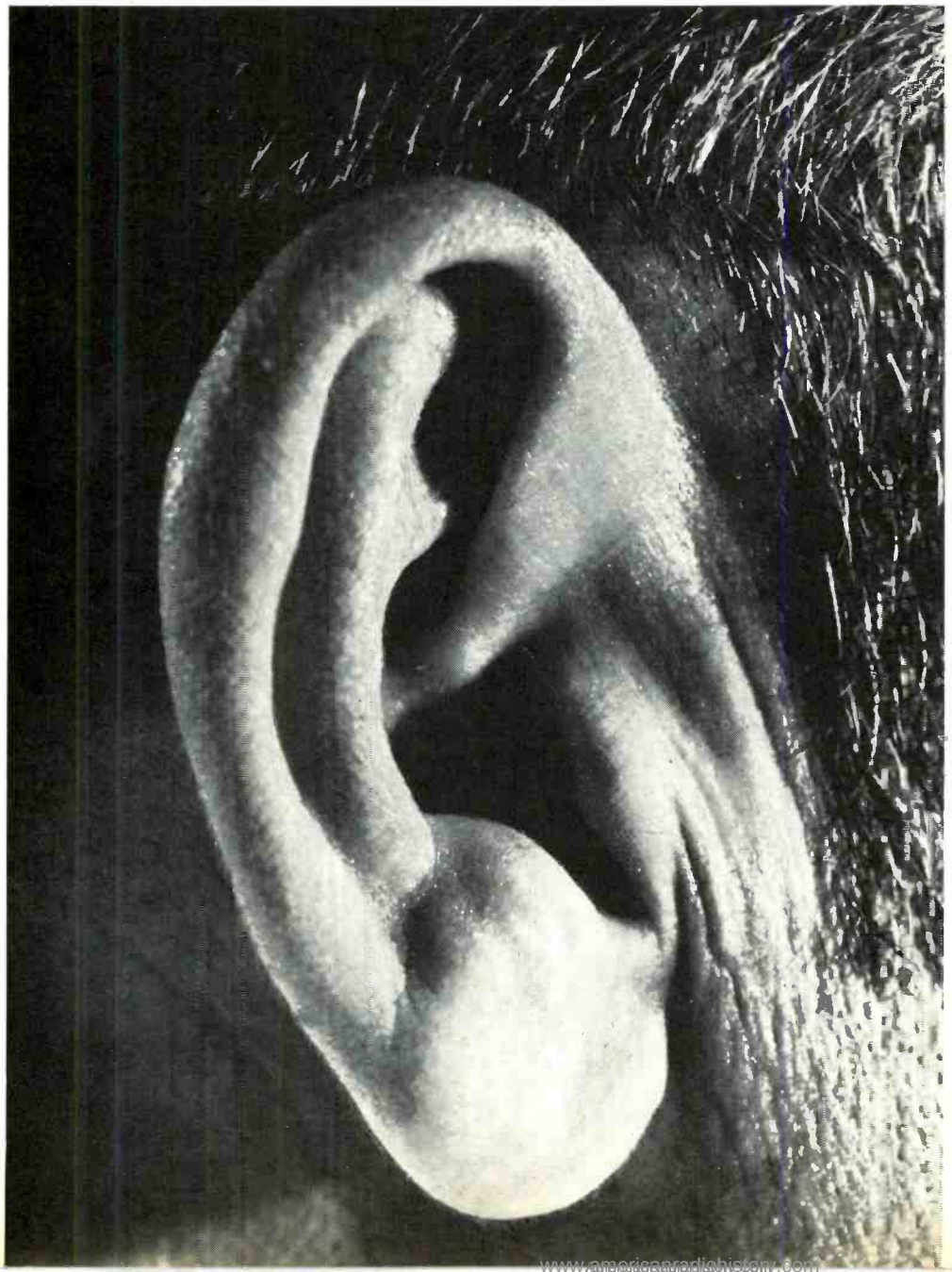
This is because sound is not symmetrical. It bends. So symmetrical shapes—ears or speakers—will confine sound to an area that won't let it bend naturally. (Cup your ear and see how directional and different things sound.)

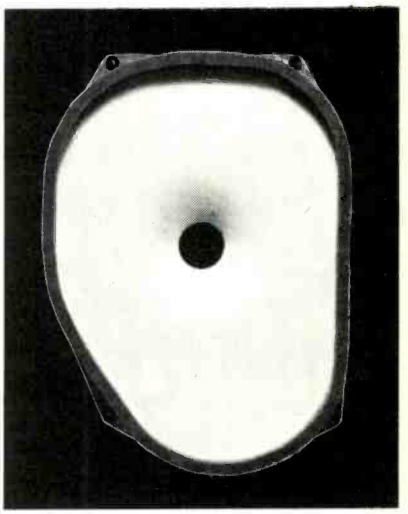
The irregular shape of a Yamaha speaker gives sound waves of different length a place to go. Long waves go to the long parts, medium waves to the medium parts and so on.

The result is a sound as close to natural as you've heard. Freer, fuller, more omnidirectional.

Listen to what natural sound is all about. If you're not convinced then, well, maybe you *are* wearing the wrong kind of ears.

Either we're right about the shape of our speakers, or you're wearing the wrong kind of ears.





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gift at all, and hers is good but not really *that* good. Lots of people have the gift, in one way or another. I can do it myself, though my memory is dreadfully short and I hate to write things down.

Don't think that all the musical talent in this world goes into the music profession! Ninety per cent never gets near a formal music lesson. And remember that Telemann, the most impeccable professional of his day, was totally self taught. So, mostly, was Beethoven. And Wagner. The good improvisers that I know (quite a few—in quite a few styles) are almost entirely self-trained. They just pick it up.

Rosemary, in addition, seems to have an excellent memory and an accurate, if slow, ability to write things out on paper. That helps. That's all. I don't feel any necessity to go further in explaining her music. Her personality, her communication with the dead, is something else again, though easily enough "explained" by experts in psychology and in parapsychology, even if they don't agree.

On her record Rosemary has put a good selection of her Liszt pieces, which are the central body of her music, along with a sampling from Chopin, Brahms, and so on. She plays the simpler pieces herself on one side. A typical forthright amateur, she gets through the notes, a bit heavily, and the sense of the music is there. The tougher pieces, the ones she can't play herself, are on the other side, played by a much more brilliant pro, Peter Katin. These really sparkle.

The pieces grouped under Liszt's name are really very pleasant and well made, her best without a doubt. They often sound like minor Liszt, though more often they are just of the period. Her Chopin is not much different, the style rather too late for Chopin (though she hits a few tricky Chopinesque harmonies). Schumann rates about 10 per cent. Wouldn't even know him. Her Schubert is much better—she has a funny streak of affinity for the music of the early part of the century. Her Beethoven "Bagatelle" is curiously like many bits of late Beethoven, notably his late Bagatelles.

When it comes to Brahms, whose forthright piano style is the easiest in the world to imitate—even I can do it—Rosemary is way out of whack. Brahms would roll his beer-barrel body if he could hear her. Debussy is terrible; same old semi-Liszt with a few bits of the Golliwog's Cakewalk thrown in. ESP or no, Rosemary is out of her depth with these composers, as I hear it. But, oddly, her little Grieg piece is excellent! (Only, I think she borrowed it. Sounds very familiar.)

"Grubelei," the work of Liszt in 3-against-5 time which she couldn't play to find out what it sounded like, is a superior piece. Its compound rhythms are handled with real sophistication, the misty altered-chord harmonies are much more striking than those of the run of other pieces. If Liszt didn't manufacture it, *somebody* did. Rosemary?

What we sense, compassionately, beyond this modest music and in Rosemary's disarming views on the composers, is a conventionality, a narrowness, that is surely no more than a reflection of her own drab way of life. This is precisely the music, these are the stories of the Great Composers, that an ordinary housewife in the poorer section of London *would* produce if—like the woodchuck—she could. Rosemary can.

Her every note and word is out of a sort of cultural hearsay, an echo of the grandeurs of Music Appreciation filtered down into a middle class wasteland. She is expressing no more that that same touching hope for the finer things of life which pins up sepia prints of Mona Lisa and the Last Supper in a thousand parlors, next to the portraits of the Great Composers and a picture of the Matterhorn, which puts a too-expensive upright piano against the wall and the Reader's Digest on top, the Complete Britannica (on installments) off in a corner. Rosemary has found a better way. It would be nice to know the composers in person, now, wouldn't it? Perhaps to fufill an otherwise empty life.

Rosemary Brown is trying so hard to finish the Unfinished Symphony it almost makes you weep. AE

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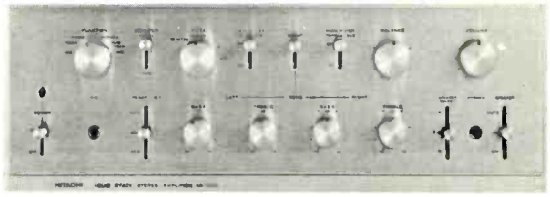
NEW YORK HI-FI SHOW 1970

Fisher Futura 201



Hitachi 1A-1200

JVC 5040-2

Harman-Kardon 230

Sony STR-6065

new receivers-and an amplifier . . .

At the top, on the left, is the new **Fisher 201** receiver which costs only $199.95. It features a FET 'front end' three IC's, automatic stereo/mono switching, FM muting, four-way speaker-selector switch, blackout dial and illuminated dial pointer. FM sensitivity is quoted at 2.5 μV and total power output is 50 watts (IHF).

The **JVC** receiver, **model 5040-2** has a power output rating of 200 watts total (IHF) and the FM sensitivity is given as 1.8 μV. It incorporates the SEA (Sound Effect Amplifier) system of tone controls which operate at five different frequencies—60, 250, 1000, 5000, and 15,000 Hz. FETS are employed in the 'front end' and two IC's are used in the i.f. stages. Other features include speaker switching, semi-variable interstation muting and a better-than-average AM performance due to the use of two r.f. stages. Price: $449.95.

The **Harman-Kardon 230** AM/FM receiver is very modestly priced at $159.95 and listed among its specifications are a tape monitor, speaker selector, loudness switch, blackout dial, and illuminated push-button on/off switch. Power output is 35 watts, total, (IHF), and FM sensitivity 2.7 μV. A walnut enclosure is available at $9.95.

Hitachi model 1A-1200 is an integrated amplifier with a power output rating of 120 watts (IHF). This is divided into four sections and a panel switch permits a selection of four 30-watt channels, one 60-watt center plus two 30-watt, or two 60-watt channels. Output-protection circuits are employed—plus a power limiter controlled from the front panel. Other features include high and low filters, separate tone controls for each channel, speaker select and mute switch, tape monitor, and provision for two phono inputs. The price of model 1A-1200 is $595.

The **Sony STR-6065** is a high-powered receiver rated at 255 watts (IHF). FM sensitivity is quoted at 2.2 μV and AM at 20 μV. Provision is made for two phono inputs and among the other facilities are loudness, filter and mute switches, four-position speaker selector and tape monitor. Price of STR-6065 is $399.50 and a smaller version with 145 watts (IHF) output, STR-6055, costs $299.50.

Continued . . .

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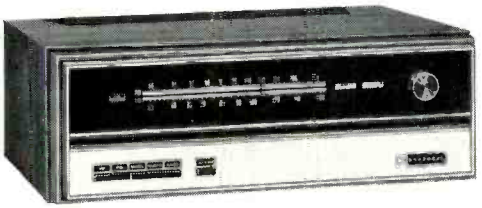

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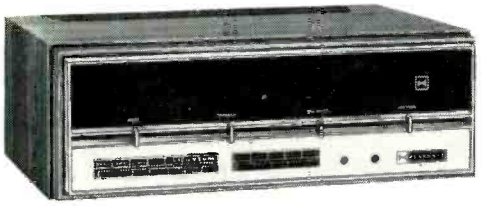

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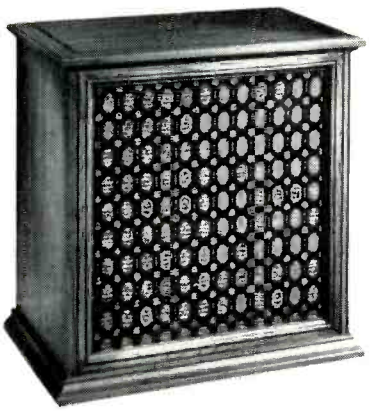

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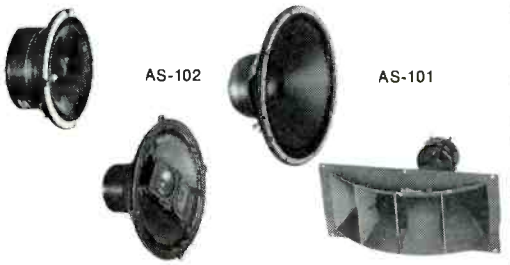

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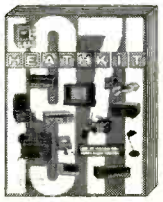

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NEW YORK HI-FI SHOW 1970

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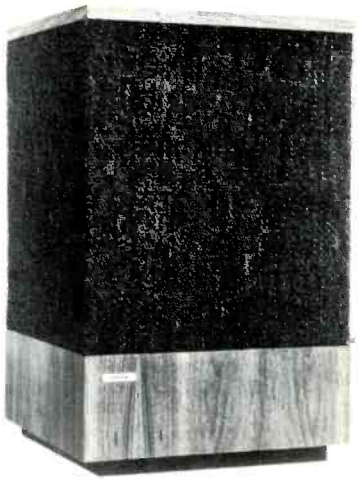
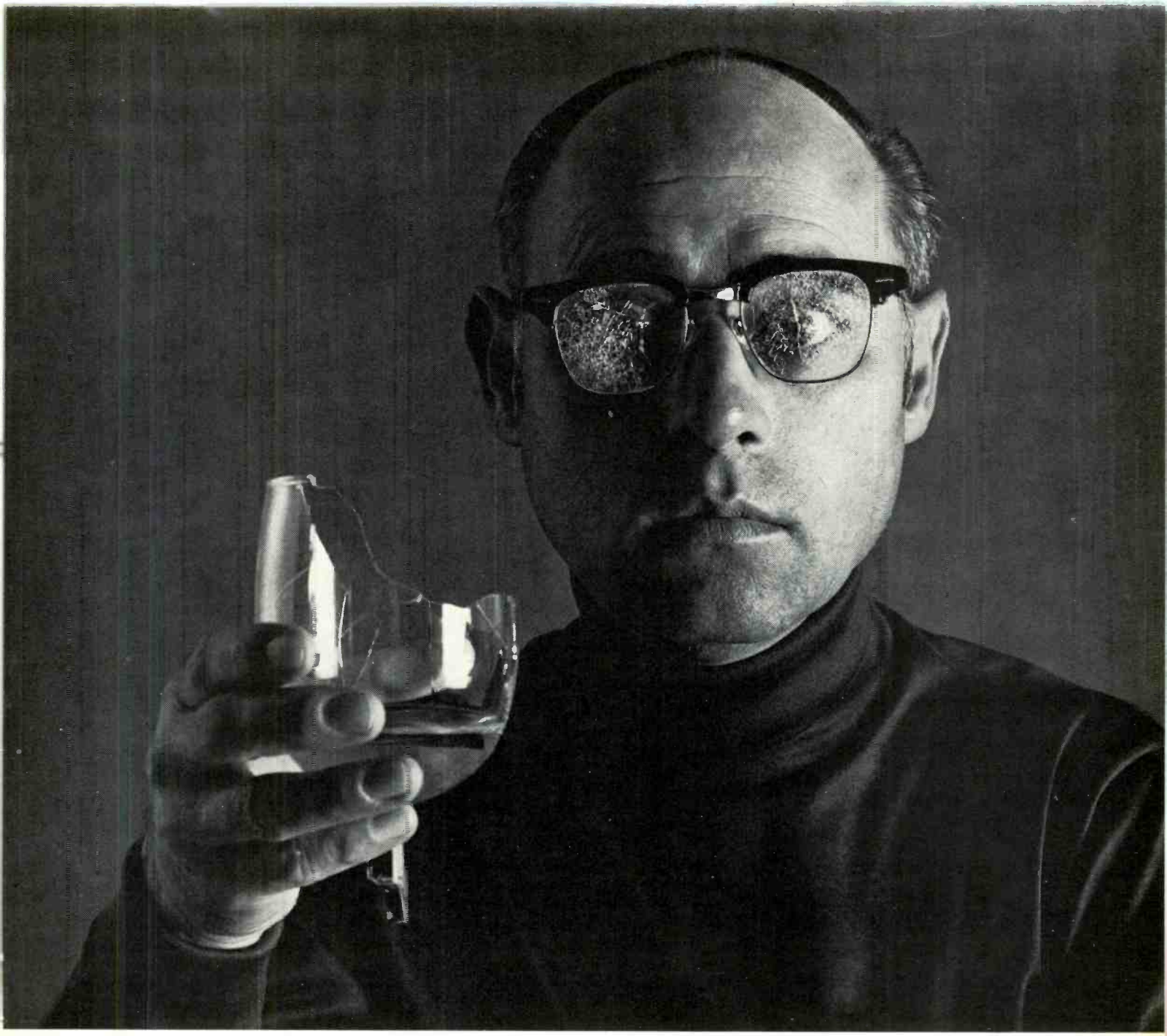


Bose 501

Sony SS 9400

Several interesting new speaker systems were being demonstrated but the smallness of the rooms and the milling crowds made judgment a little difficult. One of the systems I liked was the new **Tannoy** Orbitus I, which is an omnidirectional system using the well-known 12-inch dual-concentric speaker. It was specially modified for horizontal mounting and faces upward into a curvilinear reflector. As might be expected, sound was very smooth with a wide stereo image. Some will prefer the forward-facing Tannoy systems like the Mallorcan which have a pretty wide dispersion anyway. It is all a question of personal taste—and room acoustics! The **Bose** type of direct-plus-reflected sound pleases many people and their new 501 will appeal to those who just cannot afford the more expensive 901's. Less amplifier power is required, too . . . The 501 uses a 10-inch bass speaker with two side-mounted 3½-inch units and the overall sound has much of the spacious quality of the larger system. I almost forgot—no equalizer is required and there is no doubt that at the price of $125, Bose has another winner. **Harman-Kardon** were demonstrating their Citation system which I heard at the Los Angeles AES Show. Again, I was impressed with the natural sound and lack of coloration. It uses three 6-inch bass speakers with two high-frequency dome units-all facing upwards and slightly forward. Like all so-called omnidirectional systems, the sound pattern will depend on the rear walls of the listening room and the actual position of the speakers. Another relative newcomer is the unusual-looking **Sony** SS-9400 which has six five-inch full-range speakers. As they are placed around the 'barrel,' radiation is more or less omnidirectional. Each speaker unit is fitted with dispersion domes to prevent 'beaming.' The system is about 24 inches high and comes complete with reversible red-and-black cushions. Choice of program material in the **Empire** room seemed to emphasize the bass somewhat but there is no doubt that the big Grenadier systems have a good low-frequency response. A test report of the latest model—the Empire 6000 is now being prepared. The **Altec-Lansing** room also attracted the crowds and Don Palmquist was kept busy answering questions. Here, as in the rear **Frazier** room nearby, many people were more interested in the larger systems—at least that was **my** impression. However, the speaker that attracted my attention in the **Wharfedale** room was the relatively small W 35. It features a 8-inch bass, a 3-inch mid-range and a 2½-inch treble unit. Ideal for the smaller room-but they could also be used as the rear speakers in a 4-channel system. Most congested place in the Show (apart from the parking lot) was the **Electro-Voice** room. The reason was the demonstration of the new Feldman-Fixler 4-channel system. (Yes, Leonard Feldman and John Fixler—the 4-channel headphone inventor) More details on the FF system will be found on page 48.



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HOW MANY CHANNELS?

The accuracy of the reproduction of a Sound Field is dependent on the number of discrete channels used in the system. In this article, the author examines some psychoacoustic factors involved when using two, three, or four channels.

TWO APPROACHES MAY BE TAKEN in seeking to determine the number of channels needed for a true stereophonic reproduction—a reproduction characterized by the feeling of actually being in the presence of the original in its acoustic setting. The first is the objective, or holographic, approach, and the second is the subjective, or psychoacoustic, approach. A reconstruction of an adequate approximation to the original three-dimensional sound field is the goal of the first, whereas the goal of the second is to determine only those psychoacoustically-relevant attributes of the sound field that need be recorded for optimal presentation to the listener.

Both approaches may be seen in other fields. In color photography, for example, the little-used objective approach would require the reproduction of the physical color spectrum actually reflected by the colored object, whereas the subjective approach requires that only the appropriate balance be struck among the three-color stimuli known to characterize human vision.[1]

Although there may be subtle human-vision effects glossed over in the latter approach, it produces such satisfying results that only a major revolution in technology, or in understanding human perception, can renew the pressure to seek a new equilibrium in satisfaction, whether through reviving the objectivist program or refining the subjectivist program.

Audio engineering appears to have reached the stage at which multi-channel technology and newly-appreciated auditory phenomena have renewed the pressure towards a more satisfactory stereophonic reproduction. It is too early to tell when the new equilibrium in satisfaction will be obtained, or what system configuration it will require. While ultimate answers are not yet available, current sign posts do indicate directions in which it appears sensible to proceed.

*Associate Professor, Electrical Engineering and Physics, University of Illinois, Urbana, Ill.

Relevant Data

The objective approach involves the erection of imaginary livingroom boundaries in the concert hall, say, and the covering of the boundary surface with outward-directed microphones, each with its own recording channel. Then, in the actual listening room, preferably anechoic, the reproducing channels would excite loudspeakers in positions corresponding to those same microphone locations. A recent trial was made by Camras.[2] He used twelve channels to obtain a very realistic effect. Of these, he than sought to select the ones most apt to provide a sufficient approximation, judged by listening, to objective reproduction. It was found difficult to remain content with fewer than four channels for the front and two for the back.

The subjective approach would remove the constraint that the microphones and the speakers be placed in corresponding places, or even that they be equal in number. Instead, the psychoacoustically important characteristics of the original would be recorded with microphones placed to serve that end. Similarly, the speaker placement would be designed to serve the psychoacoustic goals of providing an optimum presentation of those characteristics. For equal satisfaction, the requisite number of channels in the two approaches could well be quite different.

Of the large mass of psychoacoustic data in the literature, those in two papers have been pointed out by Madsen[3] as indicating well-established effects clearly relevant to the perception of the directional qualities of direct and reverberant sound fields. These are the effects studied by Haas[4] and by Damaske.[5]

In the usual two-speaker stereo setup, relative intensities govern the direct-sound image localization, but, as Haas showed, if the two sounds reach the ear with differing time delays, the localization is shifted towards the earlier source. For relative delays less than 2 milliseconds, an increase in intensity for the later sound can tend to restore the original localization at the expense of some increase in uncertainty. For steady-state signals, corresponding effects may be related to phase. The well-known instabilities in ordinary-stereo image localization, with respect to changing listener positions may be explained in this manner.

For relative delays in the range from 2 to 20 milliseconds, the localization of the image at the first source is very pronounced, requiring quite substantial loudness increases to displace it to the second, and there is an increasing tendency, especially for delays beyond 20 milliseconds, for a double sound to be heard. If the double sound is not heard, however, the second source does contribute to the overall impression of loudness (integrating effect). Madsen used this integrating effect to help explain how a complicated reverberation pattern of time delays could be psychoacoustically equivalent to a much simpler pattern. A group of time-delayed replicas of a first sound, produced by reflections within the concert hall and arriving within any 20-millisecond interval, would be heard as one by the listener. However, such groups would have a highly diffuse character with respect to sounds arriving within the very first 20 milliseconds, which first group would be localized at the source.

As Madsen points out, this confusion is caused by incoherence phenomena whose effects were studied by Damaske. Damaske produced pairs of mutually incoherent sounds by placing a pair of spaced microphones in a reverberant room excited by a single loudspeaker. The signals from these would drive a pair of loudspeakers in an anechoic chamber. Subjects placed there would measure the detectability of one of these sounds relative to the other. The more widely different delay pattern (obtained with the greater microphone spacing) between the two sounds made for a greater detectability of one relative to the other. It also made for a greater feeling of vagueness as to localization.

Damaske also determined the optimal placement for the two speakers for the

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maximum detectability of one of these mutually-incoherent sources relative to the other. With one source in front, the movable source was equally difficult to detect in back as in front, but it was 23 dB more detectable if placed at the side. With one source at the side, the movable source was 16 dB more detectable at the front than if placed at the same side, and 19 dB more detectable if placed at the opposite side. In such maximum detectable positions, the impression was reported of a sound that was diffused, appearing to come from everywhere.

Taken together, the Haas effects and the Damaske effects show that a very complicated source pattern, including reverberation sources, can be psychoacoustically equivalent to a very few sources suitably placed. Thus, short cuts around the more elaborate objective-reproduction requirements begin to appear. Some of these requirements, namely that hall sounds, coming from the back, ought to be reproduced from the back, are actually seen to be psychoacoustically irrelevant, undoubtedly related to the uniaxial placement of the ears on the head, despite minor front-back asymmetries.

Requirements for Stereo Reproduction

At this point it is possible to begin enumerating the sources needed in the listening setup for stereo reproduction. If a feeling for the acoustical setting (ambiance) is to be obtained, then side speakers must be used, and two of these must be used if the impression is to be symmetrical. According to the Damaske effects, these should suffice for the presentation of ambiance, while neither front nor back speakers would make a significant contribution.

The side speakers will not, however, provide for a satisfactory localization of the direct sound. The direct-sound images would be too widely spread and too unstable in localization with respect to changes in listener position. Madsen's solution was to avoid using the side speakers for direct-sound localization and to rely solely upon a normally-placed stereo pair of speakers, up front, for that. To ensure that sole reliance, he delayed the reproduction through the side speakers by an amount equal to the propagation time from front speaker to side speaker (about 12 milliseconds). This ingenious use of the Haas effect meant that the side speaker could carry the same information as the corresponding front speaker, as in Fig. 1, with the only net effect being that the side speakers would contribute whatever ambiance information that had been recorded, and which the front speakers could not provide. The direct sound would be affected only in loudness, not directionality, by the side speakers. The effect is stable, natural, and impressive in its recreation of ambiance from ordinary two-channel recordings.

Another approach is to allow the side speakers to contribute to direct-sound localization, but to use additional speakers to focus and stabilize that localization. It has been found, with widely-separated front speakers, that such focussed stabilization may be obtained with the help of a sum-connected center speaker. Thus, it is natural to think of using a single sum-connected front speaker to augment the side-speaker pair, as in Fig. 2. Since only two channels are required, this triphonic speaker setup may be easily tried with ordinary recordings.

At first, the results are disappointing; in contrast to the Madsen system, in which the side speakers rarely attract attention, the triphonic side speakers are readily sensed as independent sources, and the usual well-ordered stereo effect is not obtained. This impression persists until mono recordings are tried. With these, a good front-and-center localization results, and the reproduction of ambiance, combined with a feeling for depth, is truly astonishing.

The mono experience indicates that a proper stereo spread would be obtained with a reduction being made in the electrical separation between the two channels. It is easy to show that, with the usual evenly-spread stereo recordings, a separation limited to about 6 dB is sufficient to obtain that same even spread with triphonic reproduction. In comparison to normal stereo, the spread source, instead of having a flat perspective—pasted against the wall, so to speak—has remarkable depth and ambiance. The amount of ambiance seems to depend upon the amount that had been recorded and to characterize the recording site, often being less for chamber music, for example. Even then, solo voices have a three-dimensional quality.

Because of the Haas effects, the amount of blending required to reduce the electrical separation of the side speakers will depend upon their physical separation (distance) relative to that for the front. For a greater physical separation, more electrical separation will be required. For very large distances, the system will be more like the Madsen system, and it may be necessary to replace the blended front speaker with a moderately-spaced stereo pair.

In both the Madsen system and the triphonic system, stereo separation is not required for the ambiance information. The Damaske effects show that it is merely necessary to present the direct

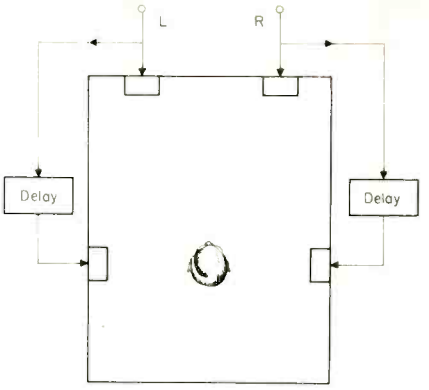

Fig. 1—The Madsen System. The side speakers are driven through a delay so that the Haas effects prevent them from affecting the direct-sound localization. They are placed so that the Damaske effects ensure a maximum presentation of nonlocalizeable ambiance (Adapted from Ref. 3).

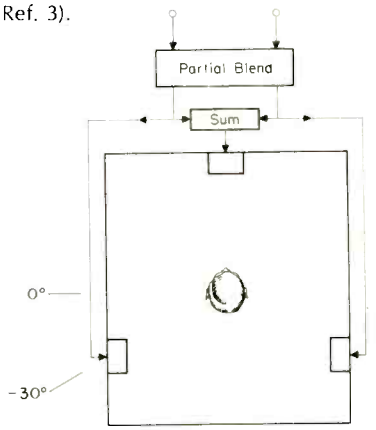

Fig. 2—The Triphonic System. The side speakers present ambiance information as in the Madsen system, but also contribute to the direct-sound localization, stabilized by the sum-connected front speaker. A variety of directional effects may be obtained.

sound from the front and the ambiance from the side. In the triphonic system, the presentation of the direct sound is "steered around" to the front to appear as phantom sources, so that its physical appearance at the sides does not mask the ambiance. Curiously enough, the ambiance still comes through if the head is directed at a side speaker, evidently because there remains a front-side presentation of sounds containing mutually incoherent components. The direct sound then appears to come to the head from the side (front of the room, of course), while the ambiance remains nonlocalizeable. Upon moving close to a side speaker, the direct-sound localization shifts as usual, but the ambiance persists as before until the listener comes very close indeed.

With such little electrical separation between side speakers, reverberation overhang, which is found to contribute negligibly to the feeling of ambiance, is

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found to come from the front. This also happens in the Madsen system if there is no electrical separation between the side speakers. Any localization for overhang is false, of course, and results because the Haas-effect integration does not extend over a sufficient interval to allow the incoherence between direct and reverberant sounds to be compared if the direct sounds have been silent for a long enough time. This localization does not appear if the separation may be maintained for the ambiance information. Recordings made specifically for the triphonic system would not require the use of any blending in reproduction, and could be made with rather little separation for the direct sound, but retain full separation for the ambiance information.

Recording for the Triphonic System

A way in which recordings may be made specifically for the triphonic system is shown in Fig. 3. The two unidirectional microphones are closely spaced to make possible the derivation of a well-focussed center channel, free of spurious outphasing effects. Thus, a good mono compatibility should obtain for the direct sound, while the angling of these microphones should provide good separation. Some degree of blending should be provided. The two bidirectional microphones are widely spaced with the direction of their null response oriented toward the direct-sound source. Their spacing should ensure a high degree of mutual incoherence with each other and with the direct-sound pickup. This ambiance-information pickup may have its separation enhanced by mixing some difference signal in opposing phases in the two ambiance channels (antiblend). The final mix could provide stereo amplitude contours like those shown in Fig. 4.

Compatibility with ordinary mono and stereo reproduction is desirable. As noted, the mono compatibility is directly provided; the exalted ambiance separation is not important for mono, since little ambiance would be available anyway. The same is true for ordinary stereo, except that the direct-sound separation may seem insufficient to some listeners. It is unfortunate that normal stereo amplifiers are not provided with a blend-antiblend control. In the interim, it will probably be necessary to leave some of the blending to be supplied in the triphonic reproduction. This compromise would be of little moment if abundant ambiance separation be surely provided in the recording. The need for a blend control is necessary in triphonic systems, anyway, for playing ordinary recordings.

In relation to the requirements of triphonic reproduction, normal stereo recording systems are capable of providing a superabundance of separation. Thus, there is a capability for providing direct-sound localizations that extend beyond the usual frontal range. Extreme side localization is obviously possible. Since Damaske's results indicate a +10- to −40-degree tolerance for side-speaker placement to provide good ambiance detection, these speakers could be displaced somewhat to the back. The three speakers would then be roughly at the vertices of an equilateral triangle, with the listener in the middle. Figure 2 already indicates such a placement. Then "extreme side," as mentioned above, becomes "side and to the back," in localization.

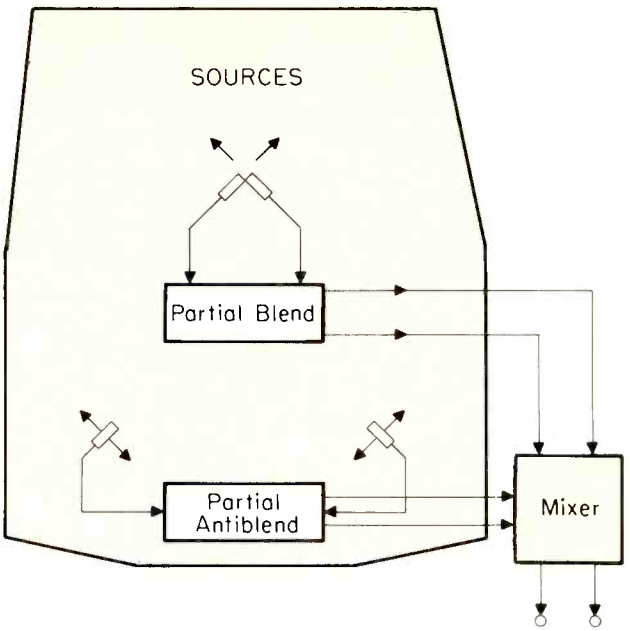

Fig. 3—Microphone Placement for Frontal Localization in Triphonic Reproduction. The recorded information may be made compatible with normal stereo and mono reproduction.

With the two side speakers carrying oppositely-phased, direct-sound information, that sound would appear to come from the back. Actually, the experience with oppositely-phased loudspeakers is that the localization is not well-defined. It appears to come from somewhere else than the space between the speakers, and the listener tends to deny a frontal localization. At the same time, the sound does not have the same diffuse quality noted for ambiance information. The localization is better described as unstable; it is this property, taken with a liability to front-back ambiguities inherent in the uniaxial ear configuration, that, because of a willingness to deny a frontal localization, makes the listener resolve the ambiguity in favor of the back. With the side speakers displaced somewhat toward the back, the acceptance of a back localization is unhesistatingly made.

A center-back localization will rarely be desired, however, since that would force the sum channel to be silent for that source, and void the mono compatibility. Off-center back localizations entailing a minor diminution in the sum channel will be more acceptable in the mono reproduction. A difference-connected loudspeaker may be actually placed at center-back as in the Dynaco proposal.[6] Such a speaker would, because of the Damaske effects, make no contribution to ambiance, and, since it would be in aiding phase with one or the other of the side speakers, it would tend to produce a further off-center bias in the back localization. Thus, such a speaker probably would make no worthwhile contribution, but that is a question for further study.[7]

The exploitation of these localization possibilities will require microphone and

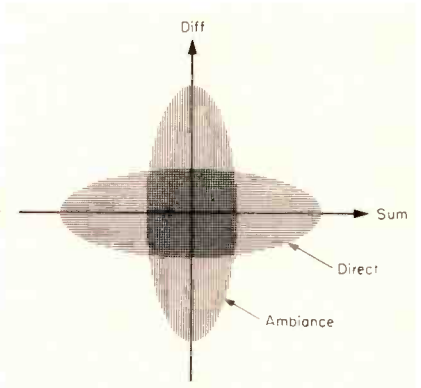

Fig. 4—Stereo Amplitude Contours for Frontal Localization in Triphonic Reproduction. Rather little direct-sound separation is required for frontal localization, although more may be permitted if blending is undertaken in reproduction.

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mixing techniques more elaborate than shown in Fig. 3. For the triphonic system, however, the usual matrix-mixing formulations appear to stand in need of modification because of the greater psychoacoustic weight attaching to the side-speaker placement. It is just this extra weight which avoids any necessity for loudness-dependent matrix-steering circuits in playback.

Triphonic Experiments

Experimenters can easily try the triphonic system for playing ordinary recordings, since no specialized equipment is involved, and many stereo amplifiers already supply a sum-channel output. In some cases, this is a powered output, while in others it is intended for driving a separate amplifier. Where the sum channel is not provided, one is easily derived, via a resistor network to excite a separate amplifier, or with the help of available transformers designed to provide a powered sum channel. Also, if the stereo amplifier makes use of a common return lead, and the same-model speaker may be used in the three locations, the Dynaco hookup (Fig. 5) is convenient. This last hookup introduces a degree of antiblend so that the blend circuit is mandatory. As noted, however, blending is needed in the triphonic arrangement, in any case.

The experimenter will find many ordinary stereo recordings with a sufficiently focussed stereo perspective to permit triphonic reproduction, upon suitable blending, with a direct-sound directionality very close to that intended by the recording director. The depth and ambiance will lend a naturalness that the listener may feel should have characterized stereo reproduction at the outset. The restoration of mono recordings is equally satisfying, and many will find the stereo spread, missing from such recordings, to be not so keenly missed after all. There will also be found a few recordings to contain some unexpected "far-out" effects.

Recordings likely to exhibit such far-out effects are those deriving from the use of a multiplicity of microphones recorded in a multiplicity of channels with elaborate mixing arrangements, both prior to recordings, and in stages leading to the final two-channel mix. Such techniques, increasingly common in recording rock groups, for example, can result in an unplanned, wide assortment of phasing combinations. The various instrumental and human voices often, in triphonic reproduction, then appear from a great variety of well-defined directions, although some of them may jump from one location to another, even from front to back.

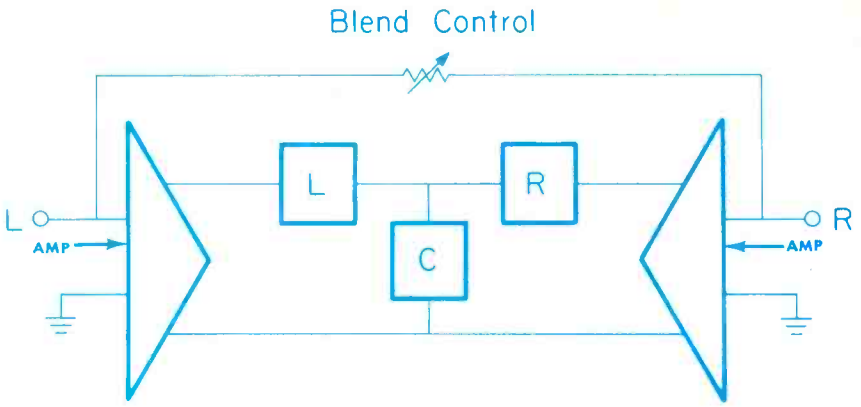

Fig. 5—The Dynaco Center-Channel Speaker Hookup. The three speakers should be the same model. The hookup introduces some anti-blend components to be cancelled by the blend control shown. For triphonic reproduction of ordinary stereo records, a more-than-normal degree of blending is advised.

While not intended by the recording director, such effects can be entertaining, and they do demonstrate the potential for a varied direct-sound localization.

Recording engineers may also experiment, of course, to find microphone and mixing techniques to bring such far-out effects under control, and to be able to obtain predictable localizations with triphonic reproduction, while, at the same time, maintaining reasonable compatibility with ordinary mono and stereo reproduction.

Conclusions

The ultimate answer to the question as to the number of channels needed for stereophonic sound reproduction has not been obtained. It has become clear, however, that, if the limited knowledge already at hand, regarding the subjective properties of human hearing, are properly exploited, then the existing two channels are capable of presenting a richness of information hitherto unsuspected. A three-speaker, or triphonic, means of displaying that information has been explained that is readily tried with ordinary recordings to demonstrate the potentialities. Recording techniques to optimize the use of these two channels in triphonic reproduction have been partially sketched.

It has also become clear that the objective approach can readily prescribe more recording channels than necessary for a specified degree of satisfaction. Four channels, once thought necessary to the reproduction of ambiance, can be replaced by two, or even one. Moreover, the objective thought that speakers should be placed at the back is seen to be psychoacoustically faulty for ambiance reproduction. It is unfortunate that it has taken a decade of two-channel stereo practice before even the beginnings of an adequate exploitation of two channels could now be recognized. Doubtless, much remains to be appreciated about the relevant psychoacoustic phenomena, so that the art of two-channel recording would appear to be still in its infancy. So long as this is the case, a consideration of the introduction of additional channels would appear premature.

What are needed are further sign posts. Madsen's elucidation of ambiance perception, and the potentialities for wide-ranging direct-sound directionality shown by the triphonic system, are beginnings. Upon consolidation of these gains, it may be possible to provide rational formulations of psychoacoustic requirements to be met by adding further channels. Without deeper study, such formulations do not immediately come to mind, but it is possible to wish for a greater stability of the direct-sound image against varying listener positions. With sharper requirement formulations and corresponding deeper understandings, the psychoacoustic relevance of adding further channels would be less clearly an open question. Until then, two channels have a lot to offer, more than had been supposed. Æ

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7. A number of readers who have tried the Dynaco arrangement do, in fact, find that there is a better ambiance.—**Ed.**

PRODUCT PREVIEW ADDITIONS

SPEAKER SYSTEMS

MANUFACTURER (Circled numbers indicate adv. page)	MODEL	WOOFER Diameter, in.	WOOFER Resonance (In System), Hz	WOOFER Enclosure Type	MID-RANGE Diameter, in.	MID-RANGE Type	TWEETER Diameter, in.	TWEETER Type	Overall Freq. Response, Hz to kHz ± 3 dB	Ampl. Pwr. for Avg. Room, W	Pwr. Handling Capacity (RMS Cont.)	Crossover Frequency (ies), Hz	Impedance, Ohms	Enclosure Dimensions, W x D x H, in.	Wood Finish	Grille Material Color	Weight, Lbs.	Price	SPECIAL FEATURES
EPI	100	8	18	Acous.			1	Cone	40-13K ±3	18	60	1800	8	21 x 11 x 9	Wal.	Cloth Brown		89.00	Free-air res.
	50	(2)		Acous.					50-18K ±3	14				13 x 10 x 8	Wal.	Cloth Dark		55.00	Long voice c ls.
FRAZIER	MK.VI F12-8W	12		Tuned	8		(2)3 or	Cone Horn	25-17K	8	25	800 3300	8	25¾ x 16⅜ x 29	Oil Wal.	Cloth Brown-gold	90	295.00	
	Super Dixielander F707-1037	10		Exp. Horn	–	–		Horn	70-17K ±5	0.5	30	800	8	22¾ x 15¾ x 26½	Util Slate	None	65	250.00	
	MK. V F12-2-5T	12		Tuned	(2)4	Cone		Horn	30-19K ±5	2	25	800 3300	8	14 x 12 x 25¾	Oil Wal	Lined Off-White	50	189.95	Also available in black t ity mode .
	MK. IV F10H	10		Tuned	–	–		Horn	30-18K ±5	2	25	2000	8	14 x 12 x 24	Oil Wal	Lined Off-White	41	99.95	
GOTHAM	OY	10	20		4	Cone		Horn	40-16K ±2			500 8000	-4700	19 x 9 x 12	Wal. or Gray	Metal Silver	44	520.00	Low-level input, contains 2-30 W amps; elect. X-over; separate level contrs.
VM	LS-85	8			3½	Cone			35-20K ±5	10	40	2000	8	26 x 26 x 20⅜	Pecan	Cloth Ant. Gold	65	210.00	
	LS-84	8			3½	Cone			35-20K ±5	10	40	2000	8	19½ x 19½ x 20	Pecan Elm Inlay	Cane	41	195.00	
(27)	LS-38	5½		Spiral Reflex					60-15K ±5	4	10			18 x 12 x 12	Oil Wal.	Cloth Black	18	95.00	
TRUSONIC	T-28	8	23				2 x 6	Comp.	40-19.5K	10	35			11 x 18 x 9	Wal.				H.F. level contr.

MICROPHONES

MANUFACTURER (Circled number indicates ad page)	MODEL	Directional Pattern	Operating Principle	Case Material	External Finish	Impedance, Ohms	Frequency Response, Hz to kHz, ± 7 dB	EIA Sensitivity, dBm	Mic Connection	Cable Length, Ft.	Cable Plug Type	Dimensions, In.	Weight, Oz.	Mounting Method	Price	SPECIAL FEATURES
NEUMANN	SM 69 FET	Dual omni, card; Fig. 8	Cond.	Metal	Satin Chrome	200 200	40-16K	–131	Cannon	33	Cannon	10 x 1⅞ d.	16	⅝-27	880.00	Dual 3-pattern mic. for stereo miking in either X/Y or M/S mode.
	U-87	Omni, card, Fig. 8	Cond.	Metal	Satin Chrome	150/ 250	40-16K	–137	Cannon	25	Cannon	8 x 2¼ c.	20	⅝-27	342.00	Studio std. for close miking; int. compartment for batt. oper; switchable 10-freq. and 10-dB overload attenuation.
	KM-86	Omni, card, Fig. 8	Cond.	Metal	Satin Chrome	200	40-20K	–137	Cannon	25	Cannon	7¼ x 1¾ d.	7⅛	⅝-27	327.00	3-pattern, switchable with 10 dB o-load sn. for close-up recording.
	KM-84	card	Cond.	Metal	Satin Chrome	200	40-20K	–137	Cannon	25	Cannon	4⅜ x ⅞ d.	3	⅝-27	252.00	Regs. batt or a.c. supply; flat freq. resp. on or off mic; 10-dB overload sw. for close-up use; accessories available.
	KM-83	card	Cond.	Metal	Satin Chrome	200	20-20K	–137	Cannon	25	Cannon	4⅜ x ⅞ d.	3	⅝-27	225.00	As above.
	KM-85	card	Cond.	Metal	Satin Chrome	200	40-20K	–137	Cannon	25	Cannon	4⅜ x ⅞ d.	3	⅝-27	252.00	As above with spec. 10-freq. rolloff for PA use.

AMPLIFIERS — Basic and Integrated

MANUFACTURER (Circled numbers indicate adv. page)	MODEL	IHF Power/Chan., W	RMS Power/Chan., W	THD at Rated Power, %	THD at 1 Watt, %	IM at Rated Power, %	IM at 1 Watt, %	Power Bandwidth, Hz to kHz	Freq. Response at 1 Watt, Hz ±? dB	Rated Output S/N, dB	Phono Sensitivity, mV	Phono Overload, mV	Tape Head Input, mV	High-Level Input, V	Output Z, Ohms	Damping Factor	Dimensions, in. W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
AUDIO RESEARCH	Dual 50 (T)(B)		50	<0.1				25-30K	25-20K ±1	90	–	–	–	1.15	4,8, 16	14			38	440.00	Basic Ampf. only.
	(T) SP-2 Pre-Amp			<.01					20-20K ±1	90 (75)Ph	2.0	50 V					15⅝ x 13½ x 5	13.5	395.00	Rated output 30V into Hi-Z; 5V into 10 KHz. Tone contr. range – ±15 dB at 30 Hz and 10 KHz.

RECEIVERS

MANUFACTURER (Circled numbers indicate adv. page)	MODEL	AMPLIFIER SECTION: IHF Power/Chan., W	RMS Power/Chan., W	THD at Rated Power, %	IM at Rated Power, F	IM at 1 Watt, %	Power Bandwidth, Hz to kHz	1-Watt Freq. Response, Hz ±? dB	Rated Output S/N, dB	Phono Sensitivity, mV	Phono Overload, mV	TUNER SECTION: IHF Sensitivity, μV	Capture Ratio, dB	THD, Mono, 100% Mod., %	THD, Stereo, 100% Mod., %	Stereo Sep., 1,000 Hz, dB	Tuning Indicator	Alt. Chan. Selectivity, dB	Dimensions, in., W x D x H	Weight, lbs.	Price	SPECIAL FEATURES
VM CORPORATION (27)	1521	55	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	18⅞ x 12 x 6 7/16	30	500.00	(2) 5-pole toroidal filters; (2) dual gate Mosfets in front end.
	1520	40	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	18⅞ x 12 x 6 7/16	30	460.00	As above.
YAMAHA (29)	AA-70	65* 45	35* 30	0.1	0.3		30-20K	30-20K ±1	75	3.0		2.5		0.5		40	Meter		18½ x 17¼ x 5½	24	229.50	*4 ohms; loudness contr; indicator lights; incls. AM.

MANUAL TURNTABLES and ARMS

MANUFACTURER (Circled numbers indicate adv. page)	TURNTABLES: Model	Speeds (see letter code)	Wow and Flutter at 33⅓, %	Rumble (NAB) dB	Motor Type	Platter Diameter, in.	Platter Weight, lbs.	Drive	Arm Mounting Provision	Dimensions, W x D x H, in.	Weight, lbs.	TONE ARMS: Model	Overall Length, in.	Pivot-stylus dist., in.	Vertical Bearing	Lateral Bearing	Stylus Force Method	Max. Tracking Error, deg.	Cart. Weight Range, gms.	Arm Resonance, Hz	Stylus Force Range, gms.	Weight, if sep., oz.	Price	SPECIAL FEATURES
YAMAHA (29)	YP-70	B	.08	–46	4-P Sync.	12		Belt		19 x 16 x 6	22						Static Bal.		5-12		0-5		209.00	Features – 2 speed motor; die-cast alum. platter.

AUTOMATIC TURNTABLES

MANUFACTURER	Model	Speeds (see letter code)	Platter Diameter, in.	Wow and Flutter, %	Rumble (NAB) dB	Max. Tracking Error, Deg.	Pivot-Stylus Dist., in.	Arm Type	Cart. Weight Range, gms.	Arm Resonance, Hz	Stat. Stack Records	Change Cycle at 33⅓ secs	Clearance Below Board, in.	Clearance Above Board, in.	Overall W x D, in.	Weight, lbs.	Weight, lbs.	Price	SPECIAL FEATURES
VM CORPORATION (27)	1555	B	11¾	.06	–56	1.5	9½	Dyn weight	3-9	8					17 x 13	5½	20	220.00	Includes Shure M-71 cartridge, base and dust cover
	1585	B	11¾	.06	–56	1.5	9½	Dyn weight	3-9	8					17 x 13	5½	16½	165.00	Turntable alone without above items

OPEN-REEL TAPE RECORDERS

MANUFACTURER	Model	Speeds (see letter code)	Power amps built in?	Max. reel size, in.	No. of heads	No. of tracks	No. of motors	Drive motor type	Direct to capstan	Frequency response * Hz to kHz, ± dB	Wow and flutter, % *	Signal-to-noise ratio, dB*	Fast wind, 1200 ft., sec.	Mic. input Z, ohms	Recording level indication type	Dimensions, W x D x H, in.	Weight, lbs.	Price	SPECIAL FEATURES
TAPESONIC	70-TRSQ	E	No	10½	3	4 or 2	3	Hys	Direct	35-26k ± 2	.08	56	35	10k 50k	2 mtrs	19 x 14 x 9½	69	615.00	Two low-Z mic. trans. inputs with Cannon XLR conn. $35.00. Port. carry case $34.50

HEADPHONES

MANUFACTURER (Circled numbers indicate adv. page)	Model	Type	Frequency Response, Hz ±? dB	Impedance, Ohms	Sensitivity mW input for 100 dBm Out	Maximum input, mW	Distortion, %	Cord Length, Ft.	Weight, Oz.	Price	SPECIAL FEATURES
BEYER	DT-48S	Dyn.	16-18K ±3	5 ea.	.0625	2 x 200	0.1	9	16	98.00	Sgl. or dbl. matching transfs. avail. for 600-ohm lines; spkr.-phone switchover box.
	DT-48SN	Dyn.	16-18K ±2	50	.0625	400	0.1	9	16	98.00	For Stellavox and Nagra recorders only; monophonic.
PIONEER (49)	SE-50	Dyn.	20-20K	8		500		16	20	49.95	2-way, volume and tweeter controls. Includes case.
	SE-30	Dyn.	20-20K	8		500		8	14	34.95	Includes case.
	SE-20A	Dyn.	29-18K	8		500		8	13	24.95	Includes case.

DIRECTORY ADDITIONS

Audio Research Corporation
2843 Twenty-sixth Ave. South
Minneapolis, Minn. 55406

Beyer (see Gotham)

EPI—Epicure Products, Inc.
185 Somerville Ave.
Somerville, Mass. 02143

Gotham Audio Corporation
2 West 46th Street
New York, N.Y. 10036

Neumann (see Gotham)

Tapesonic—Premier Electronic Labs
382 Lafayette Street
New York, N.Y. 10003

Trusonics
4959 Santa Anita
Temple City, California 91780

VM Corporation
Dept. 74, Box 1247
Benton Harbor, Mich. 49022

BASF LH* tape sets a whole new standard in sound recording

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Remember how tape used to sound? You'd turn up the volume and hear a background hiss — or turn it down and not hear the sound. With new BASF-LH tape (Low noise-High output) you eliminate all background noise and you get full-bodied, dynamic tones over an expanded volume range. The signal-to-noise ratio is improved by as much as 8 db over other low noise tapes.

BASF-LH tape . . . now everyone can have true professional recording sound reproduction — more clarity and realism, less distortion — from faintest pianissimo to booming crescendo. BASF-LH tape — packaged in the famous "Perma-Store" plastic library boxes for permanent protection. Combining quality with convenience for the most memorable recording results ever!

And the BASF Compact Cassette . . . a pocketsize powerhouse with the special low noise tape that gives you more music for your money. Packaged for portability, storage, or mailing in a mini-version of the exclusive Perma-store library case.

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We have cut the figurative fence, demolished the literal box. We have conceived an utterly unique system. One which is omni-directional and truly gives you the feeling of clear, open sound.

The speakers are the new Sony Omni-Radials. With them, you'll hear the same, ultra-realistic stereo effect no matter where you sit in the room, and no matter where you place them.

And all the sound quality you expect from Sony. Clean, clear powerful bass from six acoustic-suspension drivers with special silicone polymer suspensions (for unusually long, linear cone excursions). An individual dispersion dome over each driver cone distributes the highest frequencies evenly throughout a full 360 degrees and from floor to ceiling.

The compound-curved cabinet contributes to the system's sound quality: its constantly varying diameter prevents build-up of standing wave resonances within the enclosure and provides extra rigidity to prevent panel resonances.

The Sony Omni-Radials are beautiful to behold. Their rich, open-pore ash or walnut finishes blend into any decor. With reversible cushions removed you can use them as convenient end tables; with the cushions in place (black or red side up) they're comfortable seats.

23-5/8 inches high by 15-15/16 inches diameter at middle. Sony SS-9500, $149.50. (Suggested list.)

Sony Corporation of America, 47-47 Van Dam Street, Long Island City, New York 11101.

The new omni-radials from SONY®


SONY

Quadraphonic News

Interest in quadraphonic sound has certainly inspired the inventors, and almost every week sees a new synthetic or psycho-acoustic 4-channel system. Some of these 'black box' devices can take signals from any 4-channel source, transform them into two channels for broadcasting or recording, and then 'reconstitute' them with a decoder. All claim to generate four separate channels from any two-channel or even mono source. They include the Harman-Kardon (Orban), Dynaco, JVC, Sansui, Scheiber, IQ, and Feldman-Fixler systems. How do these black box devices work? Well, at the moment the patent situation prevents us from publishing much in the way of detail, but it can be said that amplitude, phase, time delay, and the precedence (Haas) effect are all used to provide 'switching' information or location effects. The Harman-Kardon system also makes use of reverberation. Figure 1 shows the Sansui arrangement. QS-1 is the synthesizer which processes the information into the four channels. According to Sansui, it works by "creating a complex phase-interference fringe plus phase-modulation to produce the same phase movements as are present in a live Sound Field." Two speaker arrangements are suggested, one

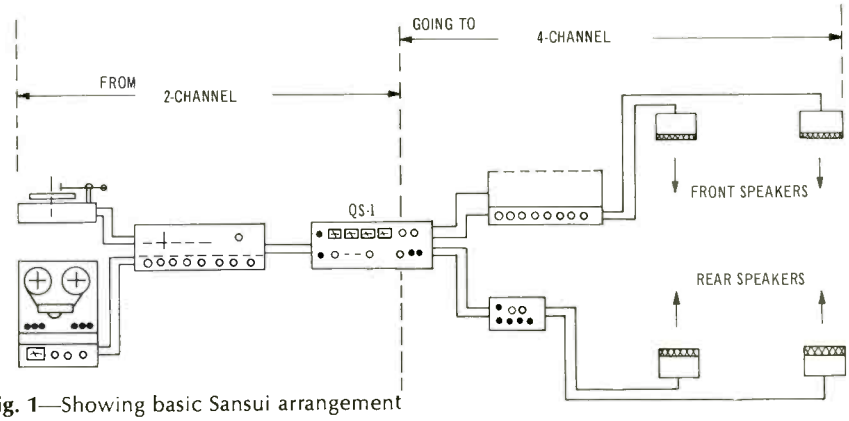

Fig. 1—Showing basic Sansui arrangement

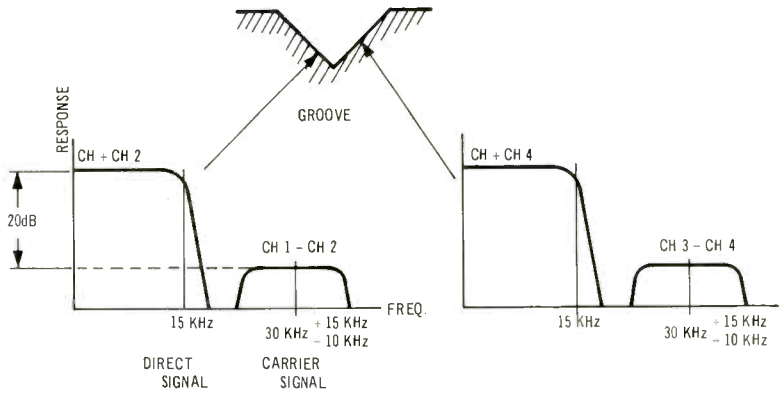

Fig. 3—JVC four-channel system

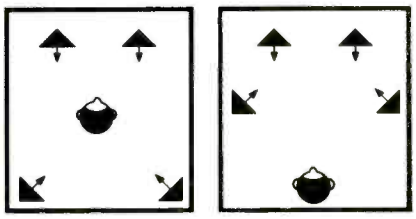

Fig. 2A and B—Speaker positions

being the more or less 'normal' positions shown in Fig. 2A, and the other a variation of the Madsen idea shown in Fig. 2B. A Sansui engineer, listening to the Enoch Light disc "Spaced Out," is quoted as saying, "You feel a fantastic chorus is located in the front center, with a slight echo to be heard from the rear speakers. Suddenly a trumpet starts playing from the right rear speaker, the exciting beat of the drums from the left front and the carefree sounds of Moog from the left rear. You also hear other Moog sounds from the left front speaker" Another engineer speaks of "The atmosphere of a concert hall and its wide sound field is reproduced in its entirety, you switch to two-channel stereo and you find it provides reproduction on so small a scale, you almost feel like you're listening to a mono rendition." Very enthusiastic, these engineers—but many people have made similar remarks about the Harman-Kardon processor and the new Feldman-Fixler system which was demonstrated at the recent New York Hi Fi Show under the aegis of Electro-Voice. Here is what Leonard Feldman has to say, "The encoder device has inputs for the four discrete channels from any quadraphonic program source. The four inputs are processed in a manner yet to be disclosed to produce two program channels which are then suitable for disc recording or FM transmission. Since no high-frequency switching components are involved, the encoded signals can be broadcast via existing FCC standards with no increase in bandwidth or any other changes in present techniques. The inventors of this system claim that the four program sources so derived exhibit separation characteristics which are extremely close to those of the original. The decoder device can be used with any two-channel material to produce four separate channels. While no claim is made for this with respect to true four-channel synthesis, a feeling of surround sound with different information coming from each of the loudspeakers is said to give new dimensions to almost any existing two-channel material." A similar claim is made for the IQ (International Quadraphonic) system but no details are available at present. Another system—which was specifically developed for phono records is the JVC mentioned in the October issue. It is a carrier system and Fig. 3 shows the arrangement. Frequency modulation is used for low frequencies and phase modulation for frequencies above 800 Hz. The decoder (which uses no less than 29 transistors) has an output of 100 millivolts and is expected to cost around $50. The four-channel disc has a channel separation of 20 to 25 dB and is said to be fully compatible. Phono-cartridge response has to extend way out to 45 kHz but JVC has a suitable wide-range cartridge available at a reported cost of $50.

CBS are also experimenting with 4-channel discs, but few details have been released. All we can say is (a) they are fully compatible, and (b) a matrix switching system is used. Æ

Which stereo hobbyist are you... the listener or the experimenter?

Pioneer caters to both.

As a reader of this magazine, listening to music is undoubtedly one of your more relaxing hobbies. In which case the Pioneer SA-900 Integrated Amplifier and TX-900 AM-FM Tuner are for you. Together, they produce the finest stereo sound reproduction. And, if you want to go one step further into the realm of stereo experimentation, this is where to start.

For instance, the SA-900 permits you to operate the pre and main amplifiers separately. You can connect an electronic crossover and two power amplifiers for 3-channel multi-amp stereo. And for added effect you can patch in a reverb amp. The possibilities are limitless. With music power at 145 watts IHF (50+50 watts RMS, at 8 ohms, both channels operating) there's unbounded power to spare. Harmonic distortion is less than 0.08%. Stepped tone controls provide the finest precision adjustments. As High Fidelity (July 1970) commented: "... For an amplifier as good as this and with as many useful features, you'd expect to pay considerably more than the ($259.95) price listed."

The TX-900 AM-FM tuner combines ideally with the SA-900 amplifier. Using three FET's and two RF stages in the front end plus two crystal filters and four IC's in the IF section, IHF sensitivity (1.7μV), selectivity (65dB) and capture ratio (1.5dB) are superb. Tuning is precise with a bright spot indicator and twin meters. A variable muting switch accommodates weak signals while suppressing interchannel noise. $259.95

See and hear both units at your local Pioneer dealer.

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Sound & Decor

Shown above is a very unusual installation—*all the equipment is housed in a mobile home!* Proud owner is Don Woodall of Kansas City and he says he had great difficulty in taking the photographs as his camera was not fitted with a wide-angle lens. Amplifiers are a Marantz 15 with a 7T, tuner is a Sherwood S2300, and the tape decks are 4010 SU and 1200 Teacs. The turntables are a Miracord 50H and a Thorens TD 150, housed in a Barzilay 3-piece ensemble. Altec 605 E loudspeakers are used and there are two 755 F units in the bedroom. Other equipment includes a Harman-Kardon cassette player, Sony C-22 condenser microphones plus some very elaborate 'switchery.'

Since the photographs were taken, a Rabco arm has been added, the two tape decks replaced by a Teac 7010 and 6010. The Marantz tuner is now a model 18. Don is now wondering whether he should add an extension to the trailer so he can put in some more equipment. (Maybe 4-channel?)

Jack Simerly, of Pensacola, Florida bought most of his equipment—including the cabinets-in the Orient. He has two tape decks, one a Akai 355 X and the other a 100-D. The amplifier is a Fisher TX-200 and the tuner a Fisher TFM-200. The turntable is a Lab-80. Pioneer CS-50 speakers are used in the living-room and a pair of Pioneer CS-51's in a bedroom.

Ron Nelson of South Taylor Oak Park, Ill., says his wife is also an audio fan and she helped to build their installation. The tuner is a Sherwood S 3300, amplifiers McIntosh C-24 and two 60's, and the turntable is a PE 2020 fitted with a Shure V-15 type II. That impressive-looking tape deck is a Crown SX 724, and the speaker systems (not shown) are modified Imperial horns using 15-inch Lansing and Stentorian bass units plus a Wharfedale 12 and a Lansing 8-inch mid-range speaker. The Nelsons have two children and no doubt they will help out when the next modifications are made . . .

Don Schroeder of South Pasadena, Cal., is very keen on Sony equipment . . . amplifier is a TA 1120, tuner a ST 5000 FW—both the TV and clock radio are Sony. The record player is a Dual 1012. Don did not mention the name of the speakers but we think they are JBL SC 99's.

Dr. Harling calls his system "Spanish Style Stereo" and it harmonizes with the decor of their home. Mrs. Harling designed the wrought iron work and some of the cabinetry, which was made in Mexico. Receiver is a Marantz 18, turntable a Dual 1019, and tape deck a Tandberg 6000. The cassette unit is a Sony TC 125 and the installation is completed—appropriately enough—by a pair of Altec "Flamenco" speakers.

A Novel FM Probe Unit

LEONARD FELDMAN

OF THE MANY MILLIONS of FM sets currently in use, relatively few are designed to take full advantage of all the benefits in performance inherent in wide-band FM transmission. Those manufactured for use in high fidelity component systems constitute the exception, rather than the rule. Less expensive "table models," portables, and other "combination" sets often sound no better than an equivalent garden variety AM radio. Their fault lies primarily in two areas. They have poor limiting characteristics and their ultimate signal-to-noise ratio is so low as to limit the useful dynamic range of listenable program material. Poor limiting results in great variations of audio output level as you tune from weaker to stronger signals, necessitating constant readjustment of the volume control. In extreme cases, with very weak signal input to the antenna, the volume control has to be turned so high that receiver-generated hum and noise make the program all but useless. Since full limiting often requires an input signal of as high as 1000 microvolts or more (a level of signal obtained only from the very strongest stations with an outdoor antenna in use), most stations are heard with varying amounts of background noise, especially noticeable during quiet passages of music or speech.

Of course, if one wants to re-build such sets internally, from front end through i.f. strip, performance could be improved, but few experimenters are "hardy" enough to rip out the innards of a tightly wired, p.c.-board-constructed compact FM radio. Instead, we propose to offer an interesting solution which, in nearly every case tested, can actually turn your FM set into a high fidelity component *without your having to alter the circuitry of your set at all.* In fact, in about 60 per cent of the cases with which we tested our FM-i.f. "Probe," we didn't even have to get inside the cabinet of the FM radio involved!

What is The FM I.F. "Probe"?

Nearly every FM set in use today consists of an r.f. front end (the section which tunes to the desired frequency of the incoming signal, amplifies that signal and converts it, by superheterodyning, to a fixed frequency of 10.7 MHz) and an i.f. strip (which amplifies the 10.7-MHz signal and demodulates the audio information by means of a ratio-detector or a discriminator). Even the poorest combination of these elements results in an enormous amount of amplification, so that in the physical vicinity of the FM detector, large amounts of 10.7-MHz signal are present—often measured in significant fractions of a volt or even in volts. What's more, the high-frequency voltage present near the detector has a tendency to "radiate" over fairly small distances, much like a small transmitter, tuned to 10.7 MHz. The FM i.f. Probe which we constructed consists of a pick-up coil, tuned to resonance at 10.7 MHz. The output voltage of this coil is fed, by means of a short length of shielded cable, to a multistage 10.7-MHz i.f. circuit, featuring two tuned IC i.f. stages followed by a combination amplifier-limiter-quadrature detector IC which incorporates the equivalent of 19 transistors, 6 diodes, and 18 resistors! This i.f. strip actually reaches full limiting when fed with an input of as little as 10 microvolts of 10.7 MHz. By way of comparison, most FM sets on the market today require considerably more signal to reach full limiting and, don't forget, we're talking about an i.f. signal only, whereas complete sets include the gain of the front end as well and still fall short of this limiting specification. Bandwidth of the i.f. circuit we built is just over 350 kHz, and the detection characteristic is extremely linear. Total harmonic distortion at all signal levels from 20 microvolts to 100,000 microvolts was measured at just over 0.25 per cent for full ±75-kHz deviation and the components were chosen to make alignment simple and foolproof.

In actual use, the "probe" coil (shown pictorially in Fig. 1) is placed in the vicinity of your FM radio's i.f. strip—preferably near the detector. The de-emphasized audio output of the outboard i.f. strip (pictured in Fig. 1) may be fed to the high-level input of any good-quality audio amplifier and loudspeaker combination. As you tune your old FM radio across the band, you will hear the various stations coming through—as if by magic!

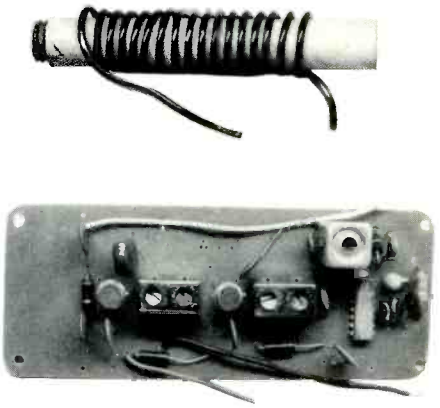

Fig. 1—Showing pickup coil and completed i.f. board.

Optimum placement of the "probe" can then be determined on the basis of cleanest, noise-free reception. In the photo of Fig. 2, the author is shown using the "probe" with a popular all-band portable receiver which also featured an FM band of questionable merit. The 10.7-MHz "spray" from this set was sufficient to preclude having to go inside the set with the probe. Full limiting (and quieting S/N of better than 65 dB) was obtained with the probe held parallel to the back of the set at distances up to four inches from the housing!

make our famous cup test ... and do your ears a favor

Take an ordinary cup and place it firmly over your ear. If this sounds like a silly thing to do, you're right. But it's no different than applying the design principle used in most of the quality headphones on the market: totally isolating the ear by means of airtight seals against your head. At the very least, it's uncomfortable. But anything is worth good reproduction . . . or is it?

By now, if you're still wearing the cup, you may be conscious of an unpleasant pressure on your ears. And that cup is getting heavy. Just like ordinary headphones do.

But smile. You can still enjoy all the intimacy, the separation, the privacy of headphone sound without discomfort. By using Sennheiser HD 414 "open-aire" headphones — a lightweight (5 oz.) unit whose unique "open acoustics" design conducts full-range sound to your ears in *two* ways. Directly through the soft, featherweight cushions. And through the air immediately around you. It's the nearest thing yet to concert-hall sound; yet at low levels, you can keep touch with the world around you. (Turn up the volume, and you're effectively alone.)

We could tell you much more about the HD 414. Starting with its professional (20-20,000 Hz) response, high sensitivity, low distortion (less than 1% @ 1000 Hz, even at 122 dB sound pressure) and compatibility with high- and low-impedance outputs.

One listen, though, is worth a thousand words. A visit to your nearby Sennheiser dealer will convince you that while cups are fine for drinking, open-aire headphones are best for listening.

For the name of your nearest Sennheiser dealer, write or call us.

The HD 414, by...

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Fig. 2—Using the probe with a popular all-band portable.

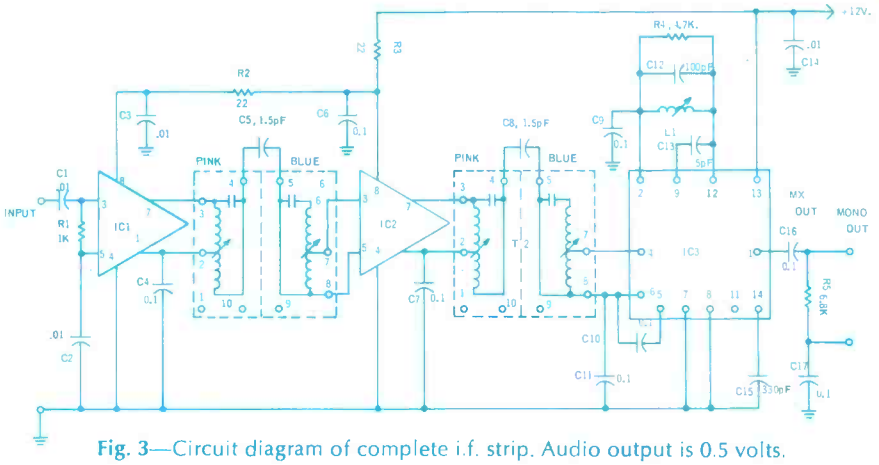

Fig. 3—Circuit diagram of complete i.f. strip. Audio output is 0.5 volts.

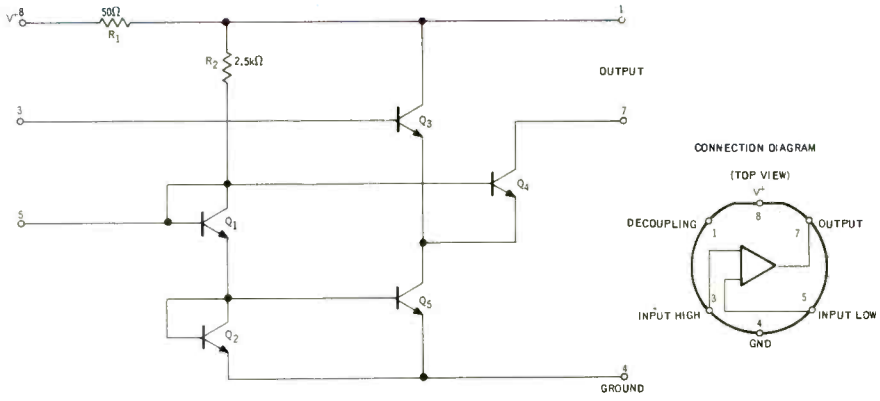

Fig. 4—Circuit and biasing arrangements of Fairchild μA 703 IC.

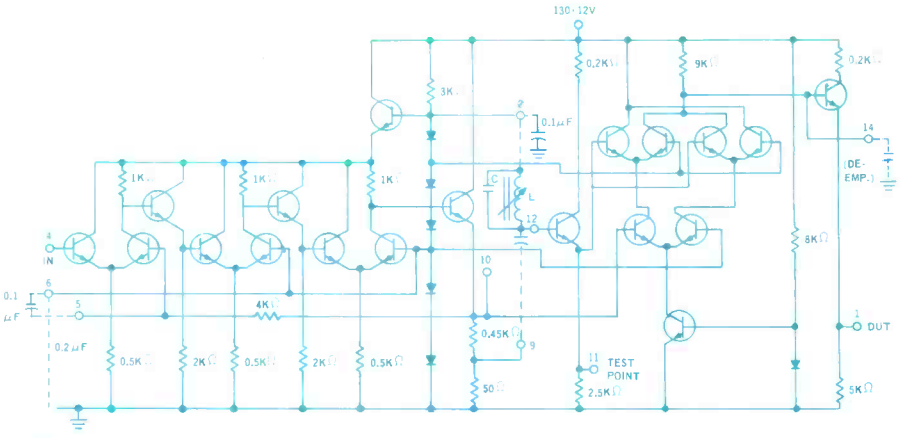

Fig. 5—All the above circuitry is contained in a single 14-pin 'inline' IC, except items shown dotted, which must be added externally. "C" is C-12 in figure 3, L is L-1 and the capacitor marked DE-EMP is C-15 in Figure 3.

I.F. Circuit Description

An overall circuit diagram of the i.f. strip is shown in Fig. 3. Input signal from the 10.7-MHz probe is fed to two cascaded μA703 E integrated circuits, each of which is terminated in an interstage dual-tuned i.f. transformer. Power gain of each of these stages is approximately 26 dB. A schematic diagram of the internal construction of the 703 device is shown in Fig. 4. The output of the second IC is fed to the Sprague Type ULN-2111A integrated circuit previously mentioned. A schematic of the contents of this remarkable IC is shown in Fig. 5. The amplifying groups of transistors to the left of terminal 10, in the diagram, comprise the amplifier-limiter section of the device and are capable of voltage gain of over 50 dB. The remaining pairs of transistors (to the right of terminal 10 in Fig. 5) constitute a quadrature-detector circuit. This highly efficient and linear form of FM detector operates in the following manner. The "direct" signal, as recovered from the amplifier section, is fed to one input of a "dual gate" circuit. The amplified signal is also applied to a phase-shifting network consisting of "C" and "L" and the coupling capacitor between pins 9 and 12 of the device. This combination presents a 10.7-MHz signal to the second element of the dual gate which is phase-shifted 90 deg. with respect to the primary or direct input. The duty cycle of the gate (period during which both inputs are in the "on" or conducting state), with no audio modulation applied, is therefore 90 deg. Since the L/C combination is tuned to resonance, frequencies above and below 10.7 MHz will cause greater or lesser phase shifts and therefore greater or lesser pulse widths at pin 14 of the device. The capacitor at pin 14, labelled (DE-EMP.) serves to smooth out these pulses to a fluctuating d.c. level which follows the audio information waveform exactly. Normally, this capacitor can also serve as the de-emphasizing capacitor required in FM reception, to provide the required 75-μsec. de-emphasis characteristic. In our design, however, we have used only 330 pF of capacitance at this point, to provide flat response beyond 60 kHz in the event that you want to use this device to feed a stereo multiplex decoder circuit. Actual de-emphasis for monophonic listening is accomplished externally, by means of R-5 and C-17 in Fig. 3. Should you desire to use the "probe" only for monophonic FM reception, C-15 may be changed to 0.01 μF, and R-5 and C-17 may be eliminated entirely, with the audio output taken directly from pin 1 of the ULN-2111A IC.

Construction Tips

A complete parts list for the "probe" and i.f. sections is tabulated at the con-

Fisher has the world's first 4-channel stereo receiver.

What do you have?

Let's compare what you have and what the Fisher 701 has.

It has 250 watts (62½ per channel). Integrated Darlington output stages.

It has 1.7 microvolts FM sensitivity (IHF). All active elements in front end are IC's. IF plus multiplex section contains 5 IC's comprising 14 amplifying stages.

It has 2 permanently tuned multipole filters, one with 5 high-Q toroidal resonators. (Alternate channel selectivity is 65 dB!)

Besides flywheel-assisted tuning, it has pushbutton electronic tuning with no moving parts (AutoScan®). And *remote-control* AutoScan is included in the $699.95 price.

The AM section has 2 permanently tuned multipole filters, one with 5 high-Q toroidal resonators.

It has sliding volume controls that operate as smoothly as studio faders.

And it has a Wide Surround® switch that feeds ordinary stereo signals at a reduced volume (after a slight delay) into the rear speakers, to create a 4-channel effect from 2-channel material.

But, most important of all, the Fisher 701 has 4 independent channels.

Now, how does that stack up against what *you* have?

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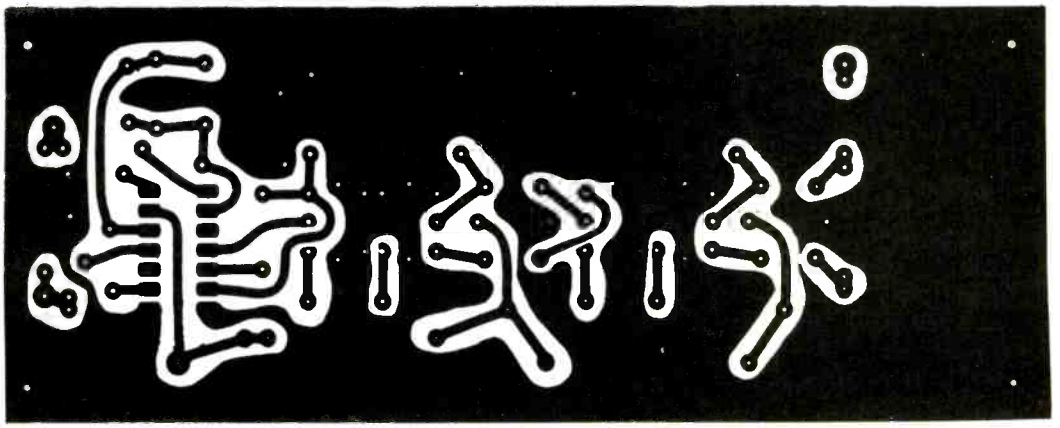

Fig. 6—An exact-size layout of the board. Copper side is uppermost.

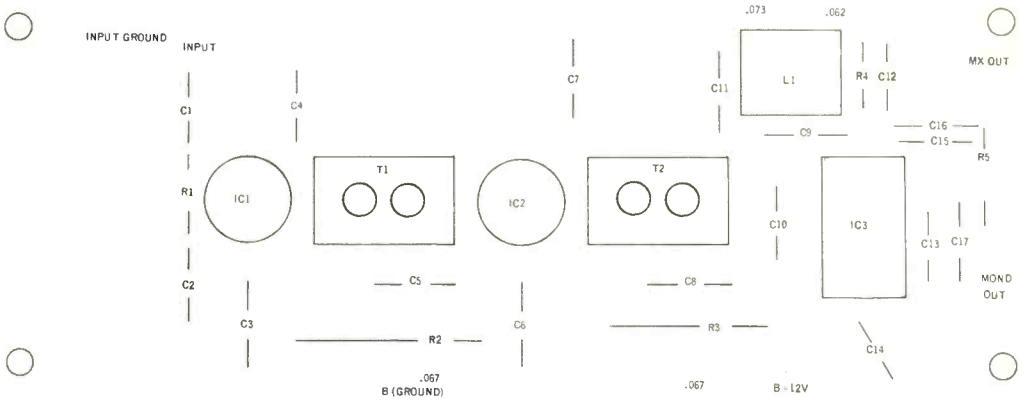

Fig. 7—Board viewed from the components side. Decimal dimensions refer to oversized holes to be drilled. All other holes are drilled .040 to .050 in diameter.

clusion of this article. While all the parts are standard catalog items, some electronic distributors may not carry all of them in stock at all times. Certain specialized parts, such as the IC's, interstage transformers, and "quadrature coil" may be obtained by writing to SCA Services Co., Inc. P.O. Box 601, Port Washington, N.Y. 11050. An exact-size layout of the p.c. board is shown in Fig. 6. In this view, the *copper* side of the board is facing you. In Fig. 7, parts positioning is indicated, this time *looking from the insertion side of the board*. Decimal notations next to coil and transformer mounting holes indicate hole sizes to be used. All non-dimensioned holes may be drilled .040 to .050 in diameter. The four corner holes are for mounting the board to a suitable chassis or enclosure and should be drilled to clear the hardware you intend to use. A pre-drilled, etched circuit board for use in this project is also available from SCA Services, for those who don't feel up to laying out and etching their own p.c. boards. When inserting the i.f. interstage transformers, be careful not to insert them backwards. When properly inserted, the pink tuning slug on each transformer will face towards the *input* end of the p.c. board. Basing of the 703 IC's should also be observed carefully. If Fairchild μA703's are used, the *flat* surface of the IC will face towards the following interstage transformer. In the case of National Semi-Conductor devices, the keyway at the base of the device will face the following transformer. Note that pins 2 and 6 do not exist on this device, though it has the normal 8-pin numbering of a standard 8-pin housing for IC's. The ULN-2111A is a fourteen-pin, dual in-line IC, and care should be observed not to insert it backwards as well. Pin 1 is coded by means of a small circular depression on the top surface of the IC. In soldering the IC's in the circuit board, apply adequate heat for a short period of time, rather than lower heat for a lengthier period. A very small pencil-tip iron will prevent solder shorts between the closely spaced terminals of the 14-pin IC.

Constructing the Probe Coil

After much experimentation we found that 17 turns of #18 enamel-covered wire, wound on a 0.281 diameter nylon coil form, supplied with a powdered iron tuning core (J. W. Miller #4200-2) resonated perfectly with a 330-pF ceramic capacitor at 10.7 MHz. The turns are wound in a single layer over the full length of the coil form. The Q obtained with this arrangement was better than 110. Of course, if you have access to a simple paper-tube coil form of roughly the same dimensions, into which a powdered iron form about ⅜ in. long can be screwed, the results will be just the same. In order not to "load down" the resonant circuit by means of the relatively low input impedance of the i.f. circuit, impedance matching is accomplished by means of capacitor voltage division, as shown in the diagram of Fig. 8. The net capacitance of 1000 pF and 470 pF in series equals the required 330 pF for 10.7-MHz resonance, while the 1000-pF capacitor more closely matches the input impedance of the first i.f. stage. The addition of a short length of shielded cable across the 1000-pF capacitor, required to get from the probe to the i.f. board, does not affect overall capacitance sufficiently to prevent tuning the circuit to 10.7-MHz resonance. As an example, if three feet of cable is required (greater lengths should not be attempted), and the shielded wire or coaxial cable has a capacitance of, say 50 pF per foot, then the effective capacitance of the 1000 pF capacitor and its parallel cable capacitance will be 1150 pF. But this altered

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● "The distortion was under 1.6% with record levels as great as +10 dB (far off-scale on the meters). In an A-B comparison of input and output signals, the Astrocom-Marlux did a truly excellent job at 7.5 ips. Even with FM interstation hiss as a "program" (one of the most severe tests of a tape recorder) virtually no difference could be heard between input and output signals...." (STEREO REVIEW, AUGUST 1970)

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value of capacitance is still in *series* with the 470-pF capacitor, so that the net capacitance in the resonant circuit shifts only from about 320 pF up to slightly more than 340 pF. The tuning core can easily take care of these slight variations. The end of the probe shielded cable can be connected directly to the input of the i.f. board. The shield should be soldered directly to the copper ground of the board, as close to C-1 as possible. If you would like to have the probe removable, the end of the cable can be equipped with a phono-tip pin plug and an appropriate jack can be incorporated in the i.f. board housing.

Alignment of the Probe

While the use of a signal generator capable of being sweep modulated will ensure perfect alignment of both the probe coil and the i.f. section, nearly-perfect alignment of these elements can be accomplished using "off-the-air" (or, more properly, "off-the-radio") signals. The completed i.f. board is powered by means of positive 12 volts, d.c. Since the entire unit draws approximately 30 milliamperes of current, the power supply need not be very elaborate. A 12-volt battery, such as Burgess type TW-2 will provide between 200 and 300 hours of service, if used intermittently for, say, 4 hours at a time. Alternatively, the simple power supply shown in Fig. 9 can be built, using parts tabulated in the parts list. The dropping resistor may need to be adjusted slightly in value, depending upon transformer and rectifier efficiency, but in our case it turned out to be 220 ohms. This provided exactly twelve volts of d.c., under operating load conditions. Actually, the i.f. circuit will work at any voltage from about 10 to 14 volts, but gain will be somewhat reduced (as will audio recovery) when lower voltages are used.

If no generator is available, connect the output of the i.f. board (junction of R-5 and C-16) to the input of an audio amplifier. Connect the i.f. probe coil as previously described. Apply power to the i.f. board. You should hear a rushing, random noise. As you move the probe coil near the FM detector circuitry of your FM radio or tuner and start tuning in stations, some sound should be heard from your audio amplifier's speaker system. Move the probe until this sound is accompanied by the least amount of background, rushing noise. Chances are that the sound of program, though noise free, may still be garbled or distorted. Rotate the tuning slug of L-1 (the "quadrature" detector coil) until the sound becomes clearest and least distorted. Next, move the probe coil away from the optimum physical location until noise just begins to re-appear. Carefully rotate each slug of the two interstage transformers back and forth for reduced noise and clearest program. Rotation of these slugs will seldom be more than a half turn or so. Each time you clear up the sound and reduce the noise, move the probe a bit further away from your radio's detector area so that you once again hear noise coming through (this is the same procedure you would follow in using a signal generator—as you align the set you keep reducing the input signal strength). Finally, when you have retrimmed all four slugs and the L-1 slug for best and clearest sound, tune the core of the probe-coil. In doing so, do not hold the coil with your fingers as this would upset the Q of the circuit. Tape down the coil in a fixed position and insert the proper tuning tool to rotate the core or slug. You should reach a definite peak in clarity of sound (and reduction of noise). Tuning this slug to either side of this optimum point will result in a degradation of the signal which is quite apparent audibly.

Those of you fortunate enough to have a 10.7-MHz signal source capable of sweep modulation can align the i.f. system and the probe using essentially the same techniques outlined, observing the sinusoidal output and, if desired, the usual "S" curve associated with i.f. alignment. Figure 10 shows a recovered sine wave with just 20 microvolts applied directly to the input of the i.f. system (generator was connected to the same point to which the "probe" would normally connect). In Fig. 11 we see the recovered sine wave with 100 microvolts applied. With the probe properly positioned, you should be able to pick up

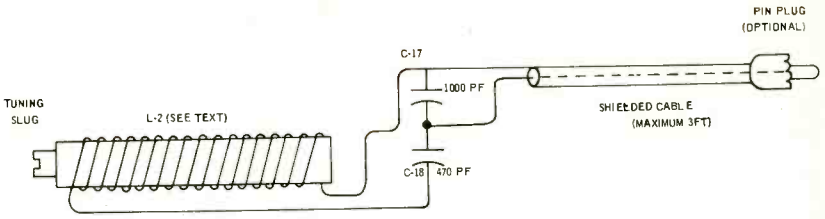

Fig. 8—Diagram showing probe construction.

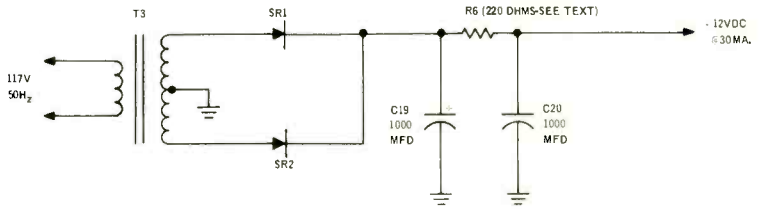

Fig. 9—Suggested power-supply circuit.

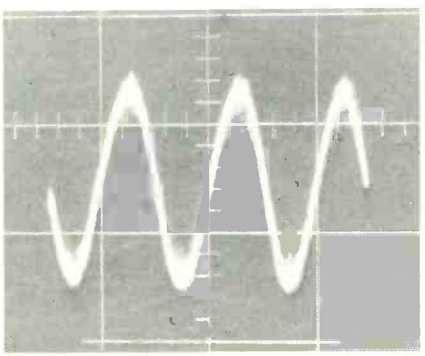

Fig. 10—Recovered audio signal with 20 μV of i.f. signal (10.7-MHz).

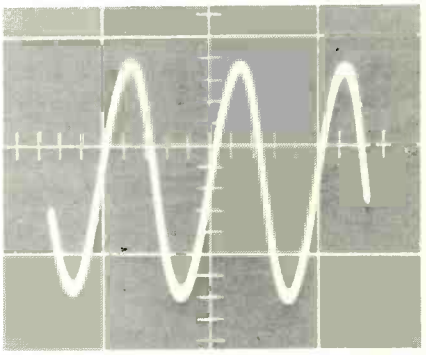

Fig. 11—Recovered signal with 100 μV of 10.7-MHz signal applied.

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Many years of stagnation in loudspeaker system design had to end. Most present day systems really do not sound any better than speakers produced years ago. With the great strides made in quality of signal source obtainable from today's better amplifiers, receivers, tape decks or cartridges, present day speaker systems leave much to be desired.

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FE-8

Excells in comparison with units priced to $650.00

8 speaker, 5-way system; 2 low bass 2 mid bass 8" woofers; 2 mid-high; 2 uh 4" tweeters; 1" particle board cabinet; frequency response 20-20,000 Hz; 100 watt input; 28¾" H x 20" W x 12" D.

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"radiated" signals at least this strong, and so the resulting audio will be as noise free or better. Finally, in Fig. 12 is depicted the overall "S"-curve response of this system, with 100 microvolts applied. It should be noted that the sweep width from end to end of this photo (horizontally) is at least ±300 kHz, and, as you can see, well over 200 kHz of that sweep is absolutely "straight line."

The i.f. strip was found to be extremely stable and not subject to regeneration even when operated out of any metal enclosure, right out on the open bench-top. As a result, some readers may want to use this strip by connecting it directly into a radio, in place of whatever inferior i.f. section might be present. In doing so, a good ground strap should be connected between the existing front end and the new i.f. strip and examination of the schematic of the particular front end used should be made, to ensure that a proper impedance match is possible between the two systems.

Just for fun, we mounted our system in a small speaker enclosure, complete with a small 1-watt audio amplifier and power supply and a small monitor speaker, as shown in Fig. 13. We did this, primarily, so that we could take the device around to various local dealers to determine whether it would "pick up" signals from all manner of FM radios on their display shelves. (It did!) Imagine their surprise, though, when we held the innocent looking "wand" or probe near the backs of their portable FM sets and asked them to tune the sets, with their volume controls turned all the way down. With no connection to any of the sets, they (and we) suddenly heard clear, noise-free FM which, even with this admittedly limited audio arrangement, sounded better than it did coming from the "signal donor" sets. Æ

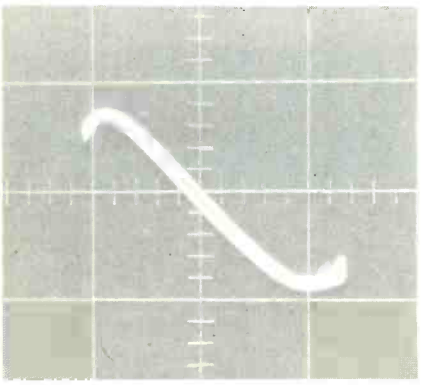

Fig. 12—Wide-band "S" curve of i.f. system shows extreme linearity.

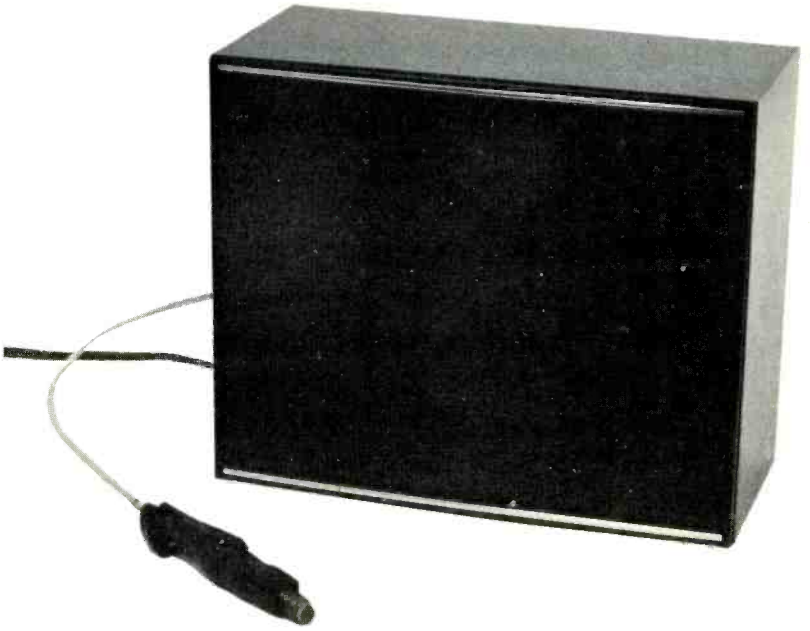

Fig. 13—Showing entire system mounted with amplifier, speaker and power supply.

PARTS LIST—I.F. Section

C1, C2, C3, C6, C14,C17	Capacitor, ceramic disc, .01 μF, 20%, 100 V.
C4, C7, C9, C10, C11, C16	Capacitor, Mylar, 0.1 μF, 20%, 50 V.
C5, C8	Capacitor, ceramic disc, 1.5 pF ±0.25 pF, 100 V.
C12	Capacitor, ceramic disc, 100 pF, NPO, 10%, 50 V.
C13	Capacitor, ceramic disc, 4.7 pF, 10%, 50 V.
C15	Capacitor, ceramic disc, 330 pF, 10%, 50 V. (See text.)
IC1, IC2*	Integrated circuit: Fairchild μA703E, or National Semiconductor LM-703L ($3.00 each)
IC3*	Integrated circuit: Sprague ULN-2111A ($5.00)
L1*	Coil, 1.3 to 3.0 μH, variable. J. W. Miller #9050 or equivalent. ($1.80)
R1	Resistor, 1000 ohms, 10%, ½ or ¼ watt
R2, R3	Resistor, 22 ohms, 10%, ½ or ¼ watt
R4	Resistor, 4700 ohms, 10%, ¼ watt.
R5	Resistor, 6800 ohms, 10%, ½ or ¼ watt.
T1, T2*	Transformer, 10-MHz i.f., J. W. Miller #8851A or equivalent. ($2.10 each)
*	Printed-Circuit Board, etched and drilled per artwork of Fig. 7. ($10.00)
Misc.	Solder, hookup wire, mounting hardware, etc.

PARTS LIST—I.F. PROBE**

L2	Coil, 0.5 to 0.9 μH, variable. (See text for winding specifications.)
C17	Capacitor, ceramic disc, 1000 pF, 10%, 50 V.
C18	Capacitor, ceramic disc, 470 pF, 10%, 50 V.
Misc.	Coil dope, 3-ft. shielded cable, pin plug, solder, etc.

PARTS LIST—OPTIONAL POWER SUPPLY

C19, C20	Capacitor, electrolytic, 1000 μF, 25 V.
R6	Resistor, 220 ohms, ½ watt, 10%
SR1, SR2	Rectifier, silicon, 500 mA, 50 PIV
Misc.	Chassis, line cord, hookup wire, solder, hardware, etc.
T3	Transformer, power: Stancor P-8180 or equivalent. (117-V pri.; 25.2-V sec., center tapped, 1.0 A).

*Kit of all these parts available from SCA Services Co., at $25.00.

**Entire "probe" assembly, pre-aligned, encased in fiber tube with connecting cable, available from SCA Services Co., Inc., Box 601, Port Washington, N.Y. 11050, at cost of $2.50.

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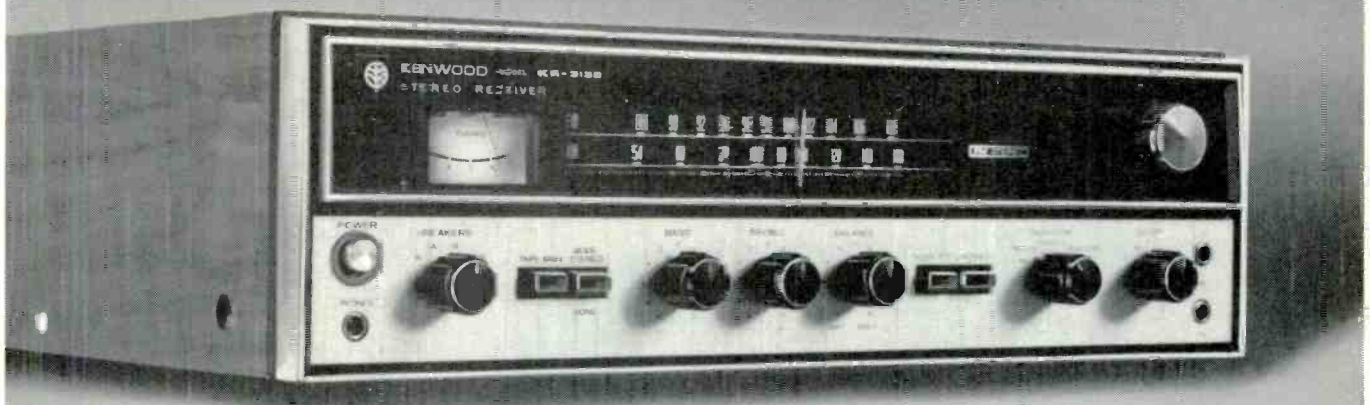

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Equipment Profiles

- Sony TA-3200 Amplifier 62
- Electro-Voice Landmark 100 Compact 68
- Empire 1000 ZE Cartridge 72

Sony Model TA-3200F Stereo Amplifier

Fig. 1

Manufacturer's Specifications:
IHF Power (Total): 320 watts, 8-ohm load; 500 watt, 4-ohm load. **RMS Power per Channel:** 110 watts, 8-ohm load; 130 watts, 4-ohm load. **THD:** Less than 0.1% at rated output; less than 0.05% at 1 watt. **IM Distortion:** Less than 0.1% at rated output; less than 0.03% at 1 watt. **Frequency Response:** 5 Hz to 200 kHz, +0, −2 dB. **IHF Power Bandwidth:** 5 Hz to 35 kHz. **S/N Ratio:** 110 dB below full power output, short circuited input. **Damping Factor:** 170 at 8 ohms, 1 kHz. **Input Sensitivity:** 1.4 volts. **Input impedance:** 75 k ohms. **Dimensions:** 15¾ in. w x 5⅞ in. h x 12¾ in. d. Suggested retail price: $349.50 (optional walnut case extra).

It's been just about two years since we reviewed Sony's preamplifier-control chassis, Model TA-2000 (AUDIO, Dec. '68). At that time we (and Sony) would have had to recommend a competitor's power amplifier as the only worthy companion to this magnificent preamplifier. With the introduction of the TA-3200F Stereo Amplifier the people at Sony need no longer be put in that embarrassing position, for this new "powerhouse" is ideally suited for use with that, or any other high-quality professional or semi-professional control chassis. While strictly speaking, the TA-3200F is a "basic" power amplifier, it does offer some of the flexibility of an integrated amplifier, as can be seen by examining the front panel layout shown in the photo of Fig. 1. At the lower left of this solid gold-anodized extruded front panel is a lever-type power on/off switch and an indicator light. A rotary speaker selector switch fellows, with positions for "main," "remote," "both," or no speaker systems. With no headphone jack supplied on the TA-3200F, one might wonder why there is an "off" position on the speaker switch. Sony chose to omit a headphone jack because the preamplifier mentioned earlier (TA-2000) is equipped with one and when it is used it is desirable to turn off all speaker systems. This makes sense in any case, since most users of basic power amplifiers often mount this component in out-of-the-way inaccessible places, whereas a preamplifier-control chassis, as the name implies, is always accessible and is the right place for a headphone jack in such component installations. Because of the tremendous power handling capacity of the TA-3200F, Sony wisely incorporated a power-limiter switch with settings for 100 watts, 50 watts, and 25 watts. This innovation is intended for speaker protection and limits the maximum power per channel to that indicated by the setting of this control. A knowledge of maximum power-handling capacity of associated speakers is necessary in order to take advantage of this feature, but more and more speaker manufacturers are now including this data in their literature since higher-powered solid-state amplifiers have appeared in recent years.

At the upper right of the control panel are individual level controls for left and right channels. Finally, at the lower right is a lever switch which selects one of two pairs of inputs. We have not seen this feature on any basic power amplifiers previously but the more we think about it, the more sense it makes. For one thing, some users may want to feed certain high-level signal sources directly into the power amplifier, bypassing any preamplifier-control chassis altogether. (A tuner having its own level controls and even tone controls would be a typical component which lends itself to such connection). At the same time, other high-level sources and low-level sources such as phono, microphone, tape head, etc. *must* be fed to a preamplifier before they can be applied to a basic power amplifier.

As Sony suggests in their well written customer's manual, the "two input" feature is also useful for comparing two signal sources or two preamplifiers.

At the left of the rear panel are the four inputs jacks associated with the two input stereo pairs. The "Normal/Test" switch located directly below the input jacks activates a low-frequency cut filter. In the "test" position, frequency response extends down to 5 Hz, as stated in the specifications. With the switch set to "Normal," frequencies below 30 Hz are attenuated at a rate of 6 dB per octave and this setting is

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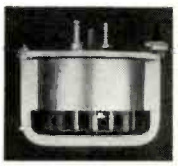
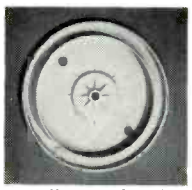
Touch the pushbuttons and the 50H plays stacks of up to 10 records, or single records automatically. Lift the arm, place the stylus in a groove and it's in manual play. Or use the silicone damped cueing system to place the stylus gently in any selected groove. The response of the dynamically

balanced arm is also quite gentle. The geometry of the arm and the frictionless bearing system in both vertical and lateral planes provide the high sensitivity and responsiveness required to get the most out of high compliance cartridges. The unique external stylus overhang adjustment and the anti-skate system contribute to reproducing the record faithfully.

Gentle record handling is just one of the attributes of the 50H. Flawless, faithful reproduction is another. The motion of the turntable is smooth and steady, free of rumble, wow and flutter. This is achieved



by the 12" dynamically balanced turntable, and heavy one-piece, non-ferrous machined casting individually balanced



to provide optimum flywheel effectiveness. The turntable is driven by a Papst hysteresis synchronous motor which maintains precise, uniform speed regardless of voltage fluctuation (of great importance in these days of brownouts and power shortages).

Nothing we can say short of experiencing it yourself can better describe the feather-touch ease with which the Miracord responds and preserves the best in your records. Find out for yourself. Miracord 50H, $175 less cartridge and base. Miracord feather-touch automatic turntables start at less than $100.

Miracord 50H

Benjamin Electronic Sound Corp., Farmingdale, N.Y. 11735/a division of Instrument Systems Corp.

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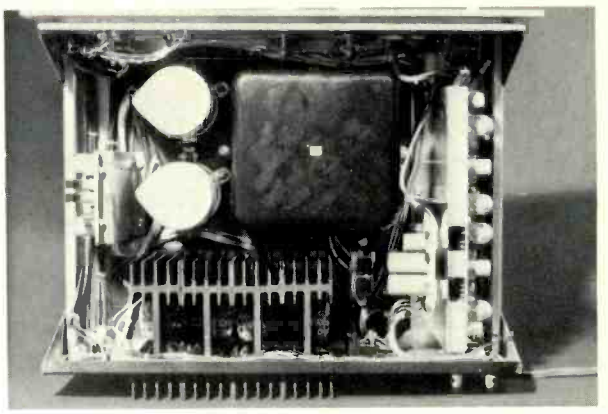
recommended by the manufacturer for the elimination of IM distortion that might be caused by sub-audible rumble frequencies, etc. Two convenience a.c. receptacles (one switched, one unswitched) are provided on the rear panel, as well as eight short-proof terminals for the two pairs of speaker systems with which the amplifier can be used. The terminals are widely spaced and are color coded (red for "hot" leads, blue for "common" of "ground" leads). Each terminal has a push button which, when depressed, exposes a hole just large enough to accept a speaker lead. When released, the speaker lead is locked in place by spring action. No twisting of wire under the head of a terminal screw is required, nor are any tools needed for making a safe and permanent speaker-wire connection.

We thought we had seen some pretty big power transformers (especially when one thinks back to high-powered tube-type amplifiers), but the one used in the Sony TA 3200-F probably beats them all, as can be seen in Fig. 3. Occupying fully ¼ of the cubic volume of the amplifier, it is flanked by a pair of 8000-microfarad filter capacitors, vertically mounted p.c. boards, and a massive quartet of heat sinks—one for each of the four output transistors. The amplifier, by the way, weighs just under 31 pounds *out of the shipping carton.*

Fig. 2—Top view. Note size of transformer.



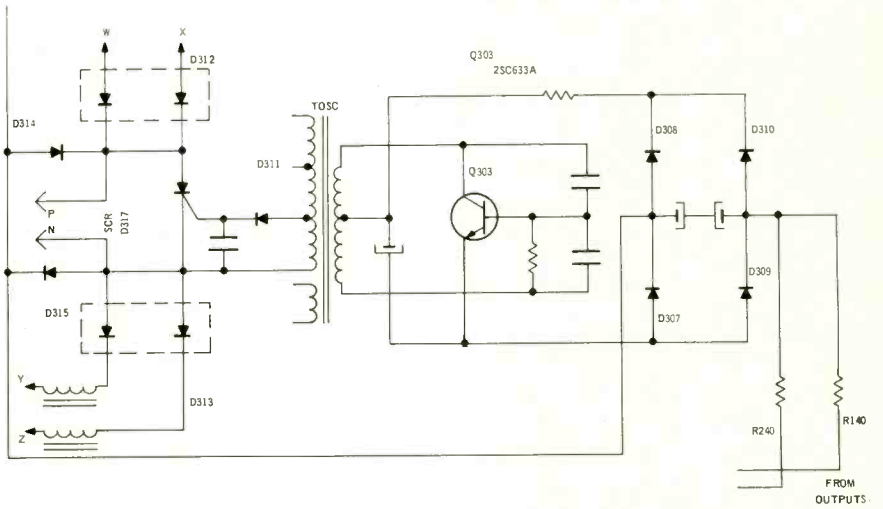


Fig. 3—Partial schematic of protection circuit. W, X, Y and Z go to the driver transistor basses. P and N are connected to a Power Limiter or clamping circuit.

Circuit Description

To avoid the use of large output coupling capacitors, the TA-3200F employs both positive and negative power supplies. This permits direct coupling between output transistors and loudspeaker. This approach improves ultra-low frequency response, provides somewhat higher power output and ensures full damping factor and better transient response at very low frequencies. The silicon transistors used in this circuit (both low-level and output stages) have a cut-off frequency sufficiently high to provide essentially flat frequency response up to 30 kHz even before negative feedback is applied. With a full 40 dB of feedback applied in the main feedback loop, response extends from 5 Hz to 200 kHz within 2 dB.

Protection circuits for both output power transistors and for the loudspeakers are incorporated in the TA-3200F. Since the latter form of protection is rather unusual in a power amplifier (most better amplifiers have some form of output-stage protection), we will describe it in some detail. Referring to Fig. 3, the output signal is extracted from the output terminal through a low-pass filter (R-140 or R-240, C-313 and C-314) and fed to a bridge rectifier (D-307 through D-310). Because of this filter, the only voltage applied to the bridge rectifier is the very low-frequency or d.c. component that might be caused by transistor faults. When the d.c. rectifier voltage becomes great enough, it turns on a Hartley oscillator circuit (Q-303 and T_{osc}). The oscillator output is rectified by D-311 and thus provides trigger voltage for SCR-D-317. When trigger voltage is applied to the gate of the SCR, the SCR turns on and shorts the base voltage of one driver transistor to ground through D-312, the SCR, and D-315. The base voltage of the other driver transistor is also shorted to ground through D-313, the SCR and D-314, stopping any current flow in the output stage and thus protecting the speaker system. The bases of driver stages of the opposite channel are similarly affected, as can be seen in the partial schematic of Fig. 3.

Performance Measurements

We have noted, of late, that test equipment limitations have prevented our being able to measure down to some of the claimed specifications of the more recent high-grade equipment which this department has reviewed. In view of this, we have just completed major revisions in our laboratory facilities and are now able to measure accurately down to 0.01% THD and down to 0.25% IM. This represents a capability improvement of the order of about three to one over our previous set-up. Despite the up-grading of our laboratory facilities, some of our measurements of the Sony TA-3200F were *still* limited by test equipment, as can be seen by examining the curves of Fig. 4. At the high-power end of the curve, we began to see meaningful distortion at a power output of 90 watts and reached the 0.1% rated distortion at 110 watts, exactly as claimed. In the case of IM, meaningful readings were obtained

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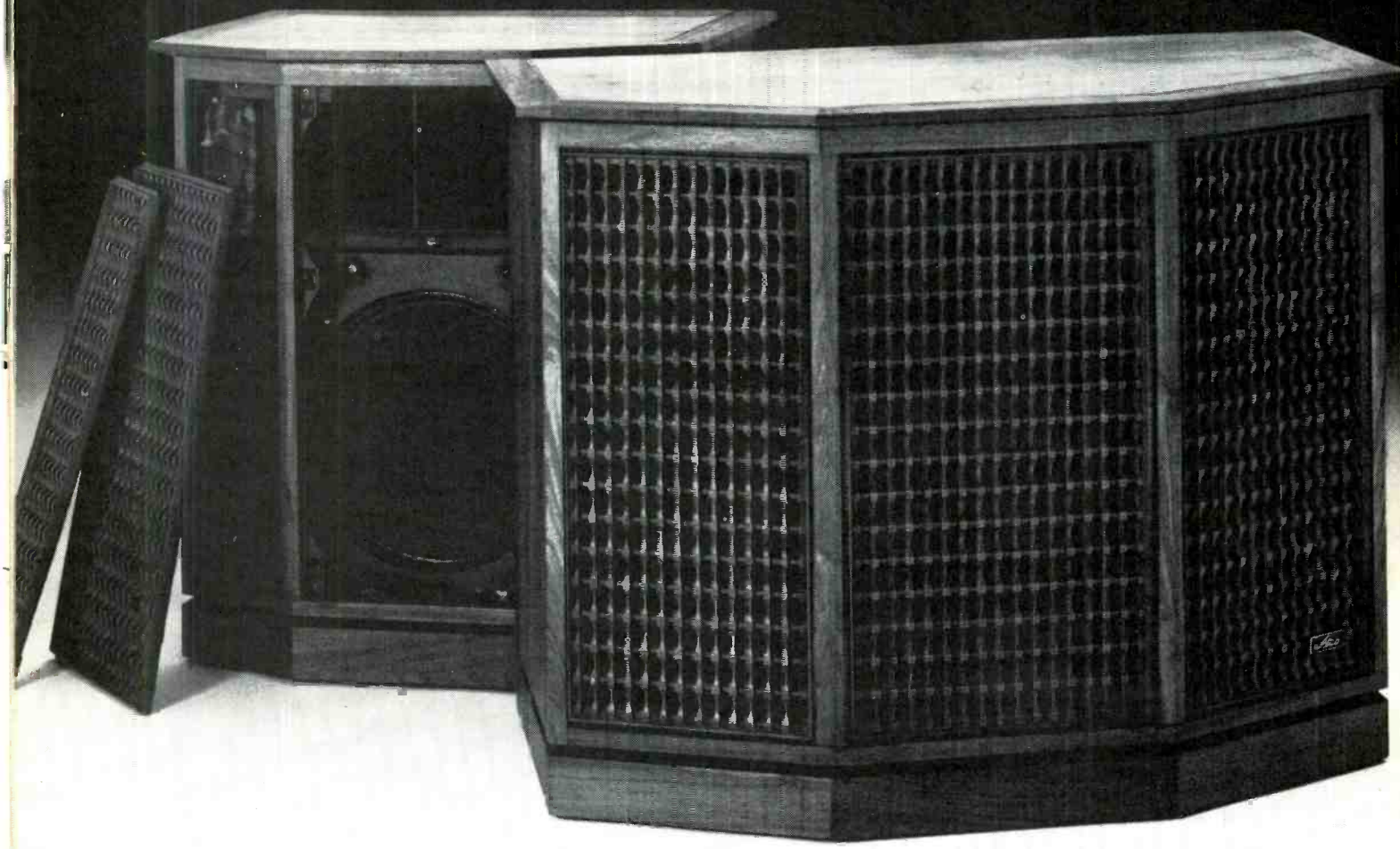

With a new 15-inch Dynamic Force woofer for better reproduction of low frequencies. Both Altec's new Barcelona and Granada speaker systems incorporate this all-new woofer. It features a long voice coil with edge wound, preflattened copper wire and a magnetic structure of extremely high flux field. Working together in our infinite baffle enclosure, this speaker is capable of producing a Dynamic Force against the compressed air in the cabinet of up to 16 psi. This greatly improves low frequency transient performance, extends low-end response and reduces distortion while maintaining medium efficiency.

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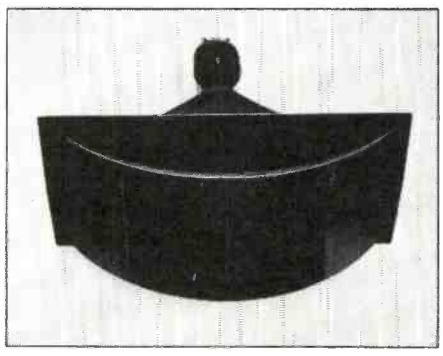

With a large sectoral horn for better controlled angular distribution of mids and highs. This exclusive horn enables the new Barcelona and Granada to keep the off-axis frequency responses of mids and highs almost identical to the on-axis responses—even in the critical mid range (above 500 Hz) where most low frequency speakers have a narrow angle of distribution. This large sectoral horn also helps extend the direct field which is where you hear the original acoustics of the recording rather than the acoustics of your listening room.

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at a power output of 80 watts, with the rated figure (0.1%) reached at about 105 watts. Both sets of curves were obtained with both channels driven. Figure 5 depicts the frequency response of the amplifier (both channels were virtually identical, and so only the left channel response is shown), and also shows the effective action of the "Normal-Test" rear panel switch described earlier. Power bandwidth, shown in Fig. 6, exceeded claims, extending from 4 Hz to 40 kHz. Bear in mind, however, that we are referring all these measurements to a rated distortion of only 0.1%. Were we to use a reference of 0.5% or even 1.0% (a more typical rating), all of the figures, including power bandwidth, would be even better. Since Sony's published specifications and descriptive literature made a point of the consistency of damping factor at all frequencies, we decided to measure this rarely plotted characteristics. As nearly as we could tell (and it took a great many 1-ohm resistors in parallel to reach the equivalent "internal resistance" of the amplifier), the "looking back" impedance of this remarkable amplifier is approximately 0.05 ohms. Divided into 8 ohms, this represents a damping factor of 160—close enough to the claimed 170, in view of the difficulty of measurement. As can be seen in Fig. 7, the value held constant at all frequencies from below 20 Hz to above 2 kHz. It should be pointed out, however, that in order to take full advantage of this extremely low internal impedance, heavy cable should be used for speaker connections at all distances beyond just a few feet. As an example, the resistance of 50 feet of even #16 gauge wire is about 0.02 ohms. A speaker placed fifty feet from the amplifier and connected by means of 100 linear feet of #16 gauge copper wire (fifty feet for each lead) would therefore encounter an additional 0.04 ohms of "looking back" resistance because of the hook-up wire alone, thereby reducing the effective damping factor to about 90! (And the resistance of the loudspeaker voice-coil plus crossover will reduce it still further!—*Ed.*)

Listening Tests

To listen to this basic amplifier with anything but equally good associated equipment would be totally unfair to this amplifier and so we borrowed a Sony TA-2000 Preamplifier and a Sony ST-5000F Stereo FM tuner. Retail value of the three units was $1128.50—but what value it was. "Total control" would best describe the combination—and "total purity of sound" would best describe what we heard. For one thing, matching levels were perfect—we operated the TA-3200F with its level controls wide open, and adjusted input levels and volume using only the preamplifier controls. We used both high- and low-efficiency speaker systems (a pair as "main" and a pair as "remote") and, other than still being able to identify the speaker's inherent characteristic sound, could detect neither distortion nor audible noise or hum from any of the electronics used. In FM listening, we were somewhat limited by station malpractices, which now became *completely* obvious. Only two stations in the metropolitan New York area seemed to contribute no noticeable noise or hum to this otherwise noise- and hum-free system. In fact, with the preamplifier level and volume controls down and our ear pinned to the high-efficiency loudspeaker in a relatively quiet ambience—we could hear *nothing*, which means that, for all practical purposes, the TA-3200F comes as close to the proverbial "piece of wire with gain" as anything we have seen to date. *L.F.*

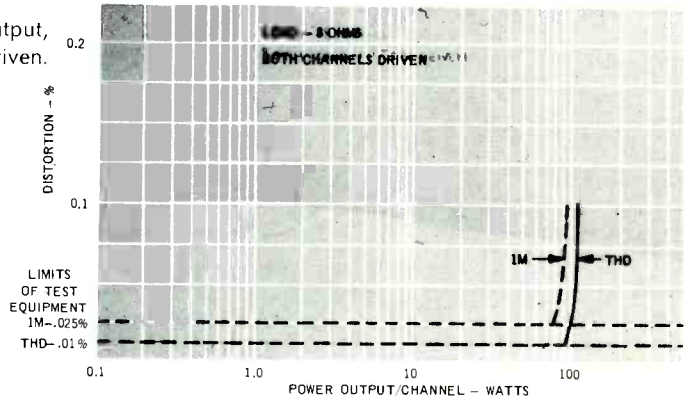

Fig. 4—Power Output, both channels driven.

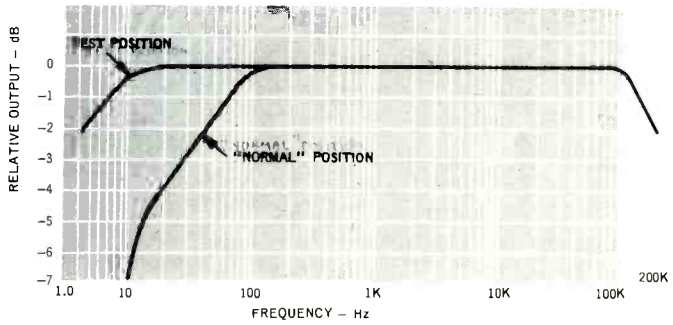

Fig. 5—Frequency Response.

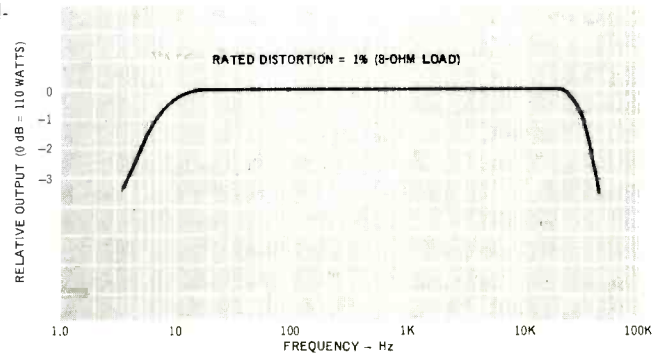

Fig. 6—Power Bandwidth.

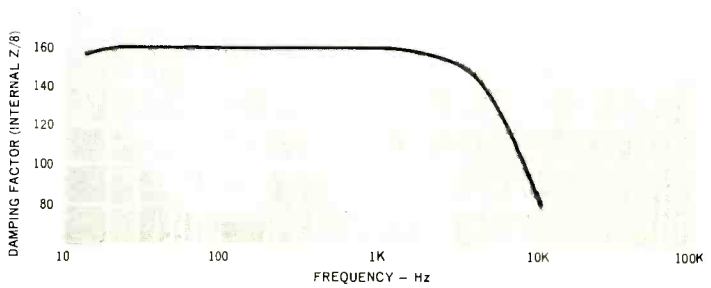

Fig. 7—Damping Factor.

To call it "an amplifier" would be like calling a Porsche "Basic transportation".

There is unusual satisfaction that comes from fulfilling a prosaic task in a far from prosaic manner.

Hence this amplifying system: the Sony TA-2000 professional preamplifier and the Sony TA-3200F power amplifier. Together, they perform all an amplifier's standard tasks in a satisfyingly impeccable manner; but their 67 levers, switches, meters, knobs and jacks allow you to perform some interesting functions that are anything but standard.

Dual-purpose meters.

The two VU meters on the preamplifier front panel, for example, are no more necessary than a tachometer on an automobile. But they do serve the dual purpose of simplifying record-level control when the TA-2000 is used as a dubbing center, and of allowing you to test your system's frequency response and channel separation (as well as those of your phono cartridge) and to adjust the azimuth of your tape heads.

A broadcast/recording monitor console in miniature.

The TA-2000 resembles professional sound consoles in more than its VU meters. In addition to the 20 jacks and seven input level controls provided on its rear panel for permanent connections to the rest of your hi-fi system, the TA-2000 boasts a professional patch board in miniature on its front.

Thus, you can feed the inputs from microphones, electric guitars, portable recorders or other signal sources into your system without moving the preamplifier or disturbing your normal system connections in the least. And a front-panel Line Out jack feeds signals for dubbing or other purposes into an external amp or tape recorder, with full control of tone and level from the front-panel controls and VU meters.

The tone correction and filtering facilities are also reminiscent of professional practice, allowing a total of 488 *precisely repeatable* response settings, including one in which all tone controls and filters are removed completely from the circuit.

The amplifier—no mere "black box"

A power amplifier can be considered simply as a "black box" with input and output connections, a power cord, and an on/off switch; and such an amplifier can perform as well (or poorly) as the next one. But in designing the TA-3200F Sony took pains to match the amplifier's facilities to the preamplifier's.

Thus to complement the TA-2000's two pairs of stereo outputs, the TA-3200F has two stereo pairs of inputs, selected by a switch on the front panel. Other front panel controls include independent input level controls for both channels, a speaker selector switch, and a power limiter (in case your present speaker should lack the power handling capacity of the next one you intend to buy).

Circuitry unusual, performance more so

The single-ended, push-pull output circuitry of the TA-3200F amplifier is supplied with both positive and negative voltages (not just positive and "ground") from dual balanced power supplies. This system allows the amplifier to be coupled directly to the speakers with no intervening coupling capacitors to cause phase shift or low-end roll-off. (A switch on the rear panel does let you limit the bass response below 30Hz if you should want to, otherwise, it extends all the way down to 10Hz.)

The individual stages within the amplifier are also directly coupled with a transformerless complementary-symmetry driver stage, and Darlington type capacitorless coupling between the voltage amplifier stages.

As a result, in part, of this unique approach, the TA-3200F produces 200 watts of continuous (RMS) power at 8 ohms, across the entire frequency range from 20 to 20,000 Hz; IHF Dynamic Power is rated at 320 watts into 8 ohms (and fully 500 watts into a 4-ohm load).

But more important by far is the quality of the sound; intermodulation and harmonic distortion levels are held to a mere 0.1% at full rated output, and 0.03% at the more likely listening level of one-half watt. The signal-to-noise ratio is an incredible 110dB. And the full damping factor of 170 is maintained down to the lowest, most critical frequencies (another advantage of the capacitorless output circuit).

The companion TA-2000 preamplifier also boasts vanishingly low distortion and a wide signal-to-noise ratio, but this is less unusual in a preamplifier of the TA-2000's quality (and price). What *is* unusual is the performance of the phono and tape head preamplifier circuits; for though they have sufficient sensitivity (0.06mV) for the lowest-output cartridges (even without accessory transformers), these preamplifier circuits are virtually immune to overload—even with input signals 80 times greater than normal.

Their sole vice: they are hardly inexpensive

Of course, at a price of $329.50 (suggested list) for the TA-2000 preamplifier, and $349.50 (suggested list) for the TA-3200F power amp, this system cannot be considered other than a luxury. But then, it was intended to be. For there are those to whom fulfillment of prosaic tasks is unfilling. And among them are not only many of our customers, but also many of our engineers. Sony Corporation of America, 47-47 Van Dam Street, Long Island City, New York 11101.

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Electro-Voice Landmark 100 Integrated Music System

MANUFACTURER'S SPECIFICATIONS:

AMPLIFIER: **Power Output:** 40 watts continuous sine wave, both channels driven. **Harmonic Distortion:** 0.15% at full output (1 kHz). **Power Bandwidth:** 20-25,000 Hz. **Frequency Response:** 20-25,000 Hz ±1.5 dB. **Hum and Noise:** −70 dB (ref 100 mV to aux and tape inputs; phono: −55 dB (ref 3 mV input).
TUNER: **Sensitivity:** 1.9 μV IHF; **Hum and Noise:** −65 dB; **Capture Ratio:** 2.5 dB; **Harmonic Distortion:** 0.5% at full output (1 kHz); **Separation:** 30 dB at 1 kHz.
GENERAL: **Changer:** Garrard 3000; **Speakers:** Two, 10×10×10 in. **Dimensions, Electronics/Changer:** 16⅛" wide, 16¼" deep, 8½" high. **Shipping Weight:** 63 lbs. **Price:** $399.95. Optional Dust Cover, $14.95.

I must admit that I do not take much more than a passing interest in compact systems these days but the EV Landmark had so many interesting features that I was impelled to take one home before I passed it to Mr. McProud for testing. I had heard one on a recent visit to the E-V plant, and I was most impressed. The speakers are housed in small (10-inch) enclosures shaped like a cube with one corner sliced off. Each contains three full-range 4½-inch speakers and a 2½-inch tweeter. One large speaker is mounted at the front and the others are placed at asymmetric angles at the back. Thus the cabinets—which are polished on all sides—can be placed in various positions to give different dispersion patterns—a very ingenious idea! System resonance is about 200 Hz and the amplifier response is 'tailored' to produce a level acoustic response down to 60 Hz. Normally, this would give rise to a high distortion with such small speakers but this is reduced considerably by the use of a servo-feedback circuit shown in Fig. 1. R1 supplies d.c. feedback from the output to the pre-driver stage in the normal manner but the current from the loudspeaker voice coils flows through the one-ohm resistor R2. The voltage developed across R2 reflects some of the irregularities and distortion inherent in the loudspeakers, and it is applied as negative feedback via R3 and C1 to the base of the amplifying transistor Q1. The net result is a lower distortion below 200 Hz where the loudspeakers are driven to a non-linear condition at high levels. As stated previously, the amplifier response is tailored to match the speaker system and this function is performed by R4, C2, and C3 (reducing response below 30 Hz) R5 and C4 (bass lift below 200 Hz) and R6 and C5 (treble lift above about 5 kHz).

So much for the theory—but how does it perform? The answer is—very well indeed. Not as good as a high priced component system but certainly better than many of the cheaper ones. Bass is full with very little coloration and even an organ sounds quite impressive. High frequency dispersion was dependent on the positions of the speakers but in no case was it too directional and the response itself is free from irritating peaks and harshness. All-in-all, a very creditable achievement and Electro-Voice are to be congratulated. (GWT) Over to Mr. McProud.

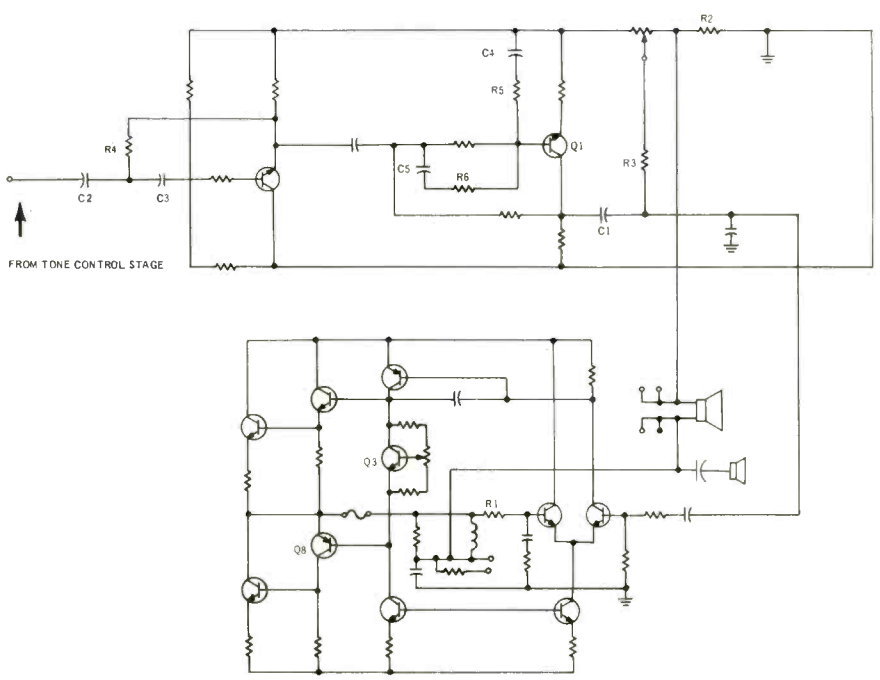

Fig. 1—Servo-feedback and compensation circuits.

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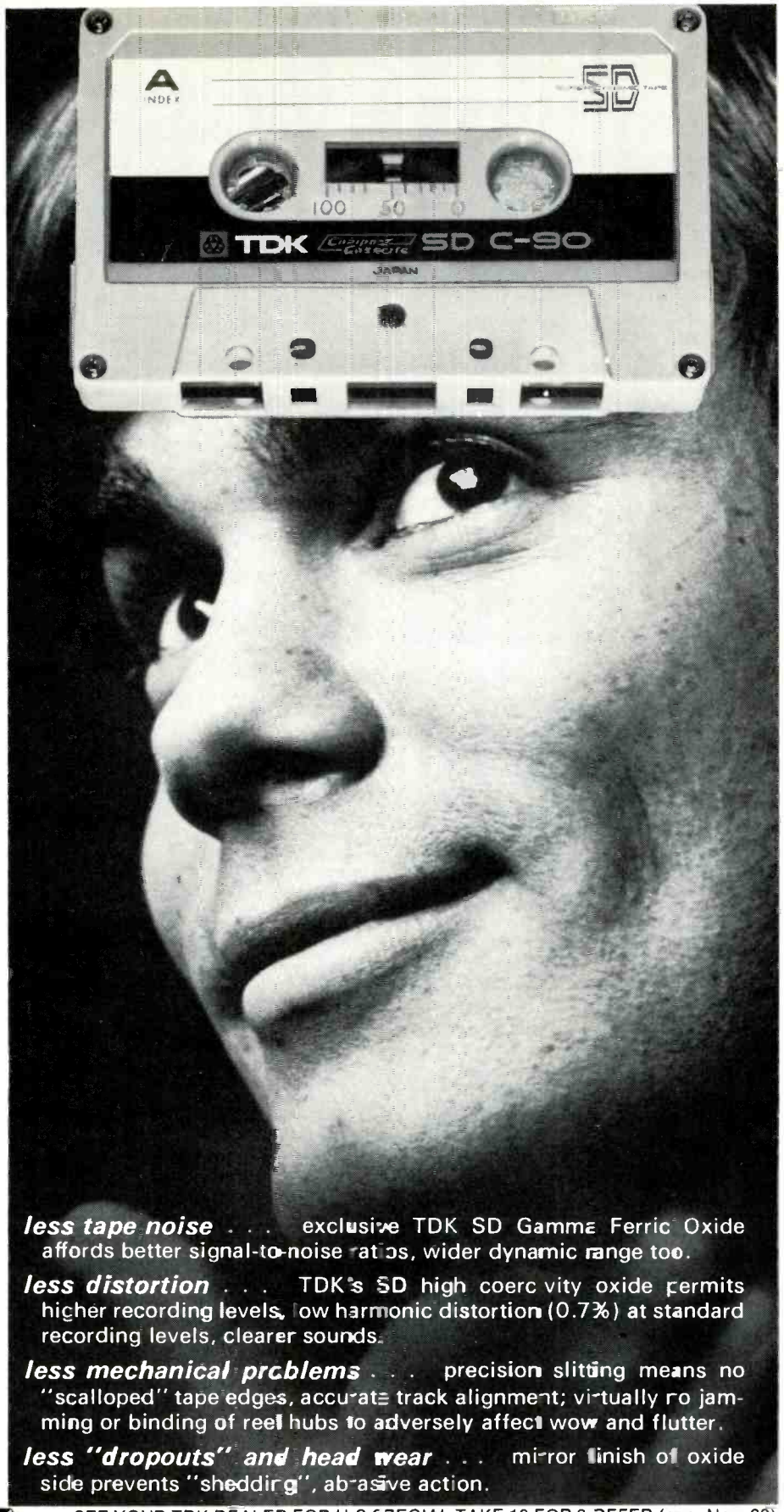

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The entire system consists of the electronics/changer package comprising the Garrard changer—equipped with a magnetic cartridge—in a neat cabinet, with the panel at the front mounting the dual controls for bass, treble, balance, and volume, and the input selector switch on the lower anodized aluminum portion. To their right are four push-push buttons for loudness, mono, tape monitor, and power. Still further to the right is the headphone jack. The upper half of the front accommodates the dial scale behind a very dark plastic window, the tuning meter, and the tuning knob. Aux and tape inputs plug into pairs of phono jacks on the back, with another pair for the tape output. The 15-foot speaker cables plug into 5-hole sockets on the back, and a pair of fuses in the speaker lines and the power-cord inlet are also on the rear panel.

The tuner section uses one FET and two bi-polar transistors in the front end, followed in turn by a μA703 IC i.f. amplifier, a ceramic filter, and a CA-3043 IC as a combination high-gain i.f. amplifier, limiter, FM detector, and audio preamp driver. The MPX circuitry is contained in one MC-1504 integrated circuit which controls the stereo indicator lamp and puts out the two stereo signals which pass through a pair of de-emphasis networks to the bases of the emitter-follower output stages of the tuner section.

The AM section employs three transistors and one IC, and the built-in rod antenna will usually suffice for urban locations. The FM input is designed to accept a balanced 300-ohm line or an unbalanced 75-ohm line.

The preamp/tone control section performs all the usual functions of amplifying, equalizing, and controlling, and feeds out to the motional-feedback board, and thence to the power amplifier/power supply section.

Power output was measured at just under 40 watts (R.M.S.) with both channels driven—more than adequate for most requirements.

It is not often that such excellent specifications are offered for a "compact" system, nor is it often that speakers of such small dimensions are capable of providing an overall acoustic response to below 50 Hz and above 18,000. And even if the FM characteristics are claimed to be what these are, it is not usual to find that the performance meets the specifications. One does not normally expect to find the tuner in a compact system to have a sensitivity of 1.85 μV IHF. But then, the Landmark 100 is not a usual piece of equipment. *C.G.McP.*

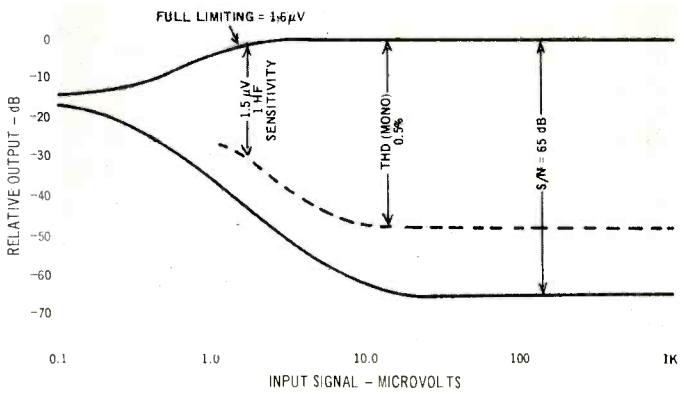

Fig. 2—FM characteristics.

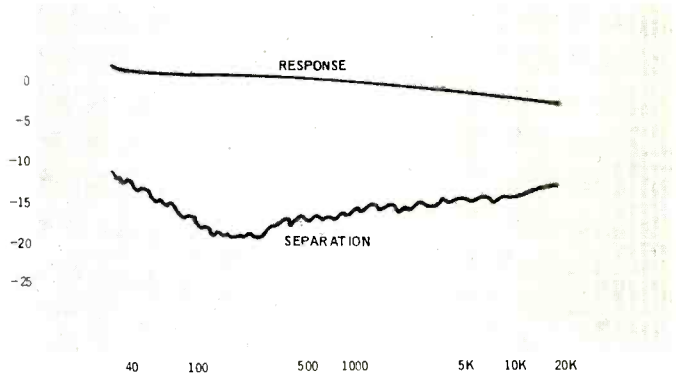

Fig. 3—Phono performance.

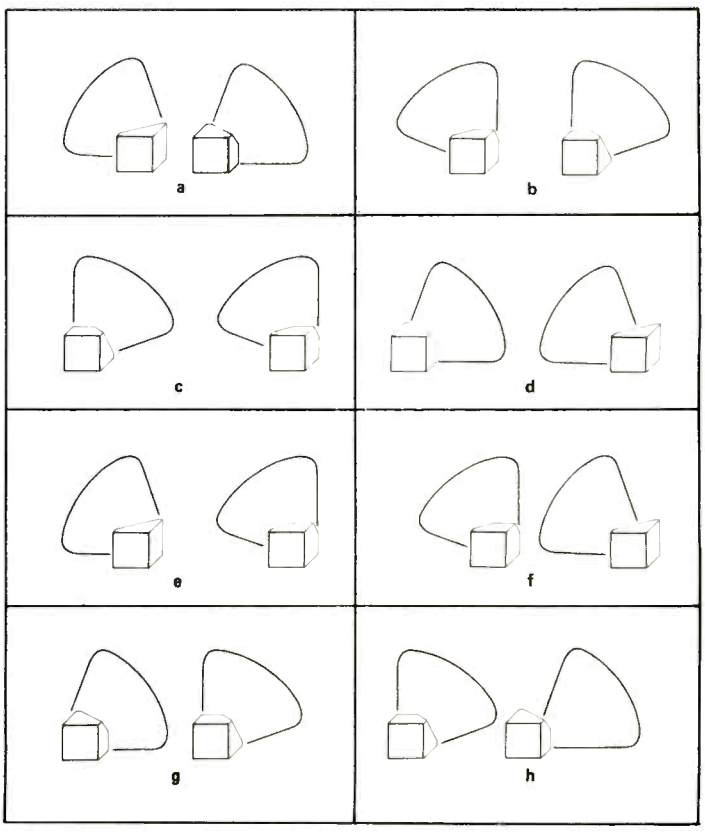

Fig. 4—Showing choice of stereo reflective patterns.

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Empire 1000 ZE Stereo Phonograph Cartridge

MANUFACTURER'S SPECIFICATIONS: **Frequency Response:** 4 to 40,000 Hz. **Output Voltage:** 5.0 mV; **Channel Separation:** 35 dB; **Tracking Force:** ¼ to 1¼ gms.; **Stylus Tip Size:** 0.2 x 0.7 mils; **Weight:** 7 gms; **Price:** $99.95.

Phonograph cartridges are getting more and more expensive—and at the same time, better. The 1000 ZE is the top-of-the-line model of the Empire line, which ranges in price down to $24.95 for the lowest priced conical-stylus unit. There are many good cartridges on the market, and most of them will give satisfactory performance on average equipment. It is when every other element in the reproduction chain is of the highest quality that performance differences between cartridges become apparent. The 1000 ZE has a user-replaceable stylus, protected by a hinged cover so you don't have to worry about damaging the stylus when you take it down to the dealer's to check the stylus tip—and for this transporting, we recommend a 35-mm film can, with possibly a few layers of paper rolled inside to fill up the voids.

The cartridge consists of four coils, disposed 90 deg. apart and wired so as to be hum-bucking to any external fields. The two pairs of coils are each wired in series to give this effect. The cores of the four coils are brought out to four equally spaced pole pieces, and two magnets are placed so as to induce fields which are varied by movement of the stylus "bar." (The term "bar" is used since it is the usual term used to describe the structure on which the stylus is mounted, but when the bar is a hollow tube one thousandth of an inch thick, the word is hardly appropriate.)

The armature, integral with the stylus bar, moves within the fields of the four pole pieces. It is the third of the three magnets in the cartridge. Technically, each pair of coils has a d.c. resistance of 1170 ohms and an inductance of 700 mH, and each channel—consisting of two coils—is designed to work into the usual load of 47,000 ohms found in most preamps, integrated amplifiers, and receivers. Output signal from each channel measured at 1.18 mV/cm/sec. (which means 1.18 millivolts for a stylus velocity of 1 centimeter per second). The figure of 5.0 mV in the specifications is not shown relative to any particular stylus velocity, but is presumed to be at the standard velocity of 3.54 cm/sec for stereo grooves, or 5.0 cm/sec for mono. We actually measured an output of 4.2 mV for a stylus velocity of 3.54 cm/sec, and for comparison purposes we converted it to the output in mV/cm/sec.

The entire cartridge structure is molded in plastic, then covered with a mu-metal shield to further eliminate the effect of external hum fields, of which there are likely to be many around phonograph motors and in proximity to power transformers in receivers and amplifiers.

Frequency response measurements were made on the cartridge with a continuous curve-plotting instrument, and results are shown in Fig. 1. The CBS STR-100 record was used, covering the range from 40 to 20,000 Hz. The range from 500 to 50,000 was obtained in a sweep from the CBS Wide Range Pickup Test Record, and outputs below 40 Hz were obtained from the frequency-step section of the invaluable STR-100. Crosstalk measurements were also made with the same record over the range from 40 to 20,000 Hz. Square-wave photos, made from CBS STR-100, are shown in Fig. 1. For these photos, the pickup was fed into a Dynaco SCA-80.

Response was found to be within ±0.5 dB from 20 to 6000 Hz, drooping to −1 dB at 15,000, then rising to a *big* peak of 1.5 dB at 21,000 Hz, then dropping off to 10 dB down at 30,000 Hz. Measured crosstalk ranged from 15 dB at 20 Hz to 26 dB at 100 Hz and remaining in that vicinity past 10,000 Hz, when it began to decrease, reaching a separation of 20 dB at 20,000 Hz. Both channels were as nearly identical as possible—at least well within 0.5 dB.

Using the CBS STR-110 record to check IM distortion, we came up with 1.8 per cent for the +9 dB level of lateral IM signal consisting of 200 and 4000 Hz, and a figure of 6.6 per cent for vertical 200/4000 at +6—the two conditions we have selected to use as standards. Since there are five bands of 200/4000 lateral, five bands of 400/4000 lateral, and three bands of vertical IM signals—all at different levels, we do not feel that space would permit listing all.

While the measurements would satisfy any group of test equipment, the real test is in listening, and here we were agreeably surprised—the listening proved that instruments don't lie. While we can't claim that we played every record in our fair-sized collection, we do claim that we played about thirty of the ones we usually break out for cartridge tests. Reproduction was exceptionally clean, with good separation and the kind of clarity one always hopes for. Smooth clean strings, crisp brasses, and solid lows were all evident throughout the listening. Separation was most evident in choral material and in our favorite opera recording—the Angel "Bartered Bride." Tracking was consistent on the 598 as low as ¾ gram, although it took the more common 1-gram stylus force on another turntable for reliable operation.

Like they say—you are apt to get what you pay for—and if your budget will stand for the cost of a 1000 ZE, we suggest you try it. And again, ungrammatically, like they say in discount-store ads, "You'll be glad you did." *C.G.McP.*

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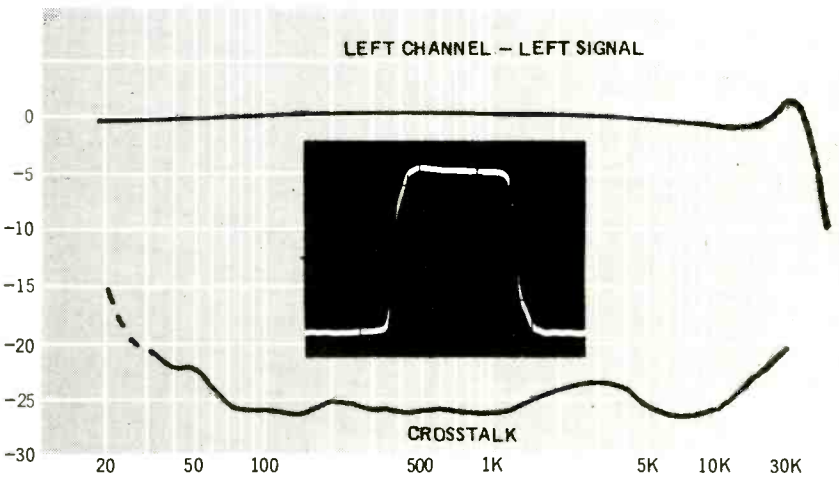

Fig. 1—Showing frequency response, separation, and square wave.

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Classical Record Reviews

EDWARD TATNALL CANBY

Julian Carillo: Mass for Pope John XXIII (1962). Chorale des Professeurs de Musique de la Ville de Paris, Blot. **CRI SD 246 stereo ($5.95).**

Did *this* record ring bells when it came in. Back in the early thirties I owned a 78-rpm disc by this very man, a Mexican experimentalist who had invented *quarter tones*. Divvy up the ordinary scale into lots and lots of notes, very close together. He wrote music, to show off the system. The bits of his "Prelude to Christopher Columbus" I remember all too well. It was in D Minor, and various instruments sort of went up a fire-siren scale, then came back down again. Period. The quarter tones tended to blend together; the "harmony" just stayed still. Absolutely *nothing* happened, except the fire sirens up and down in D minor—so I remember it.

Here, many years later, is the celebrated Carillo, in his eighties, writing an impassioned and super-Romantic Mass for the good Pope. In quarter tones. It is *sung* in quarter tones, for two whole LP sides, by the assiduous Professors of the City of Paris, who obviously would sing twenty-seventh tones if you asked them to.

The work, to be sure, is a lot more sophisticated than the bits of "Columbus" thirty-plus years ago. It is very much in the late-Romantic Church tradition of the Mass, maybe out of Bruckner & Co., which is in its favor. But the elements that are interesting in this long piece are, to my ear, precisely those which are *not* microtonal: a fair amount of simple counterpoint and some good word setting, all in a timelessly old-fashioned style of Romantic expression.

The microtones? You play this and your turntable seems to develop problems. The voices keep slithering downwards, as though the a.c. were lagging. Or slithering up, as though the power were being restored.

Yep, the same old tricks. Fire-siren scales or rather, slides, slowly down (quarter-step by quarter-step) or up. Groups of notes repeated, a quarter-tone lower each time, just to show you how it works. Chords that slowly turn inside out, fire-sirening up and down at the same time. All *extremely* sea-sick! A fine demo of the sound of quarter-tones. But what else?

Musically very little else. Yet behind all the groans and slitherings and sea-sick gasps there is, of course, sincerity and feeling—the old man really did feel strongly about Pope John, and wanted to say so in his music. Which, alas, does not make it any better.

For my ear, of course. If you want to disagree, by all means try for yourself. All you have to do is sit down and listen to the whole Mass, two complete LP sides of groans and gargantuan sighs and sliding fire-siren pitches.

Performance: A+ *Sound:* B

Marie-Aimee Varro. (Liszt, Dvorak, Schumann, Smetana). Orion ORS 6912 stereo ($5.98).

Here's that fabulous lady pianist again (and I can't find her earlier disc, no longer listed as available). Mystery. She looks young in her photo but she studied with Sauer, who would be 108 now if he hadn't died in 1942, and with Alfred Cortot, whose centenary is coming up soon. She is a direct inheritor of the Liszt piano tradition though she didn't quite make it to study with the old man himself.

Whatever her age, I'm here to say she is a fabulous pianist and musician of the old sort, who tosses off the music of the sparkling nineteenth-century pianistic geniuses with aplomb and, what's more important, good sense and utter naturalness. Listen to this gal—and then try some of our silly whiz kids, the kids with the fast fingers! No comparison.

Miss Varro, if I guess rightly, has based herself in Canada and makes her recordings at home, on some elderly species of piano with precisely the right tone for the music, and no great hassle that a few of the notes are out of tune on it. She was on another label, before; evidently the tapes are sold around.

On this record you get the six Liszt Transcendental Etudes based on Paganini, plus super-brilliant pieces by the three other composers—a Dvorak grand Waltz, a stunner by Smetana "On the Seashore" which I'd swear was by Liszt himself, and an early Schummann, the Toccata, Op. 7.

Performance: A *Sound:* B+

Choir of St. John's College, Cambridge, (Music by Bairstow, Britten, Howells, Ireland, Orr, Tippett, Vaughan Williams, Walton) dir. George Guest. **Argo ZRG 5340 stereo** ($5.95).

You'll listen to this with one of two thoughts resulting. (a) How dreadfully stuffy and conservative is this semi-"modern" British church music, from big and middling names; (b) how secure is the British church tradition, whereby today's composers can write, straight out of the last three centuries, music that fits ineffably into traditional services as though time had scarcely moved on.

This last, of course, is the whole idea. Tradition, permanence, change only in an unobtrusive way. All of this music was written not for you and me but for the English church itself—for practical use in the Anglican service. One can object, but not complain, if you see what I mean.

Actually, the range of expression is decidedly varied, within the strict "parameters" of the situation. A good deal is out of the more bombastic late nineteenth century but there is plenty of a more sophisticated earlier lineage, back to Purcell and Byrd; and some genuine modern of sorts. Quite some hi fi effects, too.

Performance: A− *Sounds:* B+

Purcell: Music for the Chapel Royal. Soloists, Choir of St. John's College, Cambridge, Academy of St. Martin-in-the-Fields, Guest. **Argo ZRG 5444 stereo** ($5.95).

Purcell: Ayres. Deller Consort. **RCA Victrola VICS 1506 stereo** ($2.49).

Astonishing how much music Purcell wrote, back in seventeenth century England, now that it is being put back into production for actual listening. Few of us will have heard any of the fourteen

(Continued on page 77)

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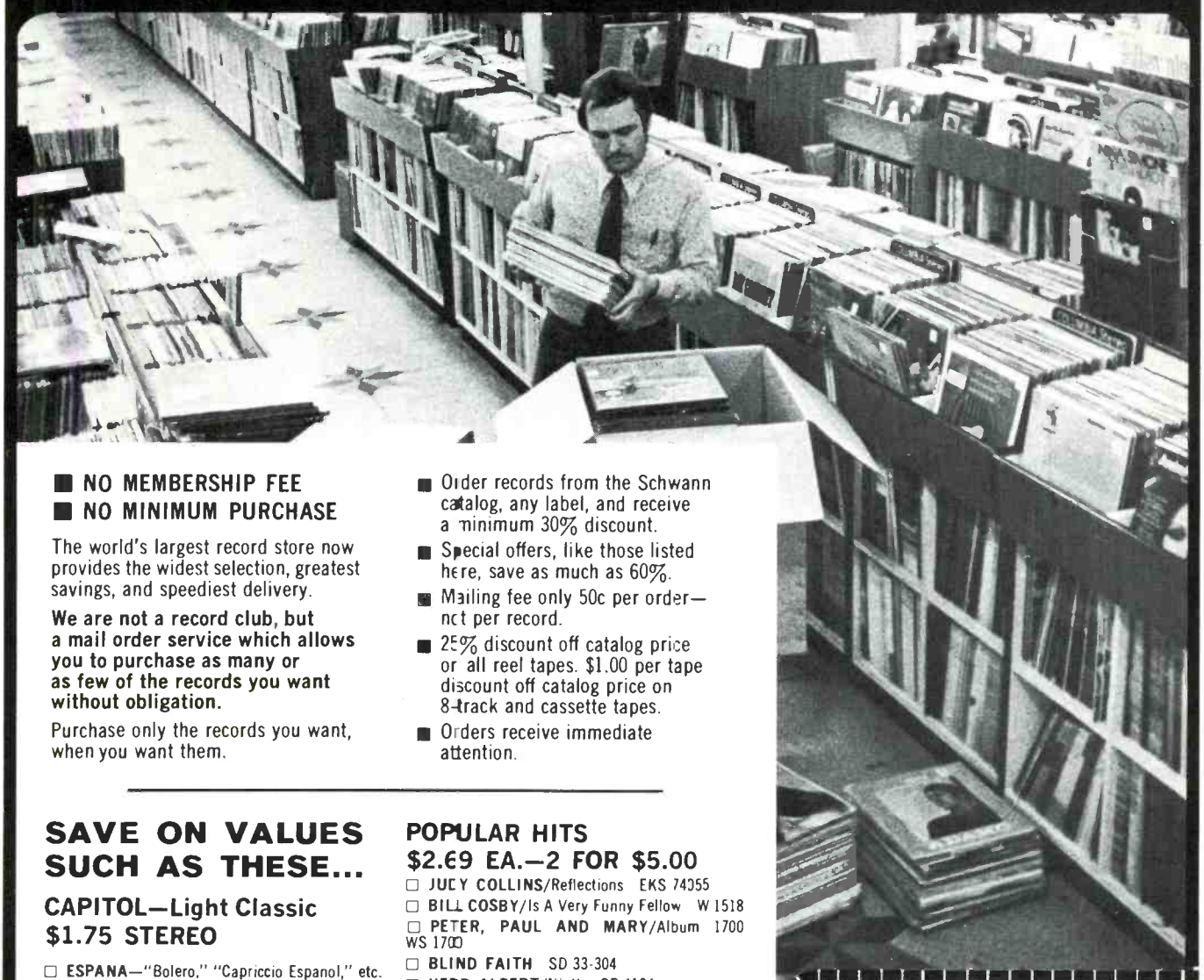

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Canby's Capsules...

TITLE	CONTENT	SOUND
CLASSIC ORGAN		
Bach Newman. (Anthony Newman plays J. S. Bach.) **Columbia MS 7421 stereo** ($5.98).	The harpsichorgan whiz-kid is back, hi-powered as ever. Fabulous technician. Plays almost everything twice as fast as ordinary organists. Bach loses pounds! Exciting, yet not warm nor relaxed; I miss a bit of contemplation now & then. Even so he is a good influence; there's too much stuffy Bach still around. Older pros are going to groan and probably should.	A new Noack organ (1969), in Worcester, Mass., nice, clean instrument if in rather dead acoustics, well enough recorded by Columbia.
Fenner Douglass at St. Mark's (Seattle). **St. Mark's Cathedral ASR 1140 stereo** (No addr. given).	This "private" (church) label offers fine music, top recording. Douglass is good—a splendid sense of style, in Bach, Cesar Franck, and French Baroque (Du Mage), imaginative, lively, well-phrased, with the contemplation so lacking in Newman. Sharp, contrasted colors, perfect for each type music. How to buy? Dunno. My letter was returned. The mailman doesn't go to church.	Superior sound in a fine big ambience, spacious but never blurred. (Eng. Glenn D. White.) The three contrasting styles are well differentiated—imagine Franck on a "Baroque" organ! This Flentrop does it.
Works of Georg Bohm and Johann Pachelbel. Lawrence Moe. **Cambridge CRS 2514 stereo** ($5.98).	Fancy new Fisk organ (1967) in the stuffy Harvard Chapel, but Moe's thoughtful, musical playing of these old composers makes up for it. Just right and a fine disk, if not spectacular.	Cambridge's carefully limited LP output is always a "labor of love"—you can hear it this solid quality sound.
The King of Instruments. Ronald Arnatt. (Brahms, Bach, Arnatt, Sowerby). **Aeolian-Skinner AS 323 stereo** ($5.98).	Ah—big sound! What an ambience. A cathedral (St. Louis) and it is all lovely space, via a 1965 Æ/S organ. Arnatt plays traditionally church, but he is good. The Bach, a bit heavy, is well registered and moves impressively. The Arnatt & Sowerby is organists' stuff, the pro at work for the other pros. I miss the lively, raw colors of more specifically oriented organs.	This is a great big organ of the now-familiar Æ/S sort, built to take care of Everything and (for my ear) falling somewhere in between, without much character. (Tops for its realistic purpose, though—which was *not* to make recordings.) The sound here is a bit distant (cf. above recordings) but clear enough for musical sense in detail. I'd call it chaste.
Organ Works of Pachelbel. E. Wm. Brackett. Optic OR 370 stereo. **(Optic Recordings, 101 Dover Rd., Glen Burnie, Md. 21061)**	More Pachelbel—here on an "ordinary" or traditional church organ, all-electric. Mr. Brackett knows how to get good music out of it even so. He has a fine ear for this German middle-Baroque. I found it quite lively, and tastefully done. Not all the good organists are famous! An especially good selection, too.	This is a relatively small organ (Casavant, 1966) in a smallish Maryland church with somewhat hard, short-reverb acoustics. But the recording has an excellent sound, somewhat intimate but expansive enough in the loud *forte* passages. Louis Mills is the engineer in charge.
Simon Preston (Reubke; Reger). Recorded in Westminster Abbey. **Argo ZRG 5420 stereo** ($5.95).	Well, well—an old-fashioned roarer! Straight out of Westminster Abbey, with a batch of roar/whisper music to match. This British whiz-kid (32) has turned out umpteen records, a mod mirror of the 100% British tradition, and not a Baroque "screaming whistle" to be heard. It's all—even Bach—done in a style of maybe 1905, but louder and tougher. He's brilliant, yet so far (youthful energy aside), totally unoriginal. But, then, British organists are a race apart. Like plenty of ours. A grand big sound, of course, from the 1905-style (1937!) Harrison & Harrison organ. Wonder when they'll tear it out and install a classic number? Never, I'd guess. We must preserve the Abbey's 1905 character, after all . . . at least for awhile.	

(Continued from page 74)

short "ayres" for small ensemble and the six larger works on these two complementary discs.

Until the revived principles of Baroque performance were generally accepted, most of this music was virtually impossible to perform with any sense. The old way of "modernizing" made hash of it —huge, mushy orchestral arrangements, draggingly slow speeds, stumbling, limping rhythms. All wrong. Now, we hear the music as a matter of course in the proper way, with original instrumentation, a brisk and natural range of speeds, and the correct altered rhythms that take the "limp" out and add the right ornamentation. Makes all the difference!

Alas, one element is still mostly unreformed—the solo voices. They offer the biggest impediment to sense in both these excellent records, in spite of the fine musicianship displayed. Just not the right kind of voices. Big, fat, wobbly, operatic-type instruments, trained for heavier, slower music and for enormous power; whereas the Purcell musical lines obviously require a wholly different vocal technique—light, flexible, accurate, able to sing fast "runs" and quirky rhythms with the accuracy of the accompanying instruments. The solo voices in both these records sound like bulls in china shops under the strain of singing the elaborate vocal lines—vast garglings, groanings, choking noises, the actual sense of the music often merely approximated.

'Course all this is perfectly normal for today's English Baroque performances, vocally speaking, and I only make the point that we've a long way to go before the solo voices match the present instrumental forces in sheer intelligibility.

On the St. John's recording of larger works with solos, chorus, and orchestra (for the Royal Chapel), the Choir with its boys' voices makes a fine sound and at least two of the solos are really right —a boy soprano and a high countertenor. The others boom and gargle. Alfred Deller is the Original countertenor (as to international rep) but his singing is now so mannered that one hears more Deller than Purcell, even though Purcell, too, was a countertenor and no doubt sang the very same music himself. Deller's associates, as usual, are of the big, wobbly-voiced kind, though very musical. The "ayres" are solo pieces with continuo and, quite frequently, pairs of recorders, a lovely accompanying sound. If you are at all conversant with Baroque you will be able to hear "past" the wobbles etc. into the gorgeous sense of the music.

Performances: B+; B *Sound:* B; B

RICHARD FREED

MARILYN HORNE is the unifying factor in three recent London releases, two of which may be said to constitute a compound reissue: the Sutherland *Norma*, originally released by RCA five years ago (now London three-disc set OSA-1394, $17.94), and a disc of Sutherland-Horne duets from the Bellini opera and Rossini's *Semiramide*, both sides of which (OS-26168, $5.98) are drawn from the respective complete recordings. The really new item is Gluck's *Orfeo ed Euridice*, essentially a preservation of last year's exciting Covent Garden production conducted by Georg Solti (OSA-1285, two discs, $11.96). All of these are more than attractive—downright fascinating, in fact—but, while enormously satisfying in their own right, neither the Gluck nor, more certainly, the Bellini strikes me as a clear-cut first choice among recordings available now, and the Rossini duets serve best as a reminder of the not inconsiderable pleasures afforded in the three-disc set from which they were extracted (OSA-1383, $17.94) or on the full disc of excerpts from that set (OS-26086, $5.98).

The new *Orfeo* from London brings to a total of seven the number of recordings of this marvelous work listed in the current *Schwann Catalog*, but, to a greater or lesser degree in each case, these represent a half-dozen *different operas*—even if we disregard the faded old Urania set conducted by Arthur Rother, with Margaret Klose, Erna Berger, and Rita Streich. On Philips World Series we have a phony stereo reissue of Hans Rosbaud's splendid account of the French version, substantially abridged and with a tenor as Orphee (Leopold Simoneau). On Deutsche Grammophon Karl Richter conducts a revision of the original Vienna version, in Italian but with a baritone Orfeo (Dietrich Fischer-Dieskau). All the others are sung in Italian, and with altos as Orfeo, yet still substantially different from each other in content.

Vaclav Neumann conducts the original Vienna version, with no additions, on Angel, with Grace Bumbry as Orfeo. Renato Fasano, on RCA, gives us the Berlioz-Saint Saens Paris version complete, with Shirley Verrett as Orfeo; this is the only current recording to include *all* the ballet music, which is quite extensive. For his Vanguard recording, with Maureen Forrester as Orfeo, Charles Mackerras chose the original Vienna version plus the two best-known dance numbers and a single aria from the Paris version; what makes the Vanguard set unique is that Mackerras, an old baroque hand, has prepared his own edition of the score, in which vocal and instrumental ornamentation is actually written out and is quite elaborate.

What Solti conducts on London might be described, for the sake of expediency, as the same material Mackerras uses, but with far less ambitious efforts in the way of ornamentation; more accurately, it is the same as Fasanos's, but without all that ballet music (a little more than Mackerras includes). In any event, what makes *this* set unique, textually, is the inclusion of the aria "Addio, o miei sospiri," sung by Marilyn Horne at the end of Act I. This aria was not even composed by Gluck, but comes from *Tancredi*, an opera by Ferdinando Bertoni, a forgotten contemporary who also composed an Orfeo, using the same Calzabigi libretto immortalized by Gluck.

Well, now, once all these differences are itemized, do they really make that much difference? Surely it does make a difference to hear a tenor or baritone as Orfeo instead of an alto, or to hear the work sung in French instead of Italian. I would rule out the Rosbaud and Richter sets, together with the old Rother, and I must say that Neumann's, too, despite Grace Bumbry's superb singing, is definitely on the dull side, in terms of both performance and sound. The real contenders, I think, are Mackerras (Vanguard Bach Guild BGS-70686/87, two discs, $11.96), Fasano (RCA LSC-6169, three discs, $17.98) and the new Solti—and these three happen to contain some of the most conspicuous textual differences with each other.

The easiest judgment to make is that the orchestral contribution under Solti is far and away the best to be heard in any of these sets. Solti's interpretation is fiery but beautifully controlled, giving wonderful life to the Overture and abundant drama to the Dance of the Furies without ever being hard-driven. In terms of tempo, there is no lack of relaxation where called for, but the slightly brisker-than-usual pacing of the great "Che faro" seems ideal, making the other performances almost a bit sluggish by comparison.

There is nothing really sluggish, of course, in any of these three sets, and both Maureen Forrester and Shirley Verrett sing that great aria quite beautifully. Forrester, however, for all her magnificent voice and genuine musicality, is the least convincing dramatically, and many listeners, I'm afraid, will be put off by what Mackerras has attempted, will find the ornamentation overdone in "Che faro," for example. Marilyn Horne also knows a thing or two about ornamenting, but displays this skill less conspicuously, giving her most notable demonstration in "Chiamo il mio ben" in Act I. Shirley Verrett, who essays few embellishments in any of her arias, is nevertheless the most appealing Orfeo of all, both dramatically and musically. How poignant her pleas to the Furies, how noble the line in "Che puro ciel!" Horne shows no lack of nobility, but her more declamatory approach does minimize any effect of poignancy. Even in "Che faro," she is more "majestic" than tender. But also, in considering "Che puro ciel," how Solti's handling of the orchestra tells, particularly in the exquisite blend of winds and voice at Horne's entry!

All in all, Fasano has the strongest trio of singers. Anna Moffo is quite the finest Euridice, while Solti's Euridice, Pilar Lorengar, simply does not give the sense of smoothness and assurance one gets from Moffo and, to a lesser but still satisfying degree, from Teresa Stich-Randall on Vanguard. Both Judith Raskin, on RCA, and Helen Donath, on London, are first-rate as Amor, and Hanny Steffek on Vanguard is only slightly less persuasive.

If a conclusion may be drawn from these brief observations, it is that the London *Orfeo*, even with Miss Lorengar trailing the rest of the team, is probably the safest bet. Solti's approach is compellingly theatrical and thoroughly musi-

cal, all elements beautifully balanced, and the sound is well up to the London standard. But a "safe bet" is generally a compromise, and that is what this set is—for those who can't go along with Mackerras's embellishments or who find all that ballet music in Fasano's set a bore (or simply too expensive). Others will be enchanted by the Mackerras edition, and still others will happily pay the additional cost of the Fasano in order to have every note of the ballet music—and the incomparably moving perfomance of Shirley Verrett.

There are textual differences in various performances and recordings of *Norma*, too, but they amount to much less than those already observed in the case of *Orfeo ed Euridice*. The Sutherland-Bonynge recording was a handsome thing when RCA presented it in 1965, and is certainly no less enjoyable now, remastered by English Decca and pressed in England. Handsome as it is, though, one must regret that Joan Sutherland was not given an opportunity for a remake instead of having this *Norma* reissued, for in the intervening five years she has made much more of the role (and Bonynge has probably developed his contribution further, too).

Dealing with what *is*, instead of what might have been, I can only say that Callas gets my vote for *Norma*, hands down. It was always one of her best roles, and in this case her later, stereo recording (Angel SCL-3615, $17.98) is so generally superior to her earlier one that one wonders why the men in the Capitol Tower bothered to reissue the earlier one (Seraphim IC-6037, mono only, $8.94). In both recordings, however, Callas scores over Sutherland, not only in terms of dramatic urgency, as one might be prepared to concede, but also in terms of sheer beautiful sound. Sutherland's sound has become even more enticing, and Callas's less so, since these recordings were made, but that can hardly affect what is already in the grooves, any more than Bonynge's capable direction may be compared with the authoritative conducting of the late Tullio Serafin (who did both the Callas *Normas*). And Callas is a tigress, for sure.

Marilyn Horne seems to take a bit to settle into her role as Adalgisa, which she would not have to do today; one ought not to make too much of this, though, for once she gets going she is, as always, pretty glorious. (For all I know, the first act may actually have been recorded last. In any event, it is a good feeling to be able to observe that a Sutherland or a Horne five years ago was not what she is now, instead of complaining that she ain't what she used

(Continued on page 82)

BERTRAM STANLEIGH

Recording Jazz

For nearly a year, now, evidence has been accumulating that the major record companies have lost interest in both classical and jazz recordings. Sales, they say, are down in both categories. Although they make fine noises about their dedication to the arts, their behind-the-scenes comments and their actions make it clear that the major labels are putting their money in those projects where the greatest market exists and giving short shrift to smaller markets.

Actually, jazz and classical sales have been making a modest gain in dollar volume. Their poor performance is only measured in comparison with the high percentage of the market that has been captured by rock and roll. It is all a matter of how you keep the books. Sales may be up in dollars, but they have dropped substantially in percentage points. Production costs are another matter, however. Whether you do your accounting in dollars and cents or in slices of the total pie, the costs of making recordings are way up. Not only are hourly rates for musicians up, but more important, the new multi-track recording techniques, that have done so much to expand the creative horizons of pop and jazz musicians, have increased recording time by as much as tenfold. Under these circumstances, even the most dedicated jazz enthusiasts must recognize that the old conditions, with scores of new LPs each month, can no longer prevail. And to some observers, the prospect of a more limited release schedule—with higher quality standards—would be not only an acceptable economy, it would be a highly desirable step toward the nearly forgotten standards that prevailed in the record industry before the arrival of the long-playing disc.

For new jazz releases, the long-playing format has had as many disadvantages as it has had conveniences. An artist was forced to come up with a dozen or so new performances for each platter, and the need for fresh releases at frequent intervals, to maintain proper public exposure, has meant that even some of the most creative of jazz musicians have committed many mediocre efforts to a medium that is designed for preservation of their most notable expressions. If the industry were to concentrate on waxing those performances that had been developed, polished, and perfected over a space of months or even years, it might miss some of the occasional lightning that strikes when normally unrelated super stars meet for a festival performance or studio date. But it would avoid the many disasters that have been perpetrated on the jazz-record-buying public during the last two decades.

Unfortunately the major record companies have not reacted to slow business by reducing output and improving product. They have simply curtailed all new recording and devoted their dwindling jazz releases to reissues of earlier material or recordings of rock that feature jazz artists. If the fate of jazz on discs were at the mercy of the major American labels, future prospects would be bleak indeed. Happily, there are several small organizations which make up in noble ambition what they lack in greed.

Just as European labels have taken over the American symphony orchestras that the major American labels have deserted, several small jazz labels have made an impressive stab at taking up the slack in new recording on the jazz scene. ESP, Arhoolie, and Delmark are three of the dedicated independent companies who continue to invest in new

recordings of creative jazz, and, as their competition from the majors diminishes, we hope that they will have the resources to take on the awesome responsibility of documenting the important achievements on the contemporary jazz scene. In the meantime, our major labels continue to define the enormity of their dereliction as they demonstrate the extent of their earlier documentary achievements by a glittering array of reissues ranging from the 1920's through the 1960's.

° ° ° °

Junior Wells: South Side Blues Jam
Delmark Stereo DS-628

This great session with blues singer and harmonica player Junior Wells is notable as the last studio recording by blues pianist Otis Spann. With Buddy Guy and Louis Myers, guitar; Earnest Johnson, bass, and Fred Below, drums, they present eight deeply-felt, soul-wrenching performances that have been accorded impeccable stereo engineering. Wells is a singer with a long, slow, heavily inflected line. No shouter, he gets the same anguished impact into his delivery with a quiet, almost hushed introduction to a phrase. Both in his singing and in his harmonica solos there is a quality of detached involvement with the central focus of Otis Spann's piano. It is stylish blues-making in the most direct and uncomplicated tradition.

Earl Hooker: Hooker and Steve
Arhoolie Stereo 1051

The same Louis Myers who played guitar on the Chicago-made Junior Wells recording, turns up on harmonica on this West Coast recording with blues chanter, guitarist Earl Hooker. Steve Miller's electric organ and the electric bass of Geno Skaggs do much to give these eight numbers the atmosphere of the dimly-lit blues bar, and Hooker's brisk, bouncy delivery keeps everything moving at a pace that never flags. The good stereo sound is sufficiently atmospheric to add its own quality to this fine recording.

Alex Moore—In Europe
Arhoolie Stereo 1048

Septuagenarian Alex Moore cut this disc in October, 1969 while on a European tour with the American Folk Blues Festival. Unassisted by other performers, he plays the piano in bright, barrelhouse fashion as he sings and whistles his way through eight of his own compositions. His funky, unflagging rhythm, spiced with generous bits of boogie have a fresh, vigorous sound and a sureness of touch that belie his years, and there is strength and control in the shouting delivery of his singing. The recording

offers a somewhat distant voice pickup which makes it hard to catch the rather ribald lyrics of such numbers as *New Blue Bloomers Blues*, a piece Moore first recorded in 1929.

The Best of Charles Mingus
Atlantic Jazz Anthology Stereo SD 1555

Reissues of five outstanding Mingus compositions in recordings dating from 1956 to 1961. Included are *Wednesday Night Prayer Meeting, Eat That Chicken, Hog Callin' Blues, Haitian Fight Song,* and *Pithecanthropus Erectus.* The last two numbers were originally recorded in mono and have been transferred in simulated stereo. While all of the sound is passable, the stereo originals do not sound substantially better than the mono-derived items. Everything has a slightly tubby quality. Except, of course, the Mingus ideas; for all their age, they are still fresh, vital, and retain their original urgency.

Lowell Davidson Trio
ESP Stereo 1012

Recorded in 1965, this set of five numbers by Lowell Davidson, piano; Gary Peacock, bass, and Milford Graves, percussion, is a whole lot easier to grasp today than it was when it was cut. It still isn't the sort of bouncy claptrap for mindless foot stomping, but it's a lot easier now to comprehend the relationship to one another of the three solo lines than it was when the *New Jazz* was getting started. For this listener, the performances are strong, atmospheric, constantly inventive, but unsettled. The music demands probing attention from the listener, but its rewards are limited. Sound is fine.

T'Other Little Tune
ESP Stereo 1082

The result of two live sessions 22- and 12-hours long, these wholly improvised performances were coordinated by Alan Sondheim, who is heard on Moog synthesizer, prepared piano, trombone, jaltarang, Hawaiian guitar, dilruba, classical guitar, soprano sax, bass recorder, marimba, and melodeon. The other four performers contribute bits on the piano, flute, piccolo, drums, tabla, trumpet, tenor sax, Moog, and voice. A variety of mixers, a tape-reverb unit, a resonance chamber, guitar amplifier with tremolo, and a contact microphone were among the special bits of equipment that went into this session. As one might imagine, much of the result has the unworldly quality associated with science fiction background music, and many effects are prolonged beyond any possible period of interest. There is nonetheless, an abundance of interesting sounds and ideas on this platter, and the overall result sounds much less calculated than this genre usually does.

Phil Woods and His European Rhythm Machine
MGM Stereo SE-4695

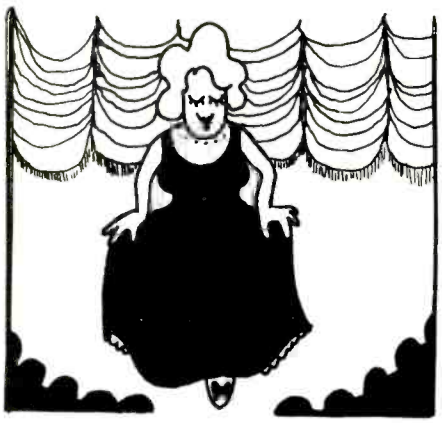
Recorded at the Montreux Jazz Festival, saxophonist Phil Woods is heard with a permanently organized group consisting of George Gruntz, piano; Henri Texier, bass, and Daniel Humair, drums. They play Leonard Feather's *I Remember Bird*, Carla Bley's *Ad Infinitum*, Herbie Hancock's *Riot*, and Gruntz' *Capricci Cavaleschi* against a noisy festival background. It's all slickly professional, and the boys work smoothly together, but one wonders what the cheering is all about. The sound is certainly not out of anyone's top drawer. Æ

OPERA

(Continued from page 79)

to be!) Christa Ludwig may have seemed an odd choice for Adalgisa when the Angel set came out, but the choice was not so much "odd" as inspired: she is a magnificent complement (or foil, if you prefer) to Callas's Norma. John Alexander, who sings Pollione to Sutherland's Norma, and Richard Cross, the Oroveso in that set, are both energetic and accurate, but somehow rather bloodless; Franco Corelli and Niccola Zaccaria put more life into these roles on Angel.

Admirers of Sutherland and Horne may well want to have this London set and cherish it, even though there is less to admire in it than in today's Sutherland and Horne, but, for *Norma*-fanciers who are neither Sutherland fans nor Callas fans in particular, preference must rest with the Angel. Dedicated *bel canto* buffs may even want both versions, or may settle for the Angel set plus the London disc of the big duets. London's sound is brighter, but Angel's (vintage 1959) is perfectly adequate. Æ



"Now" Music

(Continued from page 85)

only in quality, to the jazz-rock successes of Blood, Sweat & Tears.

The longest tune (7:49) is "More Power to Ya," but the best is the first one, "Reach Out," which includes vocal, "Sabre Dance" excerpts juxtaposed with the hardest of rock, and a Coltrane-like experiment in jazz avant-gardehood. Also noteworthy are "Good Things," which changes tempos, instrumentation, sound, and style as often as Zsa Zsa changes men, and the slower-paced "I Can See Your Face."

CAPSULE CRITIQUES

. . . WORLDWIDE 50 GOLD AWARD HITS, VOL. 1 (RCA Victor, LPM-6401) packages four discs by the only guy who could have the *chutzpah* to label such a set as this "volume one," Elvis Presley. The compendium ranges in time from "Heartbreak Hotel" (January, 1956) to "Kentucky Rain" (January, 1970). Included is a 20-page photo book. Among the best tunes are "I Want You, I Need You, I Love You," "Don't Be Cruel," "Hound Dog," "Love Me Tender," "In the Ghetto" and "Don't Cry Daddy." Only in mono.

. . . COME TOGETHER (CoBurt-MGM, CO 1002) is sing-a-long rock by The Mike Curb Generation, the most pleasant gimmick to hit the vinyl world in some time. The studio chorus translates the top of the charts so even the rocking chair set can understand. Ten cuts (including four medleys) deserve every bit of the heavy air play they've been receiving. Best tracks are "Come Together/Hey Jude," "Games People Play," "Raindrops Keep Fallin' on My Head" and "You Don't Need a Reason for Love/Give Peace a Chance/Get Together."

. . . FIREWORKS (RCA Victor, LSP-4370) is an 11-cut Jose Feliciano offering that is not up to his usual standards—but still is better than that produced by most other soul singers. About half the LP leans on Lennon-McCartney tunes, with a trio of Feliciano-penned outings causing the most excitement. Instrumentals also are noteworthy, especially the title tune (extracted from Handel's "Fireworks Suite"). Best melody is the chartbuster, "Destiny," a straight pop winner that bounces—and has extra impact from the blind Puerto Rican's overdubbed voice. Æ

SHERWOOD L. WEINGARTEN

BEETHOVEN would have been 200 years old next month had his body had the immortality of his music. Since it didn't, however, we can only wonder what the master would have thought about the modernizations to which his compositions have been subjected. And question, likewise, his reaction to a bastardized excerpt of his ninth symphony thunderously rolling around the top of the pop charts.

"A Song of Joy," of course, seems to blare forth from virtually every radio station, half the time with no mention that it is an adaptation (sic, sic, sic) of a tidbit from the final, choral movement of the ninth, which, as we all should know, was in turn inspired by Schiller's poem "An die Freude."

Anyway, the hit version seems to have inspired 80,000 copies, items that, despite imitation allegedly being the sincerest form of flattery, do little to enhance the notion of coupling classical and pop motifs or improve the reputation of Beethoven, who, were he alive, probably would be grateful, suddenly, for his deafness.

One of the shadow versions is from the baton of LeRoy Holmes, whose orchestra and chorus apparently do their best to destroy the audiophile's eardrums. A SONG OF JOY (United Artists, UAS 6769) is an album containing a dozen cuts, the lead one, naturally, being the title tune. In brief, the number is grossly over-produced, over-arranged and overbearing, with the chorus acting as if it had to compete with a rally of women's liberationists simultaneously chanting obscenities to prove their masculinity. As for any depth, suffice to say there is none; classical beauty, obviously, is not skim deep.

Handel fares better on the disc, perhaps because a heavy rock beat is superimposed on what once was known as his "Hallelujah Chorus" but since was adapted by Quincy Jones as the main title from the flick "Bob & Carol & Ted & Alice." Still, in the Holmes rendition, the chorus tend to be excessively weighty and dull.

The remainder of the disc, in sharp contrast, sticks to a straight pop sound—albeit softened with strings and the familiar Holmes feel for what Muzak mentalities desire. Excellent, though, are "Midnight Cowboy," on which the harmonica's power helps keep the stringed sweetness from becoming sticky (while the rhythm section assists by avoiding the foreground), and "Something," an upbeat winner penned by Beatle George Harrison that swings via strings, drums, brass, and flute.

Other pleasant entries include the "'Airport' Love Theme," "Love Me Tonight" (a Latinized success reminiscent, however, of a bullring rather than a lovenest), Lennon-McCartney's "The Long and Winding Road," "Spanish Eyes" (a glossy version replete with staccato strings, maracas, and brass), "True Grit," "Funny Girl" and "My Cherie Amour."

A better treatment of Beethoven's ninth, the extract at least, is found on a recent vinyl by a 26-piece combo, The Kasenetz-Katz Cirkus. CLASSICAL SMOKE (Super K-Buddah, SKS 6001) is close to being a perfect blend of old and new, with classical blurbs being recognizable but updated neatly. The ninth, for instance, spotlights an accented bass and features what might be considered electric rock-classical.

Another Beethoven piece, a string quartet, almost dashes so far back in musical history the contemporary catchiness is hidden—except that, especially the second time around, one notices the tambourine tap-tap-tapping away and an electric guitar riff at the tail.

Also on the LP, its first side in fact, are re-arrangements of pieces of Mozart's "G Minor Symphony" (heavily stringed but with an emphasis on rinky-tink piano and heavy drum beat) and Wagner's "Evening Star" (featuring a Moog-like sound of water, Afro drums and, of course, strings). A segment of Verdi's "La Traviata" seems distant from operatic normality considering the focus on a jazzy piano and rock overtones (with flashes of hot brass).

On the flip side are the longest piece, a six-minute transliteration of Dvorak's "New World Symphony" in Western dress—a soft rock opus that showcases guitar-strumming and violin loveliness, and the shortest outing, a 1:55 quickie rendition of Handel's "Bouree" on which the harpsichord effect is particularly exciting.

Three tracks on the second side, however, are not nearly as appealing as the rest. Chopin's "Nocturne" starts with electronic junk and utilizes cymbals that bring to mind the opening of a J. Arthur Rank movie (organ and guitar counterpoint, nonetheless, is effective). Strauss' "Blue Danube Waltz," used so effectively in the film "2001: A Space Odyssey," here is mired in unchanged melody and monotonous beat (saved only momentarily by a sax riff toward the end). And something entitled "Orgy of Lust" is virtually a straight rock tragedy.

Another group of musicians trying to merge antiquity and tomorrow have a second go at it on TAPESTRY (Columbia, CS 9992), a package that contains 10 tracks that almost universally fall short of their initial attempt. The New York Electric String Ensemble—with Jonathan Talbot, bass player and guitarist, as director—leans to the Baroque but also becomes ultra-experimental.

Based on a Purcell sonata in D major, to cite the former case, are two offerings, "Pomposo" and "Presto," both of which must be labeled soft rock. The latter case comes into view via "Tarantas," a rock flamenco, if you can envision such a Janus.

The combo—also consisting of Ted Irwin (guitar, bass, and piano), Lew Bottomly (guitar), Edward Brewer (harpsichord) and J. J. Peloquin (drums)—also goes back to Bach for "Allegro,"

from a sonata in G minor, and (believe it or not) "Spanish Harlem," which includes an interlude stolen from the B-boy.

"Mate" is a piece written and played by guest artist Felipe Gayo, classical guitarist who makes the instrument come alive in his hands.

The album also includes something to show the jack-of-all-trades ability of the group. "Ray Can't Play the Piano Any More," which almost destroys the entire concept of the LP, starts with strains of "She'll Be Comin' 'Round the Mountain" and wanders into a cornball country-rock format.

* * *

Los Indios Tabajaras, consisting of two guitarists who were born in Brazil but now choose to live in the U.S., goes entirely classical on its latest RCA Victor recording, but still it's geared for the pop market. DREAMS OF LOVE (LSP-4365) is the kind of velvety product that matches a clear, star-filled night when pollution and war could never enter your mind.

The best of the seven tracks by Natalicio and Antenor Lima, who might be considered the Segovias of the Mantovani set, are two extracts from Bach's "Well-Tempered Clavier"—"Prelude and Fugue No. 6 in D Minor" and "Prelude No. 9 in E Major."

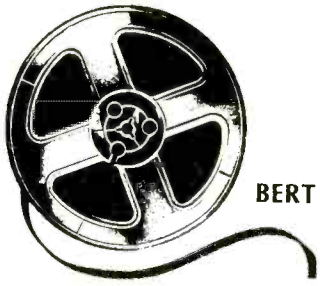
Other items include Chopin's "Tristesse" and "Valse," Sibelius' "Valse Triste," Liszt's "Liebestraum" and Sarasate's "Gypsy Airs" (Aires Gitanos), the longest cut (7:32).

* * *

Turning the tables are eight members of the Detroit Symphony Orchestra who —on SYMPHONIC METAMORPHOSIS (London, PS 573)—perform eight tunes that can be categorized as nothing but hard rock (complete with screaming voice, dissonant concoctions, and frequent changes mid-melody). The group, which debuted last year with the orchestra, calls what it does "fusion rock," explaining that it is a purposeful combination of rock, classics, jazz, folk blues, and pop.

The group's members range in age from 23 (Thomas Bacon, who plays organ, trumpet, French horn, and bass trumpet) to 40 (Donald Haas, who plays trumpet and bass trumpet). Instruments of the other six include English horn, oboe, flute, sax, clarinet, guitar, trombone, and percussion. Add to this the lead voice of Ervin Monroe, and the voices of the other seven, and you end with what should be a cacophony. Somehow, though, the whole damned thing works—well. And it's similar now and then, if

(Continued on page 83)



BERT WHYTE

Recorded Tape Reviews

You will note that tape reviews have been somewhat reduced in the past few months. This is especially true in the case of open-reel tapes. I hasten to reassure readers who have inquired that I have no intention whatever of abandoning open-reel tape in favor of the newer formats. Open-reel tapes are still the leader in quality sound and are likely to remain so for a long time. What has happened is that some companies have started to use computers to handle their review service . . . with the predictable result that sheer chaos has erupted, no one is getting what he requests, especially in open-reel. Then too, some companies have severely curtailed their open-reel releases. Then there is always the factor that what is sent to you in any of the formats, is just a lot of chaff among very little wheat. I have been told by several companies that they are returning to good old human power for their review service, and that things should normalize shortly. I certainly hope so.

* * *

American Airlines Astrostereo—Classical Program CW 230 Ampex CW 230, **open reel, 3.75 ips,** ($26.95).

This is another of those handy dandy three hours worth of quality background-music tapes, which sound so much better at home than they do in the jetliners. This is drawn from the Mercury, Philips, and World Series catalogs and is a much more diversified program than usual. Thus we have cheek by jowl such items as a part of the St. Matthew Passion, An American in Paris, Handel's Water Music, a Beethoven Piano Trio, and a generous helping of Parsifal from the 1962 Bayreuth Festival performance. Sound quality is variable, but generally good. Parsifal was recorded live at the Festival, but the relatively few coughs and hacks are not bothersome.

The Moving Sounds of Music in the Air—Astrostereo Program 65. Ampex W-65, **open reel, 3.75 ips,** $27.50

Speaking of background music for summer listening, here is yet another of those American Airlines mammoth compendiums of pop music drawn from the catalogs of such record labels as Buddah, Kama Sutra, Curtom, United Talent, and Mainstream. The thing that makes these tapes valuable above the usual level of background music is the excellent programming. Whoever puts these tapes together at Ampex has a knack of combining numbers of differing selections in a way that is musically attractive and well-balanced. The sound is quite good too, and considering the diverse scores from which the music is chosen, the engineers have done a good job of levelizing. Given a recorder with automatic reverse play, this tape will furnish three hours of continuous music which should be enough for anyone—whether they are flying or partying.

The Poll Winners—Barney Kessel, guitar; Ray Brown, bass; Shelly Manne, drums. Ampex/CR, X7535, **open reel,** 3.75 ips, ($5.95).

This was recorded way back in 1957, and I guess these days you have to go back that far to get some good jazz. What a pleasure it is to hear three great masters of their instruments, giving us eminently listenable jazz versions of "Satin Doll," "Mean To Me," "You Go To My Head," and similar numbers. The atmosphere is real loose and easy . . . there are no pretensions. Just good jazz by three of the best in the business. The 1957 sound holds up remarkably well . . . perhaps a little thin, and lacking in bass, but quite acceptable for this kind of listening.

Schubert—Symphony #9 in C. William Steinberg conducting the Boston Symphony Orch. RCA, R8S1159, **cartridge,** ($9.95).

One of the first recordings RCA has done with William Steinberg, new conductor of the Boston Symphony, and one of the last recordings RCA made with the orchestra, which is now recording for Deutsche Grammophon. A funny turn of events. Steinberg is solidly "at home" with this sort of music and the Bostonians play very well indeed for him. Steinberg breaks no new ground here . . . his tempi are conservative, his overall concept in the same mold. It is a good, serviceable reading with an especially good Scherzo and Trio, and generally excellent sound. The engineers have captured that elusive blend of good orchestral definition with

broad, spacious acoustics. The processing of the tape is a measure of how far 8-track cartridges have come since their introduction. Hiss is fairly low, and there wasn't a smidgen of crosstalk or print-through.

Beethoven—Symphony #9 (Choral). Leopold Stokowski conducting the London Symphony Orch & Chorus. Ampex/London Phase Four, **cassette,** ($6.95).

How astonishing to hold this tiny cassette in one's hand and realize it contains the entire Beethoven 9th Symphony! This surely is a major selling point of this format. Equally amazing is the tremendously exciting and vital performance of my octogenerian friend Stokowski, who must have discovered the fountain of youth. There are things which the purists will quibble about, but for the most part the Maestro is pretty straightforward, and even his "variations" seem to work! Finally, we are given the best recording the Maestro has received in his Phase-Four Series. Clean and well-balanced, with no instruments out of sonic context. Listen to this cassette on a good system, and you will hear the best from this medium yet. Now if Ampex will "Dolbyize" this so we can get rid of the hiss . . . AE

FUNCTION GENERATOR

(Continued from page 23)

Some adjustment may be needed to compensate for deviation from the theoretical beta value used, of 50, although this is not too critical in the mode of amplification used, where current gain is fairly swamped by a form of voltage feedback.

In the next article, we will take this circuit and modify it to yield a sine wave, also discussing the degree of accuracy to which the sine wave may be approached. In this presentation, we have described the effect of the values chosen, rather than showing how to calculate the values required.

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The values in the amplifier stages Q12 through Q15 were worked out backwards, using 15-K resistors, calculating the collector load, back to collector current, emitter resistors, base resistors, and so forth. AE

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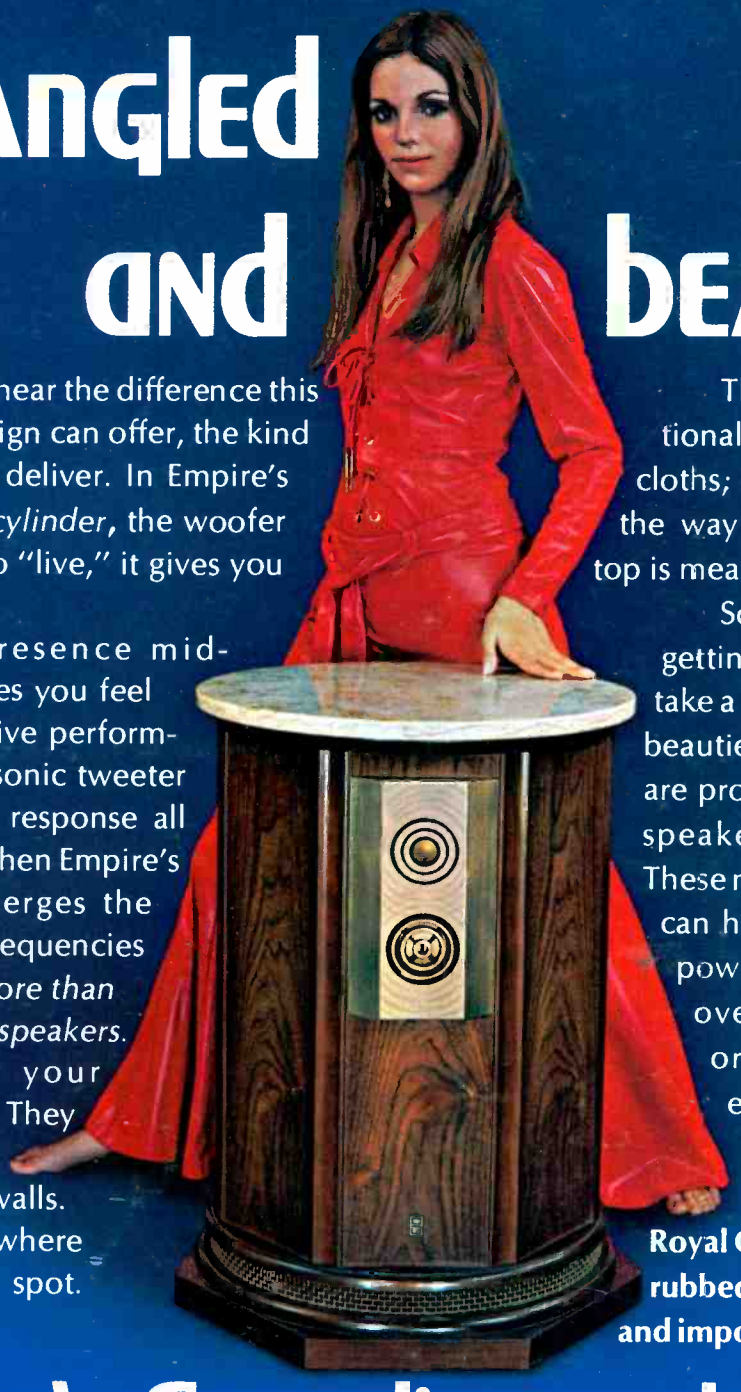

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