Invention of the screw propeller in 1836 by John Ericsson provided water transportation with a means for using steam power that was far superior to any method of propulsion previously devised. In our day, radial refraction, brought to you by the laboratories of James B. Lansing Sound, Inc., provides the best—and perhaps the ultimate—method of reproducing two channel stereophonic music in your home. Radial refraction integrates two, balanced JBL precision loudspeaker systems to eliminate the "hole in the middle," obviate "split" soloists, and to distribute the stereo effect over a wide area. The two, full-range, balanced speaker systems used reproduce all of the phenomena required for full stereo perception. Radial refraction was first used in the JBL Ranger-Paragon, a magnificent instrument that has found its way into the great homes of audio cognoscente throughout the world. Now a smaller unit, the JBL Ranger-Metregon, has been designed to bring radially refracted stereo to the usual-sized living room. No less than seven different JBL speaker systems may be used with the Metregon. You may wish to make use of JBL transducers you now own for one channel, and install matching units in the other. You may progressively upgrade your Metregon system. Write for a complete description of the JBL Ranger-Metregon and the name and address of the Authorized JBL Signature Audio Specialist in your community.
The 1959 San Francisco and Los Angeles High Fidelity Shows have some interesting historic significance.

For one thing, it is a full year since the stereo record was first demonstrated on the west coast. Of course, at that time there was very little in the way of stereo repertoire. Only a few labels released "samples," and these were "experimental" first pressings...replete with the sounds of the bowling alley, ping-pong balls, the ferry boat, the railroad engine—and of course, some incidental music. Actually, this was intentional and the basic consideration in the arrangement of the stereo program was to achieve (for these first pressings used to demonstrate the effects of stereo) the greatest auditory perspective...depth...dimension.

With regard to "timing," these records were a "found blessing" to the few phono pickup manufacturers who had "first" models of their stereo pickups and demonstrated them at the 1958 California High Fidelity Shows. It may interest you to know that certain of these manufacturers, even without our knowledge, had rewired the Garrard Model RC88 record changer as the ideal instrument for use with their stereo pickups, and thereby removed to us their complete satisfaction. Incidentally, by this time Garrard changers, already wired for stereo, were in production. Aside from the "handful" of stereo pickups demonstrated at the California High Fidelity Shows a year ago, there was little else in the way of stereo equipment for the "stereophile."

Of course this will not be the case when the high fidelity industry revisits San Francisco and Los Angeles for the 1959 High Fidelity Shows. Music will be plentiful—music for everyone—from the deep classics to the exciting tempo of the jazz combo. Today...the stereo repertoire already amounts to something like 2,000 selections on about 25 labels!

Naturally, British Industries will be at the 1959 San Francisco and Los Angeles High Fidelity Shows, and at virtually every other high fidelity show throughout the country in 1959. As in prior years, this year our stereo demonstrations, we will continue to maintain the feeling of listening within the home...of enjoying a musical experience.

We are using the Garrard Model RC 88 because this changer reproduces stereo music precisely as recorded, without introducing any disturbing or distorting factors such as rumble or wow. In fact, the Garrard changer performs better than most so-called "professional" turntables, because this changer is actually a superb turntable combined with a scientifically engineered aluminum tone arm which tracks at the correct stylus pressure without undesirable resonances. You have the added convenience of not only being able to play records simply by hand, but also stacked, with the assurance that they are being handled automatically more gently than by any human hand. This is true on a Garrard changer and at a price much lower than you
may have been led to expect. When considering the claims of changers "specifically designed for stereo," or turntables "to play stereo properly," it is well to remember that for years Garrard changers have had all the qualities necessary for this type of sensitive reproduction. Now more than ever before, it is essential to insist on a Garrard changer, and accept no substitute, if you want the finest Stereo or, of course, Monaural reproduction.

The new LEAK stereo amplifier and preamplifier are being used to control the sound. Leak professional quality amplifiers are unique because they keep distortion down to a trivial one-tenth of one percent (0.1%) at full rated power...the lowest figure ever achieved! This explains why the Leak stereo sound you will hear is so natural, and why you could enjoy it for hours without fatigue. Low distortion is the key to quality stereo reproduction. Invest wisely. It is important to remember that the amplifier and preamplifier are the very heart of your stereo system.

You will hear the Wharfedale speaker systems...integrated combinations of 2 or 3 Wharfedale speakers in enclosures designed by G. A. Briggs. These systems are are ahead of the curve for stereo because of practical size, moderate price and unusual versatility. The reason why people so appreciate their sound is the way the amplifier and preamplifier systems by Wharfedale are that Mr. Briggs has designed them to reproduce music naturally, without electronic, mechanical or acoustic coloration. You have only to hear a pair of Wharfedales to realize, that in their performance, they achieve a non-strident musical quality...a quality of clean, spacious sound that heightens the stereo effect.

A pair of Super 8's are used as an alternate speaker system. You may well wonder how such splendid sound could come from so small a speaker enclosure. The answer lies in patented RJ design principles, which mean that no other small enclosure can match the RJ in performance. Stereo does create some new problems in room arrangement which are easily solved with versatile RJ enclosures.

We have prepared a series of Comparator Guides covering the various BIC product lines. If you have not already obtained them at the shows, we will be happy to send them to you. Please write, specifying the BIC products which interest you.

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COVER PHOTO—Model home installation at Los Angeles County Fair in September, 1958. Speaker and equipment cabinets comprise Ruxton Electronics Company’s “Venezia” stereophonic ensemble, with equipment by Scott, Tandberg, Gray, Grado, Grommes, and Gerard making up the electronic portion.

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TUNER SENSITIVITY AND QUIETING

Q. Can you tell me whether it is possible to have an FM receiver which will completely suppress a strong interference signal even when the latter appreciably exceeds the desired signal? If not, what type of circuit most nearly approaches this ideal? Can you explain exactly how the sensitivity in re dB of quieting is obtained for FM tuners? Judging by the advertisements in Audio and other magazines, there are two or more methods in use. What does absolute sensitivity mean? What is the theoretical limit of sensitivity of an FM tuner? B. H. Murdoch, Belfast, Northern Ireland

A. The only answer I can give with regard to a tuner having perfect suppression, is that there is such a thing as perfection. Any limiter can be upset when overloaded with noise signal. The amount of signal needed to accomplish this will depend on the dynamic range of the desired signal and upon the design of the limiting circuit. Probably the closest approach to this ideal is the discriminator circuit, preceded by two limiters. Following very closely behind this is the ratio detector preceded by a single limiter and continuing stiff AGC. As a matter of fact, the discriminator circuit should also employ some AGC, especially at the front end. This is because a tuner must handle signals of greatly varying strength. In the New York area, for example, it is possible to receive signals as strong as 0.5 volt (yes, 0.5 volt) at the antenna terminals. At the other extreme, the tuner must accept signals as small as 0.00005 microvolts and still manage to quiet satisfactorily. That is asking a lot of a front end, and it is the reason that AGC is very much needed. Notice that with the discriminator circuit, two limiters are needed, whereas with the ratio detector, only one is needed. This comes about because the ratio detector circuit has inherent limiting properties. Further limiting would only reduce i.f. gain, and this would serve no useful purpose.

Now, let's go into the problem of sensitivity and quieting. There are several methods for measuring these two quantities. When these are applied properly and interpreted correctly, they mean much the same thing. The standard employed by the Institute of Radio Engineers may be summarized as follows: What voltage, when fed into a 300-ohm input, will give 30 dB quieting, when 22.5 kev is applied? Notice that there are two other terms which must be taken into account besides input voltage and the number of db of quieting. These are the impedance and the amount of deviation, or percentage of modulation. If we make our measurements at an impedance of 72 ohms and feed the same power to the input, the voltage appearing at the antenna terminals will be half that which would be obtained at the 300-ohm impedance. This means that if our tuner requires four microvolts for 30 db of quieting at 22.5 kev deviation and at an impedance of 300 ohms, it will need only two microvolts for the same degree of quieting when an impedance of 72 ohms is employed. This sounds like an improvement, but in reality the situation gives us only half the signal voltage provided by a 300-ohm antenna system. Naturally it is assumed that both antennas are of equal efficiency; and that they are in identical locations. In other words, the two measurements are, for all purposes, identical.

Now we come to the matter of deviation. The I. E. E. used 22.5 kev because it corresponds to 30 percent modulation. This, in turn, is roughly equal to average program material, whose peaks average, equalling 100 percent modulation. This figure was selected because people listen to average program level most of the time, rather than to peak levels. The Institute reasoned, therefore, that noise impairments average level more than it does peak levels because the average signal strength is weaker than peaks. Other methods, however, make use of a deviation of 100 percent, 75 kev, as the basis for their quieting measurements. This gives us an apparent improvement of slightly more than 3:1. Our tuner which required four microvolts for 30 db of quieting will now require only 1.333 microvolts and actually slightly less, for 20 db of quieting. If we use an antenna system and input circuit designed for 72 ohms impedance, we will have a tuner requiring only 0.666 microvolt for 20 db of quieting. That sounds like a pretty good improvement, but it is only true in the original model, or should I say, "no better than our original specifications," since we have really done nothing to the tuner. Actually, it's all in how you interpret the figures.

We can go even further in our direction of smaller and smaller input voltages for good quieting. All we need do is to assume that good limiting can be had with 20 db of suppression, rather than 30 db. We need only ¼ as much signal to obtain this degree of suppression, and our figures are growing small indeed, but then, so is the suppression. There are other factors which affect suppression.

There are other factors, however, which cannot be evaluated by the standards employed by the Institute of High Fidelity Manufacturers, Inc., to propose a new set of standards. They note that as the deviation decreases, not only does the noise increase but so does the distortion. This increased distortion is largely caused by a narrowing of the i.f. bandpass. Therefore, the standards committee of the Institute of High Fidelity Manufacturers conceived the idea of a total usable signal measurement. The method for making this measurement can be summed up as follows: What signal voltage, at an impedance of 300 ohms, and at a 75 kev deviation, will be required to cause a signal at the output of the tuner which shall consist of 5 percent total noise and distortion? The method described takes both these factors into account, and this method is quite valid. However, it certainly is going to add much confusion to already troubled waters.

Lastly, you wanted to know what is meant by absolute sensitivity. It is applied to 0.71 microvolts for 20 db of quieting, at a deviation of 22.5 kev. The reason that no greater sensitivity is possible is that the tuner, in this case, generates its characteristic amount of noise, and there is no way we can prevent this, unless this impedance were placed at 300 ohms.
THE GARRARD PAGE

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New TPA/12 Precision Stereo Arm for optimum performance with any stereo or monaural cartridge

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Admission 75¢

Rigo Enterprises Inc. 500 N. Dearborn, Chicago 10, Ill.

a temperature of absolute zero, which would of course cure the random noise generated across the impedance, but so placing the impedance would pose grave problems for the tuner manufacturer.

When making any measurement where impedance is a factor, it is important that the input to the tuner be truly matched if valid results are to be obtained. Most signal generators have outputs of 50 or 72 ohms. Equal values of resistance should be placed in each leg of the generator, and the total should equal the impedance of the tuner input. Only balanced generators should be used, since an unbalanced unit will introduce standing waves which will affect the validity of the measurement. If an unbalanced generator were used, however, all the padding resistance would have to be placed in the hot side of the line.

I wish to thank Mr. Leonard Feldman, president of Madison Fielding Corp., Brooklyn, N.Y., for his invaluable assistance in compiling this material.

High Fidelity Equipment and Dampness

Q. I have just purchased an Altec Lansing 820C speaker for my seashore home. Though I have the house on low heat all the time, dampness is ever present at the shore, and I have been told that dampness will affect the paper cones of the speakers or possibly cause the speakers themselves to rust.

Should welcome your best opinion as to whether this dampness would also have some adverse effect upon amplifiers, pre-amplifiers, etc. What means, chemical or otherwise, might be employed to overcome this?


A. You are quite correct in your concern as to what dampness can do to high fidelity equipment. Of course, much depends upon the degree to which the equipment is exposed. Extremely damp, salty air can easily cause cones to go off center, and can corrode many of the parts of your equipment, leading to a breakdown of many of the electronic components and to freezing of the controls.

Fortunately, there are things which can be done to overcome this problem partially. One thing which can be done is to place silica gel in the boxes or cabinets in which the equipment is contained. In addition, you could include in each cabinet to be protected, a device known as a Damp-chaser. This device is used extensively by piano tuners and manufacturers to keep pianos dry and at a constant temperature. These devices are also used by many manufacturers of electronic organs to protect the chassis of these instruments from the ravages of dampness. The Damp-chaser is nothing more than a heating element. Its purpose is to raise the temperature of the device being protected to two or four degrees above the surrounding temperature; this simple act will reduce condensation. These units are available in several sizes, and I would recommend that you use the largest possible size.

Once the equipment being protected is turned on, its own operating temperature will be sufficient to avoid condensation. Because of this, the Damp-chaser need not operate at this time. This can be accomplished quite easily. Simply connect the line cord of the Damp-chaser across the terminals of the switch of your system. When the device is turned on, the Damp-chaser is automatically shorted out of the circuit. When the equipment is turned off, current can flow through the device. Since the power consumed is very small compared to the device being protected, most of the voltage will be developed across the Damp-chaser, and almost none across the primary of the power transformer.
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A GOLD PLATED STEREOPLAYER!

A Bright gold finish "Micrometer Precision" land & groove type three-speed control with automatic "On-Off" microswitch
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"Wow" and "Rumble" — literally at the vanishing point...
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HAND LAPPED spindle bearing, fitted to tolerance of 1/4 of 1/1000th"

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Net Weight, 21.5 Lbs.

Complete as shown (Cartridge not included)

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duction. And now at a new low price!

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milliampere hours • transient response
within 2 db from 20 to 20,000 cps • no
magnetic pull • instant stylus replace-
ment • fits all standard tone arms and
record changers • eliminates hum problem.

Stereo Cartridges

Silk
Reference your review of General Elec-
tric Stereo Cartridges in the December
issue. We feel we may be able to add fur-
ther useful information for your readers
on the subject of hum in stereo systems, as
the result of our tests with G.E. and other
popular magnetic cartridges in a number
of different record changers.

As the review mentioned, hum does not
seem to be much of a problem with most
turntables. As far as changers, our tests
showed that hum picked up from the
changers is not serious in a good propor-
tion of those tested.

In general, we found no problems with
changers which have four-pole motors with
a full four coils. At the other end of the
scale, we found a high possibility of hum
generation in a changer with a two-coil
motor directly beneath the cartridge. One
popular changer with a two-coil motor,
however, produced very little hum. This
motor has a heavy iron cross-section, and
is located well away from the pickup. Its
position, besides the fact that it appears
to operate at a very low flux density, re-
results in a very low radiated hum field.

Our tests showed the major source of
hum to be unequal line input wiring and
grounds. To assist in correcting this, we
recently published a 16-page booklet on
cartridge connections and input wiring.
The booklet is available without charge
from our dealers or from our plant.

In summary, we feel that record-changer
performance of different cartridges
should be highly satisfactory providing
(1) the changer motor meets the design
criteria as noted above and (2) the car-
tridge connections and input wiring are
made or changed according to our recom-
endations.

W. W. DEAN,
Manager, Audio Components
Engineering, General Electric Company,
West Genesee Street,
Auburn, N. Y.

Large Box or Small Box

Silk:
Messrs. Williams and Novak, in accept-
ing my invitation to explain their state-
ment about inverted speaker enclosures—
"A large box always allows more and
cleaner bass than does a small box"—have
convinced me. I am NOT afraid, missed my point.
The substance of their answer is that the
statement referred to only applies when the
same speaker is used in both the small
and large boxes being compared. This may
seem at first to be a reasonable limiting
condition, until one realizes that there are
speaker mechanisms specifically designed
for a small box and entirely unsuitable
for a larger one.

When the first AR-11 acoustic suspension
speaker system was introduced, the final
resonant frequency of the mounted woofer
(34 cps) was, to my knowledge, at least as
low as any closed box system available
commercially, and lower than the free-air
resonant frequency of many of my best
speaker mechanisms. I believe that this is still
true today.

Thus Messrs. Williams and Novak, in
not accepting my assumption of the same
final resonant frequency in small-box and
large-box systems (as assumed which
implies the use of different woofer mecha-
nisms), invite the reader to compare small-
box bass performance, not with existing
large-box systems, but with a non-existent
system comprising a "high-compliance"
speaker in a large box. Yet the high-com-
pliance speaker mechanism, in its current
subsonic-response form, owes its design
to predict low use in a small box.

The letter shows a clear advantage of
the high-compliance speaker, in which the
mounted resonant frequency of a speaker
system is reduced by more than an octave,
and performance improved, by substituting
a large box for a small one. This is a
perfectly valid analysis for a speaker with
continuous suspensions. On the other hand,
a one-way mechanism, mounted in a box
so large as to allow a final resonant frequency
of 20 cps, would provide inferior performance
through in-
creased bass distortion and/or severely
limited power handling ability. This is due to
the fact that voice-coil explosions, for
costant input power, would continue to
increase, and at a lower frequency than the
first four for each lower octave) below 43 cps. The original
resonant point acts as a protective device,
by limiting excursions at lower frequencies.

The AR-1 has a voice coil half as long
than the gap, allowing a half inch of
centering without changing the amount
of copper immersed in the gap. This is an
unusually conservative design; speakers
with voice-coil overhang relative to the
cone area should not be used at a
low resonant frequency if they are to
handle equivalent bass power as direct
radiators. When the speakers suspensions
are themselves stiff enough to provide a
resonant frequency high enough for the
speaker's protection against over-large
bass excitations, of course, the larger the box
the better.

In any case, a direct-radiator speaker sys-
tem has an optimum resonant frequency
(a point explained in my patent on the
acoustic suspension system), and the
designer is free to determine what propor-
tion of mechanical and acoustical elements
he will employ to achieve this resonant
frequency. Box size, in relation to the par-
ticular speaker used, merely indicates what
part of the elastic restraint is mechanical
and what part acoustic. In the acoustic sus-
pension system acoustical stiffness is a
sub-
stitute for, not an additional to, conventional
mechanical suspension stiffness.

A brief comment on the remarks about
speaker Q: The AR-1 has a Q, when driven
by an amplifier with a high damping
factor, of less than 1. (Bernick: incidentally,
suggests that the Q of a direct-radiator for
good transient response, should be less
than 1.0)

I originally controlled the Q of the"grandaddy" of the AR-1 at will by a
series of small holes in the cabinet. Al-
though this is a perfectly valid design ap-
proach, I found the results with lower Q's
unsatisfactory and I stopped the holes
with plastic wood.

EDGAR VILCHUR,
Acoustic Research, Inc.,
24 Thornlikse St.,
Cambridge 41, Mass.

Maybe it WAS True!

Silk:
The recent article by Mr. Mahkut
describing the Steampux recorder is positive
evidence that American industry can
meet
(Continued on page 19)


www.americanradiohistory.com
MONOaural-Stereo Preamplifier Kit (Two Channel Mixer)
MODEL SP-2 (stereo) $56.95 Shpg. Wt. 15 lbs.
MODEL SP-1 (monaural) $37.95 Shpg. Wt. 13 lbs.
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SPECIAL "BUILDING BLOCK" DESIGN allows you to purchase instrument in monaural version and add stereo or second channel later if desired. The SP-1 monaural preamplifier features six separate inputs with 4 output level controls. A function selector switch on the SP-2 provides two channel mixing. A 20' remote balance control is provided.

Stereo Equipment Cabinet Kit
MODEL SE-1 (center unit) $149.95
MODEL SC-1 (speaker enclosure) $39.95 each

Superbly designed cabinetry to house your complete stereo system. Delivered with pre-cut panels to fit Heathkit AM-FM tuner (PT-1), stereo preamplifier (SP-1 A-2) and record changer (RP-3). Blank panels also supplied to cut out for any other equipment you may now own. Adequate space also provided for tape deck, speakers, record storage and amplifiers. Speaker wings will hold Heathkit SS-2 or other speaker units of similar size. Available in unfinished birch or mahogany plywood.

World's largest manufacturer of electronic instruments in kit form
HEATH COMPANY
Benton Harbor, MI, Michigan
A Subsidiary of Daystrom, Inc.

High Fidelity Record Changer Kit
MODEL RF-3 $64.95

Turntable quality with fully automatic features! A unique "turntable pause" allows record to fall gently into place while turntable is stopped. The tone arm engages the motionless record, and a friction clutch assures smooth start. Automatic speed selector plays mixed 33⅓ and 45 RPM records regardless of sequence. Four speeds available: 16, 33⅓, 45 and 78 RPM. Changer complete with GE-VR-1 cartridge with diamond LP and sapphire 78 stylus, changer base, stylus pressure gauge and 45 RPM spindle. Shpg. Wt. 19 lbs.

"Extra Performance" 55 Watt Hi-Fi Amplifier Kit

MODEL W7-M $54.95

A real work horse packed with top quality features, this hi-fi amplifier represents a remarkable value at less than a dollar per watt. Full audio output at maximum damping is a true 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Featuring famous "bas-bal" circuit, push-pull EL34 tubes and new modern styling. Shpg. Wt. 28 lbs.
"BOOKSHELF" 12 WATT AMPLIFIER KIT
MODEL EA-2 $28.95
There are many reasons why this attractive amplifier is such a tremendous dollar value. You get rich, full range, high fidelity sound reproduction with low distortion and noise . . . plus "modern styling". The many features include full range frequency response 20 to 20,000 CPS ± 1 db with less than 15% distortion over this range at full 12 watt output. Its own built-in preamplifier with provision for three separate inputs, mag phono, crystal phono, and tuner—RIAA equalization—separate bass and treble tone controls—special turn control and it's easy-to-build. Complete instructions and pictorial diagrams show where and it's simple to do. Cabinet is built with the Heath Time Payment Plan. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

"MASTER CONTROL" PREAMPLIFIER KIT
MODEL WA-2S $19.75
All the controls you need to master a complete high fidelity system are incorporated in this versatile instrument. Features 5 switch-selected inputs each with level control. Provides tape recorder and cathode-follower outputs. Full frequency response is obtained within ± 1/2 db from 15 to 35,000 CPS and will do full justice to the finest available program sources. Equalization is provided for LP, RIAA, AES, and early 78 record. Shpg. Wt. 7 lbs.

HIGH FIDELITY TAPE RECORDER KIT
MODEL TR-1A $99.95  MODEL TE-1 $39.95
Includes base deck assembly, pre-amplifier and roll of tape.
The model TR-1A provides monaural record/playback with fast forward and rewind functions. 71/2 and 3 1/4 IPS tape speeds are selected by changing belt drive. Flutter and wow are held to less than 0.35%. Frequency response at 71/2 IPS ± 2.0 db 50-10,000 CPS, at 3 1/4 IPS ± 2.0 db 50-6,500 CPS. The model TE-1 record/playback tape preamplifier, supplied with the mechanical assembly, provides NAGTDB playback equalization. A two-position selector switch provides for mike or line input. Separate record and playback gain controls. Cathode follower output. Complete instructions provided for easy assembly. Signal-to-noise ratio is better than 45 db below normal recording level with less than 1/2% total harmonic distortion. (Tape mechanism not sold separately). Shpg. Wt. 24 lbs.

HIGH FIDELITY AM TUNER KIT
MODEL BC-1A $26.95
Designed especially for high fidelity applications this AM tuner line will give you reception close to FM. A special detector is incorporated and the IF circuits are "broadbanded" for low signal distortion. Sensitivity and selectivity are excellent and quiet performance is assured by a high signal-to-noise ratio. All tunable components are prealigned before shipment. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

HIGH FIDELITY FM TUNER KIT
MODEL FM-3A $26.95
For noise and static-free sound reception, this FM tuner is your least expensive source of high fidelity material. Efficient circuit design features stabilized oscillator circuit and broadband IF circuits for full fidelity with high sensitivity. All tunable components are prealigned before shipment. Edge-illuminated slide rule dial. Covers complete FM band from 88 to 108 mc. Shpg. Wt. 8 lbs.

"UNIVERSAL" 12 WATT AMPLIFIER KIT
MODEL UA-1 $21.95
Ideal for stereo or monaural applications, this 12-watt power package features less than 1/4% total harmonic distortion throughout the entire audio range (20 to 20,000 CPS) at full 12-watt output. Use with preamplifier models WA-2S or SP-1 & 2. Taps for 4, 8 and 16 ohm speakers. Shpg. Wt. 13 lbs.
IT'S EASY . . . IT'S FUN
AND YOU SAVE UP TO ½
WITH DO-IT-YOURSELF HEATHKITS

Putting together your own Heathkit can be one of the most exciting hobbies you ever enjoyed. Simple step-by-step instructions and large pictorial diagrams show you where every part goes. You can't possibly go wrong. No previous electronic or kit building experience is required. You'll learn a lot about your equipment as you build it, and, of course, you will experience the pride and satisfaction of having done it yourself.

DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

MODEL MF-1 $26.95

Replace your present pickup with the MF-1 and enjoy the fullest fidelity your library of LP's has to offer. Designed to Heath specifications to offer you one of the finest cartridges available today. Nominally flat response from 20 to 20,000 CPS. Shpg. Wt. 1 lb.

"RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

The SS-1B employs a 15" woofer and super tweeter to extend overall response of basic SS-2 speaker from 35 to 16,000 CPS ±5 db. Crossover circuit is built in. Impedance is 16 ohms, power rating 35 watts. Constructed of 3/4" veneer-surfaced plywood suitable for light or dark finish. Shpg. Wt. 80 lbs.

CHAIRSIDE ENCLOSURE KIT

MODEL CE-1 $43.95 each

Control your complete home hi-fi system right from your easy chair with this handsome chairside enclosure in either traditional or contemporary models. It is designed to house the Heathkit AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the RP-3 or majority of record changers which will fit in the space provided. Well ventilated space is provided in the rear of the enclosure for any of the Heathkit amplifiers designed to operate with the WA-P2. The lift-out shelf can be installed on either right or left side as desired during the construction, and the lift-top lid in front can also be reversed. All parts are precut and predrilled for easy assembly. The contemporary cabinet is available in either mahogany or birch, and the traditional cabinet is available in mahogany suitable for the finish of your choice. All hardware supplied. Shpg. Wt. 46 lbs.

HEATH COMPANY - BENTON HARBOR, MICH.

pioneer in

diyse, electronics.

CO-OTHER HI-FI SPEAKER SYSTEM KIT

MODEL HH-1 $299.95

The startling realism of sound reproduction by the Legato is achieved through the use of two 15" Altec Lansing low frequency drivers and a specially designed exponential horn with high frequency driver. The special crossover network is built in. Covers 25 to 20,000 CPS within ±5 db. Power rating 50 watts. Cabinet is constructed of 3/4" veneer-surfaced plywood in either African mahogany or white birch suitable for the finish of your choice. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.
**LETTERS**

(from page 6)

the challenge and produce a badly needed device, with features beyond the wildest expectations. The article stirred much excitement among the members of our engineering staff. We wish to compliment Mr. Mahnlein and the Steamax Corporation on their revolutionary contribution to audio art.

We have acquired one of these machines and have been using it the past week with gratifying results. We have, however, incorporated a few changes to make the unit more efficient. The biggest improvement was that of changing the method of steam generation. We used a special generator utilizing photosynthesis as a means of subliming ice into steam without the addition of heat. (A rigorous mathematical treatment of this method appeared in the *Journal of the Brown University Intercollegiate Society* in February, 1959.)

This is a very efficient system—41.65% input delivers 43.9 db of usable output; this conforms to an efficiency of 1.05 x 10^3 per cent. The unit is small, about the size of a sewing thimble, but quite heavy relative to its size. The weight arises through the necessity of making the combustion chamber from neutrals to withstand the tremendous pressures. This is the same generator as used on our Model BLA-T4 combination calliope and sternwheeler steamboat.

The other changes made were small ones, such as utilization of an extra handle to make the apparatus completely portable, and the addition of a 1-farad capacitor across the original 0.004-ohm resistor in the flyball governor feedback system to stop a slight tendency of the governor to oscillate.

We wish the Steamax Corporation success in their venture, because this truly is a great step forward in science.

Wolfgang Ludwig Gluck, President
Gluck Loudspeaker, Paddlewheel, and Calliope Company,
Tuscaloosa, Pennsylvania

**Industry People**

**PEOPLE AND THINGS.** Herbert H. Borchardt, president of the Recoton Corporation, announces the resignation of Jack Karns as vice-president, Alfred I. Wisn., formerly secretary, has been elected vice-president, and Hank Miller, midwestern sales manager, has been elevated to national sales manager. Stephanie Sass, former-er spy Friday to the late, beloved Adolph Gross, has joined Avnet Electronics Corp. as new product manager. James Modr, who contributed with fair regularity to the pages of *Audio*, is the new technical director for Goodmans Industries; he assures us that his new position will have nothing to modify his rate of contribution to *Audio*.

Lawrence J. Epstein has resigned as director of sales and merchandising for University Loudspeakers, Inc., to accept the position of vice-president in charge of sales and promotion with United Audio Products, Inc. Doraline S. Wilmot has resigned the presidency of Rockbar Corporation to organize S. Wimpie Associates, Inc., at Mamaroneck, N. Y. The firm will act as sales and engineering representatives for a group of manufacturers in the electronics field.

Stanley Neufeld, formerly jobber sales manager, for Rockbar Corporation, has been appointed vice-president in charge of sales for Brand Products, Inc. The entire record and hi-fi industry was shocked to learn of the death on January 1 of well-known writer of "Record and Sound Retailing."
HALF TRACK?
QUARTER TRACK?
The Choice is Yours!

We believe it is time for a factual statement on quarter track tapes and tape recording. As a novelty, and in keeping with the constant trend toward miniaturization, there is today a considerable interest in home recording of quarter track (four track) tapes.

The laminated quarter track heads used on Viking decks may be used interchangeably with the half track heads for recording, and will provide for proper bias and equalization at 3 3/4 ips tape speed. On special order, Viking will provide quarter track erase heads, permitting monaural and stereo erase and recording of four track tapes.

However, the serious audio recordist will weigh these factors:

Quarter track heads provide a track width of only 43 mils as compared to eighty mils—equivalent to almost six db of absolute signal-to-noise ratio.*

Reduction of tape speed to 3 3/4 ips, instead of 7 1/2 ips, does not result in again halving the maximum possible tape output, but does necessitate a shorter head gap to produce equivalent frequency response. Such a head is less suitable for recording applications.

These are the reasons why you will find full-size, maximum-performance, half track heads on Viking recording models. Use the quarter track heads for the one thing they are designed to do best—playback of quarter track (or half track music tapes).

For your own serious music recording we recommend consistent use of the half track heads available on Viking recording decks, permitting maximum frequency response and dynamic range. Your added tape cost (for raw tape) is your best insurance of professional recording performance.

*Based on residual system hum, tube noise, etc.

Viking tape components are sold through high fidelity dealers exclusively. Further technical information may be obtained by writing directly to Viking's Customer Service Department.

Viking OF MINNEAPOLIS, INC.
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Cable: SIMONTRICE, NEW YORK (All Codes)
I have been falling all over myself in respect to the Harman Kardon "Trio" stereo amplifier, one of the very first of its breed to reach the market and the first that I received myself, for home use. It seems as though the Kardons began many years ago, but it was only last summer. I've been putting it to work off and on ever since, and my listening reaction probably has H. and K. mildly baffled, if they had hoped for an early response from me. After all, I did ask to try the machine.

This year I am quite certain that early solid state playing was going to be so complicated - so difficult, indeed, that even the most experienced audiophiles would not likely to be able to follow the machine in dual format. When only one channel was used, however, it was heard that in a trio, the unit could be fed into the machine in dual format. When only one radio input is used, for instance, it feeds into dual or left channel input - for stereo. A "right"-only switch is present on the front panel which can be used to control the amplifiers. Switch the third channel on and off to select between types of input, to the proper position - radio in this case. Some with tape recorder, etc.

Ye, it sounds complex, but it really isn't. Most newer stereo dual amplifiers have these switching facilities. This was one of the earliest, and probably helped to set up the standard formats now in use. In that, there really wasn't much that I couldn't do with these controls.

There were some things I didn't bother to try, though. Harman Kardon has some sort of dual output system that allows for stereo speakers A and speakers B, the second pair being somewhere upstairs in the front of the machine. I found, for myself, that one pair of stereo speakers at a time kept me very thoroughly busy and so I am not in a position to judge the excellent switching and extra connections that, for my cash, could have been left off - but then I might well represent the Vast Majority of stereo buyers.

There is one other facility, however, that is potentially more useful and is found in all modern stereo equipment - the triaxle teaming of the two channels to make a single 31-watt amplifier out of the pair of 16-watt units. Just flip the switch, I had no immediate need for this, though I tried it now and then out of curiosity, but those who are converting to stereo in calculated steps will find this feature to be very important. Use the amplifier first as a mono unit, 24-watt, with your single mono channel. When you're ready for a try at full stereo, with the rest of the equipment available on hand and in place, flip the switch and your single amp becomes two, of the standard output wattage.

Or if you have a 20-watt (or more) single amplifier already in use, you can put the "Trio" to work as a second full-power channel, using the two power amplifiers in tandem; the dual preamp can then serve for both channels. That's where the term "Trio" came in - three modes of operation.

I wouldn't want to offer much criticism of this pioneer amplifier on the basis of its stereo production, as of last summer, but I can safely observe a few points which possibly apply to current production of the model. As to maintenance of proper phasing between the two channels in all this complexity of switching, the less said the better! My current belief (I use the word "believing") is that Harman Kardon at Harman Kardon is still beyond reproach straight through from input to output, though for awhile I wasn't sure. There's only one last thing that I'd like to see a speaker phasing switch, somewhere on the chassis, preferably out in front and handy for quick change. It is still a challenge to me, though the inevitable phasing inconsistencies that still continue to crop up in all aspects of stereo reproduction, straight through to the microphones down to inadvertently wrong speaker connections in the home. Also, I might add, for the very practical purpose of direct AB phasing crossover. We all, every one of us, should learn to know what right and wrong phasing sounds like, in hundred circumstances.

Take out that "Speakers A and B" business and put in a phasing switch in the machine, and it would be my idea. Maybe it has already been done.

I have one major observation concerning this amplifier that is important to mention here. This is that it simply appears to be a model in the inexpensive category, where production costs must be kept rigidly under control. That is the power transformer, for instance, radiating heat and temperature, the result of inquest, is an appealing distance.

I say "implication," because, obviously, the heat that you don't pick up doesn't exist. This particular transformer is located on the chassis where it is used, are no doubt quite conventional in terms of familiar practice. But the hot part, with single audio circuits, no complications of the ground loop category, with mono magnetic cartridges of high output, hum-blocking coils and no loss of signal output, this transformer would be just fine. No troubles to pile on troubles.

But in all too many stereo applications, it is likely to wind up as a problem, though not necessarily through its own fault. What of your stereo low-level circuitry is highly susceptible to hum? It shouldn't be, but the hum is generated just the same and is unpleasant wherever the fault lies.

You should have heard the roar of hum I got the other day. I moved the tube amplifier on the German tube type and on the German tube type. I moved the tube amplifier on the German tube type. The transformer. What fault? Who knew? But the hum was there and it wasn't my fault. I'm sure that someone else in the same circumstances, notably in the case of various stereo pick-ups with total output noticeably lower than...
NEW STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifiers is a complete stereo control system in "low silhouette" design adaptable to any type of installation. Selects, preamplifiers, controls any stereo source—tape, disco, broadcasts. Superb variable crossover, feedback controls driven by feedback amplifiers pairs in each channel. Distortion borders on unmeasurable even at high output levels. Separate hi-level input in each channel for mag, phone, tape head, mike. Separate hi-level inputs for AM & FM tuners & FM Multiflex. One auxiliary A & B input in each channel. Independent level, bass & treble controls in each channel may be operated together with built-in clutch. Switched-in loudness compensator. Function selector permits hearing each stereo channel individually, and reversing them; also use as unit for stereo or monophonic play. Full-wave rectifier-mode power supply. 5-12A9/ECOS, 1-6X4. Works with any 2 high-quality power amplifiers such as EICO, HF14, HF22, HF30, HF35, HF50, HF60. Kit $39.95. Wired $64.95. Includes cover.

HF88: Stereo Dual Amplifier-Preamplifier selects, amplifiers & controls any stereo source—tape, disco, broadcasts & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp, ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamsite-type, push-pull E64 power amplifiers, excellent output transformers. "Service Selector" switch permits one preamp-control section to drive the internal power amplifiers while other preamp-control section is left free to drive your existing external amplifier. "Its performance is excellent, and the operation is uncomplicated."—Hi-Fi MUSIC AT HOME. "Excellent."—SATURDAY REVIEW. Kit $60.95. Wired $109.95. Incl. cover.

MONAURAL PREAMPLIFIERS (stack 2 for STEREO)
NEW HF60: superb new design, inputs for tape, microphone, mag-phono cartridge & hi-level sources. FM distortion 0.06%; AM 0.08%. New "closed" circuit design. HF60A Kit $79.95, wired $44.95. HF60B (with power supply) Kit $93.95, wired $49.95.

HF61: "Rivals the most expensive preamps"—Marshall, AUDIOCRAFT. HF61A Kit $54.95, wired $37.95, HF61B (with power supply) Kit $79.95, wired $44.95.

MONAURAL POWER AMPLIFIERS (use 2 for STEREO)
HF60D: 60-Watt Ultra Linear Power Amplifier with Atlas TO-300 output tubes. "One of the best-performing amplifiers; excellent excel"—AUDIOCRAFT. Kit Report, $72.95. Wired $99.95. Cover $2.45.

HF60G: 50-Watt Ultra Linear Power Amplifier with extremely high quality Chicago Standard Output Transformer: Identical in every other respect to stereo specs at $50. Kit $57.95. Wired $87.95. Cover $2.45.


MONAURAL INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF32: 30-Watt Integrated Amplifier. Kit $57.95. Wired $89.95. Both include cover.


HF12: 12-Watt Integrated Amplifier. "Packs a wallop!"—POP ELECTRONICS. Kit $34.95. Wired $57.95.

STEREO SYSTEMS (use 2 for STEREO)
HF51: Bookshelf Speaker System, complete with factory-built cabinet, Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass, crisp extended highs & wide 50,000-cps range. Capacity 25 w. 8 ohms. HWD: 11" x 24" x 9". Wiring time 15 min. Price $39.95.

FM TUNER
HF700: superb tuners tuned up to 3X Curtis costs. Pre-aligned, automatic calibration to "front end."—Hi-Fi. Kit $19.95. Wired $34.95. Two 10-NIP, 10-001,000 cps, 10 ohms. West 36" x 151/4" x 111/4". Price $97.95. Wired $119.95. Cover $2.45.

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in earlier mono equivalents and/or without the useful hum-bucking coil arrangement of the mono magnetics. Also there's likely to be more trouble—adding up to more lost straws on the straws-back. With many a three-wire stereo system still in active stereo use.

As I say, let's not try to pin blame on any one aspect or unit. Just let's have a better match all around, improvements throughout stereo. Each improvement "improves" all the other improvements. By this time, my original " Trio" power transformer, without any change at all, is far less of a liability, with the vinyl—as first simply because other aspects of stereo (including such seemingly remote factors as recorded level on stereo discs) have been improved.

**M3D Dynetic**

I was almost ready to give up the idea of comment on individual stereo cartridges, so tough is the problem of over-all system matching, in which the cartridge is only one element. But I have come to realize that in those fine-stereo discs the cartridge has been the really crucial element—even more than speaker or amplifier performance, or than stereo disc cutting. (Cutters, after all, are just a few hundred dollars; and, after all, are just a few hundred dollars.)

The cartridge will remain the crucial element in stereo sound until performance is a lot more standardized than it is as it is now. So, perforce, I think I'll better comment on cartridges as well as we can. I'll say outright, first, that the most satisfactory cartridge I've used so far (and I have not tried a number reported to be "excellent") I wouldn't call--M3D Dynetics. First and foremost, that satisfaction is not so much because of its innate, ideal, ultimate quality as, very simply, its relatively high output. That's enough.

This baby had the biggest wallop of any cartridge I had tried up to the time I received it, and for that reason alone I put it every other cartridge I had on hand into the shade. It became my immediate favorite.

So simple! Just plug in this Shure, then turn down the volume control. With that easy motion, down goes virtually every major form of buzz and hum. You'll never wonder why you have unwanted noise in my stereo systems. (Not rumble; that is an unaffected.) You could have been in my house, for not you'd needn't have heard it. But you'd needn't have heard it.

So, you see, stereo improvement is easy enough in practice. Don't throw out that sloppy amplifier, don't buy new transformers, don't get rid of your entire wire- ing system for something new. Just go out and buy a high-output stereo cartridge. My congratulations to Shure for the most utterly elemental improvement in the entire stereo history of improvement. It is done, and it's everywhere present in the M3D Dynetic line. (And the same to anyone else who has done as much in any other cartridges, Audible, but I still detect a slight bit of breakdown in the quietest recorded passage as compared to the very top sort of sound from the best (several) mono cartridges on the same record.)

I put this dramatic change to the test on the air a few weeks ago. I edited together three slices of mono Mozart, via tape, the first two played by top-level mono magnetics, the third by the Shure M3D stereo, the outputs paralleled. The difference was so minor that I did not even mention it on the air—nobody was able to hear it. I mention it here as a lesson, an one-per-cent sort of perfectionism, for those with extremely analytical ears. I wouldn't apply it to any other cartridges too. But I would guess that within the year even this small difference will have vanished, via minute improvements.

**Beyond this, I'd only say that the Shure style is study as well as highly com- pletely, the thing to note, as well as to non-stereo, less compliant, is now offered primarily for stereo changer use—the M3D.**

**Pickering**

I got two Pickering though I asked for only one, and Pickering & Co. are about to experience a good pay-off for their gamble with me. You see, I had some reservations about that fancy Pickering mono car- tridge combo, the Unipoise, when I got the original mono version some time back, so I wouldn't have bought an M3D Dynetics. First and foremost, that satisfaction is not so much because of its innate, ideal, ultimate quality as, very simply, its relatively high output. That's enough.

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The reason why people appreciate and cherish their speakers and speaker systems by Wharfedale is that they are designed by G. A. Briggs to reproduce music naturally, without electronic, mechanical or acoustical coloration.

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England's warmly regarded lecturer, author and foremost authority on sound reproduction, whose acknowledged musical taste and uncompromising principles guide every step of Wharfedale manufacture.

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bear Mr. Briggs' unmistakable stamp and achieve a non-strident musical quality which is truly unique. Full Range, Bass and Treble models, individually tested and certified.

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are integrated combinations of 2 or 3 Wharfedale speakers, in Briggs-designed enclosures. They are preferred for stereo because of practical size, moderate price and unusual versatility.

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magnetic on the books by a good many dollars. The price in itself makes Pickering a cartridge that everyone should investigate before jumping up the price ladder towards the top.

My judgment of the fine Pickering sound quality has been impelled, as usual, by those disciplinary outside complications. The damned thing gives out with what has been more or less a standard level in the stereo cartridge field—but is still a lot too low for entirely too many so-so stereo installations.

I suggest that basically this is a criticism of the rest of the stereo vs. to which continues too often too sensitive to hum and the like for any low-level stereo cartridge, of any make or type. I suppose it is technically also the "fault" of the cartridge makers, who, however, may be quite rightly designing their cartridges for the ideally best in sound, assuming that the rest of the industry will design associated stereo equipment that is up to their standards. It should be, of course.

Well, darn it, it isn't—and yet. And so here is a fine cartridge that may, or may not, be practical in your home system, depending entirely on the configurations of the rest of the stereo disc circuitry. Frankly, this cartridge has suffered along with others in its own too typical early stereo systems. I suffer, too, but deliberately because I mainly interested in what the current problems are likely to be for the customer—not having the slightest idea how our carriages look and lucky self. My systems are for the most part average and, so far, the Pickering has given the current crop, at least, an expense of too much indefinable hum. I'm using my Pickering just the same, horn or no, for their clean, sharp sound (as clean as my I've yet heard) and I expect shortly to try them for a change in a top-traver, humless system, just to see the full effect of them, unveiled. It'll be great, I assure you.

I'm intrigued, by the way, at the manner in which Pickering (i.e., Walter Stanton, President) has adapted the well known "T" stylus insert system of the old mono Pickering to the needs of stereo. The "T" unit by nature is a very little stiff, but has the lifelong back bone that is not to be put on your name on your cartridge! Like the jazz hi-fi record I reviewed a few years back (Good Time Jazz, wasn't it?) which had no title and no performers indicated. Just hi-fi. What more do you want? They got so excited over the Hi Fi they forgot to put a label on the disc. (It was good, too.)

Allied AM and FM

For these many years—back into the dim days before the war—I've been an admirer of the great Allied Radio Corporation out of Chicago and hail it, along with such others as Lafayette in New York, as practically the original promoters of the usually home hi-fi. But to date I've never had an actual piece of Allied hi-fi equipment around for evaluation. (Used to get their stuff for my own use when back home.)

Now I have on hand an important sample of their latest product line, a typical AM FM tuner out of the current crop, and I find it interesting both in itself and as a type, with a long historical series of earlier "Knights" units figuratively-swinging-out behind it in the mail-order area, mass produced, low priced, sold straight to ye customer without old time "middlemen.

Pshaw, what an old institution is this mail order business! I bought my first mail order merchandise from Montgomery Ward at the age of nine and I'm still at it—bought two complete bed outfits from Sears by mail (truck, to be exact) just last week.

Anyhow, this is a medium-fancy FM-AM "stereo" tuner from Allied, and it surely represents a solid current type of elegant medium-priced line. But then the price didn't always come in kit form, in Allied's newly expanding kit division; but this Knight of life is a ready-made version. Name of KN-120, and it goes for around $130, which is cheap for the top of the line, two complete tuners on one chassis.

Now you old timers know I don't think much of AM-FM stereo. My experience to date with the same, as tuned this model, is about as usual. One lovely, clean stereo speaker, the other full of huffs and swishes and sputters and fades, for a stereo blend that is mostly non-existent. This isn't Allied's fault, and I'm sure you can use these two tuners very neatly for many another purpose, AM-FM stereo quite aside. I've had a lot of fun with them.

You see, two tuners is only part of the value. (And, of course, it is good to have two independent systems minus the compromise inherent in many AM-FM Siamese twin tuners.) There's much value in the intelligent control and connecting circuitry used in this model.

Mystery Ceramic

I have several ceramics to report on, eventually, but I've been much too immersed in stereo listening, in magnetic stereo, to get time to try them out critically. Again, apologies for the delay, along with an observation that the ceramic stereo cartridge is inherently a pretty darned good idea, and a stereo "natural" more than the magnetic, to begin with. I suspect that ceramic sound should edge up a bit higher in the stereo-ceramic magnetic scale than it was able to in the older mono era. Keep an eye on ceramic stereo. No hum pickup, you know.

I have a fine mystery cartridge on hand that must be mentioned, though it is still untried—because it has no label on it, came in an unidentified box (from the Antiquity of Chicago) and I didn't even try to identify it positively as either magnetic or ceramic, at this point. I've put it off, due to pressure of other commitments, but one of these days I'm going to have fun trying to evaluate this interesting oddity, nameless and typeless. We'll try it as though it were a magnetic; we'll run it into ceramic inputs. We'll speculate too as to whether it may or may not be a ceramic adjusted for magnetic preamp inputs—a likelihood, these days. Thanks to its carefully covered-up construction, we may never find out at all what it actually is. If it turns out to be my best cartridge to date, there'll really be a joke.

It's black, dull finish, streamlined, looks like a ceramic. I thought it was a Shure but it isn't—I guess. Who knows? I've thought so many odd things to put your trade name on your cartridge! Like the jazz hi-fi record I reviewed a few years back (Good Time Jazz, wasn't it?) which had no title and no performers indicated. Just hi-fi. What more do you want? They got so excited over the Hi Fi they forgot to put a label on the disc. (It was good, too.)
A Hysteresis Synchronous Turntable Kit for 4950

Check these outstanding features, they're exclusive with Gray at this LOW price.

- Special hysteresis synchronous motor provides constant speed and lowest wow, flutter and rumble content.
- Heavy machine ground 12½" turntable platter with micro polished ⅞" shaft rotates in a super oilite bearing with noiseless nylon underfacing thereby guaranteeing freedom from vertical movement... a stereo prerequisite.
- Customized slip-proof, stretch-limited composite belt offers vibrationless link between motor and platter edge.
- Shock-proof motor mount is adjustable in 3 planes to compensate for lifetime movement and wear.
- Sturdy mounting plate offers maximum shielding. Easy to level and center because it extends past the platter and motor structure.
- Micro precision parts pretested for accuracy in sub assemblies.
- Assembly time 25 minutes or less with simple tools.

Gray 33 ⅓ RPM Single Speed HSK-33 Turntable Kit

Here's an exciting project for anybody who wants professional performance at a low kit cost. Gray engineering and custom mass production techniques now make this wonderful value possible. You'll be pleasantly surprised at how easy it is to fully assemble—and have ready for monaural or stereo operation—this studio designed turntable.

Also Available: 15K turntable base kit... prefinished and precision cut in walnut, mahogany, and blonde farnica veneers... complete with all accessories for quick assembly...

Gray 33 ⅓ RPM Single Speed HSK-33 Turntable Kit

Gray High Fidelity Division
DEPT. A5 • 16 ARBOR STREET, HARTFORD 1, CONN.

AUDIO • FEBRUARY, 1959

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True stereo depends upon accuracy in three dimensions. Since the very first development of the phonograph, more than half a century ago, only two dimensions were required in the mechanical system of a reproducer. Now, with the development of the stereo record, a third dimension, more meaningful and important, is not only required...it is essential!

1. The first dimension in a record reproducing system is the linear movement of the record groove under the stylus in the cartridge...accurately rotated by a quality changer or turntable, such as the STANTON Gyropoise 800 Stereotable. Its only contribution to the system must be precise motion, accurate to within 2/1000 of the correct record speed...with absolute silence and freedom from vibration. Virtually, it must revolve on a bearing of air!

2. The second dimension in a record reproducing system is the horizontal angle of the phonograph cartridge in relation to the record groove. Horizontal Tracking Accuracy is determined by the angle between the axis of the cartridge and a tangent to the record groove. Any significant deviation in Horizontal Tracking Accuracy results in distortion and increased wear of record and stylus. This deviation is called—Horizontal Tracking Error. While it is not possible to fully reduce Horizontal Tracking Error to zero...the offset angle of the STANTON UNIPOISE Arm reduces this error to a negligible factor.

3. The third dimension in a record reproducing system...is the dimension which makes stereo possible! Since the stereo record also has vertical information, a new requirement—Vertical Tracking Accuracy has become absolutely essential to the performance of a stereo cartridge. In order to provide the proper relationship between recording and reproducing stylus, the angle of correspondence between the two must be near 0 degrees. Any deviation in this angle of correspondence is called Vertical Tracking Error.

To avoid Vertical Tracking Error and accurately simulate the original recording process, the reproducing element in the pickup must be almost parallel to the record surface.

Only the Stereo-FLUXVALVE has the parallel reproducing element contained in the exclusive "T-GUARD" Stylus Assembly, a proprietary product of Pickering & Co. It assures proper correspondence between recording and playback stylus with maximum Vertical Tracking Accuracy and minimum Vertical Tracking Error.

When a record master is made (top, right) the cutting stylus bar of most stereo recording heads is virtually parallel to the record surface. Ideally, to reproduce the vertical information in the stereo recording with full fidelity, the stylus bar of a stereo playback cartridge must be similarly parallel to the record surface, and at an angle corresponding to that of the cutting stylus bar. Only the STANTON Stereo-FLUXVALVE (bottom, right) has the parallel bar reproducing element contained in the "T-GUARD" Stylus Assembly to assure proper correspondence between the recording and playback stylus. Actually, it is the vertical information which contributes the added dimension to high fidelity for true stereo. Unless the stylus bar of a stereo cartridge is similarly parallel and at a corresponding angle to the cutting stylus bar, vertical tracking error will be introduced, generating a distortion of the same kind produced by horizontal tracking error! The amount of this distortion increases with any increase in Vertical Tracking Error.

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EDITOR'S REVIEW

AUDIO FIDELITY WEEK IN NEW YORK

Although not officially proclaimed by New York's Mayor Wagner, January 12 to 18 will long live in our memory as Audio Fidelity Week. On the occasion of the opening of the Dukes of Dixieland, for a two-week engagement at The Roundtable, a plush night spot, Sidney Frey, president of Audio Fidelity, gave a cocktail party to the press and an assemblage of disc jockeys. What with celebrating, dining, and listening to the Now famous Dukes alternating with a jazz combo headed by Peter Apple, the entire evening was somewhat of a success.

 Barely recuperating from one such evening, we were catapulted into another two days later—a joint affair staged by Audio Fidelity and Stanley Warner Cinerama Corporation—on the occasion of the release of the record with the music of South Seas Cinerama covering its two shiny sides. This event started with a showing of the picture, followed by a chartered bus ride to the Hawaiian Room of the Lexington Hotel for a midnight luau, and the almost inevitable trek over to The Roundtable to hear the Dukes again.

Not satisfied with that much entertainment, Sunday night brought an affair at the Friars Club, where boy genius Sidney Frey received a plaque which reads:

Mr. Stereo Award to Friar Sidney Frey as Music Man of the Year for his vision, enterprise, and ingenuity in creating the world's first commercial stereo record.

The plaque was presented by Harry Delf, Dean of the Friars, and pictured are he and Sid (right) at the time of the presentation. Following this, Jack Barry took over as master of ceremonies and entertainment continued for several hours. Then—it being Sunday and The Roundtable being closed—the Dukes and several others migrated to Nick's in Greenwich Village to listen to more Dixieland music with considerable infiltration of the Dukes into the group already playing.

We remember being told many years ago that one could not burn the candle at both ends for a long time. Our reaction to this admonition has always been, however, that as long as you can keep it up you can get a much brighter light. Most of us Dixieland cats have enjoyed the Dukes for a long time now, and we are pleased to join in celebrations for them and for the man who brought them to us.

Sid has accumulated a number of other honors during the past year. Last August he became an Honorary Admiral of the Texas Navy, and just before Christmas, during a visit to New Orleans he became: Colonel-in-Staff of Governor Long, Honorary Citizen of New Orleans, Honorary Deputy Sheriff of the Parish of Jefferson, La., and an Honorary Member of the New Orleans Jazz Club, in addition to receiving the Mayor's Certificate of Merit. New Orleans is the home of the Dukes, and the renewed interest in Dixieland has reflected glory on their home town.

LOUDSPEAKER TESTING COMMENTS

Reactions to our comments on this page in the December issue are grouped at two opposite ends of the scale—very few being describable as mild. By and large, industry was unanimous in agreeing with us—not about the fact that someone had engaged in tests, but rather that the methods and the conclusions drawn therefrom were, perhaps, unreal. Similarly, many of our regular readers who are not in the industry agree that no listening test by a given group of people is valid with respect to the likes or dislikes of any particular individual.

On the other hand, some readers disagreed with us most heartily. They base their opinions on the idea that what sounds good to a group of presumably well trained listeners should therefore sound good to everyone. One objection—and we must consider this one valid—is that not everyone is so situated that he can drop into an audio showroom and listen for himself and that furthermore—and here we have to agree also, though we deplore the fact—even when he can, the demonstration facilities are often not ideal, to say the least. To this objection, we might suggest a cure: tell your dealer you will buy a speaker in a specified price range, but that you must be satisfied with the quality; try to persuade him to let you try out a few in your own home with your own specific listening habits—one at a time if necessary—but that you will keep one of those you try out. Naturally the ones you select for a home trial would be those you liked best in the store, with only the final decision coming from a more leisurely listening. Some dealers might go for it, others might not. But for a bona fide sale, we think it would be good business. At least, there is no harm in asking, and then you would end up with a speaker you liked and were sure you liked it.
The Army’s newest surface-to-air guided missile—the lethal Nike-Hercules—is now operational. Because it is, no unfriendly plane will be able to fly sufficiently high, fast or evasively to escape a fatal rendezvous with it.

For Hercules has a “brain”—an intellect that makes it a prodigy among today’s electronic robots. Bell Telephone Laboratories developed it. Western Electric (prime contractor for the entire missile system) is producing it. Douglas Aircraft Company is giving it its body.

This “brain” is a fully integrated guidance system, almost entirely land-based. Only the vital signal-receiving apparatus is expendable within the missile itself. Other highly practical features: it defies “jamming,” is completely mobile, is designed in separate “building block” units which are replaceable in seconds—and is deadly accurate.

Bell Labs scientists and engineers designed the world’s largest and most intricate telephone communications network for the Bell System. They developed about half of the Armed Forces’ radar equipment during World War II. And they pioneered the nation’s first successful air defense guided missile system—Nike-Ajax.

They were eminently qualified to give Hercules the brainpower it needed.
Realistic Bass Without "Boom"

BRUNO STAFFEN

The search for adequate bass has long occupied the interest of audiofans. One solution which appears to have considerable merit is presented by this author, and should be quite simple to try out.

This report on a design and construction project is intended for the audio-knowing music listener who has a tonal-range-balance memory. He has a reproduce system with all currently known elements potentially able to create live-sound illusion, and a latent interest in a possible important refinement. The purpose of this refinement is to obtain a truly noble bass sound without need for ear-splitting volume and, most important, without coloring the lower ranges of other instruments or voices. The power-handling capabilities and efficiency will allow him, if he must, to rattle windows.

Because we were concerned, in this project, with faithful tonal-range-hearing impression only, the work was done on a monophonic system. At the present state of the art, the performance of this system is at the best levels obtainable.

We were after a result that did not depend on such critical elements as interaction and room effects. We also were after a result that could be duplicated by others. The "we" are George Sellers of Altadena, California, and the writer. After much theoretical discussion of possible approaches, Mr. Sellers decided to undertake the construction and cost of the elements needed, with the writer supplying technical guidance.

Have you had the experience of standing within a few feet of an open door and being absolutely sure you were hearing a person talking and upon entering the room, found it to be a sound reproduction? If so, you've heard a truly superb reproducer, capable of faithful sound by the most critical standards. During my seventeen years of association with the engineering department of a loudspeaker manufacturing company, which maintains highest acoustic research and development standards and is generous with equipment and facilities, I've heard only a few. This includes all kinds and makes. If your instrument can be adjusted to obtain this kind of absolute realism, your pride is justifiable.

Now, leave all settings undisturbed and try the second part of the test. Play a recording with a representative group of music instruments. Does the bass sound have the permeating vitality and impact like the live performance you've heard? In these tests we are not using loudness extremes where ear audibility curves make enough of a difference to account for what is heard. Rather than confuse the issue with technicalities of recordings, levels, and microphones, I submit to you that at a given loudness range, as done in this test, our ears do not juggle tone controls with different live sound material content. If your sound has the impact of live bass with the above test, this article has nothing to offer. If not, I'm about to describe preliminary thinking and completion of a recent electro-acoustic project which gave highly satisfactory subjective results that you can surely duplicate.

The Problem

First, let me outline the problem so you can follow what we are trying to do. Many of us, with at least vestigial tonal-range memory, upon return home after a live music performance, have thoughtfully twiddled the bass lift knob on the music reproducer. We also wondered about getting the family or roommates to hold still for a bigger corner horn. Having experienced this live chest-thumping bass, we twiddle the knobs in the hope that through electronic circuits magic the same effect can be simulated at home. When the low bass begins to balance up about right, we become aware of a secondary (?) problem. Now, some of the instruments have acquired a changed tonal personality. The piano sounds "different." A viola becomes a hybrid cello. Instruments in what could be called alto or contralto range have acquired a baritone coloring. Let us assume our hero has returned home after an inspiring performance of the "Messiah." He's heard a choral group with perhaps a 30 or so instrument orchestra. The organ pedal plus perhaps two or three bass viols made a noble ground for the rest. With the reproducer, by the time he has electronically lifted his bass to approximate the impact heard at the hall, the human voices no longer

Fig. 1 (left) Typical electronic bass-lift curve. Fig. 2. (center) Acoustic output of typical enclosure-speaker with electrical bass lift of Fig. 1. Fig. 3 (right) Acoustic output of combined system. Main system adjusted for minimum coloration and bass lift provided by auxiliary amplifier and speaker. Shaded areas show increase which adds unwanted coloration.
sound clear and crisp. What happens?
To explain what happens, I must resort
to technical language and some illustrative
drawings. With a minimum of special-
ized jargon and gobbledegook, the intel-
ligent audio hobbyist will understand.
The sophisticated is asked to be tolerant.
Electronic lift and cut controls do not
affect just a restricted tone range of the
spectrum. They're designed to give a
maximum effect over a specified tone
range; but in operation, they also affect
adjacent tonal ranges. This adjacent
range influence gradually diminishes to
zero about 3 or 4 octaves away from the
range of prime interest. All commercially
available preamps have this typical vari-
able control behavior. See Fig. 1.
Based on the previously mentioned
years of electro-acoustic work, the writer
has found that the tonal range needing
acoustic output increase to obtain live
bass impact corresponds roughly to the
3rd and 4th octaves below middle C. In
practicable scientific numbers this is 50
to 100 cps. When the electronic-circuit
“boost” in this range is enough to get the
desirable hearing impact, because of the
adjacent-range increase inevitable with
these circuits, the first and second octaves
below middle C have also been appreci-
ably “boosted.”
It is this first-, second-, and some of the
third-octave range boosting that im-
parts the “barrel” qualities to human
voices and adds unnatural coloration or
“formant” to various other instruments.
In scientific numbers again, this un-
wanted increase is had over a range of
120 to 400 cps. Now the chart showing
the electronic lift obtained applies to
electrical signal only. Acoustically, if the
speaker system has an ideally linear re-

displacement over this range, the increase as
shown on the chart applies closely. But
the acoustic output of almost all enclo-
sure-speaker combinations is stronger
over this 120 to 400 cps range than the
adjacent octaves above and below. A few
really carefully designed systems for
“Laboratory Reference” use and some
theatre systems are smooth through this
range. So you can appreciate that enclo-
sure speaker systems of less than top-
level performance aggravate the colora-
tion problem with electronic bass lift.
For what this means in terms of acoustic
output see Fig. 2.
We can't rebuild our loudspeakers, so
what we need is an electronic method
to adjust or compensate the 120- to
400-cps range for no coloration of sound
and increase the acoustic output below
100 cps to where the low-bass impact is
satisfactory. To obtain a big bass sound,
the air around a listener has to be shaken
vigorously. With the main system low-
frequency electrical signal adjusted for
least coloration, the bass speaker can
put out just so much acoustic energy.
So the idea becomes to have it operate
thus and use an auxiliary bass reprodu-
cer and amplifier in addition to the original
system. We can now obtain a bigger
total “bite” on the air to impart a larger
movement to the acoustic wavefront for
chest thumping impact.
The bass auxiliary is to have negligible
contribution above 120 cps, so the aux-
iliary amplifier is “custom” modified to
minimize its electrical output at all fre-

Fig. 4. Suggested arrangement
of bass speaker. See text for general
description.

Fig. 5. Block diagram of connec-
tions between main system and
bass-lift auxiliary system.

The Low-Bass Speaker
This is not going to be a detailed con-
structional article on the speaker enclo-
sure. I propose to point out the im-
portant particulars in internal dimen-
sions and arrangement and allow you to
adapt the design to your particular ears
and styling wants. The prototype enclo-
sure was styled and built to harmonize
with the rest of the furnishings in this
friend's particular house. The basic en-
closure illustrated in Fig. 4 gives a set
of dimensions to use as a point of de-
parture. You can juggle the given inter-

dimensional shape to suit your furniture

design, but maintain the 15,500 cubic-inch
volume, and the duct cross section area
as shown. Where a firm dimension is shown,
do not change it at the risk of being
unhappy with the results and having to
discard costly wood panels. Firm dimen-
sions are 11-in. for duct length and a
7-in. minimum dimension for the space
between the enclosure back and duct

source
preamp
main amplifier
main speaker
low pass
bass amplifier
auxiliary bass speaker

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tightly sealed joints, and judicious use of bracing to reduce vibration modes.

For grille cloth or covering over the auxiliary speaker openings, the usual factors do not apply. Hi-Fi grille coverings usually are chosen to have minimum effect on extreme high frequencies. But we want a maximum effect even though there might be only vestigial amounts present. At last, decorative considerations can have precedence over acoustic effects. But it is especially important that the movement of air at the ducted reflex port not be constricted. We still want to impart a really good shake. But blocking or absorbing "highs" is no factor here. The prototype has wood "shutters" which are tilted, as shown in Fig. 5. They would roughen up high-frequency response but offer no air flow resistance for bass.

Any amplifier with 10 to 15 watts undistorted output at 30 cps will work fine. The Heath UAI was chosen because of simplicity and low cost with entirely adequate performance. Since all it has to do is to drive the auxiliary enclosure-speaker at 100-0ps and below, the input signal can be picked off the main amplifier after a voltage amplifier tube, or connected to the speaker terminals of the original amplifier. If you're one of our sophisticates, I won't presume to tell you how to obtain the low-pass response needed. For the rest of us who have no engineering background, a simple modification which is entirely adequate will be described. We will install a capacitor in the amplifier at a point where it will combine electrically with the original UAI design to shunt out frequencies above 100-0ps. From about 90-0ps going up in frequency, the amplifier output will gradually drop at 6 decibels per octave. This means that each time the frequency is doubled, the output voltage drops 50 per cent. When we reach the frequency of one octave above middle C (523 cps) the output is only one hundredth that of the desired fourth octave below. So the combined system can be adjusted to give an acoustic balance like that shown in the curve of Fig. 3.

The capacitor used is a 0.22áf 400-volt paper unit. On the UAI amplifier, it connects from pin #6 of U1 (6ANG) to any convenient ground. We used a grounding lug on the filter-capacitor mounting wafer. Because of crowded wires it would be desirable to use thin "spaghetti" insulating tubing on the added capacitor leads to eliminate possible unwanted shorting. To restore your amplifier to original wide-range operation, merely cut out the 0.22-0f added capacitor. A simple SPST switch will be installed to make the change painless.

Auxiliary Amplifier Connection

Input to the auxiliary amplifier is simply taken from the 16-0hm terminals of your present main amplifier, as shown in Fig. 6. The half-megohm auxiliary amplifier input will not even be noticed by the 16-0hm tap of your main amplifier. If your present amplifier has appreciable hum content, the auxiliary amplifier will boost this. If your added bass-speaker hum is troublesome, try two tests. First turn your preamp volume control to least loudness. If hum is still there, it is coming from somewhere after the preamp. Next disconnect the input terminal to the auxiliary amplifier. If it is gone, then your main amplifier needs attention. If not, then look into the auxiliary amplifier. The reason this hum subject is brought up is that we now have much electrical and acoustic power at lower bass frequencies. This is bound to magnify unwanted hum problems, but can be reduced to near vanishing levels. Unless your phono turntable is first rate, it too can become a rumble contributor. With this combined system, the peak power rating at low bass frequencies is your main amplifier power plus the auxiliary amplifier. The prototype uses a nominal 25-watt amplifier for the main system, which together with the 12 watts of the auxiliary equals 37 watts of low-bass electrical power. The two speakers used are both of high conversion efficiency so you can imagine the air shaking at low bass tones can be made quite fearsome!

Because there is no directivity problem with low bass tones source, the auxiliary speaker can be located anywhere in the room relative to the more critical main speaker system. The ideal position is, of course, in a corner. In fact if there is a normally open doorway or archway into an adjoining room, use the adjoining room for the auxiliary speaker enclosure. Run just the speaker connecting wires and keep the modified amplifier at the master control or equipment place. For this enclosure one thing is important. Weight the enclosure or wedge it some way to prevent "dancing" at low frequencies. Remember, we want it to shake air rather than itself!

Before "buttoning up" the installation, check the acoustic phasing of the combined system. At your favorite listening area, make sure the combined bass outputs add instead of cancel.

To check the phasing of acoustic energy, have an assistant hold the auxiliary speaker wires on the auxiliary amplifier output terminals. There will be an absolute maximum of about 15 volts at these terminals, so the shock hazard is slight. With bass tone input of say 50-0ps or music content, listen in your favorite listening area. At your signal, the assistant is to do a quick wires reversal while you listen for change in bass level. Use the connection "polarity" which gives the best bass.

To balance the system, set the preamp controls to give you the sound with least colorations from the main speaker system. Then turn up the gain on the auxiliary amplifier to obtain the bass fill-in you want. Now the preamp controls will give you over-all loudness control and will allow trim-up on response balance. You're ready to start enjoyment of your

(Continued on page 86)
Converting the Revere or Wollensak Recorders to Stereo

JOSEPH F. DUNDOVIC

This simple conversion makes it possible to perform both stereo and monophonic recording and playback using the new quarter-track system. Similar conversion techniques can be used on many other machines.

The field of tape recording has been marked by numerous advances. From the original wire recorders it has progressed to full-track tape, then to half-track monophonic, staggered stereo, and about two years ago to “in-line” stereo. Recently a new step has been taken which is just as revolutionary. The quarter-track “four-channel” system was introduced, which permits stereo tapes to be played in both directions.

Four tracks are recorded on the tape, two being used for one direction of travel, and two for the other direction. See Fig. 2 for track dimensions and spacing. The quarter-track recording head still has two channels, but the track width is approximately half that of the old system. Alternate pairs of tracks are used at a time: 1 and 3, or 2 and 4. By turning over the reels (similar to playing the reverse side of record disc) the second pair of tracks may be selected. Some recorders possess two pickup heads and reverse the direction of tape travel to accomplish this selection.

In the RCA Victor system of quarter-track stereo, the tape is completely enclosed in a compact plastic case which

* The Nortronics Company, Inc., 1015 S. Sixth St., Minneapolis 4, Minn.

is easily slipped into and out of place on the recorder, a specially designed and constructed machine which is not compatible with standard reels. Reel type recorders also will not accept the RCA magazine. Most major recorder manufacturers have magazine-type machines in production.

Advanced techniques in the manufacture of heads and tapes have resulted in such improvement in the high-frequency response that 3.75 inches per second has been selected as the standard tape speed for the quarter-track stereo system. The finer gaps (0.1 mil) and laminated-core construction of the quarter-track heads actually produce a frequency range out to 15,000 cps at a lower tape speed. Signal output from the new heads averages 2 millivolts at 1000 cps.

The combination of thinner tapes, half-speed, and the quarter-track system, permit the almost unbelievable amount of over four hours of stereo music on one 7-inch reel of tape. Needless to say, the price of stereo tapes has taken a tremendous drop, making

Fig. 1. Stereo recording setup, with AM-FM stereo tuner and additional recording amplifier used with converted Wollensak tape recorder.

Fig. 2. Quarter-track system of track spacing in relation to the erase and the record/playback stereo heads.
them fully competitive with the stereo discs. Tapes also have the advantages of allowing repeated playings with no deterioration of quality.

Quarter-track stereo recorded tapes on reels are now available in plentiful supply through retail outlets. Magazines for the RCA machines are also on dealers’ shelves. Owners of quarter-track players with reels can remove the tape from the magazines and rewind onto reels.

Thousands of owners of monophonic and two-track stereo tape machines are now faced with the problem of obsolescence. It is, of course, impractical to try to convert older tape recorders to accept the new magazines. However, it is a rather simple matter to install one of the new quarter-track stereo heads so that the reel-type tapes can be played. In fact, by the substitution of stereo erase and record heads, and the addition of a recording amplifier, stereo recordings may be made in the home directly from the radio, stereo discs, or live programs. The ability to record stereo is the tremendous advantage tape has over discs.

Conversion of Revere and Wollensak

This article will describe a representative conversion of the Revere and Wollensak recorders to stereo recording and playback. Similar techniques may be applied to other machines, some of which are easier to convert, and others more difficult.

Both the Revere and the Wollensak have a similar head nest construction. The monophonic machines use a combination record/erase head (Shure TR-5). This head is mounted on a brass base plate which pivots on a pair of brass pins, and is held down by a spring clip.

The half-track (two-channel) stereo machines differ in that they use the Shure 1/2-track record/playback stereo head in combination with a separate single-channel erase head which erases the top track for monophonic recording. The same basic mounting plate is used in the stereo machine, which has a built-in preamplifier for the second channel. Fundamentally there are two steps in the conversion:

1. Conversion to 1/2-track stereo playback.
2. Conversion to 1/4-track stereo recording.

These two steps must be taken in the above order, but not necessarily at the same time. Stereo recording may be added at any later time after the playback function has been acquired.

A stereo erase head is recommended for step one since it is as easy to install as the monophonic erase head and the progression to step 2, for stereo recording, is accomplished with a minimum of effort.

Figure 3 shows the new quarter-track erase head (left) and record head (right) mounted on the brass base plate from the recorder. The stacked erase head pictured is the Nortronics Model SE-50-WR. The record/playback head is also made by Nortronics and is the Model TLD-L1-WR, having laminated cores and a smooth, flush type face. These heads may be ordered through your local dealer at $12.50 for the erase head and $21.60 for the record head.

(Continued on page 63)
Sound Distribution at the Brussels Exhibition

A. V. J. MARTIN

Differing from most sound transmission systems, the distribution throughout the exposition area is accomplished by FM radio links, with separate receivers being employed at each loudspeaker outlet.

AN EVENT OF INTERNATIONAL IMPORTANCE, like the Brussels Exhibition, had to have a sound distribution system capable of creating a musical background of a quality which suited the high cultural achievement it intended to display. The problem was not easy, if only because of the variety of environments scattered over a distance largely exceeding one mile. After careful planning, it was decided that four simultaneous programs would be necessary. They could be broadcast either from a specially provided studio, or from several points on the Exhibition grounds, and could originate from microphones, records, magnetic tapes, radio programs, and telephone lines.

The total area was divided into several zones, each receiving a different program.

However, provision had to be made for instantaneous connection of all sound sources to a common program, so that announcements of a general interest or emergency messages could be heard everywhere.

This ambitious project met with a number of difficulties. It was soon apparent that the use of underground cables was impractical, and that a radio link was necessary. Then the high-quality requirement and immunity to the numerous interferences pointed to the use of frequency modulation, and consequently to short wavelengths in the VHF range. When the specifications were finally frozen, less than one year was left to design, test, and install the system. The final design, due to SBR, uses five 250-watt FM transmitters, feeding some 450 sound sources, each

Fig. 1. Map of the Brussels Exhibition. 1: Central Control Room. 2: Great Square. 3: Garden. 4: Auditorium. 5: Elegance Pavilion. 6: Silent Zone. 7: Amusement Park, independent sound. 8: Joyous Belgium, independent sound.

* 4916 Forbes St., Pittsburgh 13, Pa.
made of one receiver and four loudspeakers. A few cable links have been provided over short distances, mainly to pipe to the control room signals received in two special pavilions nearby. Figure 1 shows the different zones in the Exhibition. Roughly speaking, the left half receives program A, and the right half receives program B, with the exception of the wooded zones, where a special program of birdsongs is received. Also, at the extreme right, a silent zone 6 is provided, where peace-lovers can take refuge and relax.

The control room, in 1, is cable-linked to the four points 2, 3, 4, and 5; the last two being the Grand Auditorium and the Elegance Pavilion.

Zones 7 and 8 are respectively the Amusement Park and the Joyous Belgium Fair, and have an independent sound distribution.

Transmitters

The rather stringent main specifications for the transmitters were:
- Pre-acentuation: 50 ms.
- Frequency stability: without modulation ±0.002 per cent; with ±75 kc/s modulation ±0.001 per cent.
- Frequency accuracy: ±0.0003 per cent.
- Temperature range: +15 to +35 °C.
- FM noise: better than 55 db below the full modulation level.
- AM noise: better than 50 db below 100 per cent modulation level.
- AF distortion: better than 2 per cent from 30 to 15,000 eps.

They have been largely met by the design shown in block form in Fig. 2. It uses the Marconi system, where the crystal-controlled oscillator is frequency modulated by a reactance tube.

The a.f. signal enters a cathode follower, whose cathode load embodies the RC filter for pre-acentuation. Then there is a balanced modulator, to drive the reactance tube, shunt-connected across the oscillator.

The oscillator is controlled by a quartz crystal, which is part of a filter coupled to the plate circuit. Thanks to a special cut, the crystal can follow, between limits, the frequency variation due to the modulation, while at the same time controlling the central frequency of 4 mc approximately. Feedback to maintain the oscillator is provided by the grid winding coupled to the plate circuit. The grid is AGC-controlled to eliminate amplitude modulation.

The oscillator is followed by an r.f. amplifier, the output of which is rectified by a diode to provide the AGC voltage. Then come four frequency-multiplying stages, the last one symmetrical and doubling as a 3-watt driver for the final 250-watt push-pull output.

A variety of control instruments is included: a.f. test oscillator, frequency deviation indicator, calibrating quartz-controlled oscillator, and monitor.

Each transmitter is made up of four separate shielded units: modulator, frequency multipliers, output stage, power supplies. These units in turn are mounted in metallic closets with only the necessary forced ventilation openings.

Radiation is thus kept to a low level, less than 100 µv/m in the building.

The chosen frequencies are 76.60, 76.95, 77.65, 78, and 78.35 mc outside band II to avoid interfering with the radio programs. Despite the limited transmitter power the Exhibition programs have been received several hundred miles away.

The aerials are simple dipoles on the roof of the building.

A control bay receives all program inputs and distributes them to the various transmitters, at a standard level.

Reception

The 450 or so receivers are all of the same type, represented in block form Fig. 3. The r.f. amplifier is a grounded grid E92/6AB4, followed by a fre-
frequency changer and three i.f. amplifying-limiting stages. Then comes a discriminator, a first a.f. amplifier followed by an adjustable correcting filter, a second a.f. amplifier, a phase splitter, and a pair of ELS4’s in a 10-watt push-pull output stage. Each receiver can be tuned and locked on any of the five transmitted frequencies.

The design stems directly from the specifications. In particular, an output variation of no more than 3 db was indicated for a variation of input level of 10 µv/m to 0.1 v/m. This could only be met with two limiting stages. The specified signal to noise ratio was 20 db minimum for r.f. signal of 2 µv/m with a deviation of 24 k± 400 eps. This dictated the use of the r.f. stage.

The small frequency spacing between channels made compulsory a high stability of the local oscillator. This was obtained by an automatic frequency control, hence the symmetrical discriminator, to drive the resistance tube.

It was also necessary to mute the receiver in the absence of an r.f. carrier, to eliminate unwanted noises. A squelch circuit was then added, which cuts-off the a.f. for input signals below 5 µv.

The output stage feeds a cluster of four loudspeakers, each of 8-in. diameter, to ensure a good sound diffusion. Two of the loudspeakers resonate at 60 eps and two at 80 eps, to provide a certain amount of low-frequency equalization.

Since the receivers work in the open, they had to be designed for a wide range of climatic conditions, including in particular temperature variations of 40° C. Actually, during the first nights the temperature went down to 0° C, and during hot summer afternoons, some of the receivers were exposed to the sun, with the results that one could almost fry eggs on the cabinets. Still, they carried on undisturbed.

Each receiver has a closed metallic cabinet and is placed in a metallic box used as an acoustical enclosure for the loudspeakers. A rudimentary aerial is provided. The design varies according to the location.

Special Zones

Cables have been used to link the control room 1 to the Great Square, 2, and the garden, 3.

The Great Square (Grande Esplanade) is frequently used for sport or folklore shows, and it is necessary then that its loudspeakers be used for the appropriate commentary.

The Garden (Jardin des 4 Saisons) deserves a special mention. It is believed to be the first serious attempt to present hi-fi in the open. The equipment comprises three Williamson-type 60-watt amplifiers. Figure 4 shows how the signal program, coming by cable from the control room, is split between two pre-amplifiers, one for treble and one for bass.

(Continued on page 78)
YOU
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Masterpiece

The
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TAPE RECORDER
Developed & Guild-Crafted
by
Philips
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We feel that the Stereo version of the Norelco 'Continental' is the ideal tape recorder for those recordists, high fidelity enthusiasts and music lovers who seek a professional quality machine at a truly modest price. The data listed here, represent painstaking, conservative and substantiated laboratory measurements. If you find that these data satisfy your technical requirements, and reflect those qualities that you consider mandatory in your stereo equipment, by all means listen to the Stereo version of the Norelco 'Continental' at your favorite HI-FI center or Camera store. There, we feel sure, you will agree with us that the Norelco Stereo 'Continental' is, indeed, a modern masterpiece . . .

For further descriptive literature write to:
NORTH AMERICAN PHILIPS CO., INC.
High Fidelity Products Division
230 Duffy Avenue, Hicksville, L. I., N. Y.
Double-Duty Disc-Hop Consolette

JOHN WHITACRE

When you can’t find the sort of equipment you want on the market, build it yourself. Then you can be sure that it will do exactly what you want it to do—as one station did. A real multipurpose device!

W hat is a Disc-Hop Consolette? At our station the name has come to mean: A complete audio consolette designed primarily for use by a disc-jockey to "spin records" for a crowd of dancers.

It is logical to assume a Double-Duty Disc-Hop Consolette can do another job besides the one mentioned above. At our station it is used to provide excellent facilities in the auxiliary control room.

A disc-jockey playing records for dances instead of a band or orchestra, is this a new idea? The idea has been popular in the Central Michigan area for some time. No doubt some parts of the country have been doing this longer than we have.

There are a few of you big station engineers who are going to read this and say: Why build a special unit just to play records over a P.A. system? We just grab a transcription turntable, a public-address amplifier, a handful of wire, and we're in business.

That's fine for you fellows who like hard work. However, I'm sure the unit to be described will run circles around you for ease of setting up, convenience in operating, and professional appearance. Besides, it works beautifully as a standby unit at the studio.

The Original Idea

Until two years ago our station borrowed a couple of transcription turntables from the auxiliary control room, borrowed a public-address system, and used a Collins 15Z-2 Remote Amplifier, as our portable unit. It worked fine, but we found it to be time consuming to move and hook up for a show. Our way was old fashioned and expensive. Possibly it could be improved.

With this thought in mind, I called on our company president. Since he was formerly our chief engineer, I anticipated a sympathetic ear. After hearing me out, the program director and the publicity director were summoned into his office. Three meetings later plans were complete for giving our station a Double-Duty Disc-Hop Consolette.

Right away it had been decided not to restrict its use for just doing disc-jockey dances. It would be constructed to allow its full use at the studio when not on remote or dances. This meant it should have provisions for not only programming but auditioning as well. Our mixer amplifier would need at least two microphone channels, a 600-ohm line-level input channel. A way must be provided to mute speakers when used at the studio, but still allow them to be on all the time when doing dances. A cue amplifier should be included so we could cue records prior to broadcasting, listen to the cue on the 600-ohm input channel, or listen to the program on a pair of earphones. Earphones were to be used on the cue amplifier because experience had taught us cue material could not be heard above the public address speaker at some dances.

To make it even more convenient for doing dances, it must be light in weight and easily moved through doors and up stairs. Building everything into an attractive desk seemed like a good idea. Certainly it must have showmanship without being "gaudy." A minimum amount of time must be spent moving it and making ready for a broadcast or dance.

From the announcers' and operators' standpoint, it must be simple to operate. The engineers said reliability was a necessity.

A twenty-five watt public-address amplifier and a speaker with its floor stand would be the only items we couldn't get into the desk.

Past experience had taught us two-speed, twelve-inch turntables with various damped tone arms were fine companions for doing record dances. If we were content to play 16-inch transcriptions on another turntable when the...
Reduce record wear...

Less mass, higher compliance with G.E.'s
"Golden Classic" stereo-magnetic cartridge

The more moving parts, the more resistance to groove motion. General Electric's "Golden Classic" has only one moving part—the stylus—which "floats" freely in special-formula damping cushions. This means freer motion in the record groove. You get less wear on records and stylus, and superior sound at all frequencies. Hear the "Golden Classic" GC-5 or GC-7 soon. You'll agree they are a fitting climax to the famous General Electric cartridge tradition.

- Plays both stereo and monaural records
- Frequency response, 20 through 20,000 cycles
- Output 8 mv
- Effective mass of stylus about 2 milligrams
- Lateral compliance $4 \times 10^{-6}$ cm/dyne
- Vertical compliance $2.5 \times 10^{-6}$ cm/dyne
- Recommended tracking force with professional-type tone arm 2 to 4 grams. (Specifications for Model GC-5)

Model GC-5 (shown) with .5 mil diamond stylus, $26.95.
Model GC-7 with .7 mil diamond stylus, $23.95. Model CL-7 with .7 mil synthetic sapphire stylus $16.95 (Manufacturer's suggested resale price).

Smooth response on both stereo and monaural records. Consistently high channel separation, because the stylus is magnetically linked to the coils.

TM-2G "Stereo Classic" tone arm

A professional-type tone arm designed for use with G-E stereo cartridges as an integrated pickup system. Unusual two-step adjustment permits precise setting of tracking force from 0 to 6 grams. Lightweight, brushed aluminum construction minimizes inertia. Statically balanced for minimum friction, reduced stylus and record wear $29.95 (Manufacturer's suggested resale price).

See and hear the G-E "Stereo Classic" cartridges and tone arm at your Hi-Fi dealer's now. For more information and the name of your nearest dealer, write General Electric Company, Specialty Electronic Components Dept., 44A2, W. Genesee St., Auburn, New York.
Build It Yourself

A birch plywood desk measuring 24" wide, 48" long, and 26" high, was built for us by a local lumber company. To take away the "boxy" appearance, both ends of the desk were slanted inward at the bottom. Six inch maple legs were mounted under the desk. This raised the desk top to 32 in. We have found this to be a comfortable operating height when seated. Three-quarter inch plywood was used for the desk top and one-quarter inch plywood was used on the front of the desk. The rest of the desk was made from one-half inch plywood (see Figs. 1 and 2).

Two compartments for record storage and two drawers for parts storage were provided. The drawers were equipped with magnetic catches so they wouldn't fall out when the desk was being moved (see Fig. 2).

Inside the desk, near the front, a shelf was made to hold the public address amplifier.

After the desk was completely assembled, it was given two coats of outdoor spar varnish. It was well sanded before the first coat of varnish was applied and rubbed thoroughly with steel wool after the first coat was dry. When the second coat of varnish was thoroughly dry, a good grade of furniture wax was applied.

On the left side of the knee-opening in the desk, an a.c. switch and three duplex outlets were mounted. This switch controls all the power distribution for all the units mounted in the desk.

A housing for the mixer-amplifier was constructed by a tinsmith from #18 gauge sheet metal. Its dimensions are 10 1/4" deep, 18" long, and 8" high. Inside the housing a pair of slides are welded, one on each side near the bottom. These serve as guides to aid the serviceman in removing and replacing the mixer-amplifier into the housing with a minimum of difficulty. An opening was left in the back of the housing 3" high and 17" long so jacks and plugs could be easily inserted or removed from the mixer-amplifier chassis. The housing was primed and given two coats of black automotive enamel, after which it was treated with a coat of automotive wax.

For the mixer-amplifier, an aluminum chassis 3" x 17" x 10" was used. Steel chassis-mounting brackets were used to hold the front panel to the chassis.

The front panel for the mixer-amplifier was cut from a sheet of 1/16" aluminum. After all holes and cutouts were made in the panel, we had it anodized gold. As a finishing touch, two handles were provided for lifting the amplifier from its housing. Engraved plastic labels were attached to the panel to identify the control functions.

Presto, Model T-2, two-speed, turntables were mounted on the desk top along with Gray viscous-damped transcription arms. It was necessary to place a one-half-inch block of plywood under each transcription arm to bring the arm up to the height of the turntable.

The transcription arms are equipped with Pickering Model D-140 phonograph cartridges. Very little trouble is experienced with the cartridges skipping or jumping when they are jarred. We attribute this feature to the viscous-damped transcription arms.

Circuitry

Referring to the schematic diagram of the mixer-amplifier Fig. 3, it is quickly recognized as a miniature audio console.

To keep the cost down, we employed as few transformers in our circuitry as possible. Then too, since all units would be housed in the desk, it was felt there should be no drawbacks to using high-impedance mixing. Using two 12AY7 tubes for our program amplifier may seem a little strange to you, but my reason for using them will be outlined later.

Both phono preamplifiers employ a 12AY7 tube in a "lossy-type" equalized preamplifier circuit. They were used because they had low hum level, less microphonicity, and showed evidence of more stage gain than any tube we had tried previously. These stages give us plus or minus 1/2 db variation from 30 to 20,000 cps when using the Columbia Standard RIAA test record. A "scratch filter" is provided by inserting the 0.05-µf. capacitor and the 5100-ohm resistor across the input to each stage with the switch Sw1 or Sw2. Using the filter causes a rapid loss of high frequencies above 4000 cps.

In the intermediate program amplifier stage, one-half of V1, another 12AY7 tube was used. This stage was thought of as another preamplifier stage than as a driver for the program amplifier. With this reasoning, the 12AY7 tube was selected here for the same reasons it was used in the phono preamplifier stages.

For microphonic preamplifier tubes, we chose the 12AX7. It meets all demands for low noise and excellent frequency response. A 3 db rise in frequency response is noted at 30 cps over what it is from 70 to 20,000 cps. In other words, the preamplifier is flat from 70 to 20,000 cps within 1 db. Most microphones have a drop in their response below 70 cps, so we accepted the 3 db rise at 30 cps without reservation.

Some years ago the United Transformer Co. developed a portable remote
A complete, versatile stereo control system

G-E "Stereo Classic"—40 watts of clean, balanced power

General Electric's MS-4000 "Stereo Classic" Amplifier provides every useful variation in stereo and monaural amplification, quickly and easily controlled by a single set of knobs.

The balance control gives you maximum stereo effect without overloading one channel when the other is cut down. A new contour control provides smooth, gradual bass boost, while the speaker phasing switch saves manual phasing. Be sure to see and hear the MS-4000 soon.

OUTSTANDING PERFORMANCE FEATURES

* Full, balanced 20-watt output from each channel (28 watts per channel music power) * Flat response within 0.5 db from 20 to 20,000 cycles * High sensitivity, extremely low hum and noise * MS-4000 $169.95* MS-2000 (28-watt Amplifier) $129.95*

New G-E Remote Control RG-1000

Now you can get the best stereo perspective without moving from your chair! Two knobs permit adjustment of channel balance and volume up to 30 feet from the amplifier. Especially useful in stereo because of individual preferences for channel balance and audio variations. May also be used as volume control with monaural amplifier. 30-foot cord included. $14.95*

*Manufacturer's suggested resale prices.

FM-AM Tuner FA-12

Receives even weak signals with unusually low distortion, hum and noise level. No audible drift. Visual meter provides FM center channel tuning and maximum AM signal tuning. RF amplifier stage in both FM and AM increases sensitivity. FM multiplex jack for stereo adaptor. Built-in AM antenna; folded FM dipole included. $129.95*
broadcast amplifier which used 12AY7 tubes as a driver and output stage. Their circuit offered advantages we wished to adopt for our mixer amplifier output stage. We wanted to use a minimum number of tubes and employ as few spares as possible. By using the UTC circuit we could carry as few as one 12AY7 to replace any one of five 12AY7's that might go out in the mixer-amplifier. By using an interstage transformer, we could accomplish a phase-splitter stage and stage gain at the same time. Our initial cost would be greater, but there would be no tube to worry about going bad. The circuit afforded another advantage. We wanted to keep the power-supply drain to a minimum. By using low-current-drain tubes, we could do it. Even with all these advantages, we almost changed the circuit to a tube phase-splitter stage.

Construction Hints

Like nearly everyone, we were in a hurry to see how the mixer-amplifier was going to sound before taking any measurements on it. With all the controls turned down, it was plugged into the electrical outlet. As soon as the amplifier warmed up, the VU meter needle nearly went through the side of the meter case. The meter was disconnected and a pair of earphones plugged into the amplifier. Listening revealed nothing in the way of hum or oscillations. However, the oscilloscope showed an oscillation taking place around 30 kc. The oscillation was finally extinguished by swamping the grids of V7 with 100,000-ohm resistors and putting a 20-μF capacitor from grid-to-grid of the same tube. Later, measurements indicated we had not damaged our intended frequency range by doing this.

A 600-ohm input channel was provided on the mixer amplifier so a third turntable might be used. A tape recorder or remote line may also be fed into it. It is a balanced input, padded 30 db, so that zero db input will place the mixer control at 12 o'clock.

You will notice we placed a 10,000-ohm resistor from the grid of V5 to ground. This was done after it was found we could overdrive V5, thus creating over 3 cent distortion in the output. Had we exercised enough foresight to use larger building-out resistors and a smaller master gain control, this resistor probably would not have been necessary.

One-half of V5 is used to feed about

---

Get big-speaker performance in a "stereo-compact" enclosure

General Electric's LH-12 "Stereo Classic" Speaker System combines enclosure compactness with full, smooth response over the entire audio frequency range. The complete unit — with woofer, tweeter and crossover network — occupies only two cubic feet of space.

But small size is gained through no sacrifice in sound. G.E.'s new Extended Bass design puts out four times as much power (+6dB) at low frequencies as standard 12" speakers in the same enclosure. For superb stereo sound, we invite you to compare this system with all others, regardless of size.

Complete LH-12 Speaker System in four most wanted finishes at $129.95*. LC-12 and LK-12 Speakers available for separate mounting at $89.95*.

LH-6 Bookshelf Speaker System

Only 9" high, 17½" wide and 8½" deep, yet provides better low-frequency response than speakers tested in enclosures up to twice the size. Perfect solution to problem of getting high quality performance in a limited space. May be positioned on side or end, as shown at right. Also offered as kit without enclosure. From $49.95 to $57.50* (Kit form, $29.95).

New EN-50 5-cu. ft. enclosure for 12" speakers available in four finishes. $69.95.*

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*Manufacturer's suggested resale prices.

See and hear all the new G-E "Stereo Classic" components at your Hi-Fi dealer's now. For more information and the name of your nearest dealer, write General Electric Company, Specialty Electronic Components Dept., 45A2, W. Genesee St., Auburn, New York.
one volt to the input of the public address amplifier through the volume control. \( R_v \) is a three-position lever switch which selects program, audition, or an external input, for the public address amplifier. We use a radio tuner to feed the external input when doing remotes with this unit.

One-half of a 12AU7 is used for the cue monitor. A three-position lever switch selects program, phono cue bus, or the auxiliary input channel, to be amplified and fed to a pair of earphones. This switch, \( Sw_6 \), has a spring-return and upon releasing it, it always comes back to monitoring the program bus. A voltage-divider is connected across the amplifier line-output terminals. We chose this method of monitoring the program so that when the unit was used on broadcast remotes, the operator would be able to hear cue on the remote line. All audio levels appearing on the earphones from the cue amplifier are well balanced from the three sources.

The VU meter is connected across the amplifier output through a 10,000-ohm resistor. It indicates 100 per cent or zero VU when the amplifier is actually putting out plus 4 dB.

A 4-db "0" pad is placed between the amplifier output and the line terminals. Its purpose being to cause the amplifier output and remote line to "look into" a nearly constant 600-ohm load at all times. It also keeps the VU meter from being damaged if someone feeds excessive cue level down the remote line from the studio.

With the VU meter indicating zero when the amplifier is putting out plus 4 dB into the pad, this means we are feeding the remote line zero dB.

In our power-supply circuit, we used a 20-ohm Global resistor in series with one side of the primary winding. For those of you who might have had unpleasant experiences with the Global resistor in television sets, may I suggest using a regular 20-ohm, 20-watt wire-wound resistor. However, at the time of this writing, the original Global resistor is still operating perfectly.

By using the Global resistor, we eliminate the voltage surge when the amplifier is first switched on. This will prolong the tube filaments. It reduces transformer heating by lowering the primary voltage. It reduces the available filament and plate voltages. The former was desirable and the latter was no disadvantage. The amplifier filament voltage is 6.0 volts to prolong its tube life. We had plenty of available plate voltage to spare, so inserting the resistor in the primary of the power transformer was to our advantage.

On the filament winding of the power transformer, the center tap has been brought out to a voltage divider in the plate-supply circuit. This was a precaution against hum originating in the filament circuit of the preamplifier stages.

Both phone channels are equipped with "one-switches." This was done as an experiment to see what could be accomplished along this line in high-impedance mixing circuits. Then too, it was a necessity if we were to listen to cue from four sources with a three-position, spring-return lever switch. We wanted to retain the spring-return feature so that upon releasing the cue switch, it would always return to monitoring the program circuit.

The "one-pots" were constructed by mounting each phono-channel potentiometer on a small sub-chassis and then fastening a small Mierswitch under the extended potentiometer shaft (see Fig. 4). A flat spot was filed into the potentiometer shaft where the Mierswitch lever would rest when the potentiometer was closed. A normally-closed Mierswitch was selected for the purpose. When the potentiometer is in the closed position, the Mierswitch is making continuity and when the potentiometer is in any position other than closed, the Mierswitch is not making continuity. After assembling the two parts on their sub-chassis, the completed unit was mounted to the back side of the front panel with countersunk machine screws.

Our "one-pots" have worked very well and without a failure for some time now. They are noiseless from an electrical and mechanical viewpoint. In fact, it wouldn't surprise us to see some manufacturer come out with this idea in the near future.

Carbon-deposited potentiometers (Olmite) with a linear taper were used for all mixing and volume controls except the public address volume control where an audio taper was used.

Building-out resistors for the program and audition busses are 100,000 ohms. Very little interaction is experienced between mixing controls. Using 470,000-ohm building-out resistors would have given us even less interaction between controls.

Bus-bar was used to make the mixer busses. The program and audition busses are physically separated by about one inch. Cross-talk is down about 50 db between the two busses. However, the

(Continued on page 72)
NOW...

THE MARK
OF
CONTINUED LEADERSHIP

Stereo Fidelity
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Pilot

3 New Stereophonic Components
by
Pilot

We have advanced upon a new era in high fidelity—the age of stereo. And now we can enjoy music reproduced in its original sculptured dimensions with all the spatial breadth and depth of the living sounds.

Stereo fidelity is high fidelity at its ultimate best. And its demands upon equipment quality are rigid and uncompromising. For only through quality equipment can the realism of stereo be effectively achieved.

It is with considerable pride, therefore, that Pilot presents three new stereophonic components: The SP-210 stereo preamplifier, and two basic stereo amplifiers, models SA-232 and SA-260. Brilliantly engineered, the monophonic and stereophonic performance of these units reveals the painstaking care devoted to design.

The SP-210 consists of two identical preamplifiers with ganged controls for balanced stereo operation. Every measure has been taken to achieve maximum quality and versatility. Premium type, low-noise triodes are used in all low level stages, and hum-free dc on all tube heaters. Inputs are provided for all possible stereo source material: phono, tape head, microphones, FM-AM, FM multiplex and tape recorder. The extreme sensitivity of the phono input makes the SP-210 ideal for magnetic stereo cartridges, as well as for other types of pickups. There are also outputs for connection to a stereo tape recorder.

The SP-210 is housed in a modern, low silhouette metal cabinet with brass control panel. It is matched to, and powered by the Pilot SA-232 or SA-260 amplifier. The Pilot SP-210 is $89.50, complete.

Both the SA-232 and SA-260 basic stereo amplifiers consist of two identical power amplifiers. The SA-232 delivers a total of 40 watts undistorted (80 watts peak). Distortion: harmonic 1%; intermodulation 1.5%. Hum, 90 db below rated output. Total output of the SA-260 is 70 watts undistorted (140 watts peak). Distortion: harmonic 0.5%; IM 1%. Hum, 90 db below rated output. Each amplifier has power tap-off for the SP-210.

The SA-232 is priced at $89.50, and the SA-260 at $129.50. Both are supplied with brass finished metal covers. (Slightly higher in the western states.)

Complete specifications at your high fidelity dealer or write to Pilot Radio Corporation, 37-04 36th Street, Long Island City 1, N. Y.

Electronics manufacturer for more than 39 years.
Transformer Distortion

DUNFORD KELLY

The causes of distortion in transformers are fairly well known to transformer engineers, but there is little the user can do to avoid it. However, a thorough understanding of the parameters which cause distortion and the effect of core material, size, stacking, and operating conditions will help engineer and experimenter alike in their choice and use of transformers.

Audio transformers produce severe distortion at low frequencies, frequently more than the associated vacuum tubes create. Despite this fact, transformer distortion information is practically non-existent. One obstacle has been the requirement for an extremely pure sine wave for such measurements.

The data to follow may be applied, with simple calculations, to any transformer not carrying direct current, with known flux density, low-frequency impedance relations, and type of core material. Even without design information, distortion approximations are possible. Commercially available core materials have permeability tolerances as high as two or three to one in the better core materials. This reduces the possible accuracy of transformer calculations, but the results can still be very useful.

Distortion Source

Distortion is caused by the ferromagnetic core material, which is required in an audio-frequency transformer to produce sufficiently high electrical impedance. The value of the core material is its high magnetic permeability compared to the permeability of space. Available permeabilities range from slightly above unity to hundreds of thousands. Unfortunately, in a general way, the higher the permeability the lower the power handling capacity and the lower the maximum frequency at which the core material is suitable. All ferromagnetic materials are non-linear and therefore generate distortion. The distortion produced in a transformer depends on the relative circuit impedances, the type of core material and the flux density; not at all on coil configuration, shunt capacitance, and the other factors that determine high-frequency characteristics.

Ferromagnetic Theory

Ferromagnetism is complex, but some of the properties may be considered in an elementary manner. Ordinary ferromagnetic materials are composed of many crystals. These have no definite arrangement. Each crystal, even though unmagnetized, consists of many very small magnets, called domains. These have a random arrangement. Therefore they produce no over-all magnetism. When an external magnetic force is applied, the first effect is thought to be the realigning of the domains originally aligned in the general direction of the applied field, at the expense of the other domains. This slightly increases the flux density in the material. With greater applied magnetic force, the domains begin to realign themselves to the crystal axis nearest the direction of the applied field. They do not do this by moving bodily, but by a realignment of the axes of rotation of the individual electrons within the domain. The entirety of one domain orient simultaneously. Each reoriented domain increases the flux density, which therefore changes by extremely small but finite steps. This mechanism produces the region of highest permeability. A third effect further increases the flux density. With sufficient applied field, the domains smoothly shift direction from the crystal axes to which they had previously aligned, to the direction of the applied field. When this third effect is completed, the magnetic material is fully magnetized, or saturated, and can carry no additional flux. The space which surrounds the magnetic material can carry more flux, but because the permeability of space is only unity, this contribution to the total flux is generally negligible.

Magnetization involves the mechanical activity just described, and it requires the expenditure of energy. When the magnetized material is demagnetized, not all of the expended energy is recovered. The lost portion is converted to heat. This loss is termed hysteresis loss and is common to all ferromagnetic materials. At very low flux densities this loss disappears, because the physical reaction ceases. The resultant distortion also ceases.

Measurement Technique

Only the strongest harmonics were recorded in these measurements because they are the important ones, but the higher odd-numbered harmonics continued uniformly down the graphs at the highest flux densities. The even numbered harmonics were not present because no direct current was present. These measurements were made with a conventional assembly of laminations of ordinary size, rather than the long strips used in standard transformer core metal tests. The results, therefore, closely approximate actual transformers.

An exceedingly pure sine-wave voltage was impressed on a resistor and the test coil in series as diagrammed later. (See Appendix.) The only important departure from usual practice was in the use of higher series resistance which increased the transformer insertion loss and increased the harmonic percentages. This was done to allow measurements over a wider range of signal level. Variations in series resistance alter the harmonics of the output signal as well as distort it. Therefore, any one set of measurements are made with the same setting on both the primary and the secondary winding of a transformer and the secondaries are in parallel.

Fig. 1. Curves of transmission, permeability, distortion, and impedance vs. flux density for Audio A core material.

38

AUDIO • FEBRUARY, 1959
Whether converting or starting from scratch...

For those who already possess a full-range monophonic speaker system, or plan to buy one now with an eye to stereo conversion later... University can "add" superb stereo at low cost, even in rooms with "no" space for a second speaker. Here's how:

Because bass frequencies below 150 cps are strictly non-directional and do not contribute to the stereo effect, they can be reproduced by one woofer—that of the main system. In this case, the University supplies the combined bass of both channels as well as the full mid and high range of one channel. The mid and high range of the second channel is then provided by one of the three University "add-on" speakers. Because such "add-ons" are not required to produce low bass, they are small in size, easy to place for optimum stereo and decor effect, and priced most modestly. You also save the cost of a second woofer and large enclosure!

How University uses one woofer for two channel bass

This can be achieved in two ways, depending upon the kind of woofer you have. A conventional woofer—with a single voice coil—can receive these frequencies only after they are combined by the special stereo adapter network Model A-1. However, with University's exclusive DUAL VOICE COIL WOOFER★... containing two electrically separate voice coils... no such network is required. Instead, the stereo amplifiers can simply be connected one to each voice coil, thus feeding the full bass directly to this unique woofer.

Starting from scratch, another attractive and flexible approach would be to use a dual voice coil woofer in an enclosure along with one "add-on," the combination making a very fine monophonic speaker system. Later, you can convert to stereo with a duplicate "add-on," as shown at left. Now, since the woofer's position for stereo is not critical, you can place it almost anywhere in the room... and the two compact "add-ons" can easily be positioned for perfect décor and stereo effects... regardless of where the woofer has been placed.

Whichever approach you choose, University "add-ons" put you on the cost and space-saving road to true high fidelity stereo.

★University woofers having dual voice coils are models: C-15W, C-15SW, C-15HIC and C-12HIC. These are employed in speaker systems: Debonaire12 S-3, S-4S; Senior S-2S; Master S-4, S-65; Dean S-2, S-75; Classic S-4, S-85; S-9, S-9S; Ultra Linear S-10, S-105; S-14, S-15S; Troubadour S-12, S-125.

Stereofolex-1

STEREOFLEX-1 is a slim, elegant unit, with matched woven grille cloth, designed for floor placement and makes an excellent end table. Double horn-loaded with heavy-duty compression driver and extended air column for mid-range. Wide-angle driver/horn tweeter with "BRILLIANCE" control, 3000 cps crossover. " Samantha - " Gold finish.

User net: Mahogany—$110.00.

STEREOFLEX-2 is a slim, elegant unit, with matched woven grille cloth, designed for floor placement and makes an excellent end table. Double horn-loaded with heavy-duty compression driver and extended air column for mid-range. Wide-angle driver/horn tweeter with "BRILLIANCE" control, 3000 cps crossover.

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STEREOFLEX-3 is a slim, elegant unit, with matched woven grille cloth, designed for floor placement and makes an excellent end table. Double horn-loaded with heavy-duty compression driver and extended air column for mid-range. Wide-angle driver/horn tweeter with "BRILLIANCE" control, 3000 cps crossover.

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monic percentages in approximately the ratio of the total shunt impedance at the coil terminals. More accurate calculation involves the exact phase angle of the transformer resistance which is less than 90 deg. due to eddy losses. This phase angle can be determined graphically from the series resistance, the eddy losses, and the transmission. All of these are shown on the curves. As a practical matter, in comparing transformers, the assumption that both have 90 deg. phase angles does not seriously reduce the accuracy of the comparison.

Coil resistance was completely accounted for in the measurements by adding the coil resistance to the series resistance and measuring the developed voltages across an unloaded secondary coil.

Ordinary Silicon Steel

Figure 1 concerns the most widely used transformer core material, non-oriented silicon steel in laminate form. This particular core is one of the best available grades. Many factors must be controlled to produce good laminations. These laminations were annealed after stamping to remove the metal strains which degrade magnetic properties. They are very flat and free from burrs, fitting together with a minimum air gap, and allowing a maximum of material to fit in the available space. Beside the obvious requirement of good permeability, the resistivity should be high to minimize the eddy current losses which result from circulating currents in the core. Eddy current losses are proportional to the conductivity of the core material and to the square of the lamination thickness. The 3.6 per cent silicon in the core increases the resistivity about five fold, affording a corresponding reduction in eddy losses. The use of 20 gauge 0.014 in. laminations instead of the cheaper 26 gauge, 0.015 in., results in about 5/8 as much eddy current loss. If the laminations are not insulated from each other, the advantage of subdivision is lost. These laminations have an oxide coating produced in the annealing oven furnishing useful insulation. Eddy losses weight little, and reduce permeability. They do not contribute distortion. The other major core loss, hysteresis, depends on the composition and treatment of the core material. The non-linearity of the magnetization curve, often shown as the hysteresis loop, is the cause of the distortion produced in a transformer.

In Fig. 1, the third harmonic curve has two maxima. The one at the highest flux density results from the well known fact that the high power level nearly saturates the core material, causing very low permeability at the peaks of the excitation cycle. The broad maximum in the 25-gauss region is surprising. The reason is the decrease in the permeability of the core material with dropping voltage, which is also shown in Fig. 1. As the permeability of the core drops, the transformer impedance drops proportionately, impressing an increasing part of the core distortion on the circuit.

These curves were not plotted below a few gauss because of the limits of this particular measuring arrangement, but other measurements on this grade of core material show that below the one-gauss territory the permeability becomes nearly constant regardless of how low the flux density drops. This constant and low permeability region is the initial permeability plateau. Hysteresis losses and varying permeability, both of which are shown by the hysteresis loop, together cause core distortion. In the initial permeability region hysteresis losses disappear and the permeability ceases to vary. Therefore at sufficiently low flux densities ferromagnetic core distortion decreases. Below the 25-gauss peak, the third harmonic distortion decreases. Another set of measurements on this type of core material shows a smooth drop from the low-level distortion peak of 0.28 per cent at 1/10 gauss. In all probability the distortion completely vanishes at extremely low levels, too low to have practical significance.

Transformer flux density is proportional to signal voltage and inversely proportional to frequency. Therefore the highest flux densities occur only at the lowest frequencies. Flux density is also inversely proportional to coil turns and cross-sectional area.

Above the 20-gauss region the permeability curve is a straight line with almost uniform slope up to about 3000 gauss. The distortion curve shows only moderate variation in this region. This is to be expected when there are no abrupt changes in permeability.

The maximum permeability is about 770 at 4000 gauss. This is an excellent permeability for non-oriented silicon steel laminations. It indicates that the iron is at least average for its class in permeability and that the air gages in the magnetic circuit are small.

Above the region of maximum permeability, the permeability curve drops rapidly. At 15,000 gauss the permeability is about 1/10 of the maximum. The impedance of the transformer accordingly drops very abruptly in this part of the excitation cycle, producing severe distortion.

The higher the flux density, the greater the level, but the more objectionable the distortion and the lower the developed impedance. In many applications it is the diminishing permeability that limits the permissible flux density. For example, the output transformer in a negative feedback amplifier may be surrounded by sufficient degeneration to reduce the effect of the core distortion to a suitable level, and to provide uniform frequency response, but the power available from the output tubes at low frequencies may be severely limited by the low value of shunt impedance of the transformer at high flux densities. This impedance is largely reactive, a particularly undesirable load for power tubes. Negative feedback does not alter this situation. Fortunately high flux densities are encountered only at the lowest frequencies in the design spectrum.

The crowded harmonic spectrum of ferromagnetic material results from a peculiar kind of non-linearity. It is possible to have a large third harmonic generation with negligible higher harmonics, for example, the change in gain is proportional to the instantaneous signal voltage. The non-linearity in magnetic core material is not of this nature. Instead it is characterized by several regions with markedly different slopes, and fairly abrupt transitions between them.

Variable Frequency Response

The transmission curve of Fig. 1 illustrates a fact often ignored in transformer considerations. Frequency response depends on flux density or signal voltage. In this case transmission varies from 13 per cent at 3 gauss to 70 per cent at 4000 gauss, or in decibels from about -18 db to -3 db. This is at a constant low frequency. The only variable is the signal voltage. In a high-quality transformer the low-frequency loss might be

---

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limited to 3 db at a few gauss. Under those conditions the loss at 4000 gauss might be about 0.5 db. The advertised frequency-response curve could show a low-frequency loss of anywhere from 0.5 db to 3 db and be technically correct.

Transformers surrounded by substantial negative feedback do not cause this type of variable-frequency response in a serious degree, but line matching and input transformers do not usually have the benefit of negative feedback. When several of such transformers are included in one system, the effect on the bass response is to transmit the strong bass tones and drop out the weak ones. Even if equalization is used, it cannot overcome this handicap. For this reason alone it is advisable that all transformers have excellent bass response. Transformer alterations that improve the bass response usually decrease the distortion as well.

Grain-Oriented Silicon

Figure 2 is of grain-oriented silicon steel. This material is made in ribbon form, and wound on a mandrel. The resulting loop is bonded and cut into two parts, each of C shape. When reassembled, these are the transformer core. The rolling of silicon steel produces a partial crystal alignment, making the magnetic properties best in the rolling direction. The property is accentuated in grain-oriented core material. It is of limited value in laminations, where the magnetic flux travels both with the grain and across the grain, but in the tape wound core all of the flux travels with the grain, taking full advantage of the preferred magnetic direction. As a result of the grain orientation, the core losses are lower and the permeability is higher than in non-oriented silicon steel.

Circuit values were chosen making Fig. 2 directly comparable to Fig. 1. Obviously the oriented core is better in several respects than the non-oriented core. The permeability is higher, the distortion is lower, and most important, the maximum flux density is much higher.

Hipersil saturates very abruptly. Driving such a core at very high level, through a series resistance, causes the peak flux density to be less than the terminal fundamental voltage would indicate, because the core material saturates for only a small portion of the cycle, reducing the fundamental voltage only slightly, but reducing the peak flux density materially. This effect is important only with a sharp saturation point, and only at the very highest magnetic field. It results in Fig. 2 being somewhat optimistic regarding the saturation flux density. The error is negligible at 15,000 gauss but the end of the curve is an actual peak flux density of about 17,500 gauss instead of the 20,000 shown. Fundamental voltage is the usual consideration in audio transformers, therefore these measurements were based on voltage.

The disadvantages of the oriented core are higher initial cost and less flexibility than laminations which can be used in various stack heights to vary the core size. But the oriented steel has good characteristics at 15,000 gauss as the other steel at 10,000. This is a power of 21 to 1, a tremendous improvement.

A useful comparison between the two types of materials is the distortion ratio at a particular flux density. This indicates the effect of substituting cores in a transformer. In the region of 1000 gauss the grain-oriented core produces only about half as much distortion as the other core. At 10,000 gauss the differences are greater, the oriented core producing about one fifth the distortion of the other core. At the same time, the improvement in permeability is about four fold. For these reasons Hipersil is often chosen for high-quality output transformers.

At very low flux densities the distortion from the grain-oriented core is slightly higher than from the non-oriented core and the permeability improvement is slight Therefore the oriented core is not advantageous at low flux densities.

Above 100 gauss the transmission curve for Hipersil is higher and flatter than the Audio A curve, and it extends further into the high-density region.

A transformer to do a particular job at low frequencies will be considerably smaller with an oriented core than with a non-oriented core. At high frequencies the small transformer with the oriented core will be superior, because leakage inductance and capacitance increase with coil size.

50% Nickel Alloy

Figure 3 is of 50-50 nickel alloy. This material saturates at a flux density only moderately lower than for non-oriented silicon steel, while the permeability is much higher. The initial permeability is about five fold better, and the maximum permeability is three or four fold better for this particular sample. This material is especially suitable for high-level line transformers and also makes good output transformers but expense limits the latter application. This type of nickel iron is available with comparable permeability from several sources, but that known as Hypersil is particularly suitable for power applications because it is given a hydrogen purification that reduces the hysteresis loss to a very low value, resulting in a total core loss at 10,000 gauss and 60 cps of 0.24 watts per pound for 29-gauge sheet. This may be compared to 0.5 watts per pound for 29-gauge non-oriented AA silicon and 0.29 watts per pound for 29-gauge grain oriented silicon.

At low and moderate flux densities the 50-50 nickel iron produces considerably lower distortion than Audio A. As the flux density increases, the improvement diminishes. At 10,000 gauss the nickel iron produces about 5% as much distortion as the non-oriented silicon steel.

The signal transmission curve for the 50-50 nickel iron is flatter than for either type of silicon steel, and the percent transmission is better at all flux densities up to 10,000 gauss. This makes it generally superior except at extreme flux densities.

Cheap Silicon Steel

A fourth material used for these applications is silicon steel of low cost, indefinite pedigree, and poor qualities. It contains less silicon and more impurities. The main specification is the price. The variations between materials of different manufacture, and even between successive batches, will be very great. Although the curves are not shown, here is a typical curve (Continued on page 73)
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Stereo Without Bankruptcy

ARTHUR W. SEAR

In proposing a hypothetical system, the author has described one which is used in several forms commercially—but which has not yet been adopted by the home listener. Maybe it should be.

A t Audio Shows and similar demonstrations I have been intrigued by the music and audio effects that come from the new stereophonic sound reproducing systems. Then, when I look at the price tags, I am almost completely disenchanted.

It is not just the cost of the equipment that frightens me: where in my home can I find space for two sound systems that will give me the full audio range that I have been enjoying with my present monophonic system. A medium priced stereophonic sound system would probably fit into my home satisfactorily but the medium spatial effects of these and their somewhat limited bass response leaves much to be desired.

Over the years my monophonic system has grown by easy stages from a simple beginning to a four-way system with a dividing network between the preamplifier and four output amplifiers, one for each speaker. I like the big clean audio that I can get with this set, with nice round bass notes at any reasonable energy level. In fact, my present system is good enough so that I hesitate to discard it for a lesser system even though it would have the advantage of stereo "spaciousness." I have also loved with the idea of converting my monophonic system to stereo but even if I could afford another Klipsch horn, where in an ordinary room can one find place for two?

There may be many other hi-fi fans who are in the same predicament that I find myself and maybe we can find a way out of our dilemma if we can benefit from some of the characteristics of sound and the methods we use for reproducing it.

First, we cannot sense the direction of sound sources of frequencies below about 300 cps, except for the transients that may accompany the low frequencies.

Second, loudspeakers that can radiate low frequencies are generally larger and more costly than speakers that only have to radiate mid-range and high-frequency sounds.

Third, most of the sound energy is concentrated in the low-frequency end of the sound spectrum so that amplifiers for producing high-frequency sounds are comparatively smaller and cost less.

These three facts point out the desirability of using a single low-frequency amplifier and speaker for a stereophonic sound system if it is possible to do so and still keep the over-all system symmetrical.

In addition, there are characteristics inherent in the recording process that tend to simplify the problem of designing a system having a single low-frequency channel. Low-frequency sounds have long wavelength lengths in air so that low-frequency tones picked up by the microphones are likely to be nearly in phase. Placing the low-frequency instruments of an orchestra near the center of the stage, so that the distances to the stereophonic microphones are nearly equal, aids in keeping the low frequency energy in the two channels in phase. In the Westrex 45/45 recording system it is desirable to keep the low-frequency energy in the two channels in phase since in-phase components result in lateral motion of the cutter.

It is these same low-frequency components that require a large amplitude of the cutter and when voltages at these frequencies are in phase the vertical excursion of the cutter, or hill-and-dale effect, is likewise kept desirably small. The low-frequency signals for the two channels could be kept completely in phase if this part of the pick-up were taken from a third microphone placed midway between the two side microphones, and added equally to both channels. Since it is already standard practice to use three microphones when making a stereophonic recording, this proposed method of recording would not require a great change in procedure. A block diagram of how this could be done is shown in Fig. 1.

A stereophonic reproducing system that makes use of the in-phase low-frequency sound energy would have two mid-range and high-frequency amplifiers and speakers. A single amplifier and woofer would supply the nondirectional low-frequency sound energy for both channels.

Since electric waves are not completely effective in eliminating transient voltages, some provision must be made for removing any directional effect that may come from the transient response of the low-frequency speaker. This can be done by taking advantage of the Haas effect.

A simplified statement of the Haas effect is that if a sound reaches a listener over more than one path, the source of sound seems to be in the direction indicated by the path over which the sound energy arrived first. Thus if we excite two speakers spaced some distance apart with the same signal, but delay the signal going to one speaker, all of the sound energy seems to emanate from the speaker which does not have the delay. This can be further illustrated by the fact that we are not confused in our directional sense when standing in front of a wall and can tell exactly where a

(Continued on page 81)
in home  
    after home  
    after home 
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DYNAKIT STEREO CONTROL

The Dynakit Stereo Control (DSC-1) is an inexpensive, easy-to-build kit—one evening’s work—intended for adapting two conventional monophonic preamplifiers to stereo use. It is a passive unit (no tubes), so that it introduces no distortion, consumes no power, and has very little that can go wrong. Being a passive unit, it cannot supply signal gain; at the same time, it has very little insertion loss, so that there is little chance of other components having to work significantly harder at higher distortion in order to compensate for such insertion loss.

Primarily, the DSC-1 is meant to be used with preamplifiers that contain a tape-monitor switch. In such a preamplifier, the gain control is concerned by this switch either to the selector switch or to the tape input jack (for accepting a signal from a tape playback machine). The tape output jack (for making a tape recording) is linked to the selector switch. The DSC-1 is inserted between the tape output jack and the tape input jack, with the tape-monitor switch in “tape” position, which causes the gain control to be connected to the tape input jack. Hence an incoming signal (tuner, phonograph, etc.) is routed through the selector switch to the tape output jack, through the DSC-1, into the tape input jack, and to the gain control.

The DSC-1 can also be used between the output of a preamplifier and a power amplifier. In this case, the preamplifier will always operate at a relatively high level, since gain is controlled by the DSC-1 after the preamplifier. Consequently, it may be necessary to exercise care that the DSC-1 is operated with the master gain control quite well advanced, allowing the preamplifier to operate at a reduced level in order to avoid significant distortion.

Another alternative, where the monophonic preamplifier does not contain a tape-monitor switch, is for the handy audio fan or a technician to interrupt the signal path between the selector switch and the following stage, and to insert the DSC-1 in this path.

The manufacturer further points out that the DSC-1 can be connected between a signal source (such as a tape playback machine), and a power amplifier, without an intervening preamplifier. In this case one would not have the tone controls and other facilities afforded by a preamplifier. However, a source such as a tape machine or tuner would usually provide at least a gain control.

Despite its outward simplicity, the DSC-1 reflects a good deal of sophisticated thinking about the problems entailed in controlling and coordinating two stereo channels, and it provides in a logical manner most of the stereo functions that are desirable. Let us consider these functions one by one.

1. **Master Gain Control.** The vital requirement of such a control is that it have low tracking error; in other words, throughout its rotation this control should provide about the same attenuation for each channel. Thus if the two channels are balanced when the master gain control is at maximum, then they should stay balanced as gain is reduced. When tracking error is kept within ±0.5 db—that is, no more than 3 db deviation between channels—it may be considered satisfactory; within ±1 db is considered excellent. Following are the writer’s measurements on the DSC-1 he assembled. Using the left channel as a reference at various gain settings, deviations of the right channel with respect to the left channel were as follows:

![Fig. 1. Dynakit Stereo Control, shown at the left of two Dynakit Preamplifiers, which matches in appearance.](image)

**Reduction in Gain of the Left Channel**

<table>
<thead>
<tr>
<th>Gain (db)</th>
<th>Left Channel Deviation (db)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>±0.5</td>
</tr>
<tr>
<td>20</td>
<td>±1.0</td>
</tr>
<tr>
<td>30</td>
<td>±1.5</td>
</tr>
<tr>
<td>40</td>
<td>±2.0</td>
</tr>
<tr>
<td>50</td>
<td>±2.5</td>
</tr>
</tbody>
</table>

It may be seen that the deviation ranged from 1 db to 5 db, which is equivalent to ±3 dB. If one were to set the balance control so as to favor the right channel by 3 db, then the tracking error would actually be ±3 dB within most of the range of the master gain control.

2. **Channel Balance.** In addition to serving the usual function of allowing the left channel to be fed to the right speaker and the right channel to the left speaker, this switch facilitates balancing one’s equipment for stereo. An accepted technique for such balancing is to feed the same signal alternately to each speaker, meanwhile manipulating the balance of other controls (such as input level sets on the power amplifiers), until the sound from each speaker appears equally. To do so, one may feed a signal into just one channel (from a disc, tape, tuner, oscillator, etc.), and by pointing the channel reverse switch up and down one may hear the sound alternately from each speaker.

3. **Balance Control.** When the balance control is turned, say, to the left, this lowers the gain of the left channel without appreciably raising the gain of the right one. The writer measured about 15 db maximum attenuation of the left channel when the control was turned fully counterclockwise from mid-position, with the gain of the right channel being increased only about 0.5 db. (The same of course applies to the reverse switch.)

4. **Blend Control.** This is quite a clever device, consisting actually of three controls in one: (a) At maximum clockwise position, the two channels are completely isolated, operating in true stereo fashion. (b) A slight clockwise turn of the knob actuates a switch, introducing a high-value resistance between the two channels, which causes a slight amount of blending; isolation between channels is then about 20 db. As the blend control is turned progressively clockwise, the resistance, and therefore the inter-channel isolation, decreases, eventually approaching zero when the control is almost fully clockwise. (c) When the control is turned completely clockwise, another switch is actuated, causing one signal to be cut out (whether the left or right signal is cut out depends upon the position of the channel reverse switch), while the other signal is fed to both channels. This permits a monophonic source to be fed to both speakers in pseudo-stereo fashion.

The advantages of the blend control—between the points at which either switch is actuated—are at least twofold: it aids in overcoming effect of excessive microphone spacing, excessive speaker spacing, or a combination of the two. Second, at maximum blend position it permits adding the signals produced by a stereo cartridge when playing a mono record, thereby causing the audio signals (lateral informa-
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tion) to add and the vertical rumble (vertical information) to cancel; vertical rumble is ordinarily a good deal more serious than lateral rumble.

By turning the blend control from maximum counterclockwise position to maximum clockwise, the experimentally minded listener can make interesting comparisons among four modes of reproduction: true stereo, blended stereo, both speakers reproducing the same signal containing the total audio information and both speakers reproducing the same signal containing information only from one channel (either the left or the right, depending upon position of the channel reverse switch).

5. Loudness Switch. The DSC-1 is used with two preamplifiers, the gain controls of the latter will ordinarily be at a highly advanced position, thereby allowing the gain control of the DSC-1 to cover a wide range of attenuation. In many, if not most, cases, this will eliminate loudness compensation, which ordinarily takes place when a preamp's gain control is at a reduced setting. Therefore the DSC-1 allows bass boost to be switched in, the amount depending upon the setting of the master gain control. The writer measured about 1.25 db boost at 50 cps when gain was reduced 10 db below maximum; 3 db at 90 db below; 12.5 db at 30 db below; and 15 db at 40 below. No treble boost is provided. However, Fletch-Mason compensation calls for relatively little, and the treble controls on the preamps are normally more than adequate for this purpose.

6. Tape Input Switch. When connected to a tape monitor switch, the DSC-1 preampts their tape output and tape input jacks, as explained earlier. Therefore the DSC-1 provides two substitute sets of tape output and tape input jacks to permit making a tape recording and playing back a recording. Pushing the tape input switch to "tape" permits one to hear the signal from a tape machine. In the "input" position, the DSC-1 feeds through the signal sources to which the preamps are connected.

7. Master Gain Control. The DSC-1 is a relatively high impedance affair in order to provide a low resistance load to the output of the tape monitors to signal sources. Hence preservation of high frequency response becomes a problem that must be met in this instance. To minimize losses due to cable capacitance, the DSC-1 is furnished with four low-capacitance cables of one-foot length—two for input and two for output. With the master gain control full on and the channel balance control at mid-position, the writer found that frequency response was flat to at least 15,000 cps and no more than 1/2 db down at 30,000 cps. With the master gain control set for 6 db reduction in gain, which is the position entailing the most severe high frequency losses, response was still flat to 15,000 cps. With gain full on and the balance control set for 4 db reduction in one of the channels, there was about 1 db loss at 15,000 cps in this channel; with the balance control at extreme position (an unlikely state of affairs, involving about 15 db reduction in one channel), the loss was only about 2 db at 15,000 cps. These measurements were taken with the DSC-1 connected to a Dynakit preamp, which itself measured flat beyond 15,000 cps.

It should be added that the DSC-1 is a well-shielded unit, and the writer found that used in conjunction with the Dynakit preamp it introduced no hum problems.

BLONDER-TONGUE "AUDIO BATON"

New amplifiers, new tuners, new preamps, and new speakers are constantly coming on the market, but this is a unique device which has functions not duplicated by any other device commonly available. To be sure, there are de- and half octave filters, but all of them have been so far are of laboratory quality, and are much too sharp in the cutoff region to serve for any other purpose than making measurements.

The Audio Baton, however, while similar to an octave filter, is rather better described as a "super-duper tone control." Pictured in Fig. 3, it consists of seven separate amplifiers each tuned to a specific frequency, together with another stage which is followed by a high-pass filter in parallel with a low-pass filter, all with their outputs fed to separate level controls, nine in all. These controls are accessible from the front panel as knurled knobs mounted horizontally below the slots located at each octave point under a reproduction of a piano keyboard. Through the slots may be seen an illuminated white column, on which a red spiral is marked; as the knob is turned, the red stripe serves as an indicator to show the amount of boost or cut that is applied to a particular point in the spectrum, in effect drawing a frequency response curve on the simulated scale background. Each control provides a boost or cut of 15 db at its respective level control position, a boost of 15 db throughout the midrange, a 12 db cut at the 80- and 5120 cps points, and a 6 db cut at 40 and 10,240 cps. The level controls are designated with their operating frequencies, and appear at 40, 80, 100, 250, 440, 1260, 2560, 5120, and 10,240 cps. Technically, the circuit arrangement is as shown in Fig. 4. An input level switch may be set for two ranges—0.1 to 0.6 volts, or 0.6 to 1.5 volts. The insertion loss of the complete instrument is zero when all controls are centered. The IN-OUT switch by-passes the frequency-correcting circuits and provides flat response (±0.5 db) through the two feedback-controlled output stages to an output level control. With the switch in the IN position, the equalizer section is in service, and with all controls set in the "0" position, response is essentially flat from 20 to 20,000 cps. Actually the response droops about 1.5 db between each of the "peaks" since the overall response is the sum of the responses of the seven separate circuits, seven having responses which are essentially triangles with slopes of about 3 db per octave on either side of the center frequency, with the two filters—at the ends of the spectrum—having slopes of around 6 db per octave.

Performance

Distortion of the instrument in the "out" position of the switch was measured at several points in the spectrum, and was constant at 0.2 per cent. In the IN position, distortion was somewhat higher, but still less than 2 per cent anywhere in the spectrum. Hum and noise measured 64 db below the rated output of 1.5 volts. Measuring the response with all controls except 1280 cps at the +14 db position gave an output 30 db down at 100 cps and at 18,000 cps, with practically straight sides to the curve, reaching the reference level at 1280 cps. Obviously there would be some effect on the adjacent octave controls with a slope of only 8 db per octave, but in actual listening it is unlikely that one would set adjacent controls at widely varying positions.

Applications

The Audio Baton has a number of interesting applications other than the more obvious one of serving as an adjunct to a typical high fidelity music system. As a matter of fact, it is likely that the instrument will find its greatest popularity among recording studios—being considerably less expensive than equivalent devices produced for the professional field. We did some experimenting with dubbing tapes of unsatisfactory quality such as might be encountered from the garden-variety of camera-store tape recorder, and we would consider the device indispensable to anyone interested in dubbing from old records or...
Ralph Bellamy, starring in "Sunrise At Campobello", listens to stereo on his Collaro changer and Goodman's Triaxonal Speaker System.

Collaro—your silent partner for Stereo

Silence is the requirement — and silent performance is what you get when you select the new Collaro stereo changer for your stereo system. Collaro engineers have designed the high fidelity changer precision-engineered to meet stereo's rigid quality demands. Collaro's silent operation assures flawless reproduction of the exciting new stereo records every time. Here is why Collaro is your best buy.

Five-terminal plug-in head: Exclusive with Collaro. Provides two completely independent circuits thus guaranteeing the ultimate in noise-reduction circuitry.

Transcription-type tone arm: Another Collaro exclusive. As records pile up on a changer, tracking pressure tends to increase. Result may be damage to records or sensitive stereo cartridge. This can't happen with Collaro's counter-balanced arm, which varies less than 1 gram in pressure between the top and bottom of a stack of records. The arm accepts any standard stereo or monaural cartridge.

Velocity trip mechanism: Unique design of this sensitive mechanism insures that the Collaro changer will trip at extraordinarily light tracking pressures — a requirement of many stereo cartridges.

New Collaro changers include all of the best features which have made Collaro the largest manufacturer of record changers in the world — as well as important new features vital for superb stereo as well as monaural performance. There are three Collaro changers priced from $38.50 to $49.50. The changer illustrated here is the new Continental, Model TSC-840.

For full information on the new Collaro stereo changers, write to Dept. A-2, RockBar Corp., Mamaroneck, N. Y.
from tapes which are not quite satisfactory. There is no doubt that the Audio Baton can do an excellent job of correcting frequency response of the less serious types likely to be encountered in audio equipment. Roll-off of either lows or highs due to poor microphones or narrow-range amplifiers or recorders can be corrected easily, and response peaks can be smoothed out as desired.

For ordinary listening, it is possible to increase or decrease the presence effect, moving an instrument or a voice "out in front" or pushing it back at will. Telephone effects are readily obtained, as are a number of other special effects, and clarity of speech can be obtained by removing the characteristic caused by a bass control which extends too far up the scale. Similarly, screechiness can be eliminated completely.

One of the uses of rather great importance to PA system operators is in the elimination of acoustic feedbacks or "howl." By reducing the response at the low frequency, it is possible to increase output level as much as 10 to 15 db without causing an appreciable deterioration of the sound quality as noticed by the human ear. As one howl frequency is corrected, another will crop out as the volume is increased, and with a few variations in setting of the controls the over-all output level can be increased very effectively.

With the Audio Baton it was easily possible to simulate the effect described by Staffen in the article commencing on page 21 of this issue. The advantage of the increase in very low bass is quite readily apparent.

Another interesting application is in the direct comparison of two pieces of equipment—particularly loudspeakers in A-B testing. Switching from A to B while at the same time switching the Audio Baton in or out allows the listener to adjust the Audio Baton so that both speakers sound as exactly alike as possible. The difference between them is then instantly observable on the scale of the device.

For those applications where the Audio Baton is continuously in circuit, there is one feature that would be considered desirable, even though unexpected. The nine slots through which the illuminated dial cylinders are pressed are quite bright with a full 0.3 volts applied to the pilot lights. A three position slide switch on the rear panel makes it possible to insert resistance into the pilot-light circuit in two values, giving three degrees of illumination. We would prefer to use the resistor as a moveable unit larger and more legible panel designations for frequency and degree of boost or cut, but after thorough familiarization it is likely that this deficiency would not be noticed. In general, we would recommend the Audio Baton very strongly to anyone who does much recording or dubbing of tapes or discs, and for any PA arrangement where acoustic feedback might be encountered. While it is relatively simple to correct such troubles in permanent installations, there are many times when a PA system is set up for a one-night stand and it is not practicable from the standpoint of time and cost to effect a permanent cure. The Audio Baton could well be indispensable to the portable PA system operator.

**TELECTRO SERIES 900 TAPE DECKS**

With the increasing use of programs which are equipped with tape-head inputs, more and more music lovers are taking a good look at tape decks—as contrasted to complete tape recorders—for their home installations. One of the newest to appear on the market is the Telelectro Series 900, which offers a variety of facilities in a simple tape transport mechanism without electronic equipment. For those who wish a complete recording system, including record and play amplifiers and the necessary bias oscillators, the Telelectro line includes the Model TRP-11 record/play amplifier, which provides for recording from low level microphone input or from a high level source such as a tuner, and in the play mode has an output of approximately 3 volts which is adequate to drive a power amplifier directly. Controls include a record/play selector, equalization switch, noise balance, and gain control, and recording level is shown by a VU meter. Also available is the Model TRP-19 play preamplifier which is similar to the playback portion of the TRP-11.

The tape transport itself is obtainable in five forms, depending on the head complement. Model 900-1 is equipped for monophonic recording and playback and for 2 or 4-track stereo playback; 900-2 has three heads—monophonic erase and play/record heads, and a 4-track stereo head which may be used as a monophonic erase and/or record in dual monophonic and stereo or mono and stereo. Model 900-4 is equipped only for playback, and has a single 4-track head which will play mono and stereo tapes; 900-5 has three stereo heads, making it possible to monitor a tape during recording. All models require amplifiers; when monitor facilities are provided, it is necessary to have playback amplifiers in addition to any recording amplifiers that may be necessary in order to avoid a lot of plug changing.

Physically, the Telelectro decks consist of a 13 x 15 in. motor board which is covered by a dress plate which measures 13 x 14 3/4 in. This plate is satin finish stainless steel with slightly beveled edges, giving a professional appearance. The head and mechanism covers are molding plastic in a gray color. Five piano-type keys control the operation—STOP, REC/SP, Rewind, FF, and RTR.

Above the mechanism cover are located the a.c. power switch, the speed control, and the digital tape counter. All models are arranged for 7 1/2 ips. The mechanism employs a single motor, with belt drive to the reel hubs and to the tape path, the latter having a large pulley for speed stability. The braking system is a single cord which rides in pulleys, and it results in an extremely smooth and effective braking action. In switching from fast wind or rewind to play, we could not perform the operation quickly enough to break the tape. Furthermore, brake action is sufficiently gentle that damage to the tape is not stretched or broken. The deck requires a clearance of 1 1/4 in. above the motor housing and 6 1/2 in. below. The control panel is to be mountable either vertically or horizontally, but in the model tested there was no provision for retaining the tape reels on the hubs and we would not be satisfied with risking some of our unreplaceable tapes unless we were reasonably sure that the reels wouldn't fall off and wander around the room. However, a tilt of some 10 deg. should be sufficient to keep the reels in place. A solenoid-operated auto stop release was not used in the mechanism in the absence of tape in the slot, and does not depend on metallic strips on the tape.

**Performance**

In tape handling, the mechanism proved efficient and relatively gentle. Fast forward and rewind time was measured at 1 minute 45 seconds for a 1200 foot reel of tape. The model tested was 900-3, and flutter and wow (at 15 1/2 ips) was measured at 0.2 per cent, and in a 5-minute test, the absolute speed was 6 seconds fast, which is within 1.5 per cent. Feeding the output of the heads to the TAPE HEAD input of a Philco 215 preamplifier gave adequate output with the volume control at about one quarter rotation, and at a measured signal to noise ratio of 53 db the frequent response from Ampex Standard Tape type 255 recorded within 2 db of the 1000-eps level from 50 to 10,000 e/s, and on tapes of our own recording which have been played through a professional machine, response was 3 db down at 15,000 e/s. This testifies to the quality of the playback heads.

Installation in a playback system where an attractive three-speed unit is wanted, the Telelectro 900 Series appears to be well built, and to offer ease of operation together with good reproduction quality.
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SR-1000 DE LUXE
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STEREO SEPARATION CONTROL—an exclusive new SR feature that's a full year ahead—gives you finger-tip control of the degree of separation between the two stereo channels, lets you blend them at will to suit your own ear. With the Stereo Separation Control, you can fill the "hole in the middle," eliminate objectionable separation or "ping-pong" effect, and compensate for variations in stereo programming recorded with extreme channel separation.

Other advanced features:

- Phase alternating button—enables you to separate, or to exaggerate stereo programming that is heavily mixed.
- Totally inaudible distortion—only 0.08% IM at 1 volt output, 0.2% at 3 volts, 0.5% at 10 volts.
- Professional control functions include separate bass and treble, variable loudness, rumble and scratch filters.
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Combines two professional-quality 50-watt amplifiers, electronically isolated, yet on one chassis; engineered for stereo:

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Write for your copy of the exciting new 12-page SR brochure, discover why SR components out-perform and out-last all others in their price range, and "check the specs" on other SR stereo products such as the SR-380 AM-FM Tuner/Stereo Pre-Amp tone control, the SR-534 Dual 17-watt basic power amplifier, and the SR-1717 Stereo Pre-Amp/Dual 17-watt amplifier.

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WINTER MISCELLANY

Piano Music of Chopin, Vols. 1, 2, 3
Wilhelm Kempff
London CS 6040-.41-.42 (stereo)

This is unexpectedly great and profoundly pleasurable. Kempff is an absolutely top-notch German pianist. Unexpected to me, at least, because Kempff through a tremendous player of such as Beethoven (in a major series for Decca) seemed to me always a bit on the severe side. His Beethoven was manifestly not within the ordinary in every detail and in the grandeur of its conception, but he did not allow himself to be glimpsed even in the most remote corners of the works. Such a great pianist as his colleague Wilhelm Bachmman can easily produce.

Wilhelm Kempff is all grace, fineness, lyricism, with the most gorgeously nuanced tones, a wholly open and expressive manner, and a shaping of nuances and phrases that is as fine as that in his Beethoven. You'll love it, as the ad-say, and you'll like it whether you are a connoisseur or just a listener who loves good Chopin.

At the big question: who stereo? One answer, of course, is that all London's stereo these days and a "mono" Chopin would be unthinkable. But that's no reason for us to feel like paying an extra buck per disc. So, amen, and let's leave it all.

Well, not much at first, but definitely a lot more than you might expect, in the long run. Of course, the version is worth the cash, given—and this is important—a thoroughly adequate stereo system, with minimum problems in the way of hiss and hum. The (control) level on stereo piano is necessarily low yet proper piano volume is quite high, the two—here, quite distinctly, have their separate nature.

An all-stereo monos listening test on these shows that stereo does add color and life to the sound of a solo piano, even with much more positive right-and-left separation—of the piano itself. The space around the piano is what counts and stereo, making that space more real, makes the piano within it seem more natural and immediate. In fact, I seem to hear, or almost to feel, the length of the piano itself, the sounding instrument. Monophonically, it shrinks to a smaller scope; its sound shrinks somewhat with it.

That's what stereo can do for the single sound source.

Incidentally, let me say that if your stereo is rightly phased and your speakers well placed in a good position you'll have no trouble with doubling of the piano image—a piano in each speaker. They should fuse completely. I happen to be sitting as I write with my book only a few feet in front of the two stereo speakers, one to each side of me (if facing toward the sound source merely because I get a good light on my type writer) and I hear no sense of duality or split. There is that one, big piano somewhere vaguely in the space behind me.

Of course, good stereo mixing plays a part here. There are a good many ill-advised piano

* 780 Greenwich St., New York 14, N. Y.

studies where the miles are so grotesquely situated that you seem to hear the keyboard stretched out about ten feet with the pianist racing back and forth from side to side of our room. His hands require more space.

At a sensible distance, two miles will converge the piano in the proper middle position, between speakers and will simultaneously pick up the room boomie, the echo reflections, to place the piano actually in space. That's what London has done.

Schubert: Symphony in C ("The Great").
(A) Bavarian Radio Symphony Orch., Jochum.
Decca DL 79993 (stereo)
(B) Cento Soli Orch. of Paris, Argento.
London CS 6011 (stereo)
(C) London Symphony, Krips.
London CS 6061 (stereo)

A chance at these duplications gives you the idea of the problems of record reviewing in stereo these days. London, last December, sent me over five separate stereo discs for trial, of which (C), above, was merely one; but even that single disc had two rivals—and I am simply not able to play and absorb intelligently this huge and meaningful symphony more than, say, twice in a given day or week.

I got through the first two with my <=stereo and intelligence intact, but London, the third to come along, made my symphony now in coming out my ears and I am no longer honestly sure as to what is what about every version I have heard in the last six months for contemplation and I'll write you a really informative comparison of all three.

Some version is surely better than none, so I suggest that as I hear them now the Decca version with the excellent Thorsten Jochum is musically the most telling of these three, best in style and spirit, best especially in respect to many a lovely detail of phrasing and rhythm, best, all in all. In its projection of the dramatic moments of the work, London's with Krips comes very close behind, surely as fine in some parts, notably the slow movement. TheArgento version is noticeably less interesting, partly, I assume due to the all-French orchestra (oh, what a sad, wobbly, French French horn at the beginning, so unlike the German horn!)—but partly due also to inexperience in this sort of music by the music conductor. I don't see an all-French version with the extravagant praise heaped upon on Argento (who died suddenly) by Omega's copy writers.

The Decca-Jochum version has excellent conservative balance, a lot low in level and not exactly overpowering in the bass, but really fine for the music, even so. The London version is brighter, with sharper treble and heavier bass and a larger livenss; but it, too, is conservative in stereo with no very pronounced separation and not a heightened sense of room space to credit to the stereo aspect. The Omega-Argento disc is somewhat like other Omega's of this series, rather sharply separated and fairly close-up, for an interesting if slightly forced effect.


Columbia MS 6016 (stereo)

Boy, is Columbia's stereo getting nice nowadays! This has the newest, most exciting, most magnetic atmosphere I can imagine; the piano is perfectly huge and auditorium filling, the orchestra smoothly and vastly spread out around it.

Entremont is one of the new youthful producers of the more Romantic sort—he is in a loose competitive league with such as Cliburn and Glen Gould. He's good, this one, with all the power you could want when you need smooth, polished tone without the banging hardness of the last crop of virtuoso that came along after the war. Still, like the others in this group, Entremont will have to show from these fine war works to a variety of other things—or risk obsolescence via endless repeats of the same music. That's the big danger for all new pianists today. The bigger they are, the more restricted is their repertoire. Until, that is, they get big enough to tell the bosses what they want to play—or else.

The familiar Grieg ripples along here in a thoroughly professional manner, nothing remarkable but, on the other hand, suffering from unimaginable defects of feeling—which is saying a lot for a performance of this over-played piece. The Rachmaninoff, one of his very best works and the only well known one with a feeling of real musicality and power, is not bad. The music is full of sort of swish, witch-like electrical quality, emphasized by the polishing of the ominous free from melody, so often used in such music. (Cf. Berlin's Pinacothic Symphony.) The electricity is definite in Entremont's concept, though at a lower voltage than in Rachmaninoff's own performance, as of years ago. The stuff is enjoyable in stereo.

Copland: Billy the Kid (1938); Rodeo (1942). Morton Gould & His Orchestra.

RCA Victor LM 2193 (mono)

A good record, this one! Here are the two Copland ballets that first hallowed the vogue for Western material in ballet form—they've since been followed by innumerable examples in ballet, in films, musical comedies, TV shows, etc. Just as it took a German, Handel, to show the British how to write British oratorio, so it took the boy from Brooklyn, no copyboy himself, to write the first effective Western music for our own ballet stage.

The thing about Copland is that his stuff is strictly high-level, but it is strictly entertaining and strictly Western, without compromise. No highbrow effects here. There's a big Cimarron piano with big Cimarron in its hammer to make it thru enough, there's a low-down hoe-down and old-time square dance—the titles of the parts run from Buckaroo Holiday to Corral Nocturno. But even so, the music is on a symphonic plane.
ANNOUNCING...

THE NEW AUDIO FIDELITY 1ST COMPONENT STEREO SERIES

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PLEASE READ CAREFULLY

Axiom: The first and most important component of a High Fidelity Stereophonic phonograph system is the phonograph record.

It is a little known fact that until now the dynamic range of phonograph records has been restricted by the inadequacies of certain cartridges and pick-up arms. Since this new series was successfully recorded with tremendously increased dynamic range and since Audio Fidelity does not wish to compromise the full potential of this recording project to accommodate inadequate equipment, we announce with great pleasure and infinite satisfaction the new Audio Fidelity First Component Series.

Since Audio Fidelity desires to raise still further the high quality standards of its product and to maintain the Highest Standard of High Fidelity in this industry, we decided to increase the dynamic and frequency range, and level of sound of the records in this new series—and state therefore that we can certify only the highest quality cartridges and arms to track the First Component Series.

We do not recommend that you buy these records unless your equipment is of the first rank. If you are in doubt, the Audio Fidelity First Component Stereo Test Record (FCS 50,000) provides a ready means of determining the tracking ability of your high fidelity stereo equipment.

The following arms and cartridges have been found by Audio Fidelity to be capable of tracking its First Component Series records:

ARMS: Audax—KT 16; Elac; ESL—310S, P-100; Fairchild—282; Garrard—TPA/12; G. E.—TM-2G; Grado; Gray 212; Pickering 140; Recokut: S-120. S-160; Shure Dynetic.

MAGNETIC CARTRIDGES: Dynaco B & O Stereodyne; ESL Gyro/Jewel; Fairchild XP-4; General Electric GC-5, GC-7, CL-7; Grado; Pickering 371; Scott-London 1000 matched arm and cartridge; Shure M3D Professional “Dynetic”; Stereotwin (Elac) 200; Weathers FM Stereo Cartridge and matched tone arm.

NOTICE TO INDUSTRY: This First Component Series is original and unique. Any attempt at infringement or plagiarism will result in prompt and vigorous prosecution.

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This series represents Audio Fidelity’s entry into the field of classical repertoire. It was decided that the most ethical musical approach consistent with the very latest stereophonic recording equipment and technique be utilized regardless of cost.

Note, for the first time, the musical elements as heard in the concert hall are reproduced in proper balance and spatial relationship. Counter melodies and secondary voices so vital to the musical meaning of the score have now, for the first time, been given their correct auditory perspective.

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Audio Fidelity Inc.
770 Eleventh Avenue, New York 19, N.Y.
and up to anybody's standards for "classi-
cal"; Copland showed how you could be classi-
ical and Western too and he'd justly admired
for his scores. (Credit, to a large extent, to his
dance colleagues, such as, here, Lincoln
Kirstein, American Ballet, New York.) It
takes craftsmen like Aaron Copland to keep
music alive and healthy—even if he isn't
nearly a Mozart from New York. There
are many such, and they are vital to musical
development. I'm sure that in engineering and
other fields we'd never find a Copland who is
equally admired—for the same superior skill,
terrier, imagination, ability to do a poor
job no matter what. Copland is not the
American musical genius, but he is surely one of
the most promising talents in American music
to have put his services at your disposal. You
can hear it, in his work, and you'll both respect
and admire it.

Morton Gould was an excellent choice for
these works—his playing are as fine as they come.
The jazzman in Gould is always there even
though his own composing style is generally far
classical than Copland's, he obviously
appreciated the splendid new recordings
staked out in these ballets and his interpre-
tation does them proud, with full under-
standing. You'll get the feeling he'd written them himself.

London Symphony, Suskind.
Everest SDRB 3002 (stereo)
In a new record company bursts upon the scene, and its initial offerings are just about
as good as claimed, at least as here-demon-
strated. Everest is the offspring of the Britten
Sinfonia and the BBC. Because Berkley
parent company does fancy electronics of
the ultra-secret military sort and its prime
mover, Sir Peter Pears, is an engineer who
designed film recorders and the like, he has
ever had it hard to get into hi-fi records. Well,
his first chance has arrived.
The Everest classical sound is undoubtedly
taut and bright, sharp and hazy, that places
it along with the best from the leading
specialist companies. The stereo itself is ex-
ceptionally smooth and the projection of
wide-sound orchestra with clear rights
and lefts (incomparable in the percussion)
but with moderation, without excessive distor-
tion of the natural perspective—definitely,
stereo adds a lot here. The inner crooners of
the violinists was the loftiest near-the-label
sounds that have been gate away with so far.

Copland's sweet, cool, impersonal "Ap-
palachian Spring" is very well played, with
clear and bright sound and the music
soothingly sweet. My, how old fashioned this
music sounds, already! It dates from 1944 and
the mid-war period when the recording of the
music was small but still, it conveys somehow the sense—so mis-
leading as it is—of the days of compli-
city and directness, when life was easier.
Far far from it! But even so, Copland has
produce in this more-complex world
and the music of "Appalachian Spring" could
ever be written again. It is a period that is
irreversibly departed and as such it can't
help but win the heart.

Warner Bros. B 1240 (mono)
The jazz ballet with the utterly unpro-
Jazz, was one of the worst excising balls of
stage show I've ever seen in years. The score
is arranger's jazz, written-out and somewhat
self-conscious (with a pasamascica-style set
of classic variations at the end) and the
story is the familiar one of "teen-age frustra-
tion, experimentation and the odyssey of a
pariah". But the two together are really
starting in their impact and concentration, via the
choreography by Jerome Robbins, the last high-
level expression here in a field where he has been
active for long time. The ballet was part of a "package" sent to
Europe last summer for cultural exchange, first with the Festival of Two
Worlds in Spoleto, Italy, then at the Brussels
Festival. It came back to New York, which is
what I'm talking about.

The recording is only the music, but even
that is enough to give a sense of the American
"strength" of American music. Robert Prince
is an "unknown"—or was working jazz arrangements
and orchestral type.

Bernstein's similar West Side Story record-
ning seems oddly wishy-washy next to the

Giovanni Gabrieli: Processional and Cerem-
onial Music. Choirs and Orch. The Gabrieli Festival (Venice).
Vanguard BGS 5004 (stereo)
Though his recording comes in both stereo
and mono for the same price, the decision
is by all odds the best, with greater musical
reason than perhaps any recording so far done in
stereo.

There are examples of the famous anti-
phonal music in these works. The Cathedral in
Venice, written for two, sometimes three
separate choirs and their accompanying in-
struments, is an effect that is entirely
and disastrously lost in any con-
ventional recorded version of the monophonic
sort. For the first time, the original inten-
ions of the music can begin to be realized
in stereo.

Stereo doesn't actually re-create the or-
iginal of course. That would be more than
your stereo would offer. But even the moderate sense of spatial separation
between two choruses, one on each side, two
contrasting groups of the organ and a third ensemble in the middle—plus a series
of small, authentic 16th century organs
spatially placed here and there— is enough to bring
musical authenticity of an extraordinary
type. No Roger do we seem merely to hear
eardlessly repeated phrases, senselessly piled
up one on top of the next. Now we discover
that the sound generators are the one side and
the other, a musical ping-pong game that
must unnaturally outdoes those famous early stereo ping-pong technique we
heard years ago! Moreover, stereo fulfills its
other major task, namely, making a much
increased sense of room-space—a huge "hall"
(cathedral!)—and bringing a new clarity of
texture.

The performance is done with unusually
great care for authenticity, down to the old
organs and the accompanying instruments,
including some lovely typical Gabrieli brass.
The players and singers, evidently mostly
Swiss in origin along with the conductor, are
earest and persuasive. My only complaint
is of the rather too mechanical and ritualized
in a good deal of the sinfonic, a fault, however, that is common in many
judgments of the music of the 16th and 17th cen-
turies. Nothing to bother you.

Musicologists are particularly interested in
the several late Gabrieli works, from after
1600, with some remarkable harmonies and
harsh much on such occasions as Venice and Bolso.
Gabrieli's distinguished successors.

Palestrina: Masses "Aeterna Christi
 Munera" and "Laudia Sion," Les Chon-
eurs de Saint-Eustache, R. P. Emile
Martin.
Westminster XWN 18693 (mono)
We travel the world over in recorded music
and we come to expect unusual sounds, cu-
rious procedures, exotic local regions. what
we happen to be "visiting"; the differences
are not great in the standard orchestrations,
for the music of most ears, the variety is
often startling.

Here we are, then, in a Paris church, with
the local Choir of Paris bounces, tenors
and boy sopranos. They are Parisian, if the
music is Italian, and they don't sound at all like
British singers, nor like German or Austrian singers. Their
tones are rich, brilliant and very wobbling with
that surrealistic sound that comes through
the nose, as do all good French singers.

Still music is the so-called universal lan-
guage; one can talk on its being musical and
dedicated to their task. The coordinates of its
skill, rather than its balance rather too close in a past sort (the first
with two or three boy sopranos practically in
their prime, but not the same) are ab-
terribly projected, with considerable
discernment, taste and feeling. The pitch is
feeling is more than adequate, but the whole
clearer (though there's some flattening now
and then); above all, the mechanical sort
of one-two beat, so dead, pause (excepting
Purcell) singing is clearly avoided, much to
the good of the music.

If any chorals singers, churchmen or just
plain lovers of fine choral music happen to
read this, they may take my assurance that
this isn't a bad record at all and is worth a
try, definitely. For the rest of you, I can sug-
gest that the sound is as good as you might
it as might be, if one fine day in Paris, you
should stick your head inside Saint-Eustache
and listen, you will see, in these voices, it
be could be.

More of Kipling's Just So Stories. Read by
Boris Karloff.
Caedmon TC 1088 (mono)
Don't miss this, for kids of generically any
age over two, and (for you as well, if you want
to be amused, delighted, thrilled, by Kip-
pling's sunny semi-parodies of evolution (a
subject, of course, in his day). Learn about
Elephants got his long trunk, the Leopard
his spots, and the Kangaroo his hopping bit
that anticipated our own Australian. ("The
Congo" by a long time. Marvelously funny
reading, most sepulchral, by Boris Karloff.

The Fading Giant (Sounds of Steam Rail-
road, Vol. 2). O. Winston Link Railroad
Prods., (mono)
(12 E. 34th St., N. Y. 16)
A year ago I hailed Volume 1 in this lim-
lited series of records made on the Norfolk & Western road just
before the last of the 1940's and 1950's rolls
rolled. That this, somewhat different, is
is even better—good in sound, realistic
and most of all a surprisingly imaginative job
of the sort that just doesn't come in sound rec-
ording.

One entire side, for example, is a
continuous 1-hour sound journey behind a
steam locomotive, as we see it, in quick
transitions from one slice of steam "bellowing" to another, travelling from end to end of the line including station stops,
tunnels, bridges, mountain echoes and all the
rest—no commentary, no explanation in
sound. To clinch this unusual sequence, there
is a "blow by blow" account on the jacket of
the entire actual, geographical sequence of
the Armollios, as well as the Sound of Old
Steam, and we get aOing thing that anticipated our own Aeolian "The
Congo" by a long time. Marvelously funny
reading, most sepulchral, by Boris Karloff.

Audiwii • February, 1959
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The Queen's Birthday Salute (Band Concert, Royal Birthday Celebration and 21-Gun Salute). Herald Trumpeters and Band of the Royal Regiment of Artillery, Major S. V. Hays, narrator.
Vanguard VSD 2011 (stereo)

When I first put this one on, I was instantly reminded of the first time I accidentally took a three-dimensional stereo photo in double-exposure. Strange shapes, superimposed on one another, faces leering out of trees, houses at the bottom of a pool, somebody's hand in the middle of somebody else's stomach!

Ostensibly, the Queen's Birthday celebration was recorded in stereo London's Hyde Park. The photos show its wide open spaces all right. But since when do guns develop a large fat reverberation, something like that of an indoor swimming pool? Or just maybe an old fashioned army—the Royal Artillery Regiment?

Anyhow, a huge band plays across the rear of your room here, immersed in a vast indoor space, and everyone offers a British commentator—also in the rehers—gives a bit of story to help things along and keeps you up on the local traditions.

However, and no doubt about it, the 21 very large and very loud guns on Side 1 were recorded outdoors and not in a swimming pool! Same goes for a large mass of horses, dozens of them, which trot and gallop from right to left, then left to right, then right to left again, as the music plays on in its vast echo. Most confussin'.

The recording is surely a composite, the guns and the horses taken down on the spot outdoors in Hyde Park; the band music and commentary recorded indoors in some large place or other, the whole run together. But the effect loses my sense of stereo realism; for either I must imagine 21 guns and a hundred horses swooshing and booming away outdoors or I must visualize fair Hyde Park with some sort of enormous enclosure built around it to bring out the echo. Neither vision is very convincing, though the music is sturdy, ultra-British and nicely played, the horses very bouncy and the guns very artfully-like.

Incidentally, it strikes me now, as I listen to this, how extraordinarily conservative British popular music is, as compared to our American equivalent. These British tunes are set up in pre-Gilbert and Sullivan style, strictly as of around 1850 or so for the most part: John Philip Sousa sounds modern beside them—and for my ear his staff has fifty times the pep and the strength in sheer musical terms. British tradition or no, I think most Americans will find this music rather flat and tasteless, not unlike British food.

I honestly do think that our popular taste for band arrangements and settings of old familiar tunes is much advanced over the British, both more demanding and more sophisticated in every way.


It never rains but... here we go with a French band to supplement the British Artillery, and the difference is as great as any old difference between British and French ways.

The famous French tunes won't be familiar to you probably, but the style is new and it's easy enough to absorb. Jaunty, quick music, a sort of cross between "Gilt Parian" and "The Bear Goes Over the Mountain," it is much less pretentious in style than the British but also musically more complex, nearer to our own style of band music. (Ours is at a higher tension, more explosive, generally more dissonant.)

There's nice recording here, with a medium liveliness (not as big as an armory) and plenty of fat bass drum sounds and clashing cymbals.
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and all that

CHARLES A. ROBERTSON

STEREOPHONIC

Gerry Mulligan: The Jazz Combo from "I Want To Live"
United Artists US55006

Rex Stewart: Henderson Homecoming
United Artists US55009

After several months spent marking time, the new label bearing the banner of United Artists has embarked on a series of jazz recordings that tap new sources for material and the few changes that may be characteristic of the future. The two cited here represent a fresh departure in movie sound tracks and the first recorded performances of the Winter Festival Singers. Both offer rewarding experiences, not the least of which is that they bring jazz to the medium of film without altering its spirit and the other recollects the spirit of the Fletcher Henderson band.

Johnny Mandel wrote the entire score of "I Want To Live," employing a big band of West Coast musicians for the bulk of the picture, and this section of the sound track is available on United Artists' LA59005. Gerry Mulligan and the small group appear in the portions which require a more subtle underlining of the complex personality of Barbara Graham, whose dramatic story is played by Susan Hayward. The film must be seen to appreciate what is accomplished by the score, and no one who sees it will want to be without one or both of the recordings.

Mulligan's group performed with the big band, as well as the group which includes Art Farmer, Bud Shank, Frank Rosolino, Dave Pell, Bill Berkeley, and Shelly Manne. Mulligan was unable to do more than appear in the picture, as his liner notes say: "the instrument under character on Life's a Funny Thing, and Barbara's Theme, while the big band expresses her outward manifestations. The sound track is quite different from the usual studio recording, bright and almost too large for the number of musicians. It is superbly balanced and stereo gives it the necessary perspective.

Rex Stewart took charge of the Fletcher Henderson Alumni, a seventeen-piece band convening one or two or fingers at last summer's homecoming concert. The result is a change in planning and purpose and their place at a jazz festival which wants to do more than present a series of club sets. Wrapping It Up is a rite which prepared the way for the swing era, is followed by D Natural Hours, a more valuable and personal example of Henderson's conspicuous talent as leader and composer. The Alumni star as Stewart unsheath his trumpet on These Foolish Things, and Mulligan joins the other saxophone in the stormy song, and utilizing the liner notes by Bob and the Nick in their patient attitude take on a friendly glow. A master at developing a theme, Sinatra introduces the title song by Raye and Van Heusen, and finds an added touch of nostalgia in Alvin Goodman's signature and arrangements.

Frank Sinatra: For Only The Lonely

Capital SW-1053

The Ballad Style Of Stan Kenton
Capital ST-1068

Capital's latest stereo release in the popular vocal show is a continuing reliance on large units to create an impressive spread of sound.

Surprisingly, this works in reverse where Frank Sinatra is concerned and his voices, when centered between two loudspeakers is convolved with greater intimacy than in the monophonic version. One reason is that Nelson Riddle's orchestra moves out of the background and surrounds the singer with accompanying sounds. There is no lessening of talent on Great Day My Baby, but the bar and the patient attitude take on a friendly glow. A master at developing a theme, Sinatra introduces the title song by Raye and Van Heusen, and finds an added touch of nostalgia in Alvin Goodman's signature and arrangements.

Stan Kenton usually reserves ballads for the band's female vocalist, who have ranged from Anita O'Day to the current Ann Richards. On one of the rare occasions where his piano is featured in an entire set, he assumes their place in major delineations of the melody and against rich saxophone ensembles and brass chords. Among the best are "One for My Baby," featuring the pastel side of the Kenton sound in a new song, "One for My Baby," featuring the pastel side of the Kenton sound in a new song, "Don't Be That Way," a new song, and "All Alone," a new song, distinguished by its smooth and luscious trumpet, which forms the languid tempo. Stereo serves the orchestra well and none of the tone is dropped in the transfer, but the Sinatra

volume lends Ben Bernie's Lonesome Old Town.

Australis Wilson's "The Man From Nowhere" (Capitol ST-1068), by the Broadway cast presents the remainder of the list and the big band's musical ideal is in dimensions expansions enough for Seventy Six Trombones. Rex Stewart, Barney Cook, Eddie Hodges and the hard-working ensemble, under conductor Herbert Greene, command a broad sound.

Billy May's Big Fat Brass (Capitol ST-1202), scored for stereo by popular band masters, with results to balance two tee rings, three played open and throned, on the right against four trumpets and five french horns on the left. In the center are two tubas and a pair of sympathies, paced by drummer Al Woodard and completed by tuba in stereo. For the intimate band, with interludes for piano and harp, is descriptive of May's intentions on his three originals. But he evolves new and flavorful sonorities for Autumn Leaves, Love Is The Thing, and Moonlight Becomes You. And Ray Bryant's Farm Fence is a forthright seeker.

Ray Anthony: Dancing Over The Waves (Capitol ST-1068), by way of contrast, is a straight dance set built on Beachstraw, Intimacy, and Melody of the Hour. Ray Anthony: Dancing Over The Waves (Capitol ST-1068), by way of contrast, is a straight dance set built on Beachstraw, Intimacy, and Melody of the Hour. Ray Anthony: Dancing Over The Waves (Capitol ST-1068), by way of contrast, is a straight dance set built on Beachstraw, Intimacy, and Melody of the Hour. Ray Anthony: Dancing Over The Waves (Capitol ST-1068), by way of contrast, is a straight dance set built on Beachstraw, Intimacy, and Melody of the Hour. Ray Anthony: Dancing Over The Waves (Capitol ST-1068), by way of contrast, is a straight dance set built on Beachstraw, Intimacy, and Melody of the Hour. There is considerable discussion about the worth of stereo in its application to a small number of performers. That is when shows deficiencies with crystal clarity might well be a contributing factor. There are many popular stars that can only be heard by a large audience, but their songs are worth making them welcome. David Randolph describes the eighteen songs on the liner and the complete set of recordings is reproduced in the accompanying booklet.

Jazz West Coast, Vol. IV
World Pacific Stereo 1009

Gerry Mulligan: Reunion With Chet Baker World Pacific Stereo 1007

The third stereo release from this label includes one of its helpful anthologies for the listener who desires a varied sampling of West Coast jazz. It is too sophisticated for some tastes, and the quality, in general, shows considerable knowledge in the medium. The nine entries are presented under the names of such leading lights as Art Pepper, Chet Baker, Bill Perkins, Bud Shank, Bob Brozman, Dave Romanoff, Jimmy Heffling, and Terry Dugdin. Also included in the anthology is an extended version of "I'm Coming Home." From the album which unites Gerry Mulligan and Chet Baker in quicksilver time, it is a very nice set. But their after-hours sound, more like jazz, is more like mist. Mulligan writes a commemorative piece, Reunion, and enlists the aid of drummer Dave Romanoff and bassist Gary Gromes, members of his current quartet.

Chico Hamilton: Introducing Freddie Green (World Pacific Stereo 1008), gained
Happy, authentic music of the Gachos — cowboys of the Pampas. Recorded in Argentina. AFLP 1879

Intriguing, romantic, familiar tango melodies as played by Jo Basile, his accordion and orchestra. AFLP 1869

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TONY SCOTT: The Modern Art Of Jazz  
Seko Celp4250

Shortly after his return from a South African tour, Tony Scott resumed a usual acquaintance with the harpist sax and it seems to have developed into a lasting friendship. When he attended this session for the Korn label, new absorbingly the parent company, he had owned the horn only two weeks. Trying it out on two numbers, he offers a pleasant contrast in style and tone to his usual polished clarinet, playing with rugged conviction and a touch of the swing era on "Lullaby of the Leaves." The best moments are Bill Evans' piano solo on his original "Fire," the interplay of Scott's clarinet and Shakti Spitali's harp on "Thieves for Three Hats," and Clark Terry's sweetest trumpet figures on "Tenderly." Jimmy Keppler is wonderful and bustling on trombone, but has worked more closely with Scott in recent months.

Dave Brubeck engineered the date and the balance of the rhythm section, sparked by drummer Paul Motian. In particular, good in stereo. Roll Sound cut the masters.

INTEGRITY IN MUSIC...

Tony Scott: The Modern Art Of Jazz

Si Zentner: High Noon Cho Cho Cho

Bel Canto SR1007

Bel Canto SR8111

Band sidemen, like people in other walks of life, harbor definite ideas of how things should be run. When raised to the position of leader, they usually do just the opposite of what they had planned. An exception seems to be Si Zentner, who works in Hollywood studios and burned in trombone sessions under Les Brown, Harry James, and Billie May. His sixteen-piece band, assembled from among other studio talents for these recordings, operates with a careful ear and rare humor, indicating that all hands are conducted. The crew includes Manty Travik, Vern Preley, and vocalist Lynn Frank. Planned for stereo, the arrangements give the engineers enough brass choir and smooth saxophone to work with on a dozen tunes. Some are Latin-flavored and prepare the way for the High Voice set, where four drummers are added.

In the liner notes, Dimitri Tiomkin tells how the song affected scoring for films, and it may well have the same effect on the cha-cha industry. Such unlikely popular hits as "Harbor Lights," "San Domenico," and "Bird of Paradise" are converted to sultry rhythms. Billy May helped with the writing, but the resourceful lyrics for "Swing But" is unidentified.

Al Malgari: At The Chicago Stadium Organ

Audio Fidelity Stereodisc AFSD5886

Cited as the world's greatest unit pipe organ, the instrument in the Chicago Stadium lists a total of 40,000 pipes. Boz, stop, and six manuals. Set 100 feet above the floor of the arena are four huge organ lobbies, and the dynamics are manifold. No loudspeakers are required at the source to increase the volume of the tremendous pipes and they sound with natural resonance throughout the auditorium. With such physical properties, it deserves the splendid honors it has received and the fanatical attention to this recording.

At Malgari: The man in charge of this mammoth beast is well acclaimed to its peculiarities and offers for them by keeping his arrangements of popular melodies unabashedly his showpiece is "I've Been Working on the Railroad," complete with stunning locomotive, and he moves with eloquently good humor through "Butcher Bag," "Swedish March," and "Asleep in the Deep."
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John Benson Brooks: Alabama Concerto
Riverside RIP12-276

The genesis of this work lies in an anthropological field trip Harold Courlander made to Alabama, where he studied the music of an entire Negro community several years ago. While engaged in transcription of the records brought back, John Benson Brooks became attracted to the insight they give into jazz origins and subsequently linked the elements of blues, hollers, spirituals, and children's game rhythms in a concerto of four movements. The challenge of this material, to both composer and musicians, is in keeping it simple and free of worldly decencies, so small feet for persons of some sophistication. For this reason, Brooks employs a quartet, joining it on piano in the third movement on More, Members, More, and is aided in making it simple and free game of blues, brought together in an entirely worldy deceits, transcribing the elements of the original spirituals, and in molding it into a piece by a variety of players and it deserves a recording with a different personnel more than many pieces constantly turning up at a number of sessions. Perhaps Riverside will find the way clear, until musical and financial pressures are exhausted, to make its repetition an annual event.

John Coltrane: Soultrane
Prestige 7142

Lee Morgan: Candy
Blue Note 1590

Two of the younger men of jazz appear as the only horns on LP's which offer much satisfaction to those devotees who take delight in watching the development of talent into a personal entity. Both have worked long creating an individually recognizable in any context, and molded into plastic line with a lyric quality that is distinct to their own, to the extent that a presentment of this goal is displayed on Russian Lullaby, I Want To Talk About You, and You and the Night. The former sax on a blues, Lawne For Ernies, is explanation enough for the album title. His companions, trumpetist Sonny Rollins, bassist Doug Watkins, and Art Taylor again.

Sonny Rollins And The Big Brass
Metrojazz E1002

A reminder of the diminished status of big bands during the last decade is implicit in this first encounter on a new subsidiary of M-G-M, of Sonny Rollins and the big brass. Few players attain his stature, even in these trying times, without recording as a sideman in one large studio orchestra or another. Where soloists once served an apprenticeship in section work, his style was formed in an atmosphere free of such restrictions and is completely representative of a generation trained in small groups. It is not readily adaptable to conventional band arrangements and Gil Evans offered a partial solution to the problem, in writing for Miles Davis and Julian Adderley, by scoring frameworks for individual solos.

Arranging four numbers for a dozen men and the featured tenor saxophonist, Ernie Wilkins takes this process a step further, giving the brass accents fully characteristic of Rollins and altering their trait of using pedal points to punctuate a phrase to Don Butterfield's tuba. The performances are likely integrated, but their strength is also their weakness. It is hard to imagine them played, as constituted here, without the trumpet protagonist. To complete the circle, Wilkins might rework Rollins Grand Street, a melodic number containing a warm, solo note from Nat Adderley, and forward it to Harry James for trial by his new band. For Out East, the one original from Wilkins, introduces the Belgian-born guitarist Tete Thomas. One side finds Rollins in his now accustomed ceto context revising What Is This Thing Called Love, and a robust Manhattan. He also brings his attention to bear on an old Rudy Vallee favorite. If You Were The Only Girl in the World, effectively played in 4/4 time and as a waltz. An unaccomplished small ensemble, quite naturally, invites comparison with the classic 1939 version of Coleman Hawkins.

The Arrival Of Victor Feldman
Contemporary C3549

Since journeying to these shores from Britain in 1955, Victor Feldman appeared as sideman on several dates in this country. In fact he is the first to signify his arrival as a leader in this country. A triple-threat man on vibes, clarinet, and drums while with the English band of Ronnie Scott, he now de-legates the percussive effects to Stan Lee. Along with Scott LaFaro, who also makes somewhat of an arrival as a powerful and inventive bassist, they form a trio capable of handling such
wildly-separated material as a Chopin Waltz, Serpenti's Tooth by Miles Davis, and Sp'onic'.
Like other notable vibists, Feldman finds the piano valuable as a means of composing pieces to be developed later on the vibes. The process, followed on his three originals, serves the added purpose of helping decide which instrument best suits a tune and allows him to be completely at home as he alternates from one to the other. As the vibes receive an exceptional recording, however, most interest centers here and on the resonant lines of the bassist.

Oranim Zabar Israeli Troupe: On The Road To Elath Elektra 156 Ray Martin: Olives, Almonds, and Raisins Capitol 110113
The road from Beerseba winds through the Negev to Elath on the Red Sea and its history, from the fight for liberation in 1948 to the present, is related in the songs of the Oranim Zabar Israeli Troupe. Each of the five members was present at the start of the struggle to reclaim the desert and, as life spread through the arid land, helped the volume of music concerning it grow. Some of the tunes date back to another time, but the words hold the key to a whole new body of folklore. A song in Yiddish by Geula Gitl and guest artist Eliuzer Plisnik, they convey vivid pictures of fighting men, relaxation around a campfire, and toil in the fields. It would be difficult to get much closer to the source of folk music. A rhythmic number for Avraham Elber, dancer of the group, is played by Michael Kagan, on clay drum, and its composer Amitai Neeman, on accordion. Dov Seltz contributes several arrangements. A book containing translations of the text, but no subordinate needs an interpreter to appreciate the joyous Song of the Sprinter.

Traditional Jewish music of the centuries, rather than a brief decade, is presented by Ray Martin, who polished and orchestrated the original melodies. In adapting the lyrics into English, he worked closely with Bill Shepherd, the leader of a chorus which sings them with clarity and understanding. The rare humor and wisdom of Life's Philosophy, Gall God, Pore Old Able, and Yomar, Yomar become readily accessible to all. As do the compulsive rhythms of Come Dance the Hora, and The Trumpet and the Flute.

The Music Of New Orleans, Vol. 3 Folkways FA2463
This collection, the third in a series aimed at preserving some of the remnants of traditional New Orleans music as it exists in the city today, is devoted to the small informal bands playing in neighborhood dance halls. Assembled from tapes gathered by enthusiastic folklorists since 1951, it assumes an immediate documentary value as the intervening years have taken their toll of the older musicians. Among those now retired or no longer able to play are the legendary clarinetist Emile Barnes, the cornetist Charlie Love, trombonist Joe Avery, and the peerless violinist Joe Dee and Billie Pierce, "Primitve Piano," released on the Tone label last year, introduced Billie's playing and in this era of a superfluity of LPs is already out-of-print, bringing a premium on the collector's market. Tapes made in 1954, before Billie's health ended their careers, unite them on records for the first time and her spouse of thirty years standing watches her voice with sensitive trumpet obbligato. They make a delightful pair on Big Mama, Careless Love, and Married Man Blues. Barnes and Laurence Towner, on trumpet, join her on a vigorous Shake It and Break It.

The younger generation is represented by a spirited group which developed during the days of swing. Fronted by Avery, trumpetist Kid Clayton and Al Durband on clarinet, it ranges from the close ensembles of Gettysburg March to relaxed solos on Jimmie's Blues. Sam Charters, producer of the series, is heard on banjo behind Luce on Board of Fashions, and trumpeter Kid Thomas leads his band on Anyone, often made in noisy halls, the recordings are each as captivating, but full of an atmosphere far removed from the tourist attractions of Bourbon Street.

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Weathers Technical Magic has produced the lightest, quietest, and smoothest turntable ever made...no mechanical noises, no outside vibrations, and practically no rumble or feedback. Its cool running 12 pole synchronous motor maintains constant speed regardless of variations in line voltage or load. Noise level is below that of today's finest records.

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The AR-3 is a three-way speaker system combining an AR-1 acoustic suspension woofer with two high-frequency units developed in AR's laboratory over the last year.

Like the AR woofer, the tweeters used in the AR-3 represent a radical departure from conventional speaker design, and patent application has been made.*

These new tweeters are neither cone-type nor horn devices—they could be described technically as hemispherical direct-radiators. We believe that their uniformity and range of frequency response, their low distortion, and their transient and dispersion characteristics establish new performance standards, and that the AR tweeters make a contribution to treble reproduction similar in degree to that made by AR's acoustic suspension woofer to bass reproduction.

The AR-3 has the most musically natural sound that we were able to create in a speaker, without compromise.

*Patent applied for by E. M. Wilich, assignee to Acoustic Research, Inc.

Harry Arnold: Big Band + Quincy Jones
EmArcy MG39139

Harry James: Harry's Choice!
Capitol T1093

Brightened considerably when Harry James displayed his revitalized unit last summer, the big band picture is even clearer with the arrival of an import from Sweden. Harry Arnold was last heard introducing Ernestine Anderson, an American singer who first found fame abroad, and now enjoys an association with composer-arranger Quincy Jones, a native of this country quartered in Paris. Several of the solos are known here for their work with small groups and include pianist Bengt Hallberg, also saxist Arne Domnér and trombonist Asa Persson, our personal favorite. Jones is in the basic spirit in his contributions to the date, offering a warm contrast to Arnold's coolish Breeze Encounter. Trumpeter Bruno Balz, a section solo from the Hampton band, is featured on Meet Benny Bailey, and Horace Silver's Deadlift. This last arrangement, along with one of Roux 406, belongs in every jazz library and indicates that Jones will make himself heard from abroad.

Harry James also continues under the basic spell and his trumpeter, both muted and open, varies on new settings from Eddie Wilkins for Make Believe, I Want a Little Girl, and Willow Weep For Me. Together they work up a handsome Blues for Brie, and Wilkins writes aifty strolling Just For Fun. The sax team of Willie Smith and Sam Firmanes covers most phrases above the breezy rhythm section.

Arthur Lyman: Hawaiian Sunset
Hilitecord R807

By virtue of the reverse logic peculiar to record companies, the program most suitable as a preface to the work of Arthur Lyman arrives as the third of a series. The primitive instruments which he employed to achieve a unique blend in his previous efforts are returned to their natural setting. Instead of mixing exotic South Sea sounds with classic, popular, and modern jazz idioms, he plays the ballads of Hawaii in typical native style. Fewer aural surprises are furnished, but there is the novelty of hearing this music handled with skill and an antiquite touch. Solon has it been performed so well, and many listeners will find themselves revising their estimate of the languorous melodies.

The familiar Bouquet Lei and no longer seems trite, and Hawaiian War Chant is revealed as a love song. A coconut shell heralds King's Seventh, and included among the other traditional numbers is the Wedding Song. As before, the Kaiser Aluminum Dome contributes to the superb sound and a stereo version is available. If Lyman's talents have somehow escaped your notice, this album provides an introduction upon which to base a lasting acquaintance.

Felix Slatkin: The Military Band
Capitol W1056

At the head of a seventy-piece group composed of Hollywood musicians and generations from service outfits, Felix Slatkin displays another facet of his conducting experience, gaining leading an Air Corps Band while stationed at Santa Ana, California, during the war. A Salute to the Services nobly awakens to revive and presents official versions of the anthems of each branch, tied together by a variety of drum corps rhythms from the eleven-man percussion section, before Taps and a mighty Star Spangled Banner at the close. There are six Sousa marches, with a selection of seven for the piccolo passage in Stars and Stripes Forever, and a task force of six tubas adds depth to Under the Double Eagle, and American Patrol.

In dealing with an organization of such quantity, Slatkin never lets the quality deteriorate or the marching beat bog down. The first-rate sound has plenty of space, but you may easily prefer the stereo disc which is due in the stores by the time this note appears.
Atilio Stampone: Tango Argentino
Audio Fidelity AFLP1880
Piano By Mores
Capitol T10159

For some years the tango has suffered neglect because of the concentration on other Latin American rhythms and these albums, both recorded in Buenos Aires, will go a very long way toward righting the balance in the eyes of the public and recording companies. The two leaders are excellent pianists, popular in Europe where love of the tango never lapsed, and their music is ideal for listening or dancing. Tangos grow as rapidly in their native clime as popular songs do here and none of the dozen tunes played by Atilio Stampone is a holdover from Valentino days. His orchestra is broadcast over Argentina's two top radio networks and Audio Fidelity's Sidney Frey and Johnny Robbins fell down to ensure the quality of the recording.

Mariano Mores varies his collection with milongas, a waltz and his two-part concert piece, Tango Khapangy. He turns back the pages for La Companoria, but six numbers are from his own pen. Pianola point of the arrangement and the recording is his sparkling piano, in contrast to Stampone's tendency to display the orchestra. If the tango ever displaces the cha cha and mambo in these parts, both men should be on the front northbound plane.

NEW LITERATURE

- General Electric Company, Dept. SKY, West Genesee St., Auburn, N. Y., announces specification sheets on six new GE "Stereo Classic" high fidelity components. They are:
  - Sheet No. Product
  - MS-1000 and MS-2000 stereo amplifiers.
  - Model LK-12 coaxial speaker, Model LC-12 two-way speaker system kit.
  - MF-1 stereo preamplifier.
  - Model BG-1000 stereo remote control.

All are available from authorized GE hi-fi component dealers. None of your nearest dealer may be obtained by writing to the address shown above.

- Belden Manufacturing Company, 1447 W. Van Buren St., Chicago 50, Ill., offers 283 new stock items in its 1959 Electronics Wire Catalog No. 855. This new catalog has been completely re-designed with all wires grouped by type and application, for easier use. All essential electrical characteristics and construction details are shown for each item, with each type of wire clearly illustrated. Typical listings include shielded microphone and power supply cables, TV camera cables, hi-fi, stereo and phonograph cables, and cables for installation of intercom equipment.

- Microtran Company, Inc., 145 H. Mineola Ave., Valley Stream, N. Y., has available a new short form catalog listing complete specifications of Microtran transformers. These include miniature, subminiature, transformers MIL-T-21A, and industrial transformers which are available from distributor stock. The short form catalog serves as a ready reference for a quick run-down on Microtran transformers, showing the wide range of models at a glance.

- Leonard Radio, Inc., 66 Cortlandt St., New York 7, N. Y., announces publication of the "Hi-Fi Guide," a 128-page catalog of high-fidelity parts and equipment. Contents of the book are complete listings of monophonic and stereophonic components of the catalog are available on request, as well as related audio accessories.

To order the new GRAY 12" stereo-mono-phonc
tone arm KIT only 23.95

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"...lives up to its claims in full measurement, delivering superb performance."

"...does not degrade or change the quality of an LP dubbed on tape."

"...S/N ratio agrees exactly with advertised claims."

"...performance fully up to professional standard in many respects."

Ferrograph Stereo equipment is designed to meet traditionally exacting high quality standards.

Two superb models are available:

The Ferrograph Stereo 88 is designed for both recording and playback of stereo tapes. Professional quality twin-recording amplifiers and playback pre-amplifiers are built. Monaural recording/playback on both tracks is also possible.

The Ferrograph Stereo 35 is designed for the playback of stereo tapes and also offers all the features monaurally of the popular Ferrograph 3A Series. While it is possible to employ auxiliary amplifiers, the Ferrograph "Stere-ad" unit offers the ultimate in matched amplifiers resulting in superb stereo reproduction.

Conversion kits to permit stereo replay are now available in limited quantities to owners of non-stereo tape recorders.

ERCONA CORPORATION

(Electronic Division)

16 W. 46 Street, Dept. 17, New York 36, N. Y.

In Canada: Astral Electric Co. Ltd.

41 Danforth Road, Toronto 13

CONVERTING TO STEREO

(from page 25)

The price of the complete conversion kit, which includes detailed instructions and patch cords is $88.20. Heads made by other manufacturers can be substituted provided they have similar dimensions and electrical characteristics.

Conversion Steps for Monophonic Machines

1. First of all, remove the old combination head from the mounting plate and unsolder the leads to the head. These leads are then connected to the pins of the upper tracks of the new quarter-track erase and recording heads.

2. The scale template of Fig. 4 is then glued or taped to the under side of the mounting plate. The two head mounting holes are center-punched and drilled, and the heads are bolted to the plate as shown in Fig. 2.

3. The head assembly is put back in the nest as shown in Fig. 5. The miniature phone jack is shown mounted on the head cover, which is lying upside down just above the head nest in the photograph. The bottom channel of the record/playback head is connected to the miniature jack. To the left of the head nest is the spring hold-down clip which has a piece of sponge rubber cemented to it to help apply pressure downward on the head assembly.

4. The screw to the left of the erase head on the base plate is used to azimuth the pickup head for maximum high-frequency response on playback of pre-recorded tapes. The face plate across the faces of the heads should also be checked as shown in Fig. 2. Spacers or shims should be used if necessary to obtain the correct head height.

5. The foregoing is all the modification required on the recorder to convert it to stereo playback. The recorder amplifier and sound system is used for one channel. Any tape playback amplifier (the Nortronics PL-100 is an example) may be connected to the second head channel thru the miniature jack. Together with a speaker, this gives the second sound channel for stereo reproduction.

6. If another amplifier is available that does not have a tape head input with NARTB equalization, then a pre-amplifier can be added. Figure 6 is the circuit diagram of such a preamplifier which may be mounted on the chassis of the power amplifier, using the same B+ and filament supply. It has from 0.1 to 0.5 volts output, and so will drive most crystal phone cartridge or tuner input circuits. The preamplifier may, of course, be built up on its own chassis with its own power supply.

7. The recorder may still be used for monophonic recording and playback, in addition to stereo playback. For monophonic application, the top channel is used in the same manner as with the half-track system.

Conversion of Half-Track Stereo Machines

8. These machines come equipped with a half-track in-line stereo head, and a single-channel erase head. If we replace the two heads with the quarter-track erase and record heads, then we shall be able to play back quarter-track stereo, and also record and play...
back quarter-track monophonic tapes.

9. Remove the present heads, using a hand drill to drill out the eyelets holding the erase head in place. The old half-track monophonic erase head may be left in, if desired, to simplify the playback conversion. This erase head will be adequate for monophonic recording. It may be replaced at a latter time when the step to stereo recording is made.

10. Mount the new heads and make the adjustments exactly as described previously, for the conversion of the monophonic machines.

Adding Stereo Recording

11. An additional recording amplifier is required to permit stereo recording. Either the Nortronics RA-100, or the Viking RP-61A will be satisfactory. The RA-100 is used for recording only, while the RP-61A has a preamplifier for use during playback. A minor internal modification is required on the RP-61 for correct bias, since it does not have a bias control.

12. It is also necessary to synchronize the bias oscillator of the tape recorder with that of the recording amplifier. This is normally accomplished by connecting the plates of the respective oscillator tubes together through a coupling capacitor. The RA-100 and RP-61 already have a synchronizing jack on the rear of the units which connects to the oscillator plate.

13. On the tape recorder, a 0.0047 uf 400-volt paper capacitor should be soldered to the plate terminal of the oscillator tube. The other end of the capacitor is connected to a patch cord which may then be plugged into the synchronizing jack on the recording amplifier.

14. For dual channel erasing a set of jumpers is connected between the upper and lower pins of the erase head. The erase head is then operated by the recorder oscillator. It is not necessary to remove these jumpers for monophonic recording since the second track is not used.

With the two recording amplifiers synchronized together stereo recording is now possible. Two microphones may be used for recording live material, or stereo programs from the radio may be put on tape. Using a turntable and stereo cartridge, we can copy stereo discs on to quarter-track tape. In addition we can also copy stereo tapes by using two machines, one for playback and one for recording.

Either 7.5- or 3.75-ips tape speed may be used for recording, depending upon the requirements. Difficulty may be experienced with excessive high-frequency response at the higher tape speeds due to the improved performance. This can be corrected with the equalization control on playback.

*Including designs by Arthur A. Jansen
made only by NESHAMY ELECTRONIC CORP., Neshaminy, Pa.
Export Org.: 25 Warren St., New York 7, N. Y. Cable: Simontrice, N. Y.
The Piano vs. the Harpsichord

HAROLD LAWRENCE

Ever since the end of the 18th century, when it lost its predominant position in the keyboard world, the harpsichord has been multiply misinterpreted, and misunderstood. To the Romantic Age, its musical value had been totally demolished by the advent of the new pianoforte, next to which it appeared as primitive as the electric friction machine is to the storage battery. It seemed as if the harpsichord, along with the shawm, cornett, and serpent, was to be relegated to museum exhibits and music encyclopedias.

References to the sound the harpsichord made were contemptuous—a custom that has continued to the present time. Vaughan Williams, for example, compared the harpsichord to the "tinking of a sewing machine"; another critic described its tone as "a scratch with a sound at the end of it"; and even Virgil Thomson, who is pro-harpsichord, wrote of a harpsichord recital as "a shower of needles."

Throughout the 19th century, the harpsichord was absent from the musical scene. Its reappearance was brought about by the turn-of-the-century reaction against German romanticism, bringing with it a fresh evaluation of early music. Little by little, the 19th-century attitude toward music written before Beethoven's Eroica gave way to a more enlightened approach. Discerning musicians chose to bypass transcriptions of early music and went directly to the sources, investigating original scores, studying performance standards of the Baroque and Renaissance periods. Instruments such as the recorder, viols, and harpsichord were utilized in order to recreate the sound as well as the style of the early works.

While it must be frankly admitted that, to the general public, Bach's sonatas for violin (unaccompanied) performed with "Bach" bow, or Purcell's Fantasias played by a "cheet of viol" is of little more than academic interest, harpsichord recitals have become popular features of today's concert life, thanks to the pioneering work of Wanda Landowska, who has regularly performed for sold-out houses and whose recordings are still available in other instrumental releases in the RCA Victor catalog. Landowska's recording of Bach's Goldberg Variations, for instance, sold more than 35,000 copies during the first six years of its release.

The nature of the harpsichord's return to the 20th century after more than a century's retirement, indicates that its life cycle is far from completed. Unlike the viola da gamba, whose growth long ago reached its final stage, the harpsichord is very much alive. Contemporary composers have written works especially for it, manufacturers have made various changes in its design and construction over the past fifty years, and the demand for new harpsichords has reached an all-time high in our time.

There is hardly any danger of the harpsichord displacing the piano, as was the case in reverse in the last years of the 18th century. The piano is and will remain the leading keyboard instrument. More to the point is the fact that the harpsichord possesses qualities which render it uniquely suited to certain musical styles and periods.

A "load of guitars" is one of many descriptions applied to the harpsichord, whose strings are plucked by quills or leather point plectra. Basically, the mechanism operates in the following manner: A key is depressed, raising an upright wooden rod ("jack") to which is attached a quill (or leather point). The quill plucks the string, then falls back to its original position, neatly bypassing the string in its descent. At the topmost end of the jack is a damper which stops the string's vibration when the key is released.

The first obvious difference between the piano and the harpsichord lies in tone production. Touch plays an all-important role in piano technique where hammers strike strings. On the harpsichord, finger pressure has no significant effect on tone quality; the string is plucked only when a certain minimum force is applied, and pressure beyond this point does not appreciably alter the tone, though a really determined pounding will be heard slightly differently.

This dynamic inflexibility was recognized by early harpsichord builders who added a second keyboard (manual) for loud-soft contrasts. (Later instruments were built with as many as four manuals.) Different timbres were obtained from the same key by the use of multi-jack mechanisms. That is, several jacks were mounted along the same string, tonal variety being achieved by means of (1), different jumping points; (2), position of the jacks on the string (just as in violin playing, variety in dynamics and tone color can be accomplished at different points between the bridge and the finger board). Stops of 4', 8' and 16' were also incorporated, giving the harpsichord a wider range. (Bach's instrument, for example, had a 5-octave compass.) Thus, the development of the double keyboard and compass/timbre stops provided the player with an enlarged dynamic, tonal and expressive palette.

By itself, however, such dynamic level and tonal setting is still ineffective produced. Once the player has selected a particular registration for a phrase or section, gradations within that framework are impossible without stop changes. The pianist, on the other hand, is faced with no such restrictions. He may proceed from a piano to a forte without shifting gears, hence the name piano/forte.

It was the piano/forte capability that put the harpsichord out of business in the last part of the 18th century. In an attempt to compete with the first pianos, manufacturers of harpsichords adapted the "Venetian swell" to their new models. This mechanism operated on the Venetian-blind principle, letting out or shutting in sound. It was a crude device that merely served to
Now! The Most Important Product Announcement in the History of H. H. Scott!

The H. H. Scott engineering laboratories proudly introduce the new Model 299 40 watt stereophonic amplifier and control center. It contains many advance features that not only meet the needs of today's stereophonic program sources, but anticipate the requirements of the future.

Check the details of this new amplifier, and see for yourself why the new 299 is superior to any other amplifier available.

- 4 Phase reverse switch to compensate for improperly phased tape recordings or loudspeakers.
- 5 Special balancing circuit for quick and accurate volume balancing of both channels.
- 6 Separate record scratch and rumble filters.
- 7 Unique visual signal light control panel instantly indicates mode of operation.
- 8 Can be used as an electronic crossover (bi-amplifier).
- 9 Special compensation for direct connection of tape playback heads without external preamp.
- 10 Special switching lets you use your stereo pickup on monaural records.
- 11 You can play a monaural source such as an FM tuner through both channels simultaneously effectively doubling power.
- 12 Loudness compensation.
- 13 Stereo tape recorder output.
- 14 D.C. filament supply for preamp to virtually eliminate hum (30 db below full power output).
- 15 Distortion (first order difference tone) less than 0.3%.

Write for complete technical specifications and new catalog A-2.

Audio • February, 1959
cross-talk is believed to come from close spacing between the channel switches rather than from the mixer busses (see Fig. 4).

The negative plate-supply bus connects to a chassis ground at only one point, A mounting screw on the first microphone input transformer was selected for this. All component grounds are made directly to this bus and not to the chassis ground.

To prevent "ground loops" and transient noises, only insulated shielded cable was used where shielded cable runs were necessary.

Lever type, three-position, positive action switches were used after all channel mixers. Because of the make-before-break contact arrangement of these switches, we experience absolutely no switch "clicks" when one is used. When the switch is in the center position, it shorts that mixer stage to ground. This helps eliminate cross-talk and "leak-through" from the channel when it is not being used.

Only on the two microphone channels were the second half of these switches used. The bottom contacts were used to activate the speaker muting relays when the console is used at the studio. The contact action is brought out to the back of the chassis through a four-contact female Jones plug.

While we tried to economize in other parts of the unit, this was not the case when transformers were selected. In most parts, our selection of audio transformers accounts for the line frequency response and low hum level obtained in this amplifier.

A quantity of carbon-deposited resistors were used in the amplifier circuit. They aided materially in giving us a low noise content from the preamplifier stages. They cost a little more, but they are well worth the additional expense.

Operation and Handling

In case the mixer-amplifier fails while we are doing a non-broadcast program, it is possible to continue programming by plugging one of the transcription arms into a phone input on the public-address amplifier. An "in-the-line" microphone transformer is used to convert our 50-ohm broadcast microphone from low impedance to high impedance, matching the microphone input on the public-address amplifier. This feature allows the operator to continue with the public-address program until our repairman arrives.

To keep our outfit from being defaced while it is being moved, a heavy canvas cover was made so it could be protected.

The unit is moved from place to place in a pickup truck and this cover serves to protect it from the elements in bad weather.

Instruments used to make the performance measurements are the same ones we use to take "proof-of-performance" measurements on our broadcast equipment. No external ground was made to the equipment being tested. We wanted to simulate, as nearly as possible, conditions which exist when the unit is used on remotes.

Performance

Earlier the frequency-response measurements were given for the microphone preamplifiers and the phone preamplifiers. Frequency-response measurements taken by feeding tones into the auxiliary input channel gave us ±1 db variation in level from 30 to 20,000 cps. Hum and noise combined, were 62 db below 0 db output at the amplifier line-output terminals. Distortion proved to be no greater than 0.75 per cent at any frequency from 30 to 20,000 cps. Above 100 cps, the distortion was no greater than 0.5 per cent.

The average unloading and setup times are from 15 to 30 minutes, usually the lower figure if we don’t have to check out a remote line.

A local trucker has been contracted to move the unit for us. An engineer goes with him to help move the unit into place and connect it. The announcer or operator helps the trucker disconnect it after the job and load it on the truck.

Our Double-Duty Disc-Hop Consolete has been to County fairs, school dances,
cause the steel may not have been typical, cheap 26-gauge laminations were tested. At 14,000 gauss they had a permeability of 1850, or twice that of Audio A, and about 1/4 as much distortion. The high permeability at 14,000 gauss could lead to the assumption that the core loss was low. This was not the case. The measured power factor of these laminations was about twice that of Audio A at this flux density.

At low flux densities the core material was most inferior. The low flux density peak in the distortion curve reached 18.6 per cent third harmonic compared to 10.4 per cent for Audio A.

The permeability at 3.4 gauss was 237 compared to 650 for Audio A. The impedance of the transformer using the cheap core material would be correspondingly low, and the distortion correspondingly high.

Air Gaps

Ideally, the maximum electrical impedance results when the magnetic path has no air gaps. This is impossible with laminations. The result of the unavoidable air gaps is the lowering of the apparent permeability of the core material. All other factors being equal, the impedance...
Sound Talk
by A. Fiore, Director of Engineering and Manufacturing

QUALITY CONTROL—KEY TO PERFORMANCE

The performance and durability of hi-fi equipment is closely related to quality control standards adopted by the manufacturer. In fact, next to its basic design, the product’s performance is most strongly affected by the degree and nature of quality control used in its manufacture.

Quality control begins early in the design stages when the engineer selects and specifies the most reliable materials for the job. Next, several hand-built prototypes, representing many hours of laboratory development, are subjected to stringent tests and measurements. When the units are judged acceptable for production, strict laboratory performance standards are established. Each production-line unit must meet or exceed this standard before it is shipped.

Rigorous quality control conditions are instituted at key production points. One-hundred percent inspection of parts and sub-assemblies, high grade tooling, precision instrumentation and test equipment, and a constant emphasis on quality are just a few of these conditions. When dealing with machined tolerances of 1/100,000 of an inch or parts so small they must be assembled under a microscope, quality control of workmanship becomes critically important. Qualitative procedures are developed to promote reliability of workmanship and to lessen the possibility of human error.

The final objective of quality control is a built-in resistance to failure under specified environmental and operational conditions. ALTEC designs and builds sound equipment for a wide variety of applications. The ALTEC High Fidelity line is famous for faithful reproduction. Stereo in its early stages was pioneered by ALTEC for theater and recording use.

ALTEC high intensity sonic generators are used for environmental testing of missile and jet aircraft components. There is a good chance that the sound system in the auditorium or stadium of your own home town is an ALTEC. Strict quality control makes it possible for ALTEC to produce diversified equipment that functions as specified, under any conditions, anywhere— from the Equator to the Arctic, from the stratosphere to subaqueous depths.

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pedance of the transformer coil varies inversely with the length of the magnetic flux path, so that lengthening of the path lowers the impedance. A small air gap has a large effect on the magnetic circuit because the permeability of space is unity while the permeability of the ferromagnetic core is commonly in the thousands. The numerical effect on the length of the magnetic circuit is determined by multiplying the length of the air gap by the permeability of the core material and adding this equivalent length to the length of the path in the ferromagnetic material. The apparent permeability is inversely proportional to this total length.

It follows that the higher the permeability of the material, the more severe the loss due to the air gap.

Small transformers suffer from the fact that the unavoidable air gap is a larger part of the total magnetic path, causing a greater reduction in effective permeability.

The manufacturers of lamination materials state that the usual minimum air gap with fully interleaved laminations is at least one thousandth of an inch, and that the minimum gap with great assembly care, and only with very large laminations, is one half thousandth of an inch. Fortunately these figures are very pessimistic.

Figure 3 for 50% nickel alloy shows a maximum permeability of 25,000. If the magnetic material were perfect and had infinite permeability so that all of the reluctance were in the air gap, a .0005" gap in the 4.5" total path of the EI-75 lamination would limit the apparent permeability to 4.5/0005 or 900. Obviously then, the air gap is very much less than .0005".

To calculate the air gap from the electrical measurements, it is necessary to make an assumption about the core material. Of the various magnetic properties of these core materials the one that seems most predictable is neither the initial nor maximum permeability, but the ratio of maximum to initial permeabilities. Production variations in maximum and initial permeabilities are very large but the ratio of maximum to initial permeability is less variable. The measured ratio with an air gap is always less than the actual ratio for the material alone. In the extreme case where the air gap constitutes the entire magnetic circuit the permeability is invariant.

Initial permeability is commercially measured at 20 gausses. These curves show 20 gausses to be too high. One gauss measurement would be more suitable. Using actual initial permeability figures, the ratio of maximum to initial permeability is lower for non-oriented silicon, and the nickel alloys seems to be about 10 to 1. Using this ratio, the maximum permeability of the core material in Fig. 3 is calculated to be 36,600, the initial permeability 3,800 and the air gap .00008", about one one-hundredth of one thousandth inch.

Even this very small air gap reduces the permeability of the assembled core from a maximum 36,600 to 25,000, indicating that the reluctance of the .0008" air gap is about half as great as the reluctance of the core material at maximum permeability. Because the adverse effect of an air gap is proportional to the ferromagnetic permeability, it has slight effect on the initial permeability, causing a reduction only from 3,600 to 3,500.

Figure 4 for a very small Mametals core shows a maximum permeability of 10,000 and an initial permeability of 6,600. The small ratio of these permeabilities indicates a large relative air gap. This is logical for several reasons, the small magnetic length of 2.5" for the L-14 laminations, the small overlapping area of small laminations, and the high permeability of Mamelals. The values for this core material, based on the 10 to 1 permeability assumption, are found to be 86,300 maximum permeability, 8,630 initial permeability, and .000128" gap. This gap is about twice the length of the gap of the larger EI-75 laminations. It has reduced the maximum permeability to less than one fifth, and the initial permeability to about two

---

Fig. 4. Curves of transmission, permeability, distortion, and impedance vs. flux density for Mamelals core material.
thirks in the assembled core. If this particular Mumetal had been tested in the E7-1 laminations used for Fig. 3, the curve would have shown maximum and initial permeabilities of about 40,000 and 8,000, due to the shorter air gap and longer magnetic path.

These very small calculated air gaps might be questioned. A designer who uses large quantities of l-14 laminations in geophysical transformers checks careful calculations for permeability. He reports an initial permeability of 6,000 to 8,000 for assembled cores. This may be directly compared to the 6,000 of Fig. 4.

The one indefinable factor in these calculations is the assumed permeability ratio of 10. If the actual ratio were less than 10 the air gap would be even shorter. If the actual ratio were 20 instead of 10 the calculated gap of Fig. 4 would be .000133" instead of .000128", only about one ninth longer. Manifectly a large error in assumed permeability ratio results in a small gap error. It seems unlikely that the calculated gaps are seriously inaccurate.

An air gap inserted into a closed core increases the energizing current. It might be expected that the distortion would also increase. This does not result. The additional exciting current energizes the air gap which is linear. The extra exciting current is according to size of air gap. The actual result, which has been well verified experimentally, is that distortion decreases slowly with increase in air gap. Considering the magnitude of other core variables, this effect is insignificant with small air gaps. Because an air gap decreases the impedance of a transformer, it impairs the transmission and is generally avoided.

(to be continued)

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gram; the suspension system will also
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the user. Complete data on the Stereodyne
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any audio-range equipment are supplied
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is supplied by a 20-20,000 cps oscillator in
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via a 10 volt supply to the device under
test which, in turn, forces a current
through a resistance, then an audio signal
is superimposed on the current drawn by
the device. An audio output signal is used
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network enables the instrument to accept
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coining, and AFC off. Attractively fin-
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- Fisher Multiplex Adaptor. This device
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included is provision for balancing on the
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of the S-5000 include: All dual controls;
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with either set of input sources; stereo,
stereo-reversed, monophonic 1, mono-
phonic 2; stereo reverse switch for inter-
changing channels, or both stereo
control center with dual 14-watt power amplifiers
which may be switched to provide 28-
watts for monophonic use. Intermodula-
tion and harmonic distortion are both
1 per cent at rated output. Frequency
response is 20 to 20,000 cps. Con-
trols include a stereo reverse switch for
interchanging channels, a balance control,
and a gain control which governs volume
in both channels simultaneously. Cabinet
design is in the modern styling which
recently won for Arkyay the Fashion
Foundation's coveted Gold Medal Award.
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are supplied with the kit. For complete
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Expressway, Richmond Hills 18, N. Y.

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through a resistance, then an audio signal
is superimposed on the current drawn by
the device. An audio output signal is used
for the purpose of the test. The response
curves are drawn automatically by a pen
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indicating system. The response curves
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- Thorens Turntable Kit. This new 33 1/3-
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can be assembled in half an hour without
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network enables the instrument to accept
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The FM and AM sections of the Knight
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Selector (ON/OFF, FM, STEREO, AM);
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the Crosby multiplex system. It is
designed for use in a stereophonic sound
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receivers, equipped with a multiplex jack.
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exclusive features, including a highly
balanced matrix stage which provides

some precision craftsmanship that character-
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* BIB Tape Splicer. An indispensable accessory for any tape recorder user, this new BIB nylon tape splicer is extremely simple to use and can be employed both for mending broken tapes and for editing purposes. Made of nickel-plated brass, the BIB splicer comes mounted on a beak-
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**CIRCLE 81A**

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**STEREO**

*(from page 14)*

sound is coming from even when a good share of the sound energy we receive bounces off the wall. This is because we sense direction by means of the direct radiation which arrives just a few milliseconds before the echo comes from the wall.

Therefore if we put a little delay in the channel driving the woofer we will not suspect it of being a source for transient sounds and it doesn't make any difference where the low-frequency energy comes from. This is where my big Klipsch horn comes in handy because it has a built-in air column that is the equivalent of a five or six millisecond delay line.

The twisting five or six-foot path from the speaker cone to the mouth of the horn does very well as an artificial delay line. Since sound travels at a speed of approximately 1100 feet per second, it takes nearly 6 milliseconds for a sound wave to travel from the speaker cone to the mouth of the horn. This is ample delay to eliminate the directional effect of the Klipsch horn and leave creating of the spatial pattern to the two midrange and high-frequency speakers.

Incidentally, the low-frequency horn must be of the type that includes a closed chamber around the back of the speaker so that no radiation comes directly from the speaker cone.

The phrase "mid-range and high-frequency" seems a clumsy expression to identify that portion of the audio spectrum above the low frequencies. I would like to suggest the word "alto" for this range. Alto is a short euphonious word that would designate the audio frequency range above the bass, which would probably be the range upward from about 250 to 350 cycles per second whether this range was covered by one, two, or more speakers. In this usage, alto would mean minus-less, similar to the color designation of magenta to specify a color that is minus-green.

As shown in Fig. 2, my proposed system will be a stereo pickup, two preamplifiers, two 300-eps crossover networks, two small power amplifiers for the two alto speakers, and one power amplifier to drive the low-frequency speaker. Five watts should be ample to drive the small speakers and twenty watts should be enough for the woofer.

For me, the big advantage of this arrangement is that I can use my present low-frequency speaker to get those nice round bass notes and the two alto speakers with their two amplifiers will not be too expensive.

I suppose that I should finish the project and try it out before writing about it. But the project is moving along rather slowly so if anyone can point out

---

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---

**Fig. 2. Block diagram of reproduction system.**

why this system will not be satisfactory, maybe I won't have to finish the job. Actually, I am still debating with myself whether the stereo project is worth while. When I go to a concert I usually sit so far back that all the sound seems to come from one direction. In fact, the only way that I can tell that the string section is on the left is because I can see them there with my opera glasses. But in the interest of progress, I shall continue with the current project.

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**AUDIO ETC**
(from page 16)

...anything like that. But I soon get the idea when I read the instructions, where there was more room to explain.

Natch, there are outputs for the stereo amplifier systems, the simplest common being one direct, from the AM source and the other FM. Natch, the tape outputs are for recording off the air—singly or in stereo form—at the same time as the out-loud playing. But we have other things to think about than FM-AM stereo, and Allied has them sewed up here.

Suppose you get sick of the AM half of your stereo, or the AM goes on a different signal; you'll want your FM in both speakers. Simple; flip a lever switch out front and both amplifiers get the FM signal. In phase, of course; I checked it.

Suppose you want to see what gives an AM for a moment or so, without fouling with separate volume controls on your amplifier (you may not have them)—just flip the switch to the other end and you get AM only, in one speaker. The other is silent. (Who wants AM in both systems. Use FM, if you want two speaker sound quality.)

Flip the same switch to the center position and you get AM in one speaker, FM in the other.

The principle of all this is good, and practical. The normally-AM outputs are used for anything that is to supplement the FM output—whether it is AM, or simply a duplication of the FM channel, two-speaker stereo FM, which is the most useful sound on the air right now. (If, in the future, you want multiplex FM stereo, it will come out through its own separate rear output already built-in, to be mixed in the multiplex adapter with the regular FM signal.)

I found, oddly enough, that I can use both AM and FM at once quite often—for different signals. On Sundays, for example, I have to check on my own taped program via FM from New York. In the middle of it (I know it by heart, of course) there is a local weather broadcast I like to hear. So I turn myself down low on the FM channel listen to the weather on AM through the other speaker. When it's over, I flip that neat little lever switch and instantly hear myself on FM through both amplifiers, the AM killed.

On further study, you'll find that all the potential one- or two-channel functions you can think of will work out in one way or another with this switching arrangement. The only trouble at all with it is, as I say, in the terminology—the more versatile is your switching, the more difficult is the labeling. The middle switch position here is called "stereo" by default, since it allows for separate AM and FM reception to the two outputs, but its usefulness is much wider than that, as you can see.

This FM tuner is medium-sensitive and for the first time I can evaluate the linearity difference between a sensitive FM tuner, in my country location, and a very sensitive one. For almost all ordinary purposes I find no useful difference between this tuner (rated 2.5 µv for 20 dB quieting) and my old Fisher (1.5 µv), via the same FM antenna.

But on the myriad of extremely weak and distant stations receivable in my exceptionally good location there is, or seems to be, a slight difference. I haven't tried to make an AB comparison; not important. I do suspect, though, that in a very few exceptional situations the ultra-high sensitivity factor is worthwhile. This is really an aside, since for 99 per cent of those interested in Allard's KN-150 the difference in practice will be nil between this tuner as rated 8.5 µv and the presently highest-rated tuner (as rated by the maker, of course) the Sherwood at 0.95 µv.

In other respects I find this tuner excellent, and not significantly unlike the earlier ones of high quality that I've tried out here. Nothing has gone wrong so far—after a month or so. (Ha! It's Sunday at one, and I've just tuned in my program on FM, tuned the AM tuner to the weather station, set my egg timer for 1:10, set the switch to FM on both channels. When the bell goes off, I'll flip to the middle position and listen both to the weather and self at once. Nice.)

The metal FM feature and one quirk should be noted on the KN-150. Allied has a special circuit called Dynamic Sideband Regulation that can be switched into FM...
modulation is on a modulator with) the ones, loud, close by now, for to lower volume background judge what too to improve distortion possibility station. A common reason; but center that I've heard tuning more seem to sharp, more pleasant, quite unnecessary, but notice unable to explain mercifully. Tuning more positions eut it. I prefer a FM dial straight end of the signal pickup noise; it is there or have are enough experience yet. One odd trouble has cropped up on Allied's AM reception, which I gather they are already aware of and are eliminating—or have eliminated. On strong AM signals there is a persistent humming background noise; it disappears with the station itself. Weak stations don't show it, only strong ones. This apparently is related to the signal pickup of the ferrite antenna built
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into the rear of the set. I note that noise seems to increase when I take hold of the ferrite "stick" at certain positions. This is a trouble that will surely be eliminated, if you receive any more to suffer from it. I suspect that Allied will be glad to help you.

My impression is that the KN-120 (as built with other Allied Radio tuners) is a well built, well designed tuner. One of its principal aspects, decked out with good styling and intelligent switching, plus a bit of forward looking radioism in the DSR circuit, the whole available at rock-bottom cost in the usual mail order fashion. The original maker is the well known Rudell Borg Company.

No Instructions

Several intriguing gadgets have come my way recently and, by coincidence, none of them included that practical necessity (especially for the critic and with a public responsibility), an official instruction sheet. I haven't got around to asking for the same, thanks to other business—a couple of hundred stereo records, for example, all clamoring for a trial in a large pile almost to the ceiling—and so I expect there'll be a slight delay (of a year or so). I'll mention some of this stuff for your curiosity, minus my own trial, just to be sure.

First, there's the Enchorser, a curiously calculated permanent magnet set that is set up against your already-recorded tapes, intended to raise a large proportion of the print-through on them without noticeably affecting the main signal itself. Each set includes two magnets, one mild, the other drastic for serious cases. The mild version is claimed to do no damage at all to the basic recorded signal and may help remove moderate print-through. The drastic one will clip your signal down a bit, but may make a useless tape usable, for precious preserved material. This is a product of Audio Devices and I do hope, when time allows, to try it out on my own older tapes. I can use it. Meanwhile, you'll be interested to know about it and may want to try it out yourself.

Secondly, there is the Magnum-See kit, which ingeniously makes the actual magneto track up a tape visible to the eye. The thin selenoid of magnetic particles is impressed on the tape. I asked for a kit and was told it was complete. I can see liquid and assorted pieces of equipment, the whole in a neat plastic box. Only trouble was, that the company forgot to include instructions and I am not the sort who memorizes a half-pint of magnetic suspension, to pour same over some unlucky tape, valuable or no. When and if I get some directions, I'll try out Magnum-See with considerable interest. Meanwhile, if you want to see your own recordings with your two naked eyes, try Magnum-See out for yourself. Your kit will probably have directions in it.

Finally—no directions needed—there is a semi-professional but extremely useful taping gadget called the Tape-Strake, that solves the tough problem of recording actual tape speed with accuracy, while the tape is moving and without confusing complications. (Note, the expanson range at the right speed, but does the tape itself? It might be slipping, for all you know.)

This gadget, from the Scott Instrument Labs of New York, is simply a flat wheel in a machined frame, with a strobe pattern on it (no 3½ ips on mine). You slide the wheel against the tape itself, gently, and read the result. The wheel can be adjusted up or down to fit against tape at various heights from the base plate, but the device is made with the Ampex in mind and even

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REALISTIC BASS
(from page 23)

new system and to satisfy visitors like George Selles does.

The original work was done on Sellers' record reproducer system using a home-built-and-styled version of the Jensen Imperial system. In a good sized room, the over-all balance is very good, but the living room of his house just didn't quite "have it" for a vital bass that was wanted. The auxiliary bass system has lived up to expectations completely. Organ pedal notes set the room throbbing and yet the other material is comfortable to hear. On Duke Ellington Up Town, the band is clean and crisp and yet when the man kicks that "whammy" bass drum, it feels and sounds like they dropped a body on the floor. With the same settings of controls, Susan Reed and her Irish Harp have an absolute presence. It's wonderful!

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**Industry Notes...**

**IHF ELECTS OFFICERS.** Joseph N. Benjamin, president of David Bogen Company, was re-elected president of the Institute of High Fidelity Manufacturers, at a membership meeting held January 19 in the New York Trade Show Building. Philip L. Dundas, president of Ampex Audio, was elected 1957 vice-president, Saul Marantz, president of Marantz Company, was elected secretary, and Milton Chubb, president of Audiograph Corporation, was re-elected treasurer. Board members elected for a two-year term were, in addition to the officers, William N. Grummes, president of the Grummes Division of Precision Electronics, Inc., and Walter D. Stainton, president of Pickwick Company.

**COLUMBIA, GE TRANSFER HI-FI OPERATIONS.** The phonograph division of Columbia Records, Inc., has been transferred to CBS-Hytron, manufacturing branch of the Columbia Broadcasting System, Inc., the parent company. James J. Shallock, who resigned recently from Philco Corporation, has been appointed vice-president of CBS-Hytron and general manager of the CBS phonograph operation. All marketing activity will be conducted from CBS'S Madison Avenue headquarters in New York.

The responsibility for high fidelity phonograph components now manufactured by the specialty electronics components department of General Electric Company in Auburn, N. Y., has been transferred to GE's radio receiver department operations will continue in Auburn, and no change in either distribution or marketing of high-fid components is anticipated.

**PRINCIPLES PREDICT $5 MILLION TAPE MARKET FOR 1959.** Quoting from a market survey, J. W. Orr, president of ORRadio Industries, Inc., estimates that magnetic recording tape sales of $21 million in 1958 and a jump to the $35 million mark in 1959. The growing market in recording tape is reflected in 1958 sales of high-fidelity Irish brand tape, which beat 1957 by 36 per cent. If the tape industry maintains its current pattern of growing at the rate of 20 per cent per year, tape sales in 1960 should run around $115 million, Mr. Orr stated.

**DATES SET FOR I.R.E. CONVENTION.** March 24 through 28 have been selected as the dates for the 1959 national convention of the Institute of Radio Engineers, to be held again at the Waldorf-Astoria hotel and the New York Coliseum in New York City. More than 5,000 engineers and scientists from 40 countries are expected to attend. Of particular interest to audio engineers is a technical session scheduled for March 24 in the Sert room of the hotel. Titled "Contributions to Stereo Sound Reproduction," the meeting will comprise a paper delivered by engineers of worldwide repute in the science of stereo sound.

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