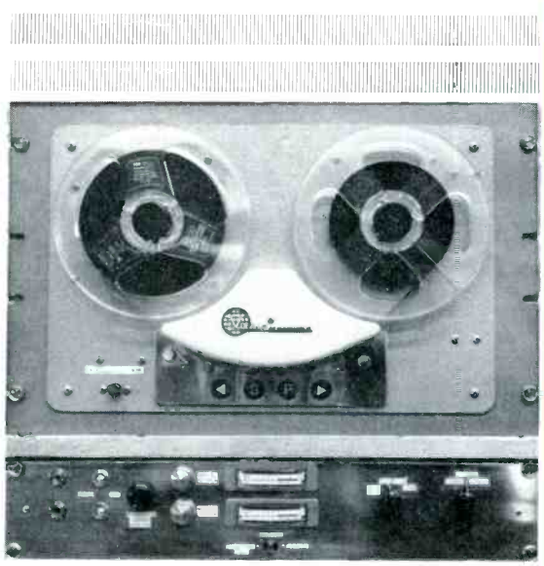
AUDIO

...the original magazine about high fidelity!

OCTOBER/1964

60¢



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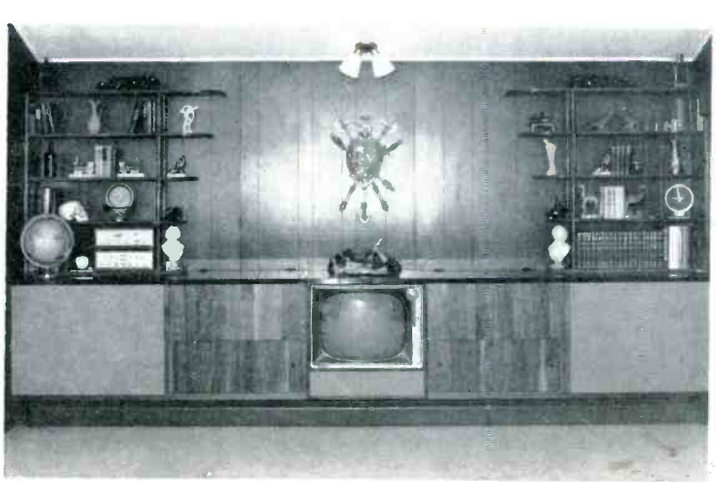

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BONUS:

Audio calls new Scott Solid State 312 ". . . One of the finest Tuners anywhere."

. . . and you can own one for only $259.95

"If any doubt remains in the minds and hearts of audio fans as to the acceptability of transistors for use in high quality FM-stereo tuners, the Scott 312 should still these fears forevermore," said Audio Magazine in their July 1964 issue (Page 32). "It is fully qualified to take its place beside such excellent tuners as the 310 and 4310. In some ways the 312 surpasses its predecessors . . . it is one of the finest tuners Scott makes. And that means it is one of the finest tuners anywhere.

". . . the limiters must be quite unusual judging by the extremely effective performance they provide. In the automatic stereo position . . . the 312 automatically sets itself for stereo or mono reception . . . this is done electronically and is probably the quietest automatic stereo switcher we have not heard.

"Perhaps the best testimonial to the over-all circuit, however, is the performance which we (Audio) list on the following table: Cross modulation index: 82 db; Stereo frequency response: = 0.7 db 3- to 15,000 cps; Signal-to-noise ratio: 65 db; Capture ratio 4 db; Selectivity: 34 db; IHF usable sensitivity: 2.0 μv; AM suppression: 56 db; Impulse Noise Rejection: excellent; Distortion: 0.5%; Stereo separation: 36 db at 1000 cps."

"In addition, the Scott 312 pulled in 36 stations loud and clear on our standard antenna, and was truly excellent in suppressing impulse noise . . . the 312 has excellent tuning feel and last, but not least, the sound quality of the 312 is to our ears the best Scott has ever produced. Altogether, a product to be proud of . . . "

New Scott 350-D — Scott brings you automatic stereo control in this latest version of the famous 350 Series Stereo Tuner! Scott's amazing Auto-Sensor circuitry immediately indicates when you have tuned to a stereo broadcast, and automatically switches the tuner to stereo operation. And, you can now forget about multipath distortion caused by bounced and reflected signals . . . with the 350D, you can visually eliminate this nuisance. Never before has this feature been included in a unit at this low price. Exciting new styling incorporates easy-to-read slide rule dial and flywheel-balanced tuning knob. Sensitivity 2.3 μv; $224.95

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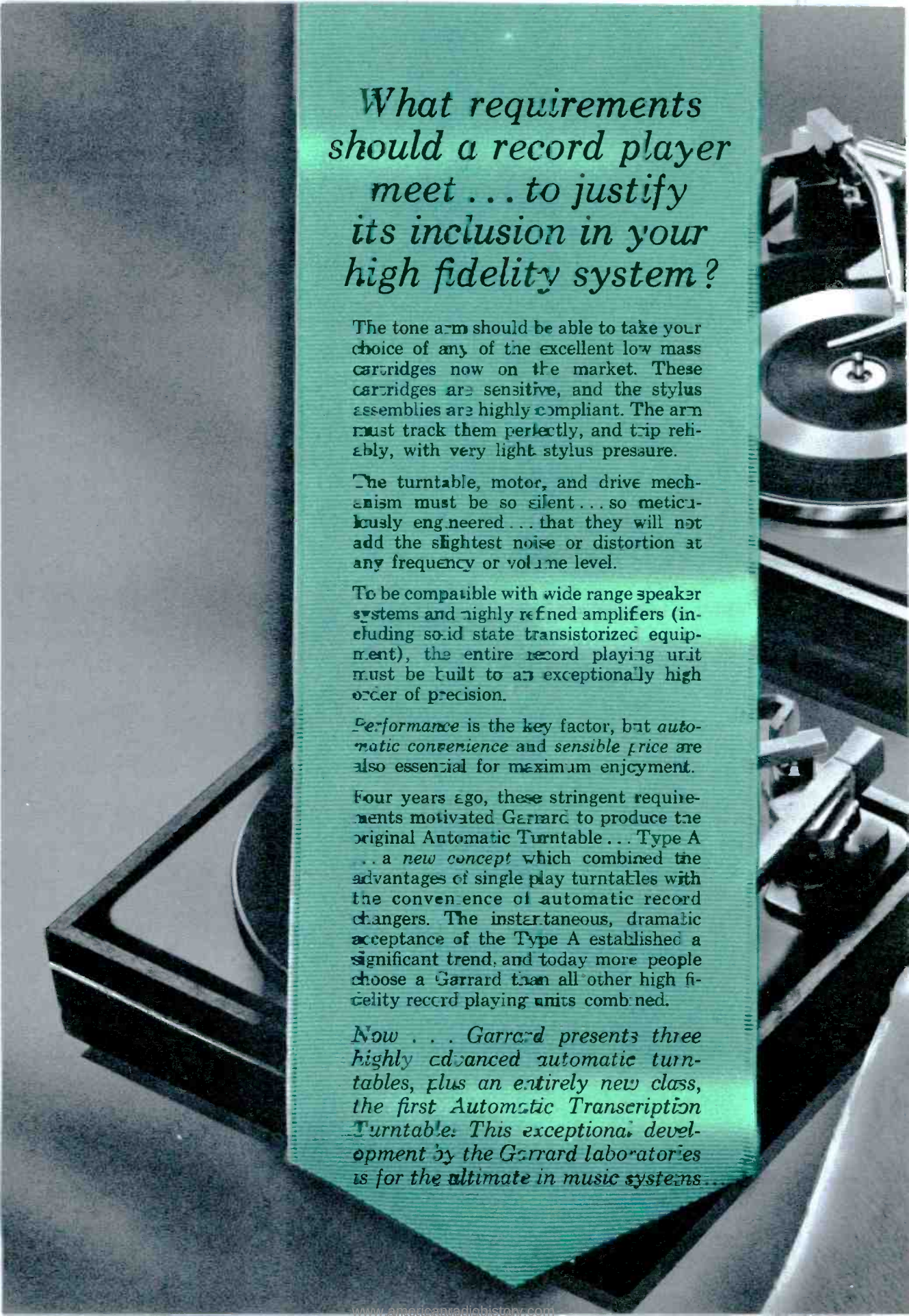
In these 32 pages we offer you technical and non-technical explanations of today's most advanced record-playing equipment.

This includes **LAB 80** *the first Automatic Transcription Turntable*



What requirements should a record player meet . . . to justify its inclusion in your high fidelity system?

The tone arm should be able to take your choice of any of the excellent low mass cartridges now on the market. These cartridges are sensitive, and the stylus assemblies are highly compliant. The arm must track them perfectly, and trip reliably, with very light stylus pressure.

The turntable, motor, and drive mechanism must be so silent . . . so meticulously engineered . . . that they will not add the slightest noise or distortion at any frequency or volume level.

To be compatible with wide range speaker systems and highly refined amplifiers (including solid state transistorized equipment), the entire record playing unit must be built to an exceptionally high order of precision.

Performance is the key factor, but *automatic convenience* and *sensible price* are also essential for maximum enjoyment.

Four years ago, these stringent requirements motivated Garrard to produce the original Automatic Turntable . . . Type A . . . a *new concept* which combined the advantages of single play turntables with the convenience of automatic record changers. The instantaneous, dramatic acceptance of the Type A established a significant trend, and today more people choose a Garrard than all other high fidelity record playing units combined.

Now . . . Garrard presents three highly advanced automatic turntables, plus an entirely new class, the first Automatic Transcription Turntable. This exceptional development by the Garrard laboratories is for the ultimate in music systems . . .

This new kind of Garrard is called the LAB 80

This is the

LAB 80

More than an automatic turntable, it is an Automatic Transcription Turntable

The Lab 80 is designed for professional reproduction of LP/stereo records (33⅓ and 45 rpm) . . . literally without compromise. It was created expressly for those who have not been willing to accept any automatic unit heretofore.

Now, feature-by-feature comparisons will verify that the concept of the single play turntable combination has been obsoleted by a superior new class of mechanism.

With the Lab 80, Garrard establishes a spectacular new precedent in record playing equipment . . . combining precision, performance, and convenience of a standard not previously available, in single play or automatic units.

The price of the Lab 80 is $99.50

To visualize what the Garrard Laboratories have achieved in the Lab 80, we urge you to take the time to read the galaxy of advancements built into it.

(Here are some highlights . . . described in greater detail on the following pages)

NEW BIAS COMPENSATOR negates "skating" . . . keeps stylus evenly in groove no matter how light the tracking force.

NEW DYNAMICALLY BALANCED TONE ARM made of lightweight, non-resonant wood, insures optimum performance from every cartridge.

NEW MASSIVE NON-MAGNETIC 12" TURNTABLE is balanced in motion for perfect speed.

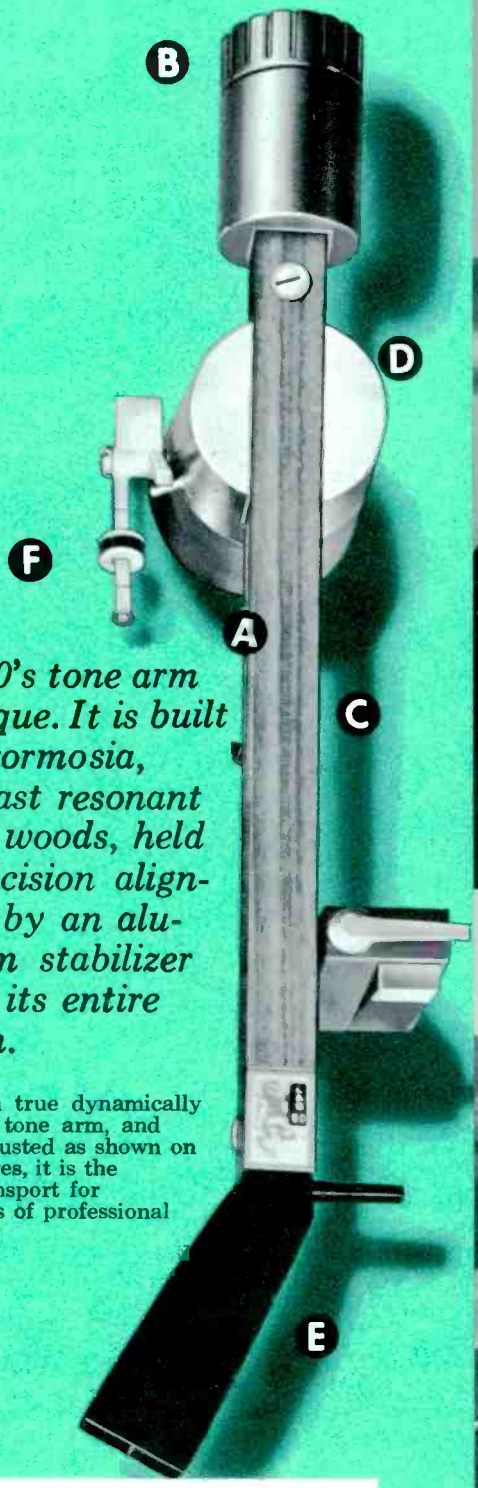
NEW INTEGRAL CUEING DEVICE allows you complete control of tone arm, for manual play without damage to records or stylus.

NEW LOW-MASS SHELL is compatible with the latest pickup designs.

NEW MAGNETIC TRIP permits virtually frictionless automatic operation and shutoff.

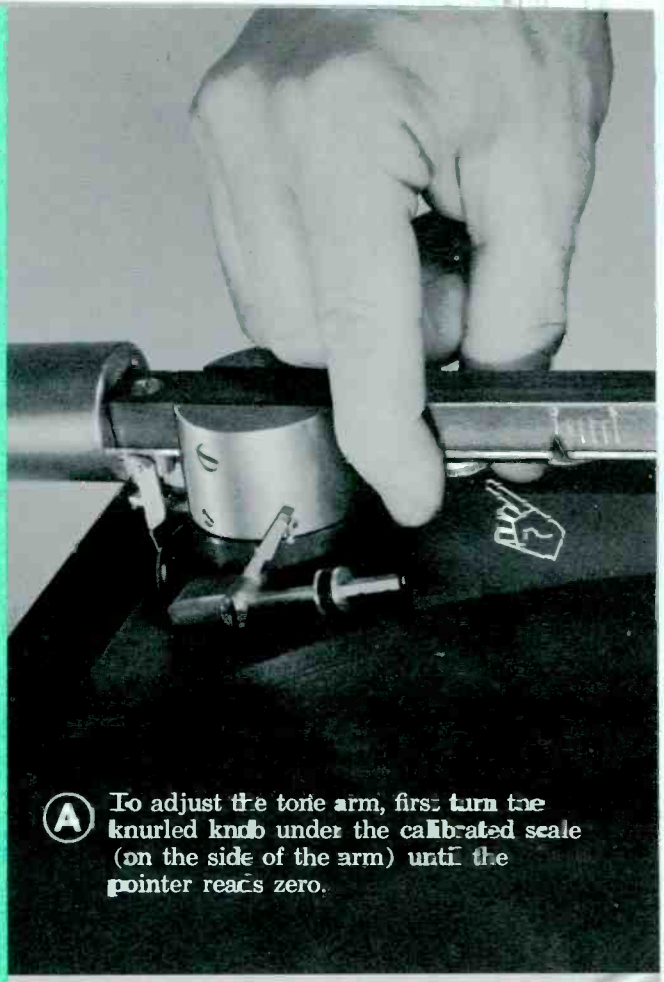
NEW ISOLATION MOTOR SUSPENSION prevents even slightest vibrations from reaching turntable.

NEW ANTI-STATIC MAT discharges static electricity, prevents dust accumulating on records.

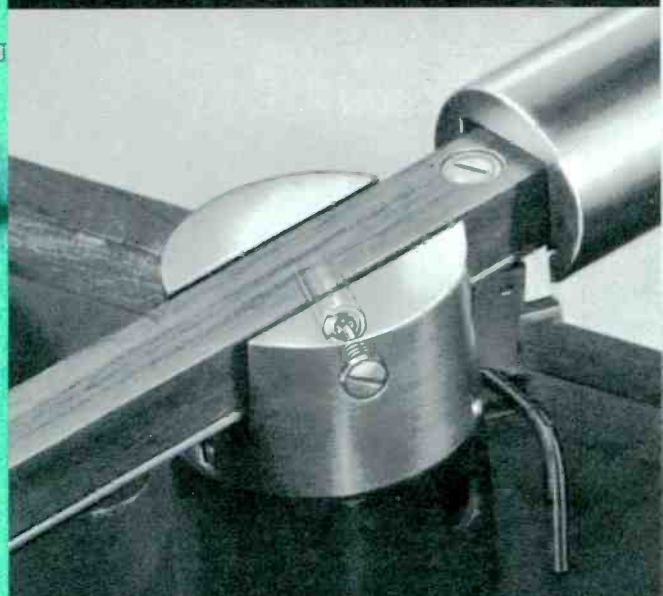


Lab 80's tone arm is unique. It is built of Afrormosia, the least resonant of all woods, held in precision alignment by an aluminum stabilizer along its entire length.

This is a true dynamically balanced tone arm, and when adjusted as shown on these pages, it is the ideal transport for cartridges of professional calibre.



(A) To adjust the tone arm, first turn the knurled knob under the calibrated scale (on the side of the arm) until the pointer reads zero.

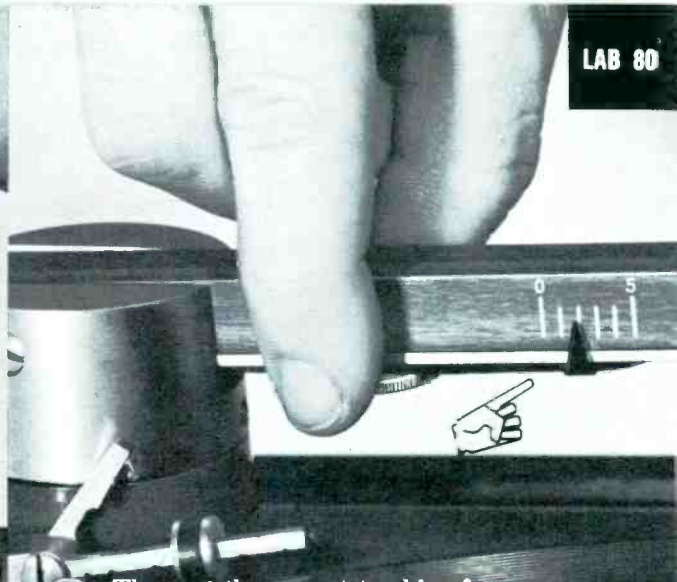


(D) Because of today's featherweight tracking, the slightest interference with free movement of the tone arm may affect the performance of the cartridge. To avoid this, the Lab 80 arm moves on special needle pivots, set into ball bearings. The flat geometry of the arm cancels out warp-wow distortion; and the low center of gravity eliminates sensitivity to external jarring.

An important note regarding stylus pressure and protection of your records:

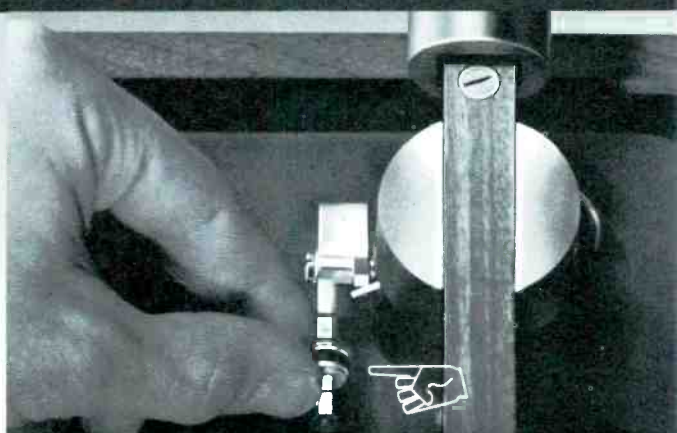
As a service, we wish to point out that under no circumstances should any cartridge be operated at a lower stylus pressure than that prescribed by its manufacturer. Specifications for stylus pressure are determined by the basic design of the cartridge. To track at a pressure lower than specified may cause many undesirable effects, in terms of damage to record grooves; intermodulation and other distortions.

(B) Next, balance the arm until it floats level at zero tracking force. This is done by rotating the fine adjustment on the movable counterweight at the rear of the arm. (Note that the counterweight is isolated in rubber.)



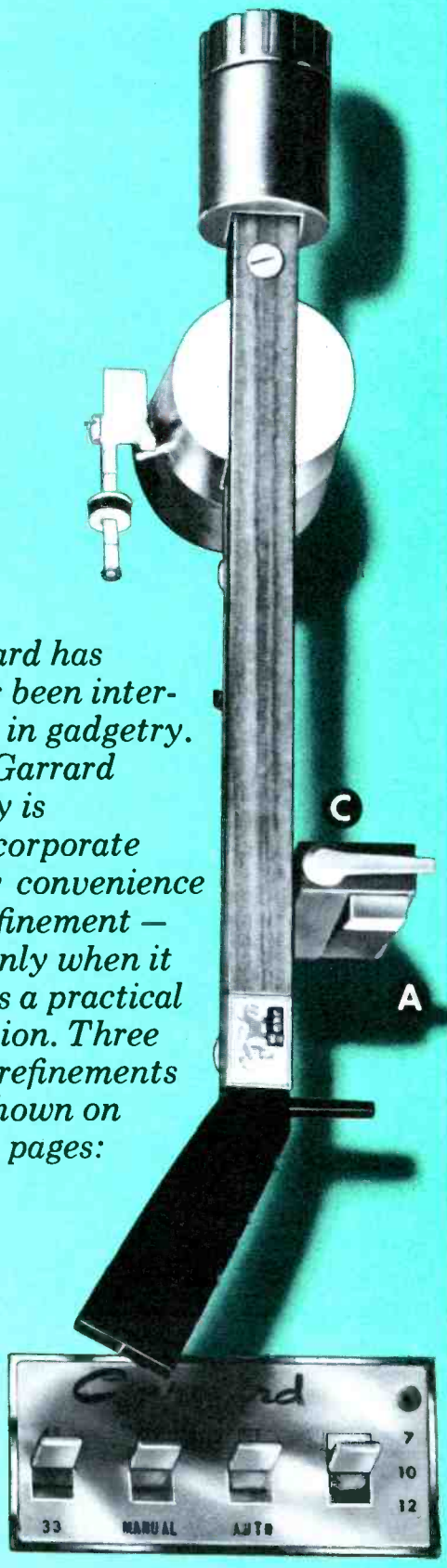
(C) Then set the correct tracking force, as specified by the cartridge manufacturer. Turn the knurled knob under the scale, listening for the clicks, which can also be felt. Each click represents ¼ gram, providing an accurate audible setting, confirmed visually by the indicator on the side of the arm. (Since some professional cartridges today may be tracked as lightly as a fraction of a gram, this uniquely accurate method of setting is necessary to insure the best performance.)

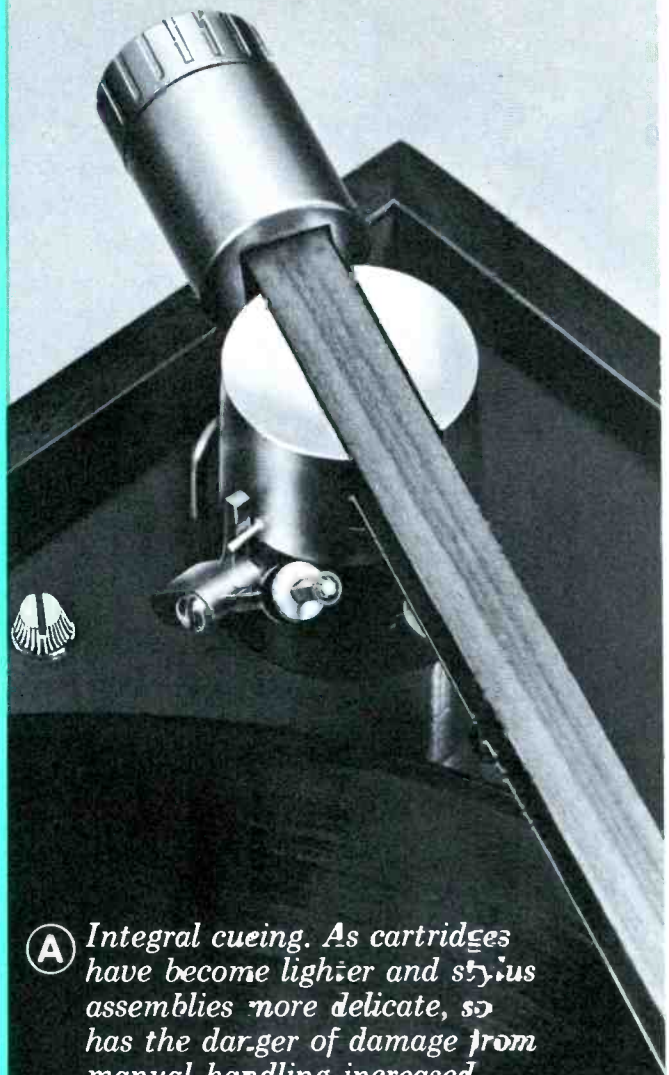
(E) The lightweight design of the shell makes it compatible with all cartridges including the new low mass professional types. The shell slides into the tonearm on channels and is fixed rigidly with a knurled screw, so that it cannot resonate or rotate from side to side. A new long finger lift insures safety in handling the shell.



(F) One major problem in all record playing equipment is the tendency of the arm to slide inward across the record. This is overcome in the Lab 80 through an exclusive, patented bias compensator which accurately cancels out any tone arm skating force, making it possible to use a cartridge with the highest compliance and most delicate stylus assembly. Setting the bias compensator is simplicity itself. A weight on the compensator is moved to a position along its scale corresponding to the stylus pressure which has been set, establishing a direct relationship with the stylus pressure reading on the tonearm.

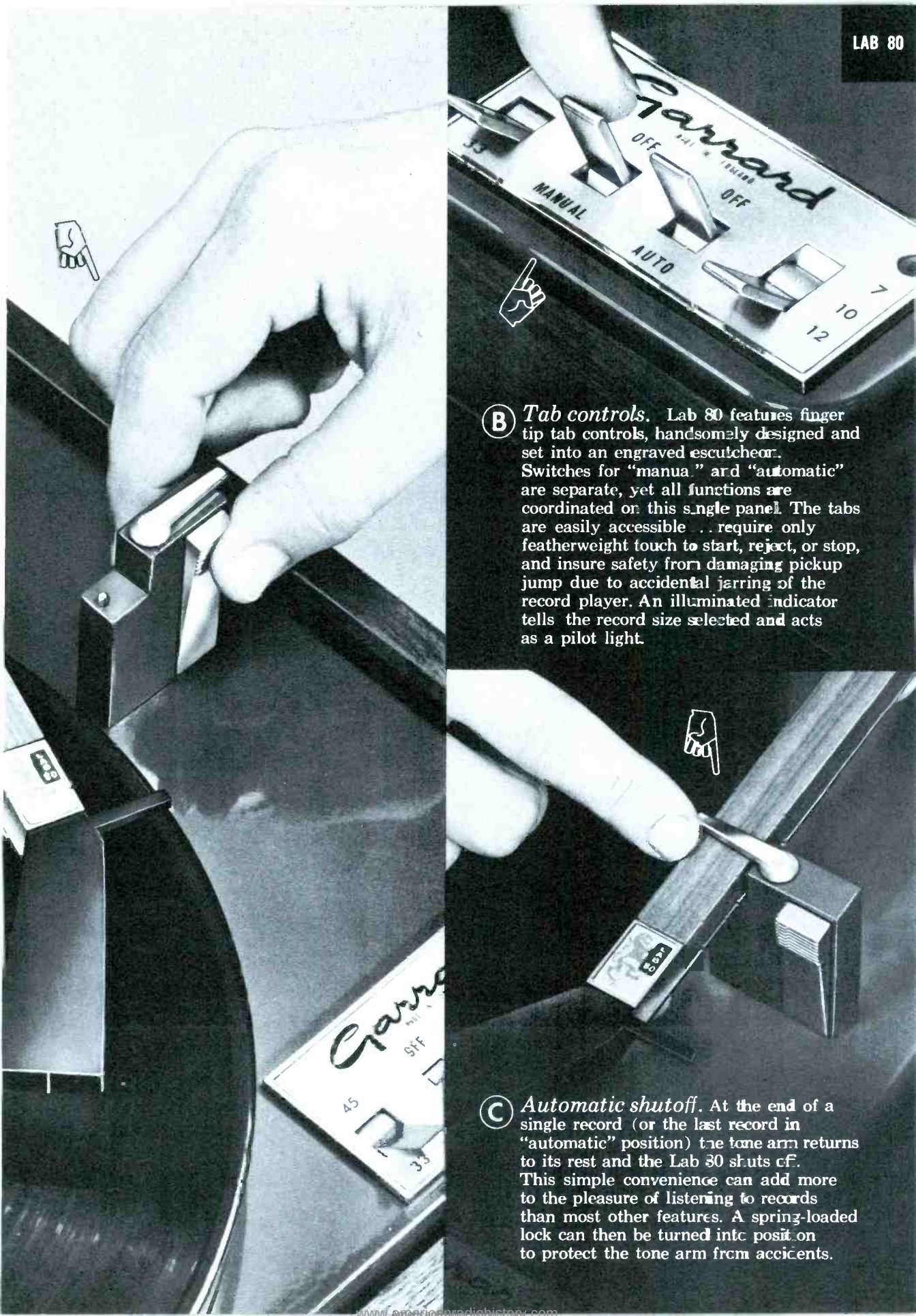
Garrard has never been interested in gadgetry. The Garrard policy is to incorporate every convenience or refinement — but only when it serves a practical function. Three such refinements are shown on these pages:





(A) *Integral cueing. As cartridges have become lighter and stylus assemblies more delicate, so has the danger of damage from manual handling increased. Now, in the Lab 80, Garrard has incorporated an integral cueing device, which is activated whenever the manual lever is thrown. The tone arm is suspended safely and accurately ½ inch over any record groove selected. Then press the tab control on the front of the tone arm rest . . . and the arm gently lowers under featherweight control. The first demonstration will show you dramatically the convenience and safety which this feature imparts.*

(If it is desired to lift the arm off the record during play, simply touch the manual switch, and the arm rises gently, directly over the record groove. You can then safely reposition the arm or reactivate the cueing device, and lower the stylus into the very same groove!)

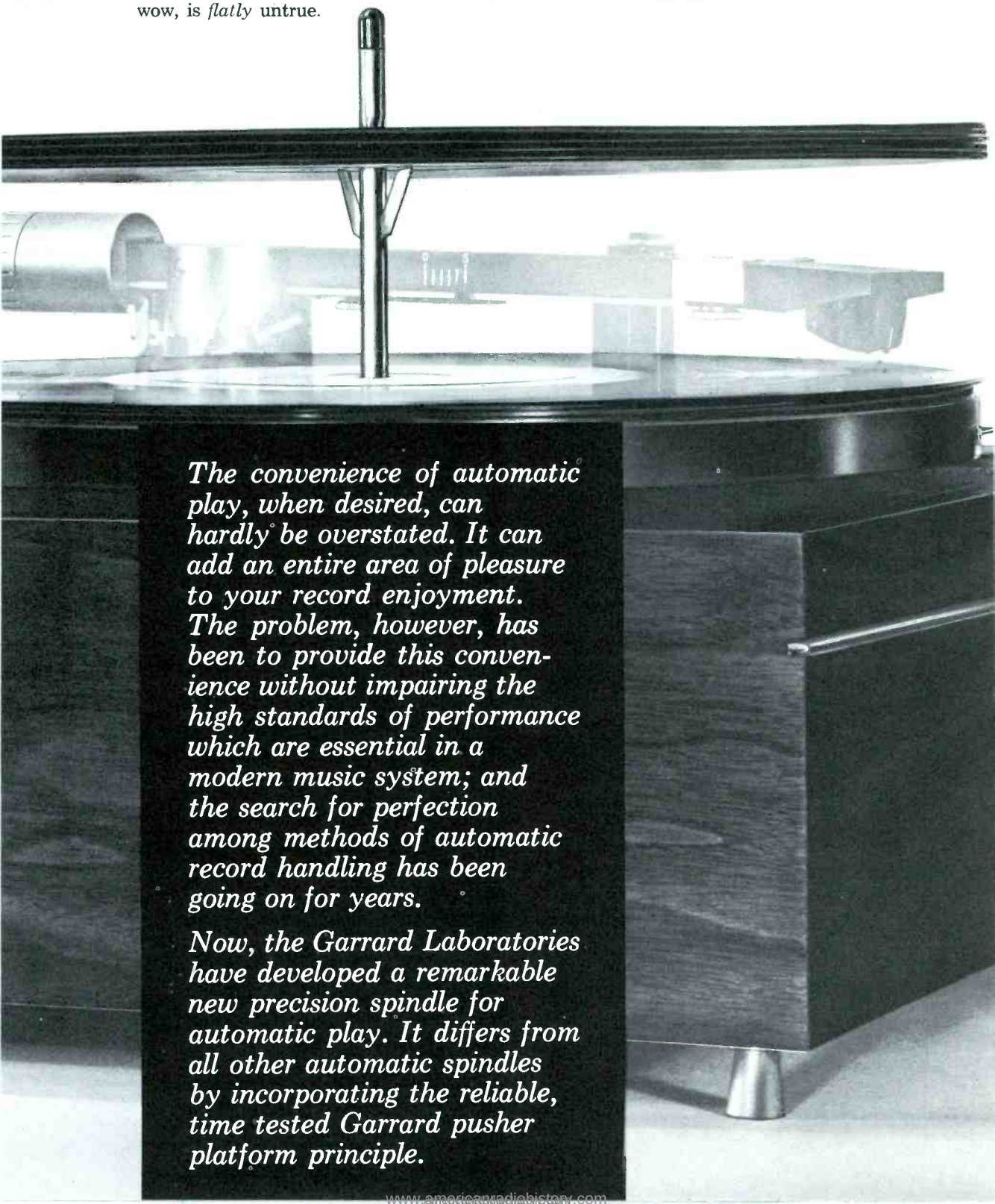


(B) *Tab controls.* Lab 80 features finger tip tab controls, handsomely designed and set into an engraved escutcheon. Switches for "manual" and "automatic" are separate, yet all functions are coordinated on this single panel. The tabs are easily accessible . . require only featherweight touch to start, reject, or stop, and insure safety from damaging pickup jump due to accidental jarring of the record player. An illuminated indicator tells the record size selected and acts as a pilot light.

(C) *Automatic shutoff.* At the end of a single record (or the last record in "automatic" position) the tone arm returns to its rest and the Lab 80 shuts off. This simple convenience can add more to the pleasure of listening to records than most other features. A spring-loaded lock can then be turned into position to protect the tone arm from accidents.

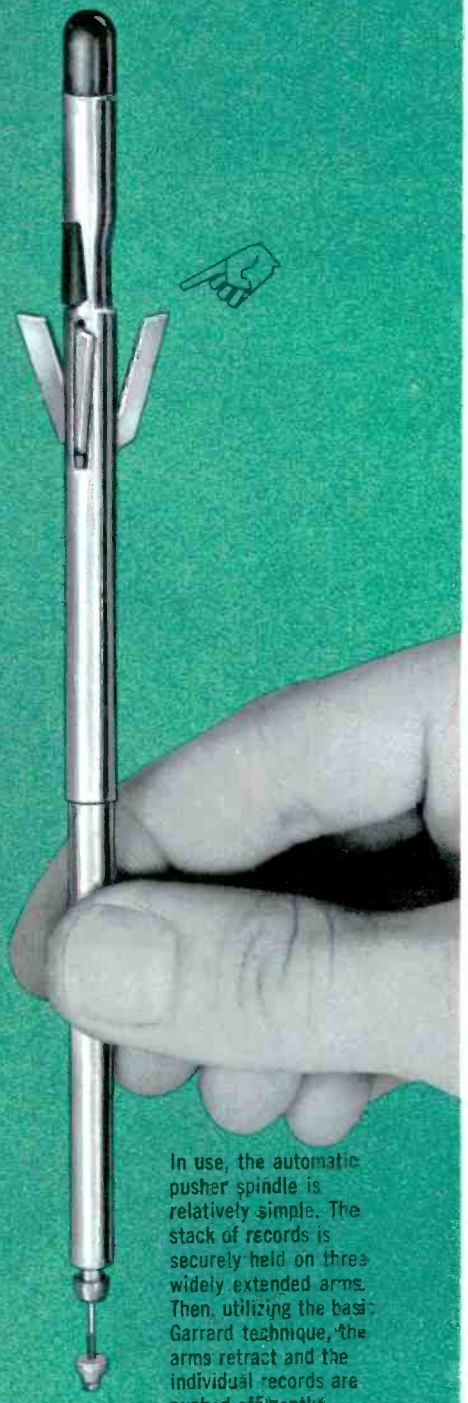
Concerning manual vs. automatic play: With the present state of the art in the design and manufacturing of tone arms – as exemplified most particularly by the low geometry of the Lab 80 and other dynamically-balanced Garrard arms – the maximum variation in stylus pressure between one record and a stack is in the order of 0.2 gram (two-tenths of a gram).

Thus, it will be seen that the significance of the question of whether or not it is important to play only single records at a time on any turntable, has been eliminated. The contention that stacking several records creates flutter and wow, is *flatly* untrue.



The convenience of automatic play, when desired, can hardly be overstated. It can add an entire area of pleasure to your record enjoyment. The problem, however, has been to provide this convenience without impairing the high standards of performance which are essential in a modern music system; and the search for perfection among methods of automatic record handling has been going on for years.

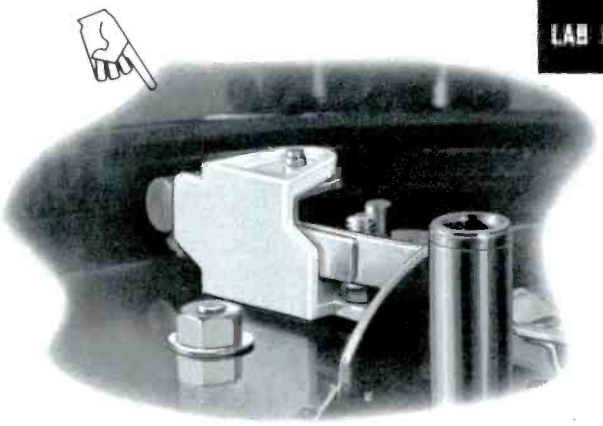
Now, the Garrard Laboratories have developed a remarkable new precision spindle for automatic play. It differs from all other automatic spindles by incorporating the reliable, time tested Garrard pusher platform principle.



In use, the automatic pusher spindle is relatively simple. The stack of records is securely held on three widely extended arms. Then, utilizing the basic Garrard technique, the arms retract and the individual records are pushed off gently.

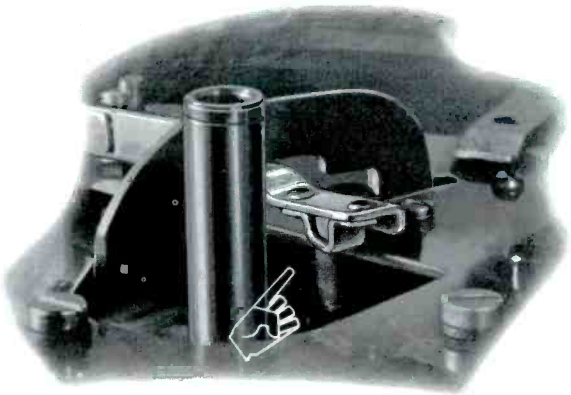
This is the technique which established Garrard as the pre-eminent name in automatic record playing equipment, because it proved, over the years, completely reliable and gentle to records. Now, the pusher platform principle has been designed into the spindle, creating the safest, most positive-acting device of its kind.

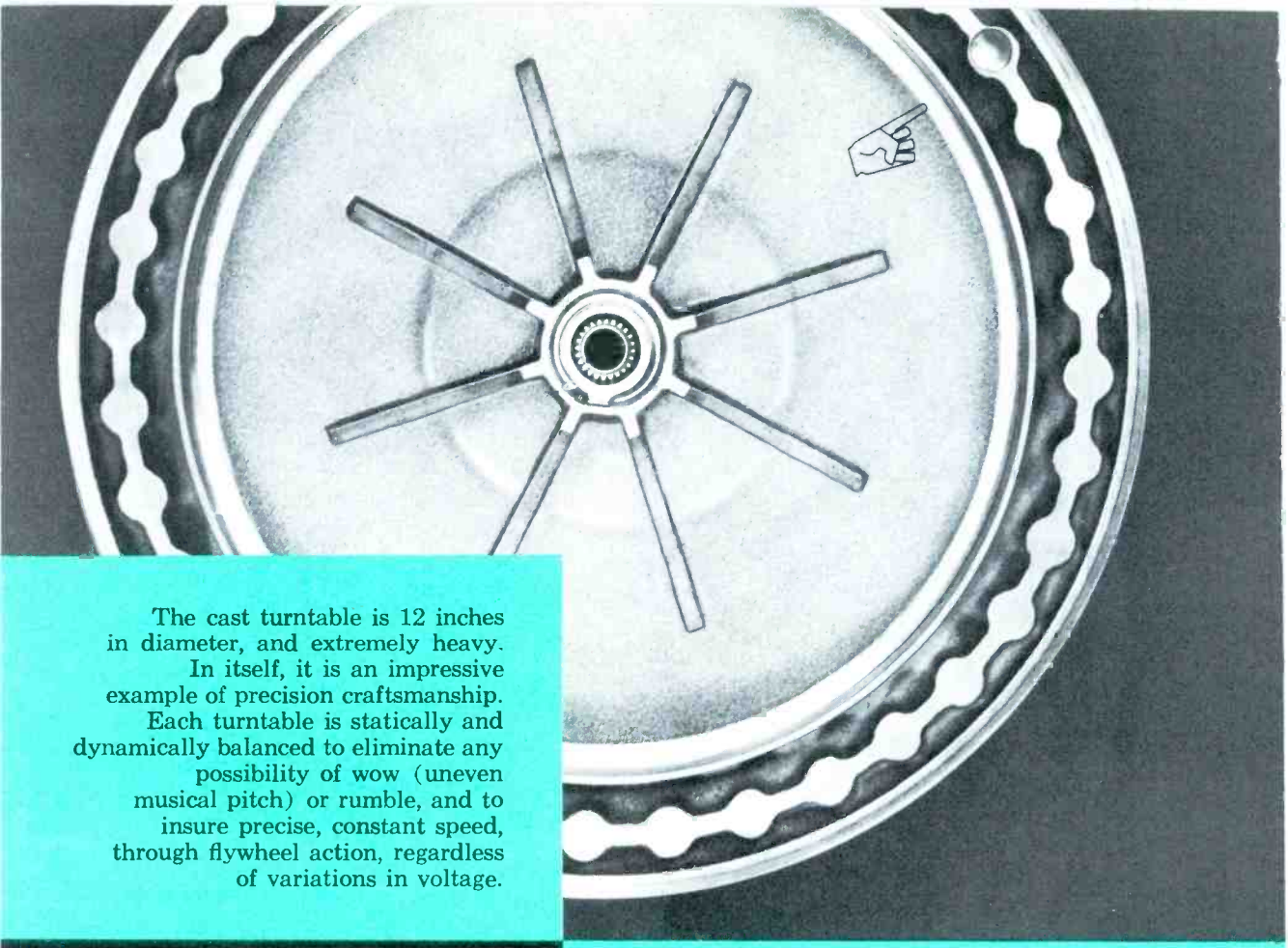
(Of course, this spindle is used only for automatic play. A short spindle is provided for your use in playing single records.)



The trip mechanism is the device which activates the automatic record changing and the automatic shutoff at the end of the last record. Since the tone arm mechanism must engage the trip mechanism, the problem with automatic units has been to accomplish this with the least possible amount of friction or drag. Indeed, one of the points claimed in favor of single play turntables has been the lack of a trip mechanism, even though no one will dispute the tremendous advantage of the automatic feature. In the Lab 80, the trip mechanism is revolutionary and obviates this argument. The trip assembly is molded completely of Delrin® the remarkable new Dupont "slippery" material which has an exceptionally low co-efficient of friction. Resistance of the trip mechanism to the tone arm engaging it becomes virtually unmeasurable.

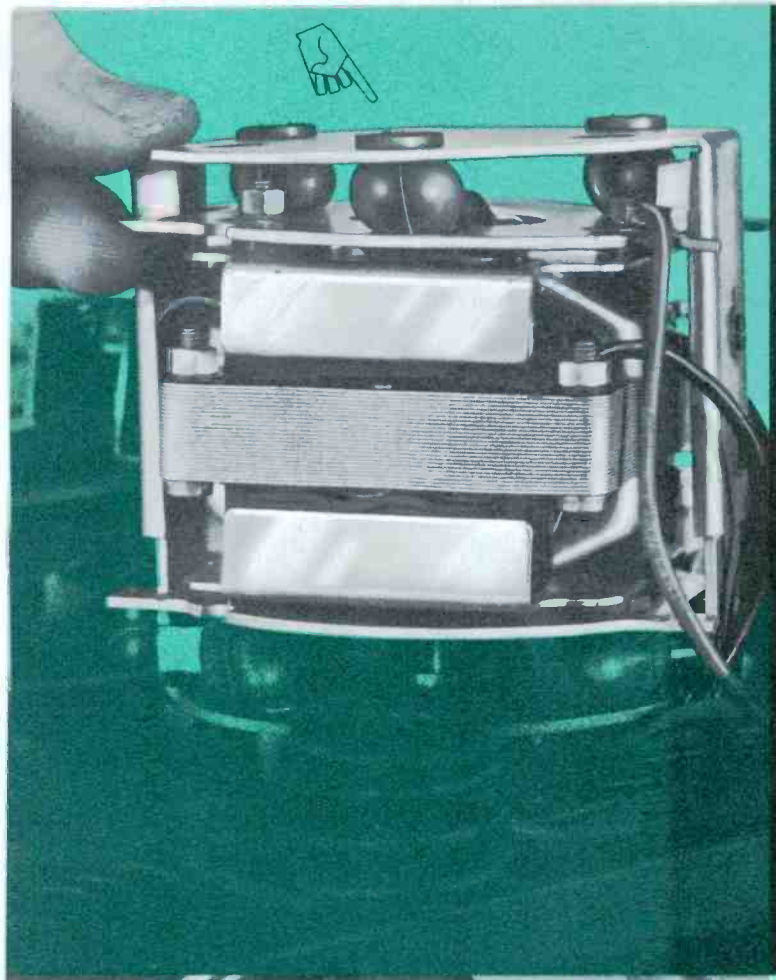
The tripping cycle is activated by ultra-sensitive magnetic repulsion (through the use of magnets with polarities which repel each other), eliminating the need for mechanical contact. The combination of these two principles, ingeniously applied for the first time to an automatic record playing device, is the answer of the Garrard engineers to the stringent requirements of ultra-sensitive cartridges, allowing the unit to trip reliably, at virtually zero force.





The cast turntable is 12 inches in diameter, and extremely heavy. In itself, it is an impressive example of precision craftsmanship. Each turntable is statically and dynamically balanced to eliminate any possibility of wow (uneven musical pitch) or rumble, and to insure precise, constant speed, through flywheel action, regardless of variations in voltage.

The special turntable mat is formulated from a remarkable new anti-static material. It dissipates the electrical charge on records, so that they will not attract dust. Dust is one of the key causes of record wear, as well as unwanted noise. The fine grooves of the mat have been scientifically designed to provide full support to the record.



Constant, reliable speed, of course, is essential. Recent tests confirm the traditional Garrard viewpoint that the motor type (induction or hysteresis) is not the key factor in fine reproduction. It is basic compatibility of the motor to the particular turntable/drive mechanism, and meticulous manufacturing, which determine outstanding results.

The Lab 80 is powered by the unsurpassed Laboratories Series® motor (with dynamically balanced armature), designed and built entirely by Garrard, which will maintain speed within NAB standards even through the unlikely line voltage variation of 95 to 135 volts.

The loose assumption or contention that only a hysteresis motor can maintain speed with such reliability is simply untrue.

It is isolated from the unit plate by a revolutionary suspension system of rubber anti-vibration devices and damping pads. This ingenious mounting system frees the Lab 80 from any vestige of spurious vibrations which might reflect in record reproduction.

The entire Lab 80 unit floats on a new 5-point foam-damped spring suspension system, which isolates it from external jarring and the mechanical interference known as "feedback". Installation is simple and practical. The Lab 80 is stereo wired, with a 4-pin, 5-wire system; separate ground connections . . . the ideal wiring because it eliminates danger of hum-causing factors. Leads plug into the player with Amplok plug (for AC) and twin female phono sockets on the unit plate, for the audio connection. This simplifies connecting or disconnecting the player. Dimensions are compact enough to fit most high fidelity cabinets.

Specifications:
2 speeds: 33⅓ and 45 rpm.
100-130 volts, 60 cycles AC (50 cycle pulley available).

Minimum cabinet dimensions:
17" left to right; 14¾" front to rear;
5½" above and 3½" below motor board.

This, then is Garrard's Lab 80 Automatic Transcription Turntable . . . a record-playing unit unequalled by any now on the market . . . destined to establish a new milestone by Garrard in the continual striving toward perfection which characterizes our industry.

This superlative mechanism has been magnificently styled to grace the finest music system, the smartest decor. On its decorator base, the Lab 80 is a symphony of shimmering satin metal, grained wood, and a special iridescent color that picks up and reflects the warmth of the cabinet finish. Into this excellent unit have been lavished every skill, every technique known to the Garrard Laboratories. To judge for yourself how well they have succeeded, use the convenient chart below to compare the Lab 80's main features with any other record playing unit you may be contemplating.

COMPARATOR CHART

LAB 80	Other	
✓		Dynamically balanced, counterweight-adjusted tone arm of Afrormosia wood
✓		Calibrated stylus pressure scale, with click settings
✓		Low mass shell
✓		Bias compensator (Anti-skating device)
✓		Integral cueing device
✓		Finger tip tab controls
✓		Automatic play, when desired, with revolutionary pusher spindle
✓		Delrin® trip mechanism with magnetic repulsion
✓		12 inch, balanced, weighted, anti-magnetic turntable with anti-static turntable mat
✓		Laboratory Series® 4-pole shaded motor
✓		Motor isolation system
✓		4-pin, 5-wire stereo wiring with Amplok plug connections

This is the new

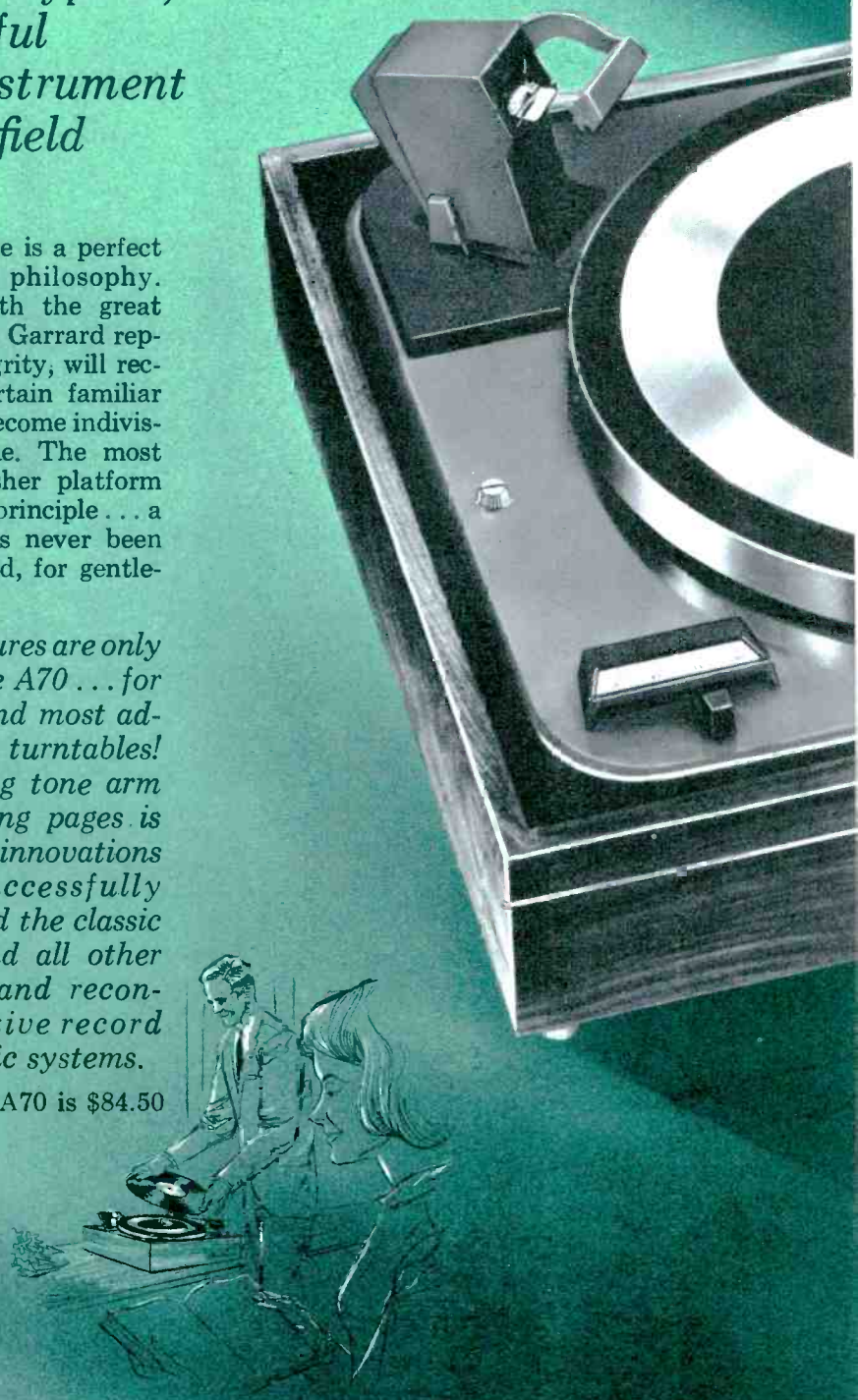
Type A70

ultimate expression of the Automatic Turntable concept, which Garrard launched with the original Type A, the most successful record playing instrument the high fidelity field has ever known

This new automatic turntable is a perfect expression of the Garrard philosophy. Those who are familiar with the great models which established the Garrard reputation for unassailable integrity, will recognize in the Type A70 certain familiar proven features which have become indivisible from the Garrard name. The most notable of these is the pusher platform automatic record changing principle . . . a classic mechanism which has never been equalled, much less surpassed, for gentleness or reliability.

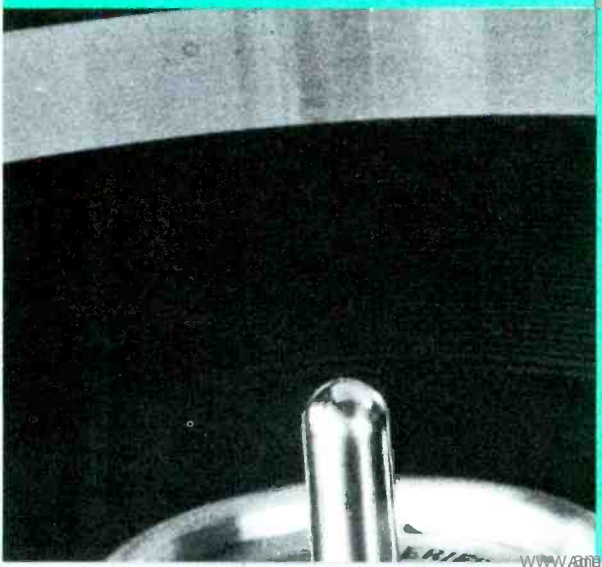
However, traditional features are only half the story of the Type A70 . . . for this is also the newest and most advanced of all automatic turntables! For example, the exciting tone arm described on the following pages is but one of a number of innovations which confirm how successfully Garrard has re-engineered the classic unit, advanced it beyond all other automatic turntables, and reconfirmed it as the definitive record player for the finest music systems.

The price of the Type A70 is $84.50

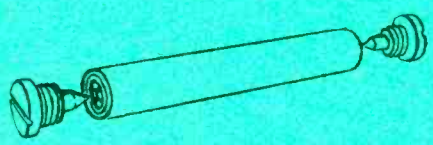


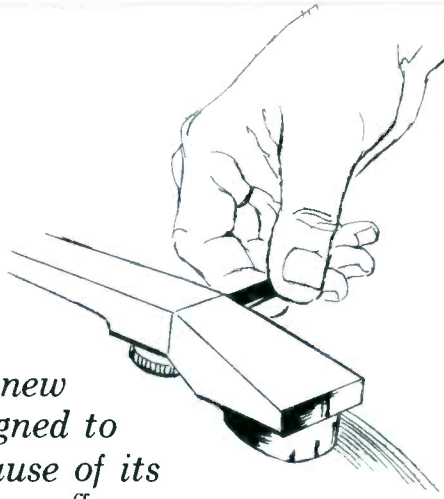

TYPE
A70
Garrard
Garrard

The adjustable counterbalance weight at the rear of the tone arm . . . low and in line with the cartridge . . . establishes an optimum center of gravity. This assures accurate tracking and makes it possible for the arm to resist external jarring and vibrations.



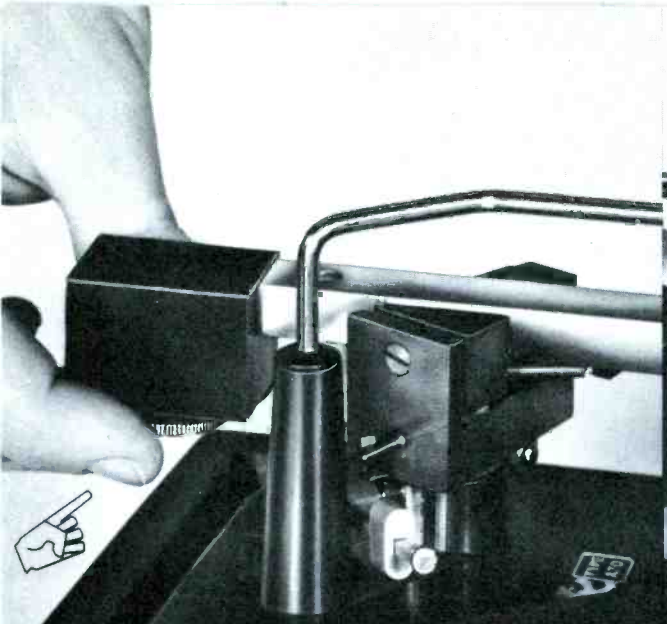
Special needle pivots set into miniaturized ball bearings, make vertical motion of the tone arm virtually frictionless.



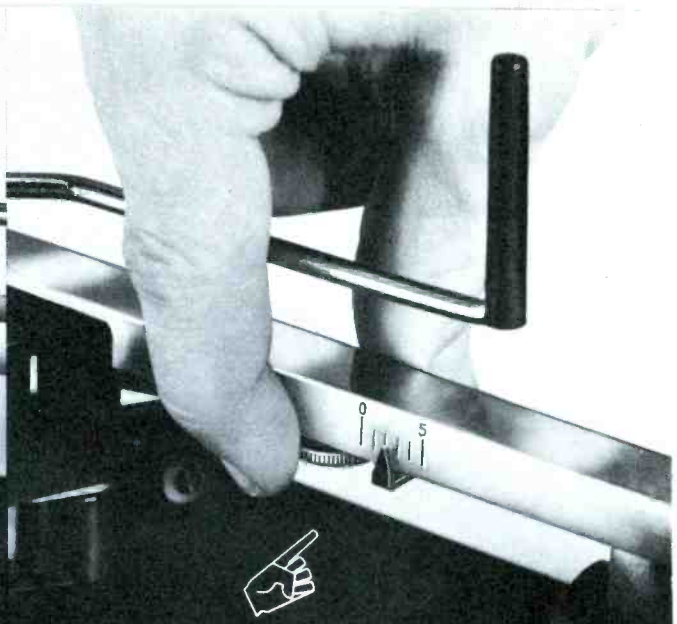


The Type A70 features a completely new dynamically balanced tone arm, designed to an exceptionally high standard. Because of its low mass and flat geometry, this arm offers impressive advantages in tracking capability. Since total side pressures acting on the arm at the stylus have been kept infinitesimal, the Type A70 achieves outstandingly clean reproduction with modern cartridges.

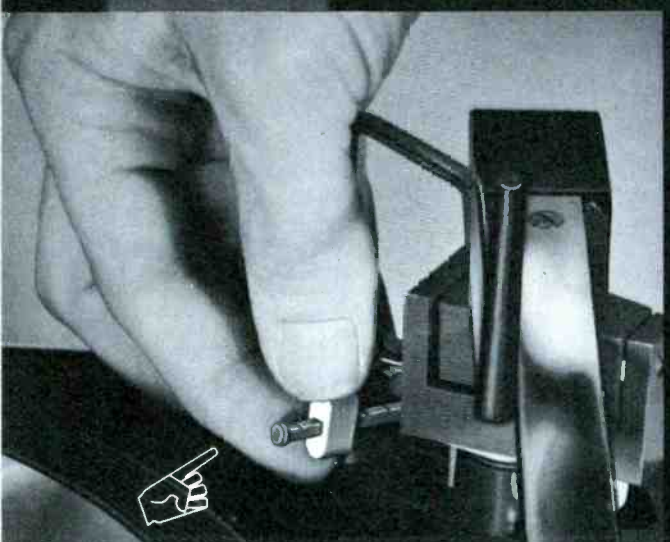
The slide-in shell locks positively into position and takes any cartridge, including the very light, high-compliance professional types. The cutaway form provides low mass, and simplifies installing and servicing the cartridge. An extended finger lift enables the user to handle the arm safely and conveniently.



Stylus pressure on the Type A70 is adjusted in two simple steps, similarly to the Lab 80. First, the sliding counterbalance weight is moved to the position which balances the cartridge (so that the arm floats level above the turntable), and locked in position by tightening an accessible adjusting screw. The arm is now in balance, at zero stylus pressure.



Then, the correct tracking force prescribed for the cartridge is set by turning the adjusting screw under the tone arm. The reading is taken on the calibrated scale at the side of the arm. As the knurled screw turns, a click is heard (and felt) for each ¼ gram. The stylus pressure setting, therefore, is extremely accurate.



As in the Lab 80, the Type A70 tone arm incorporates an adjustable bias compensator anti-skating device. Simply slide the weight to the notch corresponding on the scale to the stylus pressure. With the bias compensator set, the arm will track accurately and without distortion — even if the player is intentionally tilted, the record warped, or not concentric. It will bring out the best in any cartridge used, applying equal pressure on both sides of the stereo record groove, to minimize stylus and record wear.

The full-sized, balanced turntable of the Type A70 is unique, having certain advantages not found in other units. Actually it consists of two turntables balanced together . . . a drive table inside and a heavy cast turntable outside. These are separated by a resilient foam barrier, which damps out noise and vibration. Being non-ferrous, the cast table offers no attraction to magnetic pickups, which might affect tracking pressure. The heavy turntable weight is the optimum for perfect torque and flywheel action in the Type A70.

TYPE A70 COMPARATOR CHART

A TYPE A70 ✓ OTHER ☐

Dynamically balanced, counterweight-adjusted tone arm

B TYPE A70 ✓ OTHER ☐

Flat silhouette and low center of gravity (tone arm)

C TYPE A70 ✓ OTHER ☐

Audible/visible ¼ gram check settings on stylus pressure gauge built into tone arm

D TYPE A70 ✓ OTHER ☐

New lightweight shell

E TYPE A70 ✓ OTHER ☐

Adjustable bias compensator (anti-skating device)

F TYPE A70 ✓ OTHER ☐

Needle pivots for tone arm bearings

G TYPE A70 ✓ OTHER ☐

Exclusive full-sized, heavy, balanced cast "sandwich" turntable

H TYPE A70 ✓ OTHER ☐

Double shielded Laboratory Series® 4-pole shaded motor

I TYPE A70 ✓ OTHER ☐

Ultra-sensitive trip with Delrin®

J TYPE A70 ✓ OTHER ☐

Garrard's exclusive pusher platform, offering the great advantage of automatic play when desired, without compromise (Safest automatic record handling principle ever developed)

K TYPE A70 ✓ OTHER ☐

Garrard iridescent color, compatible with all cabinet finishes

L TYPE A70 ✓ OTHER ☐

New decorator base — optional

M TYPE A70 ✓ OTHER ☐

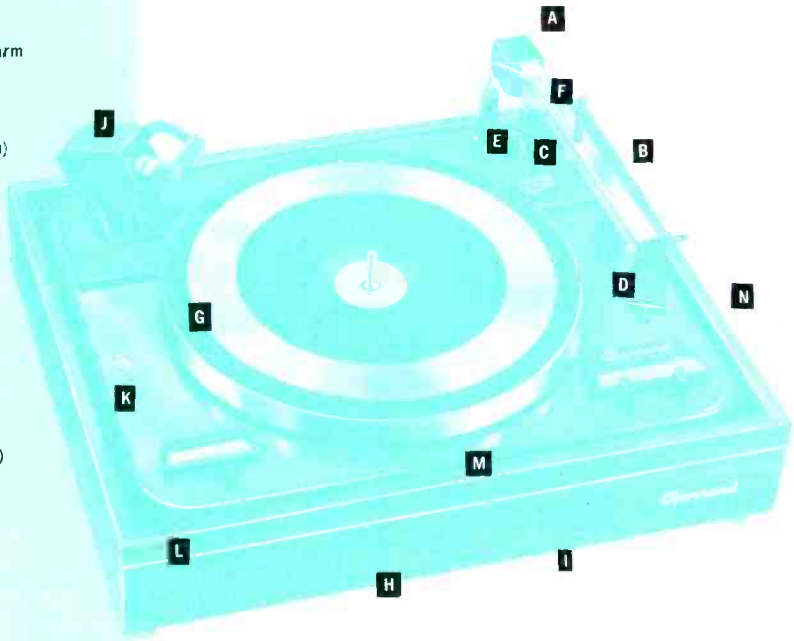
Spring cushioned suspension, damped by foam rubber to prevent feedback and sympathetic vibrations

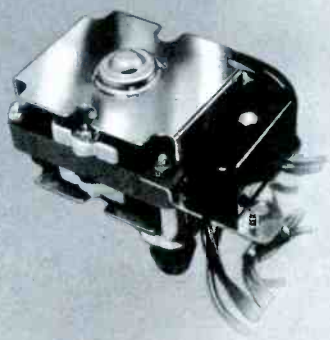
N TYPE A70 ✓ OTHER ☐

Simple installation and service: Type A70 is stereo-wired with 4-pin, 5-wire system. Separate ground connection eliminates hum. Leads simply plug into player with built in Amplok plug (for AC) and female twin phono socket on unit plate (for audio)

Specifications:
4 speeds: 16⅔, 33⅓, 45 and 78 rpm.
100-130 volts, 60 cycles AC (50 cycle pulley available)

Minimum cabinet dimensions:
16¾" left to right, 14⅛" front to rear,
6" above and 2⅞" below motor board





The Type A70 is built around the Garrard Laboratories Series® shaded 4-pole motor, designed specifically for use with this turntable and drive assembly. It is shielded completely, top and bottom, with accurately oriented plates which prevent any interference or hum, even when ultra-sensitive magnetic cartridges are used.

The new trip mechanism of the Type A70 is a marvel of sensitivity. As in the Lab 80, it is molded of Dupont Delrin®. Friction is eliminated to such a degree by this "slippery" material, that the side pressure on the tone arm becomes virtually unmeasurable, and the unit will trip perfectly every time, with no affect upon tracking ability.

This is the new

AT60

an automatic turntable with intermix capability

Handsomely dramatic in the new Garrard iridescent color and brushed aluminum, this precision model meets all the critical performance standards required of a Garrard automatic turntable, offering the additional advantage of compact versatility. The tubular tone arm is particularly efficient... dynamically-balanced and counterweight-adjusted, with built-in stylus pressure gauge.

Under its distinctive turntable mat, the AT60 incorporates a heavy, die-cast, oversized turntable — dynamically-balanced and non-magnetic. This feature — so vital to professional performance — has been found previously only in the highest bracket automatic turntables.

The price of the AT60 is $59.50

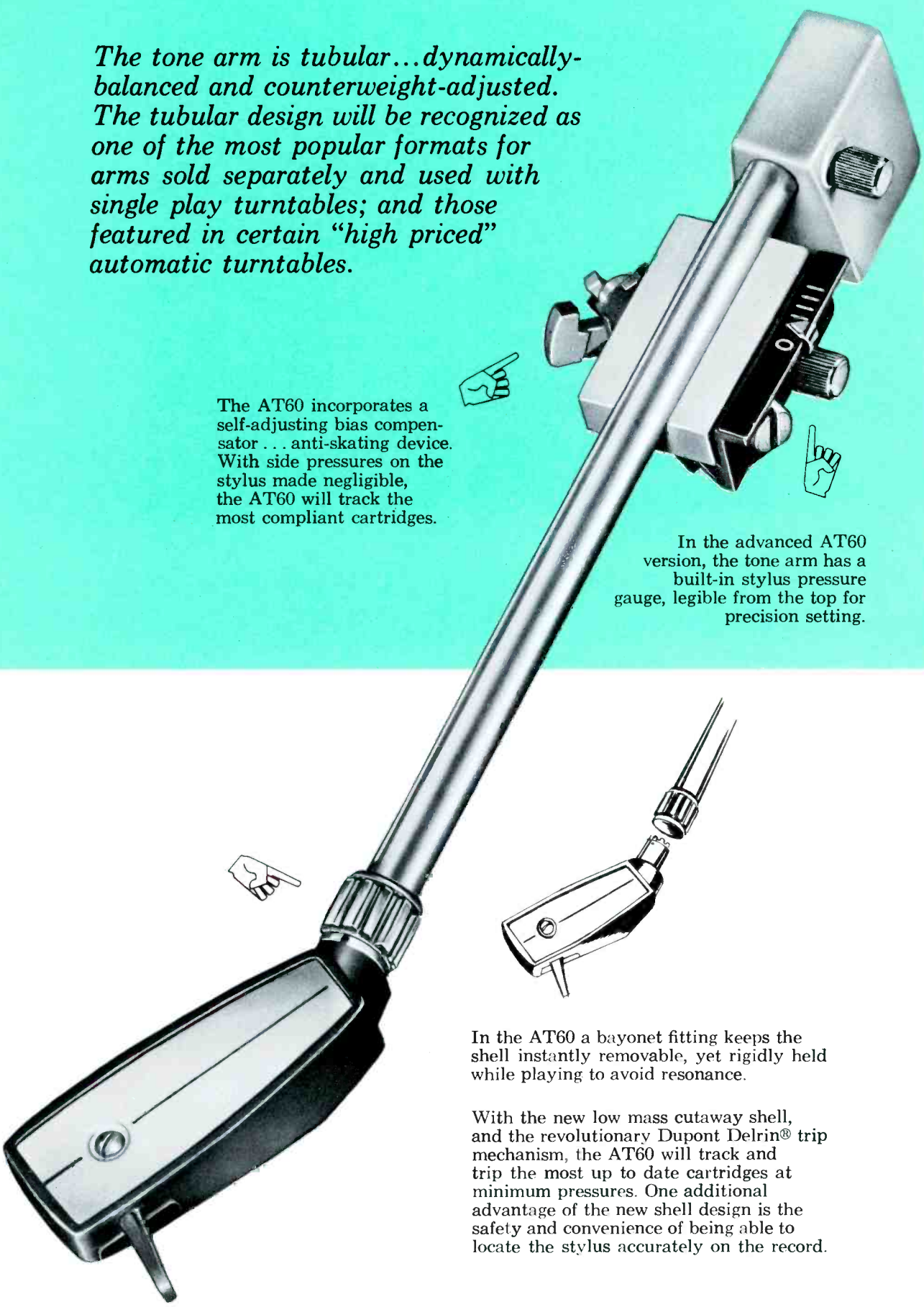
This massive turntable makes for more constant speed, and correct torque through flywheel action. It also facilitates using the AT60 with refined cartridges and amplifiers of greater sensitivity than in earlier music systems.

The turntable of the AT60 is an example of the Garrard policy of consistently upgrading equipment by incorporating the advantages of higher priced units as soon as they can be made available . . . when the changes can be expected to impart genuine improvement in performance.

The tone arm is tubular...dynamically-balanced and counterweight-adjusted. The tubular design will be recognized as one of the most popular formats for arms sold separately and used with single play turntables; and those featured in certain "high priced" automatic turntables.

The AT60 incorporates a self-adjusting bias compensator . . . anti-skating device. With side pressures on the stylus made negligible, the AT60 will track the most compliant cartridges.

In the advanced AT60 version, the tone arm has a built-in stylus pressure gauge, legible from the top for precision setting.



In the AT60 a bayonet fitting keeps the shell instantly removable, yet rigidly held while playing to avoid resonance.

With the new low mass cutaway shell, and the revolutionary Dupont Delrin® trip mechanism, the AT60 will track and trip the most up to date cartridges at minimum pressures. One additional advantage of the new shell design is the safety and convenience of being able to locate the stylus accurately on the record.

AT60 COMPARATOR CHART

A AT60 ✓ OTHER ☐

Tubular dynamically-balanced counterweight-adjusted tone arm

B AT60 ✓ OTHER ☐

Built-in stylus pressure gauge, legible from top

C AT60 ✓ OTHER ☐

Tubular overarm

D AT60 ✓ OTHER ☐

Needle pivots for arm bearings

E AT60 ✓ OTHER ☐

Automatic bias compensator (anti-static device)

F AT60 ✓ OTHER ☐

Lightweight cut-away shell and finger lift

G AT60 ✓ OTHER ☐

Positive-acting tone arm safety catch to prevent accidents, simplify portability

H AT60 ✓ OTHER ☐

Heavy, cast, oversized turntable

I AT60 ✓ OTHER ☐

Double-shielded Laboratory Series® 4-pole shaded motor, in a special version designed exclusively for the AT60

J AT60 ✓ OTHER ☐

Automatic intermix operation, when desired

K AT60 ✓ OTHER ☐

Supersensitive trip. As in all the new Garrard models, the AT60 utilizes Dupont Delrin® to offset friction and make it possible to track and trip high compliance pickups at correct minimal tracking force

L AT60 ✓ OTHER ☐

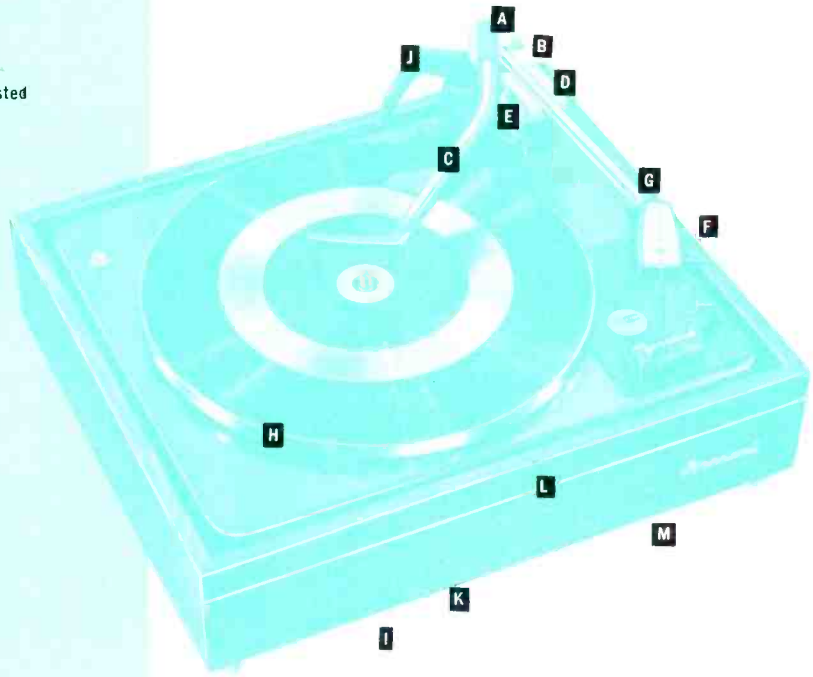
Decorator styled base — optional

M AT60 ✓ OTHER ☐

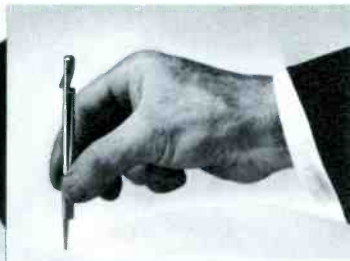
Simple installation: AT60 is fully wired for stereo, with a 4-pin, 5-wire system utilizing separate connection for ground, to eliminate hum. Leads connect to the changer with a built-in Amplok plug (for AC) and a female twin phono socket mounted on the unit plate (for audio). Simply plug-in at the player!

Specifications:
4 speeds: 16⅔, 33⅓, 45 and 78 rpm.
100-130 volts, 60 cycles AC (50 cycle pulley available).

Minimum cabinet dimensions:
15⅜" left to right, 13⅛" front to rear,
4⅞" above and 2⅞" below motor board.



Two spindles are provided. A convenient short spindle is used for playing single records manually.



The short spindle is interchangeable with a center-drop spindle for automatic play, when desired.

With the automatic spindle and tubular overarm in position, the AT60 becomes the safest and most reliable center-drop intermix automatic available today. The spindle removes for safety and convenience in taking records off the turntable. AT60 is compact, fits easily into any record changer cabinet or space.

This is the new

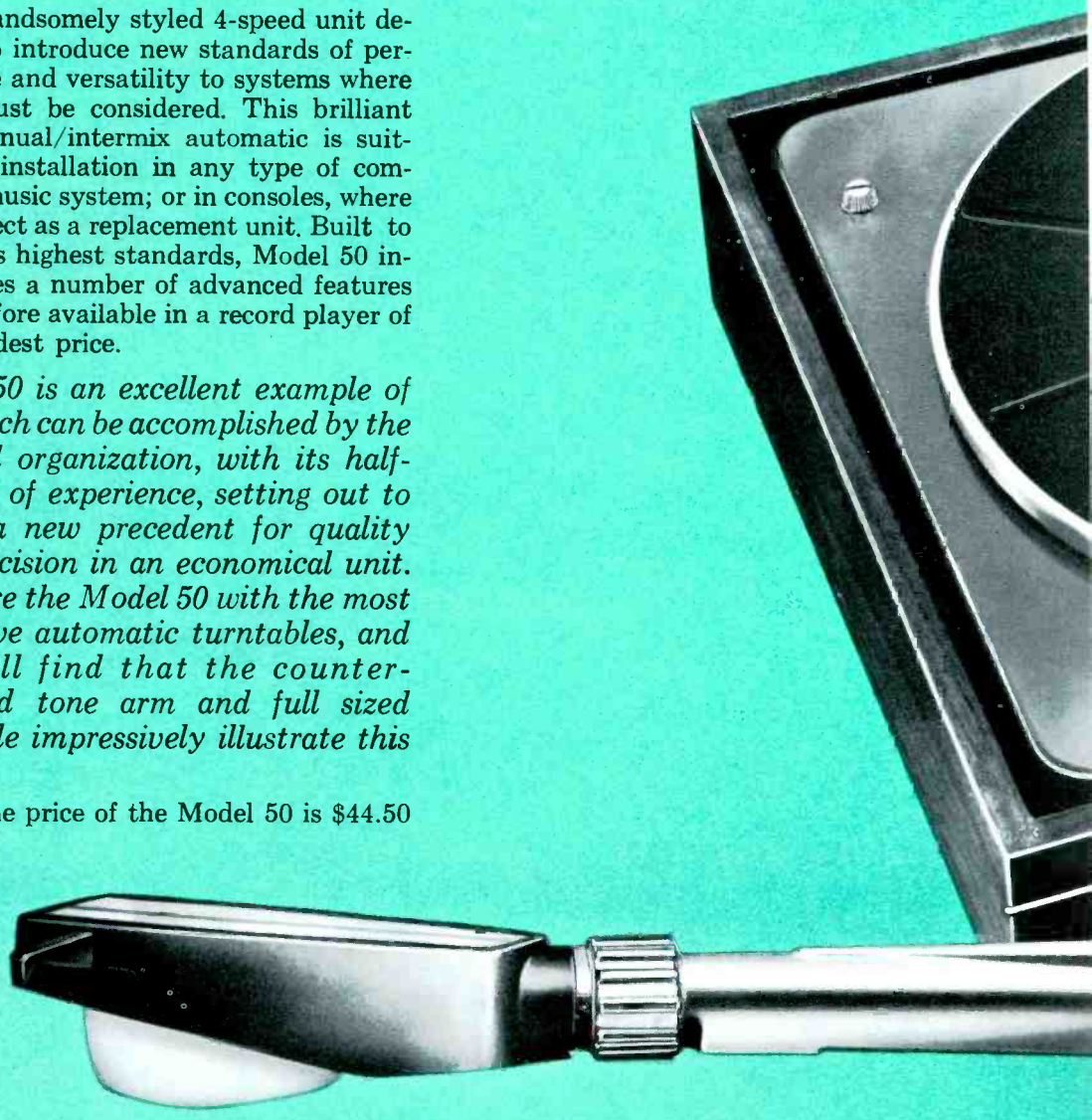
Model 50

Garrard has now designed an exceptionally compact automatic turntable at the price of an ordinary record changer!

It is a handsomely styled 4-speed unit designed to introduce new standards of performance and versatility to systems where space must be considered. This brilliant little manual/intermix automatic is suitable for installation in any type of component music system; or in consoles, where it is perfect as a replacement unit. Built to Garrard's highest standards, Model 50 incorporates a number of advanced features never before available in a record player of such modest price.

Model 50 is an excellent example of how much can be accomplished by the Garrard organization, with its half-century of experience, setting out to create a new precedent for quality and precision in an economical unit. Compare the Model 50 with the most expensive automatic turntables, and you will find that the counter-weighted tone arm and full sized turntable impressively illustrate this point.

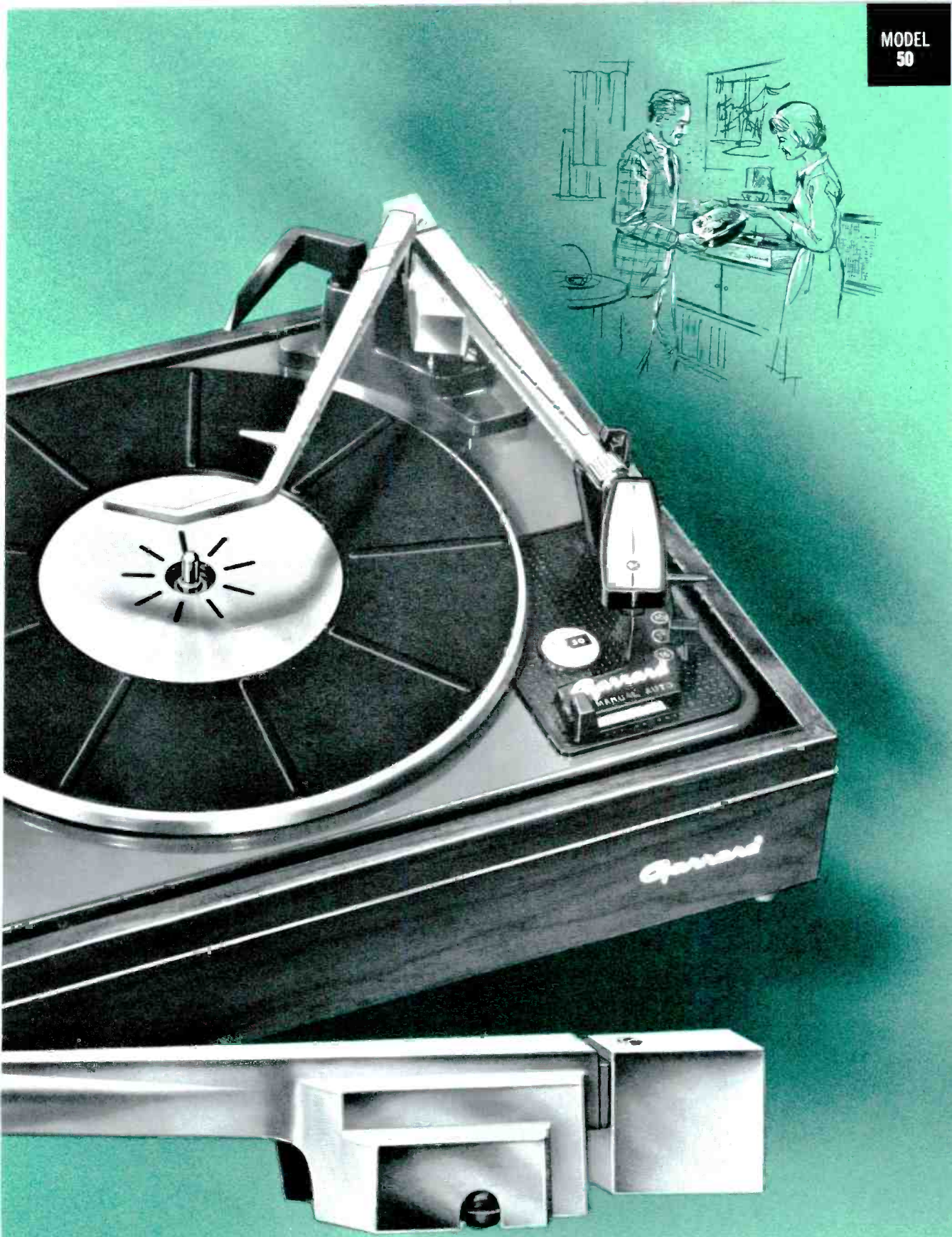
The price of the Model 50 is $44.50



The shell is the lightweight cut away type with an extended finger lift for safety in handling. It plugs in . . . accommodates your widest personal choice of cartridges . . . can be removed from the arm instantly to change the cartridge or service the stylus.

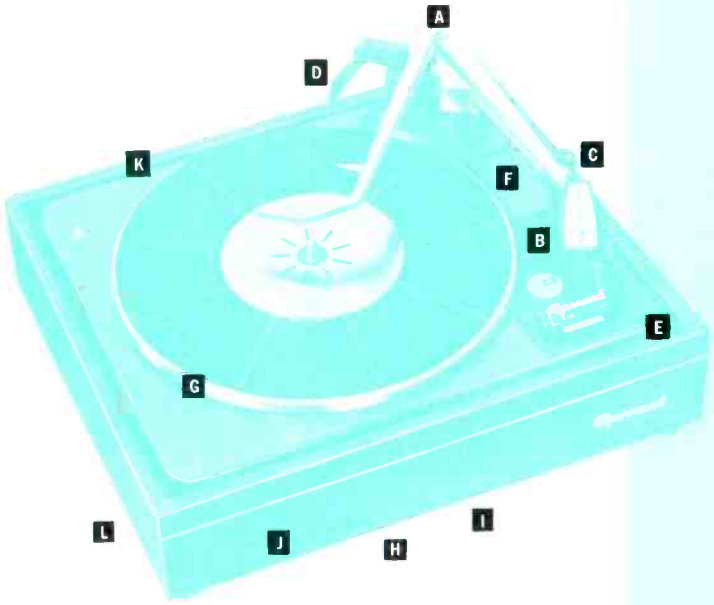
Stylus pressure is adjusted with a simple, accessible finger touch device, for correct tracking force, according to the cartridge manufacturers' specifications.

MODEL
50



The graceful cast aluminum tone arm is counterbalanced – the first time this type of arm has been available in a popular priced unit. This feature alone gives the Model 50 particular significance – an automatic in the economy field which can track high quality cartridges, for finer sound reproduction

MODEL 50



MODEL 50 COMPARATOR CHART

A MODEL 50 ✓ OTHER ☐
Counterweighted cast aluminum tone arm

B MODEL 50 ✓ OTHER ☐
Lightweight cut away shell, with extended finger lift

C MODEL 50 ✓ OTHER ☐
Tone arm safety catch, for easy portability

D MODEL 50 ✓ OTHER ☐
Automatic intermix operation when desired

E MODEL 50 ✓ OTHER ☐
Handsomely styled unitized control panel with separate positions for manual and automatic play

F MODEL 50 ✓ OTHER ☐
Simple, convenient stylus pressure adjustment

G MODEL 50 ✓ OTHER ☐
Oversized turntable with decorative mat

H MODEL 50 ✓ OTHER ☐
Super sensitive trip with Dupont Delrin®

I MODEL 50 ✓ OTHER ☐
Garrard 4-pole shaded "Induction Surge" motor, with dynamically balanced rotor, shielded from hum. Constant speed assured, free from vibration

J MODEL 50 ✓ OTHER ☐
Decorator styled base — optional

K MODEL 50 ✓ OTHER ☐
Garrard's most compact unit, fits any cabinet

L MODEL 50 ✓ OTHER ☐
Installation is simple. Model 50 is fully wired for stereo, with a 4-pin, 5-wire system utilizing separate connection for ground, to eliminate hum. Leads connect to the changer with a built in Amplok plug (for AC) and a female twin phono socket mounted on the unit plate (for audio). Simply plug in at the player!

The turntable is oversized; and the handsome mat is reminiscent of previous Garrard models in a considerably higher price echelon.

Model 50 is the most compact multi-speed automatic turntable. Only 6½" in height overall, it will fit where other automatics may not. Sparkling in the new Garrard iridescent color and brushed aluminum, Model 50 will enhance the appearance of any music system.

In automatic position, Model 50 intermixes records of any size or sequence. Two spindles are provided. A convenient short single play spindle is interchangeable with the center drop automatic spindle, removable for safety in handling records.

Specifications:
4 speeds: 16⅔, 33⅓, 45 and 78 rpm.
100-130 volts, 60 cycles AC (50 cycle pulley available).

Minimum cabinet dimensions:
14⅞" left to right, 12½" front to rear, 4⅝" above and 2⅞" below motor board.

Garrard

WORLD'S FINEST

There is a specific Garrard model for your high fidelity system.

LAB 80 Automatic Transcription Turntable $99.50

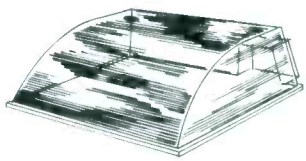
TYPE A70 Automatic Turntable $84.50

AT60 Automatic Turntable $59.50

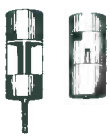
MODEL 50 Automatic Turntable $44.50

In selecting the Garrard model which best meets your requirements, you may depend upon the experience of your dealer. (We publish a list of Garrard dealers and will be pleased to send it on request.) Bear in mind that the purpose of the record playing unit is not only to perform excellently, in conjunction with the other components in your music system . . . but also to protect your growing, valuable library of records. A Garrard is a long range investment . . . built by a manufacturer with 50 years of experience, respected throughout the world for its tradition of integrity. Your Garrard is built for the years, and its performance to your complete satisfaction is assured by a meticulously trained and supervised national authorized service organization, supported by the most complete stock of spare parts in the industry, available throughout the country.

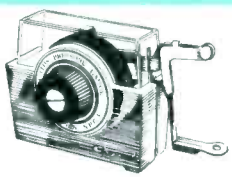
MOUNTING BASES. Decorator styled in Oiled Walnut, or sanded, unfinished . . . with precut mounting boards for all Garrard units.
$4.45 to $5.50
(Mounting boards for cabinet installations–$2.25)



DUST COVERS. Molded from clear vinyl to protect your Garrard from accidents. $4.95



AUTOMATIC SPINDLES. For 45 rpm records. $3.80



MODEL SPG3 STYLUS PRESSURE GAUGE. A sensitive, precision gauge which helps to maintain correct tracking force at all times. $2.95

A wide range of accessories is available, to simplify installation of your Garrard automatic turntable, protect your record library, and add to your listening pleasure.

Prices and specifications subject to change without notice.

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OCT., 1964 VOL. 48, NO. 10

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Sound Reinforcement

• A Basic Course in Commercial Sound. Chapter 8. Norman Crowhurst. Amplifiers and electronic equipment.

Profiles

• Magnecord 1024 Stereo Tape Recorder (at last).

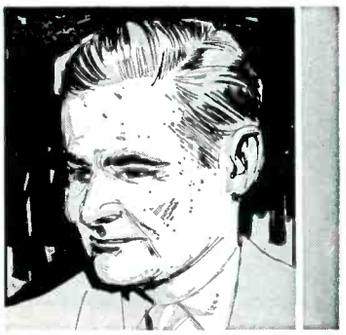
• ADC 303A "Brentwood" speaker system.

In the Nov. Issue

On the newsstands, at your favorite audio dealer's, or in your own mailbox.

AUDIO CLINIC

Joseph Giovanelli



Send questions to:
Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn 26, N. Y.
Include stamped, self-addressed envelope.

Connecting A.C.-D.C. Amplifiers

Q. I am building my music system from "scratch." I want to obtain a tuner of of high quality (FM) and put the sound through my TV set or small record player. Later I will add the other components. Could you advise me on the pitfalls and problems, and suggest a way of avoiding them?

The record player and TV set are very low in quality and do not use transformers whereas the tuner does use a power transformer.

How do I match the two components—tuner to record player and tuner to TV set? R. N. Holmes, Blossom Park, Ontario, Canada.

A. When using an a.c.-d.c. amplifier, the first point to remember is that you should not ground the tuner or the record player as is so often recommended except as will later be explained. Grounding the equipment can result in damage to the equipment or in a blown fuse if the polarity of the supply line happens to be favorable to that kind of trouble.

The next step is to disconnect the cartridge from your record player and to connect the output of the tuner to the input of the record player. Through the use of proper jacks and/or switches, it is possible to have the cartridge re-connected to the record player whenever required. Be sure that the ground terminal of the tuner is connected to the ground of the record player and that the "hot" output terminal of your tuner is connected to the "hot" input terminal of your record player.

Make these connections with the a.c. line unplugged because of the possibility of electric shock. Once these connections are made, you can plug them back into the line and listen to them. There will be no problems involving impedance matching.

The procedure outlined here can be used to connect any source to your record player if the source is not of the a.c.-d.c. type.

For greater safety, the record player could be connected to the power line via an insolation transformer which is capable of handling the wattage required by your record player. If this transformer is used, the equipment can be safely grounded to a radiator or waterpipe, as required.

Further, the use of this isolation transformer makes it possible for you to connect your record player to any other a.c.-d.c. source without danger of blowing fuses because of accidentally reversed polarities.

There is an added safety factor in terms of the personnel handling the equipment. Let us suppose that your tuner has a metal cabinet. Let us suppose further that the system was not grounded. If the polarity of the a.c.-d.c. amplifier was not correct, the user of the equipment who touched the tuner case and a radiator or other grounded object would receive a dangerous shock. Even though it is true that this shock hazzard can be avoided by making sure that the a.c. plug is placed in the socket in such a way that the chassis of the equipment is connected to the ground side of the line, it is far better and safer to use an isolation transformer.

The same safety precautions hold true for your TV receiver as were described for your a.c.-d.c. record player. However, very little information of a specific nature can be given you which will help you connect your tuner to the audio input of the television receiver. Television receivers have audio circuits which vary considerably from one model to the next. In some the de-emphasis network is placed ahead of the audio circuit, while in others the network is placed between the audio voltage amplifier and the output stage. In this latter instance the de-emphasis network must be removed before the tuner is installed. If the network is not removed, sound quality will be bassy. (Of course, the network must be installed every time the TV set is to be used for viewing. A switching arrangement can probably be easily arranged.)

Provision must be made for disconnecting the sound detector from the audio input when the tuner is to drive the TV set.

Connecting Headphones to Power Amplifiers

Q. The phones I am considering are described as being 8-ohms each and are cabled for stereophonic use. However, when these phones are used with a special network supplied by their manufacturer, the impedance is 100-ohms per phone. I assume they should be connected to the secondary winding of the output transformer. My output transformer is a complicated Partridge transformer with lots of secondary windings now interconnected for a 16-ohm loudspeaker. I would like it to stay that way.

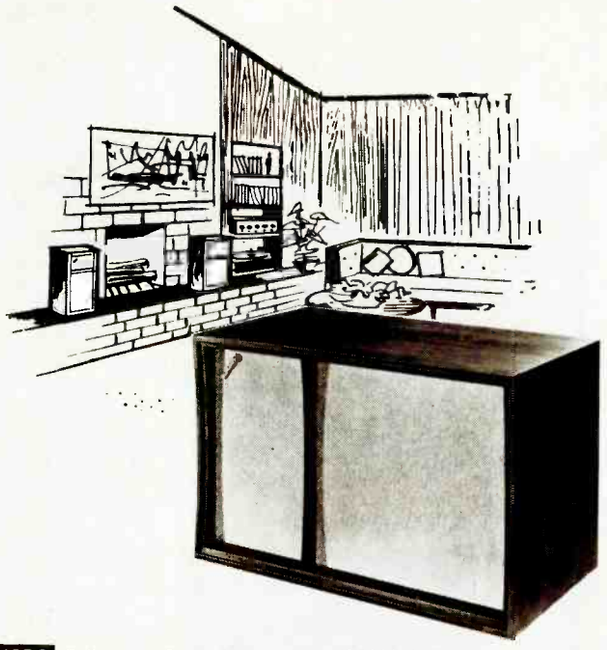
What is the optimum connection of the leads from the two phones, parallel or series? Does it matter? (You see, this is for a monophonic system.) If parallel, the total impedance becomes 4 ohms or, with the network, 50 ohms. What happens if they are connected this way to the 16-ohm winding of my amplifier? In series the total impedance is 16 ohms or, with the network, 200 ohms.

The phone description states that only a couple of milliwatts are needed to drive them. Is any precautionary network needed

W90 shown on optional mounting base

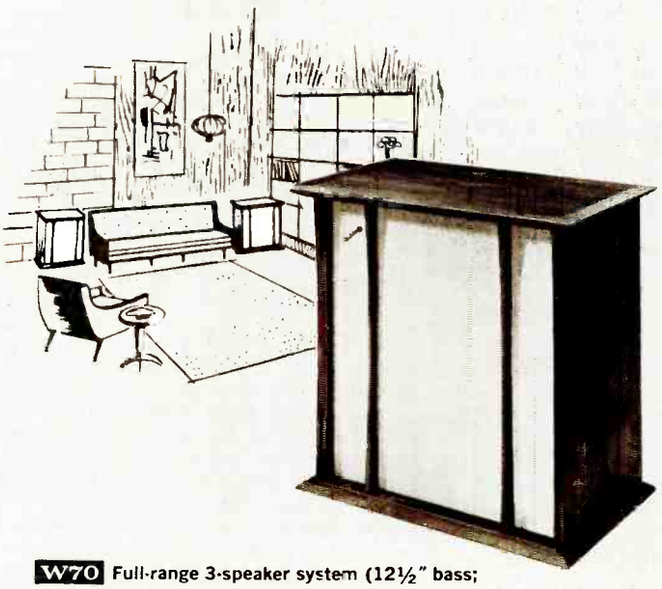
W90 6-speaker system (two 12½" bass, two 5½" mid-range, two Super 3 treble), superbly matched and integrated with a magnificent sand-filled enclosure.

The impact of the great Wharfedale systems used in G. A. Briggs' notable live vs. recorded demonstrations, now in a new format—neither compact nor large, to sound well and look well in any living room. Maximum performance through advanced acoustical techniques—speakers with polystyrene facing—enclosures with tuned and distributed ports. Now restyled with decorator bouclé fabric grille and handsomely finished table top. **Oiled or Polished Walnut, $272.50; Utility model, $256.50.**



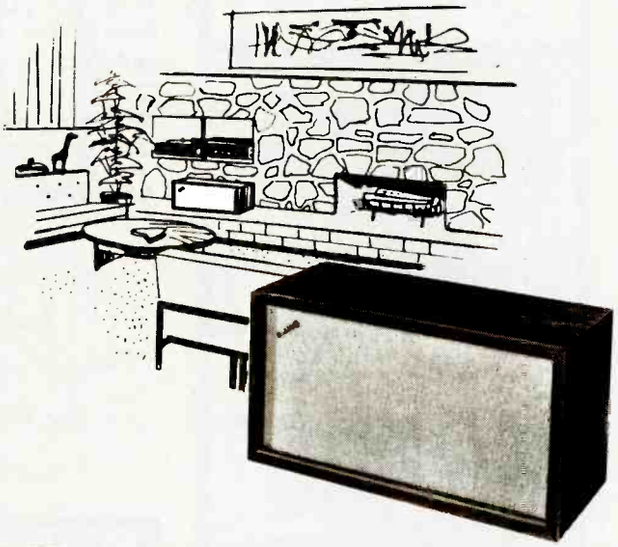
W60 Full-range 2-speaker system (12½" bass; 5" mid-range tweeter) in exclusive sand-filled enclosure.

The original Achromatic system, W60 continues to be the most popular Wharfedale model. Its high standing was established by comparative tests against speaker systems of every calibre. New magnetic materials, a more compliant cone surround, and other developments have now added luster to its recognized acoustical qualities. Fine furniture detailing, including new decorator-selected champagne bouclé grille fabric. **Oiled or Polished Walnut, $122.50; Utility model, $106.50.**



W70 Full-range 3-speaker system (12½" bass; 10¼" mid-range; Super 3 treble) in exclusive sand-filled enclosure.

An unusually versatile system providing excellent bass, transparent highs and the fullness of a superb mid-range. Recent technical advances make it compatible with the latest electronic equipment, including solid state. Now restyled with champagne bouclé grille and decorative table top and base . . . an attractive addition to any listening room. **Oiled or Polished Walnut, $172.50; Utility model, $153.50.**



W40 Full-range 2-speaker system (10½" low frequency; 5" mid-range tweeter) in exclusive sand-filled enclosure.

Now, W40 incorporates a highly advanced 10½" bass speaker with extremely high flux density magnet, providing excellent low end. Highs are reproduced without stridency through the same cone-type 5" tweeter as in the W60. Restyled with distinctive champagne bouclé grille and decorative molding, it is admirably suited to any music system where space must be carefully utilized, but quality is required. **Oiled or Polished Walnut, $83.50; Utility model, $72.50.**

WHARFEDALE COMPONENT LOUDSPEAKERS

Full Range 8" Super 8	Full Range 10" Super 10	Full Range 12" Super 12	Woofer W 12/RS	Woofer W 15/RS	Tweeter Super 3
RS/DD $26.50	RS/DD $47.50	RS/DD $89.50	$52.50	$89.50	$26.50

Newest Achromatics

by Wharfedale

For Comparator Guide and swatch of new grille fabric, write Wharfedale, Div. of British Industries Corp., Port Washington, N.Y.

Circle 104 on Reader Service Card

to prevent overdriving and damaging the phones? S. W., New York, New York.

A. Your letter indicated there is a network which can be used in conjunction with the headphones. Presumably there are instructions which accompany the phones and network showing the interconnection between the two. Therefore, I recommend the use of the network because it probably was designed to minimize headphone damage. I shall consider the network as an integral part of the phones.

The point which is probably most important is that the amplifier be loaded with something near its rated impedance. Therefore, connect a 16-ohm resistor across the output transformer when the phones are to be used. The fact that the network may, and indeed will, give you a mismatch of impedance between the phones and the amplifier is of no consequence here.

It does not matter whether series or parallel or series hookup is used, but be sure to maintain correct phasing. For purposes of this discussion, I shall assume that the phones are connected in parallel.

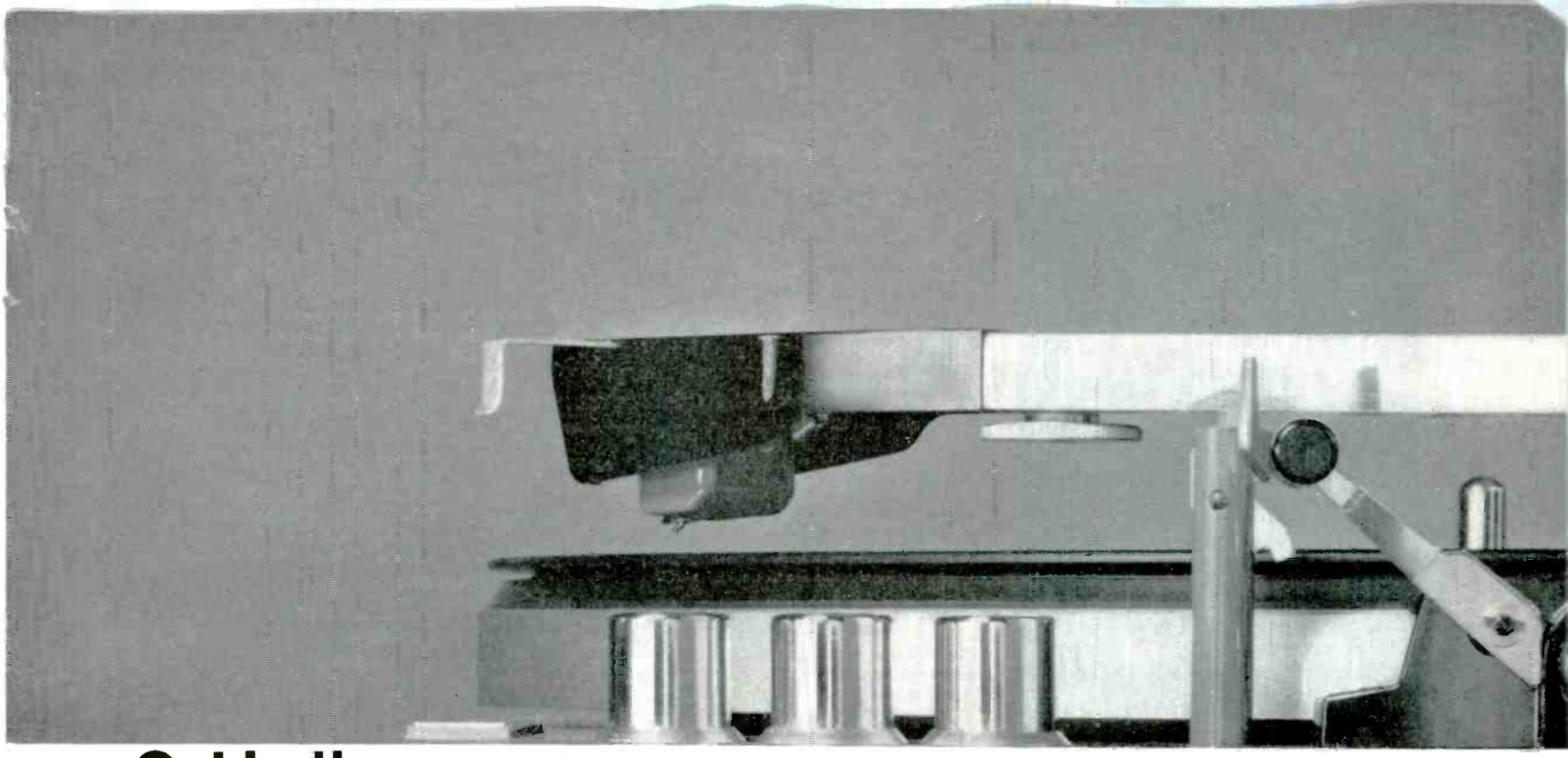
If it should happen that too much hiss level is heard in the phones, you must then introduce some power loss into the system. This is easily done by placing a resistor in series with the phones and the amplifier. Assuming that the network associated with the phones results in an impedance of 50 ohms, you can place a 50-ohm resistor in series with this network. The effect of this 50-ohm resistor will be to reduce the power fed into the phones by some 6 db. If this power reduction is not sufficient, further reduction is possible by increasing the value of the series resistor. The next logical value would probably be 250 ohms.

Always begin your headphone listening with the volume control of your preamplifier turned down. This precaution not only will avoid any damage to the phones, but will also avoid extreme sound pressure against your eardrums which could conceivably cause injury. If your equipment suffers from transient clicks when inputs are switched, the volume control should be turned down to zero level before changing inputs.

The wattage of the series resistor is not really critical. A resistor capable of dissipating 2 watts is ample.

However, the 16-ohm shunt resistor should have a rating of at least 10 watts. Most of the amplifier power will be spent in heating this shunt resistor. The actual amount of power taken by this resistor will depend upon the value of the series resistor used and upon the loss within the special network associated with the phones. The higher the value of series resistor, the greater will be the power taken by the shunt resistor.

The series resistor does two things. First, it requires more power to be fed from the amplifier than would be needed if the phones were connected directly across the output terminals of your amplifier. This will reduce the background noise often heard in phones when they are connected without this series resistor. Second, the arrangement discussed here reduced the possibility of damage to the phones by accidentally feeding too much level into them. Without the network and series resistor, even a small rotation of the volume control will be sufficient to cause damage to the phones and great sound level at the eardrums. If the amplifier must work harder to supply signal to the phones, the volume control must be opened further before the point of headphone damage is reached. AE



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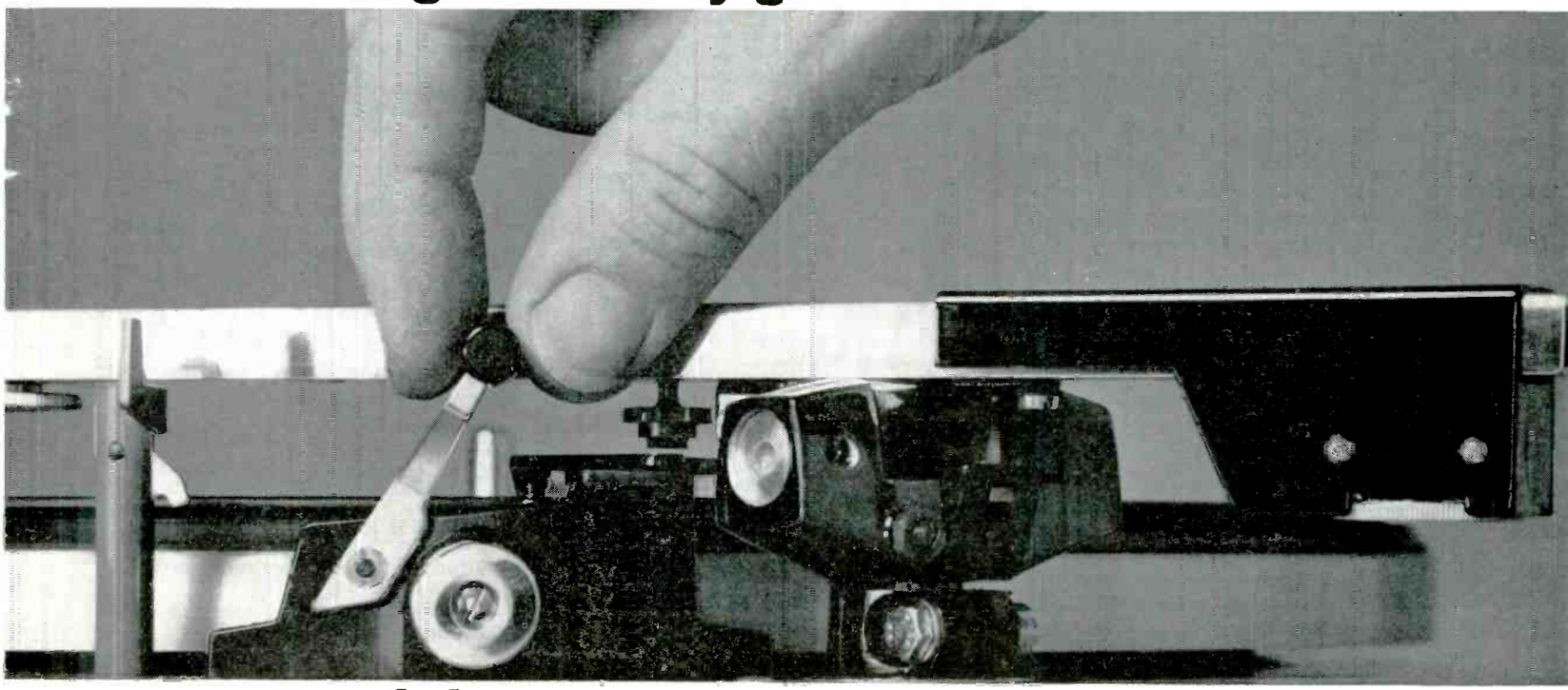

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BENJAMIN MIRACORD

Circle 129 on Reader Service Card

LETTERS

RFI

SIR:

May I commend Mr. Giovanelli for his "Audio Clinic" in your August, 1964 issue —Radio Frequency Interference in Home Music Systems. As a consulting broadcast engineer, I have had considerable experience with radio interference problems, including several of the type he describes, and I would agree fully with the various electronic remedies he prescribes.

However, I disagree on a few points. Speaking of the Citizens Radio Service and the Amateur Radio Service, Mr. Giovanelli says: "if a person is receiving from either or these classes of service, even though the transmitting equipment is operating perfectly, the law assumes that his own equipment is not designed, maintained, or operated correctly. It then becomes his responsibility to correct the condition."

It is not clear to whom the word "his" refers—the person operating the transmitter, or the person operating the receiver? I assume it is the latter, for I know of nothing in the FCC rules nor the Communications Act which "assumes" that a transmitter is operating incorrectly simply because one receiver suffers interference. This would be a supreme case of ignoring the negatives —the many receivers in the immediate vicinity which are *not* being interfered with.

Further on, Mr. Giovanelli says: "Sometimes, but rarely, nothing can be done to eliminate the interference; the transmitter is just too close and too powerful."

My associates and I, in fifteen years of engineering, have never found such a case. Perhaps if the receiver of interference doesn't wish to spend much money, this might be so; some remedies are rather expensive. But *something* can always be done.

Mr. Giovanelli continues: "About all you can hope for is cooperation from the operator of the transmitter. If he is a responsible person, he will maintain radio silence during times you wish to make important tape recordings."

I fear that "cooperation" has nothing whatsoever to do with the case in point. For one thing, a properly-adjusted and operated transmitter in the Citizens Radio Service may be operated without restriction as to time. Under such circumstances, since fault lies with the receiver than the transmitter, the transmitter operator has no obligation to "cooperate." As a matter of fact, since the CB transmitter is being used for the business or personal affairs of the CB licensee, it would be to his disadvantage to stay off the air.

Also, while it is true, as Mr. Giovanelli mentions that stations in the Amateur Radio Service may be ordered to maintain "quiet hours," I feel that he should have read Par. 97.131 of the FCC Rules and Regulations a little closer. This paragraph provides for "quiet hours" *only* between 8 p.m. and 10:30 p.m. and on Sunday from 10:30 a.m. until 1 p.m., local time. It further provides that this prohibition shall apply only if interference is caused to "receivers of good engineering design including adequate selectivity characteristics." Quiet hours are not a panacea, and they may not be applied at the whim of the listener.

There is a misleading statement in Mr. Giovanelli's text: "If he (the transmitter operator) is unwilling to cooperate and if the nature of his transmissions or if his conversations with *any other party* exceed five minutes, this operator can be reported to the FCC. (This applies only to operators in the Citizen's Radio Service.)" (Emphasis supplied)

Of course, anyone may be "reported to the FCC"—with or without cause. But only under very certain, special circumstances would the Commission take action against a CB licensee in the situation described above. The restriction mentioned above, which can be found in Par. 95.81 (f) of the Rules and Regulations, applies only to Class D stations in the Citizens Radio Service—and not to Class A, B, or C stations. Furthermore, this restriction does not apply to communications by Class D stations involving the immediate safety of life, the immediate protection of property, or civil defense communications as provided in Par. 95.121. Finally, and most importantly, it does not apply to the majority of the ordinary, routine communications engaged in by Class D stations—the type of service that Class D is primarily authorized for—communication with other units of the same station—in other words, between one's home and one's car. The restriction applies *only* to communications between two separately-licensed stations in the Class-D Citizens Radio Service.

I would also like to point out that the person receiving interference from a station in the Citizens Radio Service (but *not* the Amateur Radio Service) may not divulge or publish the contents or meaning of such transmissions of the CB transmitter, that he may overhear by means of such interference, to a third party; nor may he use such information for his own or anyone else's benefit, without permisison of the originator of such information. This restriction is found in Section 605 of the Communications Act of 1934. The penalty is $10,000 fine or one year in prison, or both, for the first offense; $10,000 fine or two years in prison, or both, for the second or further offenses. The only transmissions exempted from these provisions are distress signals, amateur radio signals, and broadcasts intended for the general public—radio and TV broadcasts for the use of the home audience. Tape recordings made of interference from a transmitter in the Citizens Radio Service would constitute a violation of Sec. 605.

THOMAS R. HASKETT
Haskett & Volkman
Broadcast Engineering Consultants
2935 Marshall St.
Cincinnati, Ohio 45220

More Corrections

SIR:

Some time ago I sent in a series of new products, for listing in your August Product Preview. Thank you very much for including them.

Unfortunately, there seems to be a mix-up. I thought I had indicated, on the forms, that these are all being distributed, not by my old organization, LECTRONICS, but by my new marketing organization, I.M.F. Products.

IRVING M. FRIED,
I.M.F. Products,
7600 City Line Ave.
Philadelphia, Pa. 19151

SIR:

We note that an unintentional error occurred in the reference on page 37 to the Quad FM tuner in the August issue product review. The price of $94 applies to the tuner only and the multiplex decoder costs a further $64.

J. H. WALKER
Acoustical Mfg. Co., Ltd.
Huntingdon, England

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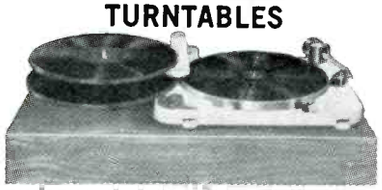

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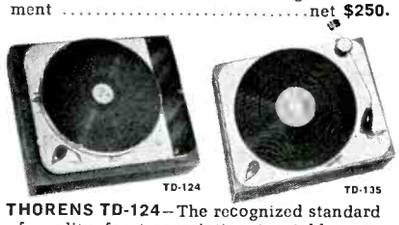

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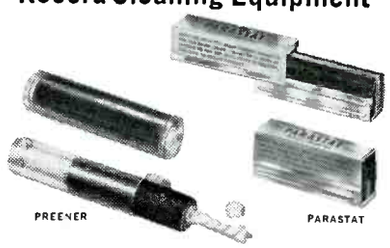

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AUDIO ETC.

Edward Tatnall Canby

LIVER THAN LIVE.

I. Mono for the Stereo Listener

First, a bit of immediate background. Though in the months of my absence from this perennial department I resolutely closed eyes and ears to audio, I had to open them once in awhile in some areas. Notably in recording, since I was ankle-deep in the middle of it most of the time.

Some record buyers may have discovered that, for one thing, I've been writing liner notes (the musical annotations that appear on the backside of the record jacket). My effusions, indeed, have been so Canbyesque—i.e., lengthy—that the company got back at me by eliminating paragraph indentations, to save a bit of previous space. And small type, too. So if you read me on the Nonesuch label (classical branch of Elektra Records), take a big breath and plunge in heartily; there's no place to breathe until the end.

Also on my Nonesuch agenda were some other activities. One, at last, was the release of my first very own "commercial" record, the Canby Singers under my direction. We've been making tapes for several years; some three quarters of an hour of them have been distilled onto Nonesuch H-1026 and H-71026, mono and stereo respectively, entitled "O Great Mystery" (after the first three pieces, which concern the Christmas story and begin with those words). It's choral music of the Sixteenth and Seventeenth centuries, unaccompanied.

Much of my 1964 summer went into the editing, assembling and annotation of this disc. Boy, does it take time to put together just *one* LP record! Very healthy experience for a record critic who is faced by hundreds of records every day, each waiting for its hopeful place in the sun.

Another activity during those months was purely advisory; I passed judgments on assorted recorded material and promoted opinions as to this or that recording problem. Much of this was in the musical area. My technical comments mostly were confined to such pronouncements as "note 50-cycle hum" (there's a lot of that distinctive sound to be heard on European LP releases) or, maybe, "peaky distortion in the mid-range—is it in the disc cutting or on the tape??" And I kept reminding everybody, probably unnecessarily, that RIAA and NAB don't operate in Europe; European tapes and discs sound funny when played back on U. S. equipment, unless equalized.

To Enhance or Not?

Once in awhile I was tossed a mightier problem on which to give an opinion. One day I found myself writing "a few paragraphs" as to whether good mono tapes should be treated to "stereo enhancement," electronic two-channel reprocessing for stereo playback.

My answer was definitely yes. And that is why I am mentioning the subject here.

You see, a great many excellent tapes are available, both here and abroad, which lack only stereo to make them "modern." Also, there is an immense quantity of good material worth reissue even though technically it is not quite up to date. Is an "artificial stereo" worth considering, as things stand now? (The enhanced or treated version would, of course, be in addition to the straight mono release, providing the now-usual dual offering, one for mono machines, one for stereo.)

Well, as you know, most record companies avoid it in their mono-only releases. They may be a bit afraid of the technical complexities but, more likely, they simply do not think it is "ethical" to put out a simulated stereo. Unfortunately, a lot of buyers have the same feeling. And so in most record catalogues you'll find blank spaces where there is no stereo version though the mono release is available. In Schwann, these underprivileged records are listed in light numerals, lacking the big, black boldface entry that indicates stereo. Sort of a negative feeling about it, if you ask me.

However, a few boldfaced record publishers *have* gone into stereo enhancement, or electronic rechanneling, or what have you, in order to provide an optimum product to suit the stereo playback system.

RCA tried out a simulated stereo Toscanini reissue. (Haven't heard of any more since.) Columbia has gone in for it, if I'm right, for some valuable historic reissues from pre-stereo days. Philips has used it for first-release material—not reissues at all—and with notable success. Just try one of the handsome Philips albums of music from the Congo, all issued in synthetic stereo. Excellent. Awhile back, Capitol did a noble job after Sir Thomas Beecham's death, issuing one volume of the Haydn "Salomon" Symphonies in synthetic stereo to match the rest in another volume in real stereo. Seems Sir Thomas had died halfway through the stereo re-make. The two volumes, one in stereo, the other in synthetic stereo, even shared the same cover design. They make a most instructive comparison, and furnish an excellent example of the proper use of this electronic enhancement for stereo playback. Both volumes are, again, *an optimum product for the stereo player*. If you have a mono machine, then buy the mono version.

If we are to appreciate this extremely useful new recording technique, we must get one thing straight, right off. To create a literal synthetic stereo, in terms of the complex separations and spatial locations of the real thing, is quite impossible. Though one can do a surprisingly good simulation, that is NOT the primary purpose of the "electronic re-channeling." And so direct comparisons between real stereo and simulated stereo are pointless, though interesting.

Pointless because there never will be both true *and* synthetic stereo versions of the same recording! True stereo is always preferable—natch. Nobody in his right mind will synthesize a stereo sound from a mono recording which also exists in true stereo form. And so don't go around judging synthetic stereo as though it were real. It isn't. It can't be.

The real purpose of it, may I repeat, is to provide *an optimum mono product for the stereo playback system*. Contrary to most people's ideas, the straight mono disc is *not* by any means that optimum product.

Mono via Stereo

That requires a bit of explanation. Look at it this way. The mono recording, no matter how hi its fi, is given a *very poor* spatial reproduction on a good stereo system. The better the stereo, the more unnatural is the mono sound.

What? Don't all the ads say that a stereo system makes your old mono records sound "even better?" Well, they're wrong. The fact is that the mono record, equipment being equal, sounds *worse*, not better.

Just think about it for a moment. A stereo system playing a true stereo record spreads the sound sidewise for a "sound curtain" that is often actually wider than the speakers' separation. It does it *internally* via the recorded stereo differences between the two channels of

(Continued on page 120)

Meet the new Royal Grenadier . . . . . world's most perfect speaker system. Pretty soon every stereo system 'round will be featuring this revolutionary divergent lens speaker system. The first loudspeaker ever designed and engineered for stereophonic reproduction. Lets you sit anywhere—hear everything.

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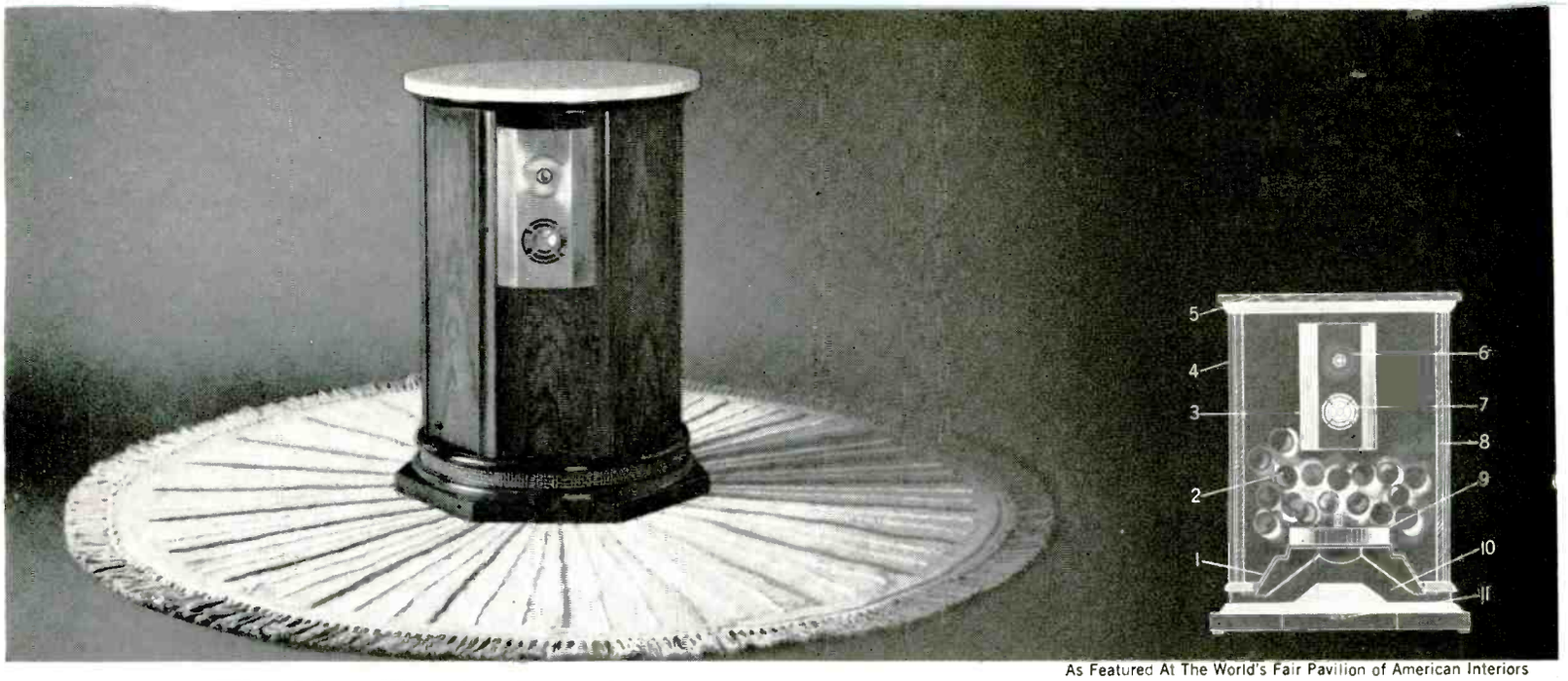

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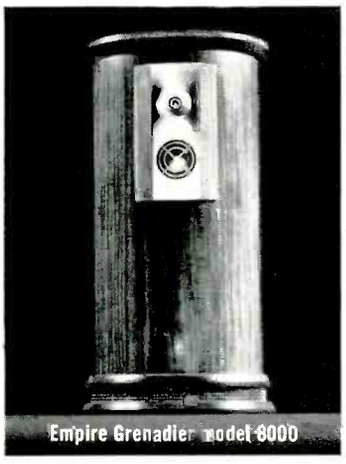

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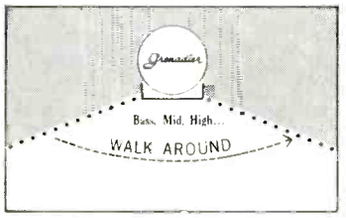

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You will notice no change in sound level of bass, mid range, and highs. Full frequency and separation is assured by Empire's exclusive divergent acoustic lens system.

Try this same test with any other brand of speaker. Some speakers will only have a narrow angle of high frequency sound propagation. Some may have 2 or even 3 bands of high frequency sound. With these or other speakers, slight shifts of position, turning one's head, or even leaning to one side may cause sharp changes in the listening tone and level. Not so with the Empire Grenadier.

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ABOUT MUSIC

Harold Lawrence

Prelude to a "Take"

The session described below took place on May 19th in a midtown New York studio a few hundred yards from Carnegie Hall. The events cover a span of about an hour and forty-five minutes. "Prelude to a 'take'" is part of AUDIO's continuing coverage of recording activities. Note that this session was referred to by Chester Santon in his review of Broadway Marches *in the September issue. The record was produced for Mercury Records by our own Harold Lawrence.* ED.

Perched on a stool in the empty recording studio, the wiry figure in the black turtleneck sweater pored over the manuscripts spread out before him on the music stand. From time to time he tossed a cue to an invisible player, hammered out a cadence, and scribbled notes to himself in the score. It was an hour before session time, but this was not unusual for Frederick Fennell. Since his first recording in 1953, he had always arrived at the hall along with, or ahead of, the engineers and stagehands, his scores tucked under his arm and a mug of coffee in his hand.

Inside the control room, I was reviewing the microphone setup with engineer George Piros. The copyist had just delivered the parts for the session and arranger John Krance was hurriedly making the inevitable last-minute corrections. Technicians moved into the hall through the forest of microphone booms and began to "scratch" the microphones while Piros verified the inputs on the board.

Everything had been made ready for the musicians, including the placing of ashtrays next to virtually each chair. (The Surgeon General's report apparently failed to shake up studio musicians. Within minutes after the start of a typical New York session, an acrid pall of smoke hangs over the players.) The musicians now began to file in. Instruments were pulled out of cases, reeds tested, valves checked, and fingers limbered up. Bob Swan, the session's contractor (a former percussionist with the Eastman Wind Ensemble under Fennell) gathered the proofed instrumental parts from Krance and distributed them to the waiting players. Soon the hall filled up with that pleasant chaos of tuning and private rehearsing that the 18th-century English music historian, Burney, called a "Dutch concert."

As the habitual late comers took their places, the studio clock indicated the session had officially begun. Swan counted noses. When he came to the trumpet section, he spotted an empty chair, looked around the hall, and blanched slightly. A telephone call revealed that the player had left town, probably because he had double-booked himself—one of the risks of heavy studio dating. Swan held a meeting with Fennell, Krance, and composer Alec Wilder, who was attending the session as a guest of the conductor. Names of musicians were tossed back and forth. "How about L---?" "No good; he's playing a show at N.B.C. this afternoon." "B--- would be perfect." "I've already tried him; he's out. I left my number." Wilder then put forth the name of another player and the others nodded vigorously in agreement. The call was placed; miraculously, the trumpeter was available and could make it to the studio in about 35 minutes.

Five minutes past session time. By now the din was overpowering. I cupped my hands over Fennell's ear: "Fred, start rehearsing *without* the trumpet. We'll use the time to set our balance." Fennell slipped his baton under his arm and clapped his hands. "All right, gentlemen, settle down, please! We'll start with Strike Up the Band."

The musicians facing Fennell in the brightly lit hall—probably the only recording studio with chandeliers (see photo)—were deployed in the following manner:

All fourteen microphones were set to a cardioid pattern and fed to three-channel and monophonic Ampex tape machines. The trombones, one percussion, traps, double bass, frets, accordion, and organ were assigned to the left channel of the stereo tape; the French horns, one percussion, tuba, and reeds to the center; and the trumpets, one percussion, and some reeds to the right. For better visual communication, the trumpets and trombones had been placed on platforms. Telefunken U-47 microphones picked up percussion, reeds, accordion, French horns, and organ; RCA 44's were employed for the frets and the rest of the brass (trumpets, trombones and tuba); an RCA BK-5 was on the traps; and, for the double bass, an RCA 77-D.

To the guests in the control room, the sounds emerging from the three Altec loudspeaker systems mounted above the

(Continued on page 107)

Fig. 1. Fennell in action.

LIGHT LISTENING

Chester Santon

The King and I (Lincoln Center Original Cast)

RCA Victor LSO 1092

The famous thirteen-year old Rodgers and Hammerstein musical, "The King and I," was selected to open the brand new Music Theatre of Lincoln Center in New York City. Housed in the aisle-less 2,700-seat New York State Theatre, the Music Theatre is the branch of Lincoln Center devoted to the production of musical plays, operettas and musical comedies. Dick Rodgers himself is the president and producing director of the Center's Music Theatre, a fact that should augur well for productions of the future. Said fact doesn't seem to make much difference in the case of this revival of "The King and I" that RCA has recorded with the Music Theatre original cast. Not even Rodgers can surmount the fact that Rise Stevens and Darren McGavin are just not in the same league with Gertrude Lawrence and Yul Brynner as Anna Leonowens and the King of Siam. The producers of the record appear to have had misgivings about the un-Oriental accent of television's Mr. McGavin ("Riverboat" and "Mike Hammer"). He is given considerably less to do here than Yul Brynner did in the famous Decca recording of the original Broadway production. Lee Venora, Patricia Neway and Frank Porretta offer substantial help in the supporting roles but they don't provide sufficient reason to place this album on the same footing with the two "King and I" cast releases (stage and soundtrack) already in the catalog. This release does offer something not found in the earlier recordings—the Oriental version of "Uncle Tom's Cabin" as told by Lee Venora and the chorus in the ballet *The Small House of Uncle Thomas*. The sound of the album, recorded in Brooklyn's Hotel St. George is below recent Dynagroove standards. Manhattan would appear to have better facilities for RCA's show albums.

Morton Gould: Latin, Lush and Lovely

RCA Victor LSC 2752

This latest in a long series of Morton Gould releases offers a fresh tribute to his very high standards of music making. Some of the tunes Gould plays here have been known to sound pretty mediocre in other hands. By means of clever and subtle percussion located throughout the width of the orchestra, the arrangements find new uses for stereo without a trace of ping-pong effect. You may even find yourself listening with interest to an uncomplicated item such as *Yellow Bird*. The Latin tunes (Desafinado, Amor, Adios, etc.) fare extremely well under this treatment. Gould's famous classic, *Tropical*, heard in brand new sound, is almost worth the price of the album alone.

Eddie Dunstedter: Pipe Organ Favorites

Capitol ST 2068

Any month that sees the release of a fine pipe organ record is considered a good month in my book. It's a distinct pleasure to greet this latest disc by Eddie Dunstedter. Capitol Records has always tried to give its leading organist releases that were free of gimmicked sound. Dunstedter's stereo records, dating back to 1960, provide a good picture of progress in capturing the challenging sound of a pipe organ. The pattern of mike pickup is reasonably uniform throughout the series, allowing one to assess the gradual improvements in the stereo disc cutting process. Dunstedter takes full advantage of Capitol's luxuriant sound. From the clearly defined pedal notes at the low end through the luminous colors of the organ's midrange to the crystalline highs, this is a recording of natural, unforced beauty. Four of the selections have the added appeal of supplementary instruments played by John Gray and Milt Holland. Between them, Gray and Holland weave guitar, mandolin, vibes, marimba and percussion into the rich sonic patterns of the Robert Morton four-manual, 24-rank theatre organ now located in the Lorin Whitney Studio, Glendale, California. Deep-voiced drums embellish the old favorite *I Don't Know Why* while vibes and marimba do the same for *Charade*. It must be more than mere coincidence that so many ex-theatre pipe organs have found their way to California, an area where good audio components have always been held in high respect.

Stan Kenton Presents Jean Turner

Capitol ST 2051

I've taken the liberty of boiling down the title of this album in order to get it within the confines of a normal heading. Capitol, with no regard for problems of space, and even less for the consumer's sense of the ridiculous, has given this album the following title: "From the Creative World of Stan Kenton Comes the Exciting New Voice of Jean Turner." If this trend keeps up, the titles in a record review column are going to read like one long plug for a series of circus acts. Oddly enough, puffery of this kind is really unnecessary in the case of this release because the album does have a lot to offer the Kenton fan. Jean Turner turns out to be just the sort of singer this band has needed for quite a while. It seems to me that the band's most famous vocalists such as Anita O'Day and June Christy were not able to dazzle the listener with quite the versatility that Miss Turner displays in this debut album. Some of the Turner charm may be a product of her native San Francisco as she glides through the most complicated of the slick arrangements provided by Stan Kenton, Lennie Niehaus and Bill Holman. A working band such as this one enjoys a great advantage when it comes to coordinating a vocal and instrumental line. Unlike the typical make-up group backing a vocalist at a recording session after a few hours of rehearsal, the Kenton crew had a ten month period to work with Jean Turner on the Holman and Niehaus arrangements while on tour fulfilling concert and dance dates.

Golden Hits of Hawaii

Warner Bros. WS 1549

Let's Hula

Warner Bros. WS 1550

In these two stereo records the Warner label provides a reasonably complete course in the Hawaiian style of relaxation. Beginners will find the first album the logical entry point for the uniquely carefree world of one of our nicer new states. The basic songs associated with the islands are presented by a six-man group called the Outriggers, preoccupied here with guitars, vibes, Hammond organ and exotic percussion.

The second album goes a step beyond the Outrigger's—and most other Island releases. A mixed chorus, recorded in Hawaii, sings native songs in what is claimed to be the first album recorded specifically for instruction in the hula. Warners evidently mean business because they have a hula instruction booklet packaged in the album. The clarity of sound in both records is particularly useful in the hula-learning disc since the dance is supposed to be performed in time with the words as well as the music. These records combine refreshment with relaxation in their sound.

Sammy Spear Orchestra: A Little Traveling Music

London Tape LPM 70068

This reel should serve to reassure other baton wavers that an orchestra leader can attain star billing after years spent in the shadow of a show business phenomenon. Sammy Spear, the Musical Director of the Jackie Gleason Show for many seasons, seems to enjoy this opportunity to come out from behind the Roman candle personality of one of the nation's leading clowns and make his own way on records and tapes. It is a bit of a surprise to find Spear occupying the London label in this tape release in view of Jackie Gleason's long association with Capitol Records. As it turns out, the unbuttoned Spear style of music making is just the sort of material that has not been too plentiful on the British label. Like Gleason, Sammy Spear is a native of the genial borough of Brooklyn. His musical credits include sojourns in the trumpet sections of the orchestras of Benny Goodman, Morton Gould and Percy Faith. His radio and recording work as a trumpeter encompassed appearances with Andre Kostelanetz and Arturo Toscanini. Reflecting the specific travels Spear has completed with Gleason, this album uses the television show's *That's a Plenty* as a bright introduction to far-from-lethargic arrangement of *Chicago, St. Louis Blues,* and *Back Bay Shuffle*.

Skitch Henderson: Hollywood Award Winners

Columbia CS 8826

Nancy Wilson: Hollywood—My Way

Capitol ST 1934

On the evidence of these two releases, record producers show no sign of running out of award-winning Hollywood tunes. It seems to be a deep-rooted tradition in the film capitol to hand out song awards in lean years as well as creative ones. Some idea of the size of the backlog of award winners currently available may be gained from the fact that only two tunes overlap in these widely different albums. In the Columbia release Skitch Henderson presides at the piano while his orchestra accompanies him in finely-shaded versions of Hollywood's Best. Henderson's solid talent needs no introduction at this late date despite the fact that this is his first disc in the movie catalog devoted solely to music. The thoroughly adult approach to the piano has had far more influence in the record field than Henderson's meager representation in the LP catalog would indicate. (Victor and Decca, following a pattern all too prevalent in the industry, have discontinued all the Henderson albums made for them before he signed up with Columbia.) The orchestra's most recent miking is ultra-close and scrupulously clean. Piano and percussion, usually the main stumbling blocks in the production of truly crisp sound, are models of their kind here. If you've steered clear of Hollywood fare on the grounds of ho-hum performance in the typical release, give Henderson a whirl. There's real class in both the playing and the sound.

Nancy Wilson has made enormous strides in popularity. As happens all too frequently, with each succeeding release, her style has become mannered to such a degree that I now find ideal listening satisfaction only in her earlier albums. Now that Miss Wilson is treading on the heels of Ella Fitzgerald, it would be asking too much to expect a reversion to an earlier style of delivery. In my book, her's was one of the freshest voices in the business as heard on Capitol albums ST 1319 and ST 1440. If, on the other hand, you prefer your Academy Award winners sung in a supercharged manner, here's your chance to get them in natural, clean-cut sound.

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The Fisher

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Toros and Toreros

Capitol ST 10350

For many years this label has explored the musical byways of the globe in its exhaustive "Capitol of the World" series. In earlier days the task was simpler than it is now because mono was more easily handled by the recording crews of the individual countries involved. This record from Mexico indicates that distortion-free stereo is by no means a one hundred percent certainty in that part of the hemisphere. But for the quality of the sound, definitely on the sour side, this release would have filled an interesting niche among the recordings we have of authentic band music of the bull ring. La Banda de Genaro Nunez is heard in a program of comparatively recent pasodobles written in honor of contemporary bullfighters such as Paco Camino, Capetillo and Del Olivar. This interesting project comes a cropper, unfortunately, because the sound simply isn't up to what we now expect of a ranking label such as Capitol.

Glenn Miller on the Air

RCA Victor LSP 6101

The excavation of old Glenn Miller discs still goes on. This three-record album contains a slew of material recorded off the air. Some of the forty selections go so far back in time only a few listeners will believe that Miller once played such gems as *Pin Ball Paul, Papa Niccolini* and *The Gentleman Needs a Shave*. All this took place back in the late Thirties and early Forties while the band was filling a succesion of dates at the Paradise Restaurant, The Cafe Rouge, Meadowbrook and Glen Island Casino. The indifferent frequency range of the discs kills what little aural difference were once discernible in the original broadcasts.

The Very Best of David Rose

M-G-M SE 4155

With thirty albums in the current LP catalog, David Rose can hardly be considered a stranger in any home where a better grade of popular music is enjoyed. Of these albums, (a few on the Kapp label, the rest on MGM) I would immediately pick this release as the best stereo representation of the long famous talents of David Rose in both the composing and conducting departments. Considered in the light of Rose's musical output over the years, this release comes close to being the cream of the crop. Hardbitten record buyers are apt to suspect (sometimes with ample reason) that a release that is a good offering in terms of performance and musical content is remiss in the sound department. Such is not the case in this recording. The choice of hall location for this particular session makes up for the compression present in the re-recording process that is part of a 21-channel undertaking. Val Valentin, director of engineering at MGM, recorded this fifty-piece orchestra on the main floor of the Palladium Ballroom in Hollywood. With plenty of room for each section of the orchestra, the familiar Rose classics (still tops in their class) get a chance to bloom anew. *Our Waltz, Holiday for Strings, Deserted City* and *Dance of the Spanish Onion* have done their share in building the reputations of Morton Gould and Andre Kostelanetz along with that of their creator. They've never sounded better in this definitive treatment by the composer. Several David Rose novelties of smaller fame should get a lift as a result of this attractive album. His *Holiday* series ,for example, is more extensive than many listeners realize. Anyone who has ever struggled with the casual action of a smooth-running trombone will enjoy the precision of the Rose trombone section in the composition, *Holiday for Trombones*. Equal examples of taste and polish are to be found throughout the rest of the album. A careful reading of the credits on the back of the album will reveal a wrinkle you don't see too often. Along with the names of the producer, engineer and photographer of the cover is to be found the name of James B. Lansing as exclusive supplier of the playback speakers used by MGM in this recording session. AE

Until another stereo tape recorder matches all the following features, the Ampex 2000 will set the standard in stereo tape recorders. Ask anyone who knows.

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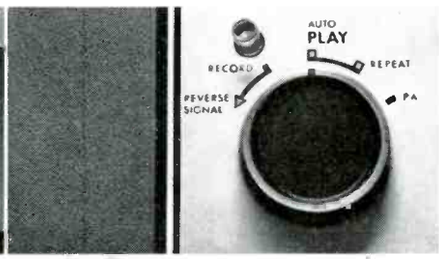

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Frequency response at 7½ ips:
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Wow & Flutter at 7½ ips:
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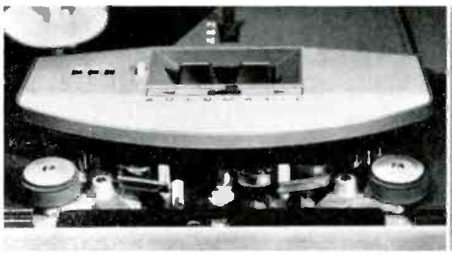
guaranteed minimum: 1/8 of 1% (.0012)

Guaranteed specifications. And only Ampex can dare do it. Reasons: only the best engineering, quality control, and materials (plus the Ampex name) go into every Ampex tape recorder.



Double Capstans. Provide constant tape tension resulting in fidelity at 3¾ crowding that of 7½ ips! Plus—eliminates the need of pressure pads. Benefit: no excess wear of the heads!

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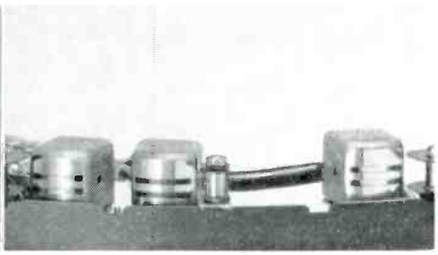

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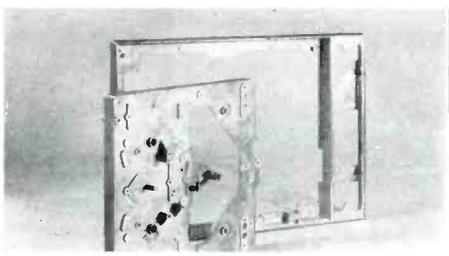

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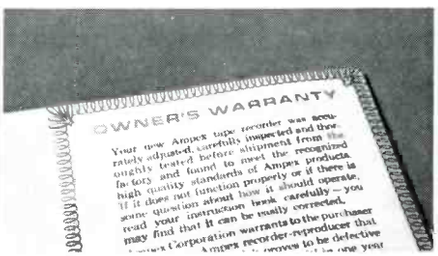

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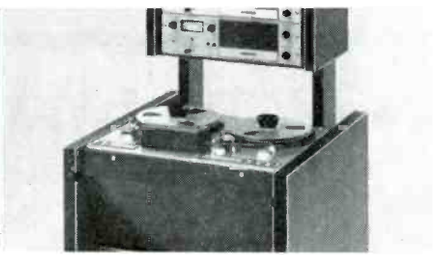

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EDITOR'S REVIEW

THE PACE QUICKENS

The evidence of the recently-concluded High Fidelity Show in San Francisco, and our preview of the New York Show this month, conclusively demonstrates the quickening pace of the trend towards solid-state devices. Last year the major portion of most major lines was tube, with enough transistor units to provide a solid-state "veneer." This year there are at least equal numbers of tube and transistor units, and some lines are totally solid-state. Obviously, by next year we will witness a reverse situation; tube units will be in the minority.

Is there a technical reason for this increased production of solid-state equipment?

Partially.

It seems that the transistor manufacturers have finally come to grips with a characteristic of transistors which has caused much grief in the past: secondary breakdown. It was this characteristic (not alone of course, but a major factor) which caused so many unexpected failures in the past. Now, although there is still some ambiguity as to its causes, the transistor manufacturer can define the area of operation wherein the transistor is safe. The circuit designers at last can design circuits and be assured that the devices are safe enough within given ratings.

Another catalyst was the reduction of cost of silicon devices. Silicon transistors are more rugged than germanium transistors, especially when high power is required. Unfortunately, up until last year, a silicon device cost five-to-ten times as much as an equivalent (power) germanium. Of course this placed it well beyond the realm of commercial possibility. Can you imagine the price of an amplifier wherein the output transistors alone cost the manufacturer about $100?

Last year the price of silicon transistors was reduced so that the ratio is now perhaps two-to-one or less. Certainly a reasonable price to pay for extra ruggedness. (By the way, it should not be assumed that silicon devices necessarily perform better than germanium devices just because they are more rugged. Performance depends on a variety of characteristics which vary from one transistor type to another.)

One of the major catalysts for the quickening pace is not at all technical in the sense of new discovery; it is the increasing sureness of the engineers in designing with transistors. It is certainly to be expected that a new technology would take a certain amount of time to be absorbed, and transistors are a new technology as compared with tubes. An example of this was the almost universal use of tubes in the first multiplex adapters, and now they are almost universally solid-state; in the rush to get multiplex adapters into production, engineers naturally used devices with which they were more familiar.

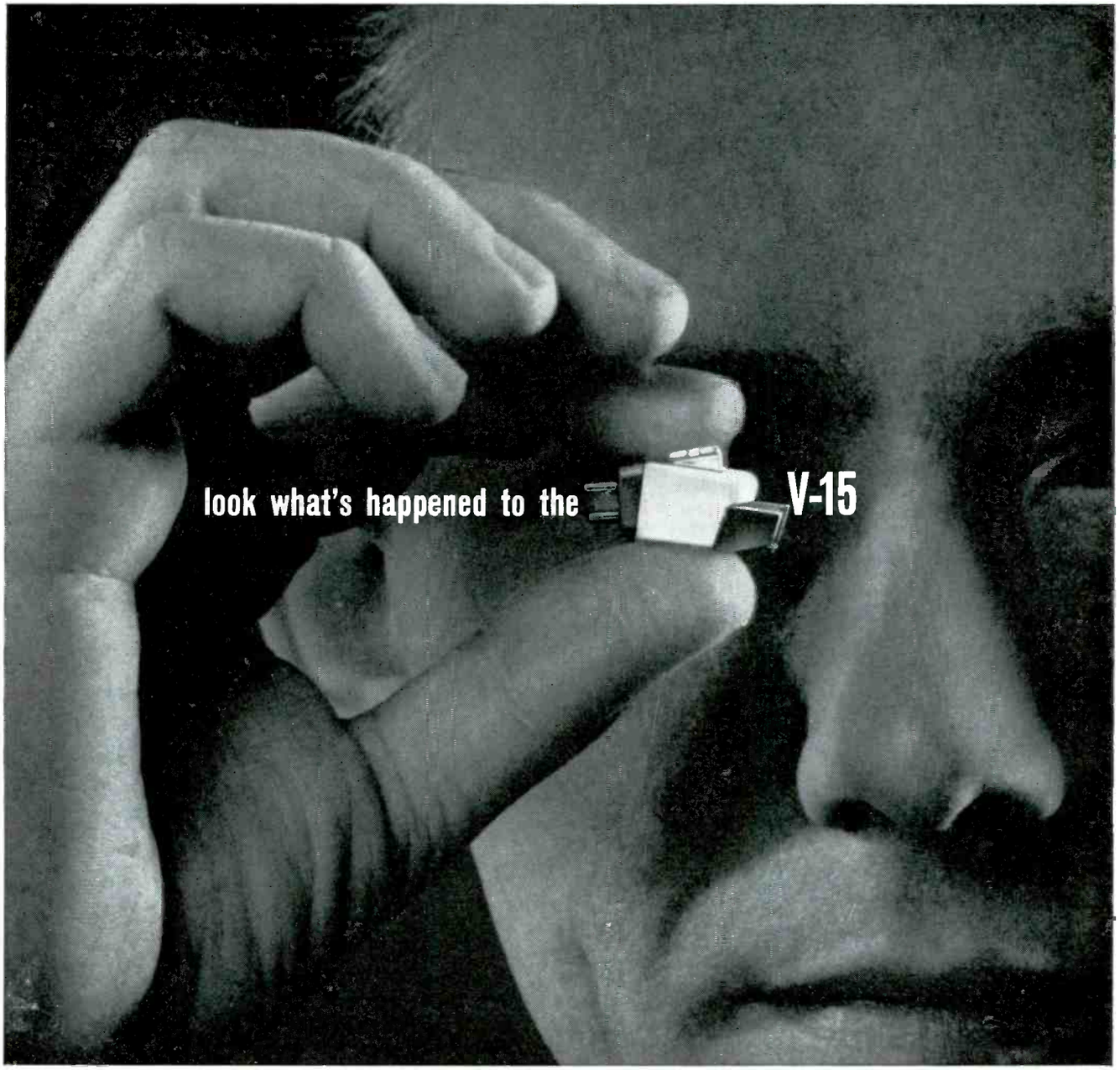
Now that the trend towards transistors is clearly established, we can expect designs to become increasingly sophisticated as engineers discover those "little tricks" which come only with experience. Also we can expect improved transistors at much lower prices. An exciting period of discovery is in store for us.

Raymond V. Pepe

As announced but briefly in our September issue—because of the time we received the sad news—Raymond V. Pepe died in Los Angeles on August 15 following a heart attack. Chairman of the Board of the Institute of High Fidelity, Inc. since May of this year, he had previously served two consecutive two-year terms as President of the Institute.

Born in New York City on February 9, 1912, he went from Columbia University to the comptroller's office of New York City under Mayor LaGuardia. Mr. Pepe was associated with TWA before World War II, served as a major in the U. S. Army, and after the war occupied various positions in Southern California industry, including that of general manager of Timm Aircraft Corp. He joined James B. Lansing Sound, Inc., in October, 1955, where he served as director of the company's worldwide marketing activities until his death.

He is survived by his wife Karla and daughter Lori, 2½. Ray was tireless in his service to the industry and to the Institute, continually beyond the call of duty. The entire audio industry—and specifically those of us who were privileged to work closely with him in Institute activities—will find it difficult to forget his personal charm and his diplomacy in dealing with the problems which have confronted the industry during his years of tenure. We shall all miss him.



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Audio power *should* be one of your major criteria of amplifier performance. The important thing is to use the same yardstick of comparison.

Among responsible component manufacturers, the commonly-accepted expression of audio power today is "MUSIC POWER"—the amplifier's output capability across the full spectrum of orchestral sound.

If you simply like to play with bigger numbers, multiply MUSIC POWER by two (the way some manufacturers do) and you get "PEAK POWER". It's exactly the same rating but it *looks* twice as powerful.

But the really important measurement is "CONTINUOUS SINE-WAVE POWER" with both channels operating simultaneously. This is the *meaningful* measurement, used in laboratory work. It separates the wheat from the chaff.

Sherwood's new S-9000 delivers 150 watts of MUSIC POWER . . . 300 watts of PEAK POWER . . . and 100 watts of CONTINUOUS SINE-WAVE POWER at less than ½% harmonic distortion. (At normal levels, distortion never exceeds 0.15%).

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An Electronic Organ Design

WINTHROP S. PIKE

A pipe organ enthusiast's design for an electronic organ which may well outperform many pipe organs. His thesis is that 2–5 ranks of oscillators would provide organs of good-to-excellent characteristics.

IN TWO PARTS—PART ONE

IN A RECENT article in this magazine ("Organs and Organ Music," October and November, 1963) I attempted to show that certain definite requirements must be met in an organ if one is to be able to play the classic literature of the instrument upon it. These requirements were spelled out in some detail. Being human, I found it quite impossible to avoid letting my bias (toward the pipe organ) show. Several readers took me to task for my critical attitude toward electronic organs. In the light of this, it is obviously incumbent upon me to come forward with some concrete suggestions for their improvement. This article does so, presenting a design which, I believe, will be satisfying to play and capable of doing justice to most of the literature. Though I must emphasize that I haven't actually built this organ, it is a "paper" design, there is nothing new or untried in it (no new principals). To my knowledge, however, there is no commercial instrument quite like it in all respects.

It seems clear at the outset that the major problem is economic rather than technical. Although many pipe organists would not agree with me, given ample funds, I believe that it is perfectly possible to build an electronic organ which is virtually the equivalent of a fine pipe organ. One has only (?) to design a good pipe organ, then set about substituting a suitable electronic tone generator for each pipe therein. Due attention must be paid to both the transient and the steady state regimes of each pipe's speech for success. For many classes of tone satisfactory methods of simulation have been found. The result will not be inexpensive. Several such organs have been built by at least one of our leading manufacturers (Allen) and they have been universally acclaimed. See, for example, page 356 of the current (7th) edition of Barnes's "The Contemporary American Organ."

Most of us, however, both have less grandiose intentions and appreciably less ample purses. A more modest instrument would suffice for home use. The art, then, lies in designing an instrument which, while remaining capable of handling the demands of the literature, will:

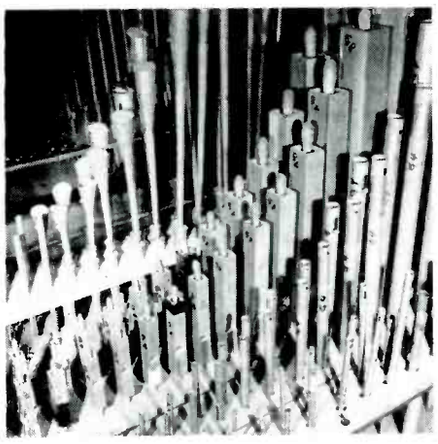

Fig. 1. The Great Division of a Small Pipe Organ.

1. Use a minimum of costly tone generators.
2. Exploit as fully as possible certain practices possible only in an electronic organ.

Let us examine some of the possibilities.

Broadly speaking, there are two general approaches to the problem. The first is to use continuously running tone generators, switching their audio signal outputs into the input of the tone forming and reproducing systems by means of the playing key contacts. The Hammond, Baldwin and Schober organs and some of the recent Conn instruments are examples of this technique. The second method is to actually start and stop the tone generators (oscillators) with the playing keys. The Allen, Artisan, Rodgers and early Conn organs use this method. What are the relative merits of each?

Continuously running generators have a number of advantages. First, there is a wide choice of available generator types, both electro-mechanical and all electronic. In the latter, frequency division may be used, reducing the tuning problem to a mere 12 adjustments for the entire organ. As all pitches produced by the organ are continuously available, they may be collected by suitable keyboard bus bars each of which operates at a different pitch level (8 ft., 4 ft., 2 ft., and so on). By applying "formant" filters to the outputs of these bus bars it is readily possible to get, say, 8 ft. tone of one timbre and 4 ft. tone of some other timbre simultaneously from only one set of generators. The economic advantages of this are tremendous. Ninety-seven generators will cover the entire range of needed pitches, from the bottom note of a 16-ft. stop to the top note of a 2 ft.

On the debit side, three criticisms may be levelled at this approach. First, the ensemble (chorus effect) of all the commercial instruments using this principle known to me is inferior to that of even the smallest instruments using keyed oscillators. This remains true despite the employment of a variety of extraordinarily ingenious techniques for improving the ensemble which have been invented by some of the most brilliant men in the industry.

Second, most well-voiced ranks of pipes are fairly uniform in loudness and timbre over the normal, five octave, range of the manuals. Any self respecting pipe organ Trumpet stop, for example, will have much the same power and harmonic structure from top to bottom. This isn't always true of orchestral instruments, but it is true of well-voiced ranks of organ pipes. Such uniformity of loudness and timbre is difficult, if not impossible, to obtain in the frequency divider type of organ. The Trumpet stop, for example, is usually made with a single resonant circuit attempting to cover the entire range. Similarly, the resistance-capacitance high-pass and low-pass filters used for string and flute tone offer like problems. It is indeed a tribute to the skill of the designers of these organs that they are as good as they are.

But an even stickier wicket is the matter of realistic attack control. I feel that this is most important, particularly when

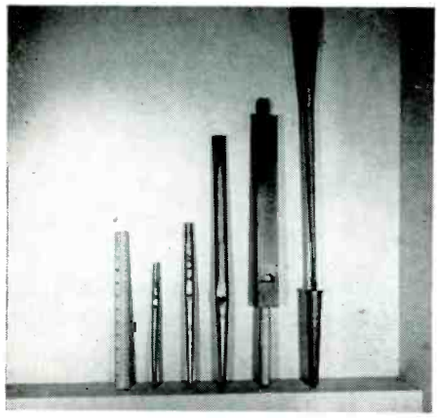

Fig. 2. The five middle C pipes of the Great. From left to right they are: (A) Quinte, 1-1/3-ft.; (B) Fifteenth, 2-ft.; (C) Principal, 4-ft.; (D) Gedact, 8-ft.; and (E) Oboe, 8-ft.

the organ is to be used in a non-reverberant home environment. Organ pipes do not have an instantaneous attack. *Figure* 1 shows some of the pipes of the Great division of my organ. There are five stops (i.e. five ranks of pipes) on the Great of this organ. All five of the middle C pipes are shown in *Fig.* 2. The middle C of the 8 ft. Gedact, shown at D, takes about 15 cycles to build up to full amplitude after wind is admitted to it by the electro-pneumatic slider and pallet chest upon which it is planted. Further, when the wind is cut off, it takes about the same time to stop sounding. Since the frequency of this pipe is roughly 260 cps, this corresponds to an attack time of 15/260 second or a little less than 60 millisecond.

The middle C of the 4 ft. Principal (2C) requires about the same number of cycles to start. However, since its frequency is twice that of the Gedact (an octave higher) it reaches full amplitude in half the time, 30 milliseconds. The 2 ft. Fifteenth (2B) takes only 15 milliseconds. When all three of these stops are drawn and middle C is played, the result is complex. The pipes actually come on one after another starting with the Fifteenth. As all pipe organs have behaved in precisely this fashion for centuries it seems perfectly natural to our ears and one must not too hastily label the phenomenon a "defect." How are we to simulate it with continuously running generators?

It is difficult to find an economical method for doing so. Whatever circuit one uses must be repeated for each playing key of the keyboard(s) at each different pitch playable on that key. Thus a 61-note manual with three pitches (8′, 4′ and 2′) will require no less than 183 attack control devices if several tone colors are to be derived at each pitch. There's room for invention here.

One manufacturer (Baldwin) has successfully used variable resistance key contacts. Although these do mitigate the abrupt attacks which this organ would otherwise produce, the attack timing relationships existing in real ranks of pipes are not preserved. Another manufacturer (Conn) has recently applied a novel transistor keyer to the production of certain voices. This may well be a good solution, though I have not yet had an opportunity to hear this organ in action.

With individually keyed oscillators the problem does not exist. By arranging the playing keys to apply plate (or collector) voltage to the oscillators through suitably proportioned resistance-capacitance filters, any desired attack time can be produced and the attack times of a rank of oscillators can be made approximately inversely proportional to frequency as is the case in a rank of pipes. As an added bonus, the key contacts are no longer in the audio signal paths. Contact and wiring capacitances cannot create a crosstalk problem and exotic contact materials are not required.

A price must be paid, however, and it is not trivial. A major constraint is immediately placed on the design. It is this. One cannot readily play a rank of keyed oscillators with one timbre at one pitch level and another timbre at some other pitch level simultaneously. Thus such a simple and useful combination as an 8 ft. Flute plus a 4 ft. Principal will require two ranks of oscillators. If, however, one wants an 8 ft. Flute plus an 8 ft. Principal (both stops the same pitch) this can be approximated with a single rank by means of appropriate tone changing circuits. Many examples of these can be found in the literature.[1,2,3,4,5] Despite this restriction, which will invariably tend to make an individual oscillator organ more expensive, the advantages in tonal realism seem to me overwhelmingly in favor of using this approach.

Now each oscillator of our organ is going to cost close to $5.00. Some typical circuits are shown in *Fig.* 3. Note that

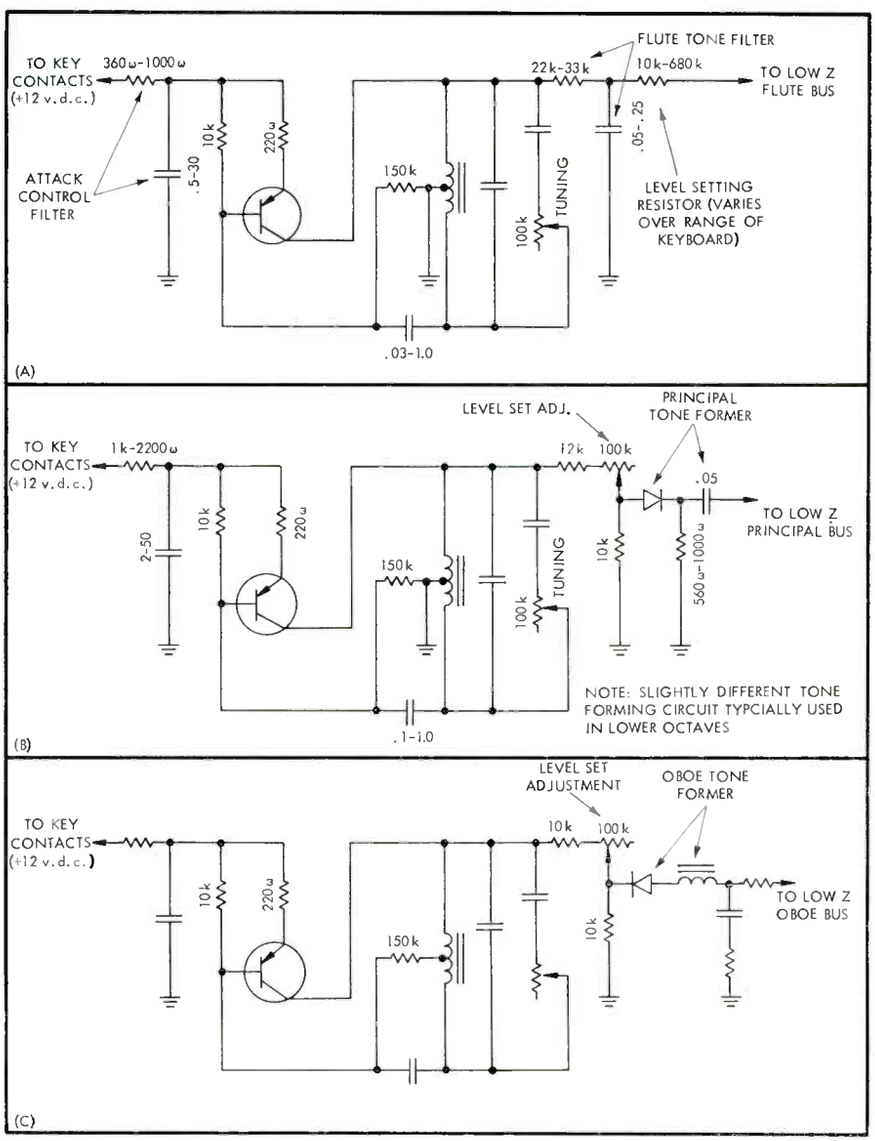

Fig. 3. Some typical oscillator circuits: (A) Flute oscillator, 32 cps to 8000 cps; (B) Principal oscillator, 65 cps to 4000 cps; (C) Oboe oscillator.

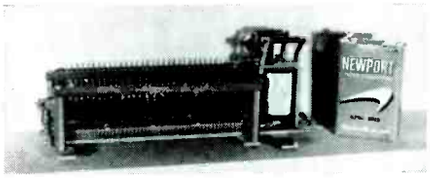

Fig. 4. A pair of 32-contact "switches" such as are used in the Pedal division.

even the simplest circuit, the Flute oscillator of (A), requires one coil, 5 capacitors, 6 resistors, one potentiometer, and a transistor. For more complex tones more components are added as in (B) and (C). One can't skimp on quality either, unless one is willing to put up with a frustrating amount of unreliability or tuning instability. For one manufacturer this means Permalloy toroidal inductors and Mylar-film capacitors. The $64 question, then, is just how many expensive oscillators does one need?

For at least 50 years, the so called "unit" principle has been used to reduce the number of tone sources in both pipe and electronic organs. Most of yesterday's theatre organs, for example, were unit organs and paradoxically many a "giant $50,000 Wurlitzer" had fewer actual pipes than its less pretentious cousin in the little church around the corner. Curiously enough, with modern electronic circuitry the possibility exists of building a better unit organ than one can with pipes, although the technique for doing so, which I shall propose now, has not been widely exploited. This comes about because of the fact that transistor oscillators can be made to have virtually constant frequency over a wide range of supply voltages. This is totally unlike organ pipes in which relatively small changes of wind pressure will affect both the pitch and speech very markedly. Let us explore this possibility, first digressing long enough to make sure that both the "unit" principle and its shortcomings are fully understood.

Consideration of a concrete example is the easiest way to come to grips with this rather confusing subject. Let us suppose that one wants both 8 ft. and 4 ft. Flute stops on a particular manual of an organ. The best and oldest way of doing this is with two separate ranks of pipes. One 61-pipe rank is used for the 8 ft. Flute and a second 61-pipe rank for the 4 ft., making a total of 122 pipes. This is what would be found in a so called "straight" pipe organ, such as that shown in *Fig.* 1. The great advantage of this arrangement is that one has complete freedom in adjusting the timbres and dynamic levels of the two ranks to produce the best result. One rank might be a stopped flute and the other open, for example. Usually the 4 ft. rank will be softer than the 8 ft. Also, both ranks will be nearly uniformly loud throughout their ranges or may, in some cases, be voiced so as to grow almost imperceptibly louder as one proceeds from the bass upward into the treble. It takes a lot of pipes. At about the time that electric actions were introduced into pipe organs, it was realized that the flexibility offered by such actions made is possible to do something about this. An approximation of the same result can be made by using only one extended rank of 73 pipes; a "unit" rank. One simply takes the 8-ft. rank, adds an extra octave of 12 pipes on the top end and puts in some additional switching. When the 8-ft. stop is drawn on the console, the 61 playing keys are connected to the lowest 61 pipes by means of a 61-contact relay. When the 4-ft. stop is drawn, a second relay connects the keys an octave higher, using the top 61 pipes. Obviously the principle can be extended as far as one likes. In pipe organ parlance such relays are called switches, the term relay, for some perverse reason, having a quite different meaning. A pair of typical 32-note "switches" such as might be used in the pedal division of an organ, is shown in *Fig.* 4. In some organs the switches are an integral part of the key mechanism.

While in the example cited, this would save no less than 49 expensive pipes, the results in a pipe organ are never as good as if individual ranks had been used. For one thing, both stops, since they come from the same rank, must have the same timbre. More serious, the normal loudness balance which would exist between 8-ft, and 4-ft. ranks is upset. If the rank is used at only these two pitches this isn't particularly serious, but if it is further extended to higher pitches the result will be unbearably shrill. The usual corrective expedient is to roll off the loudness in the treble end of the rank. While the required rolloff varies with the timbre of the rank, the acoustical environment of the organ, and the tastes of the voicer, it is always considerable. *Figure* 5 shows the measured amplitudes of two unit ranks of oscillators in a good commercial electronic organ. Note the curve for the unit Flute, shown by the solid line. Aside from some seemingly large (but surprisingly innocuous) ups and downs caused, according to the manufacturer, by component tolerances, there is a general downward trend in amplitude as one goes up in frequency. The top note of this rank is intentionally about 30 db down from the bottom one.

Apparently the ear is more critical of Principal tone, with its greater harmonic content. The dashed line depicts the response of the Principal rank of the same organ. The manufacturer has found it advantageous to equip each oscillator of this rank with an individual output control. Note the remarkable uniformity up to about note 61, followed by the gradual roll off to the top note. In this rank the top note is only down about 17 db from the bottom note but it is a short rank, having only 72 oscillators.

This treble rolloff is not a good solution, though it is the only one possible in a unit pipe organ. First, in playing ordinary four part harmony (such as a simple hymn) the top note tends to be the weakest. Secondly, there seems to be something aesthetically wrong in having a melody grow weaker as it ascends in pitch, as must inevitably happen in the usual unit organ. As one disenchanted writer[6] has put it, "None of the great organs of the world are unit organs."

Fortunately, this dilemna can be solved in an electronic organ, removing these objections to the use of unit ranks of

(*Continued on page 116*)

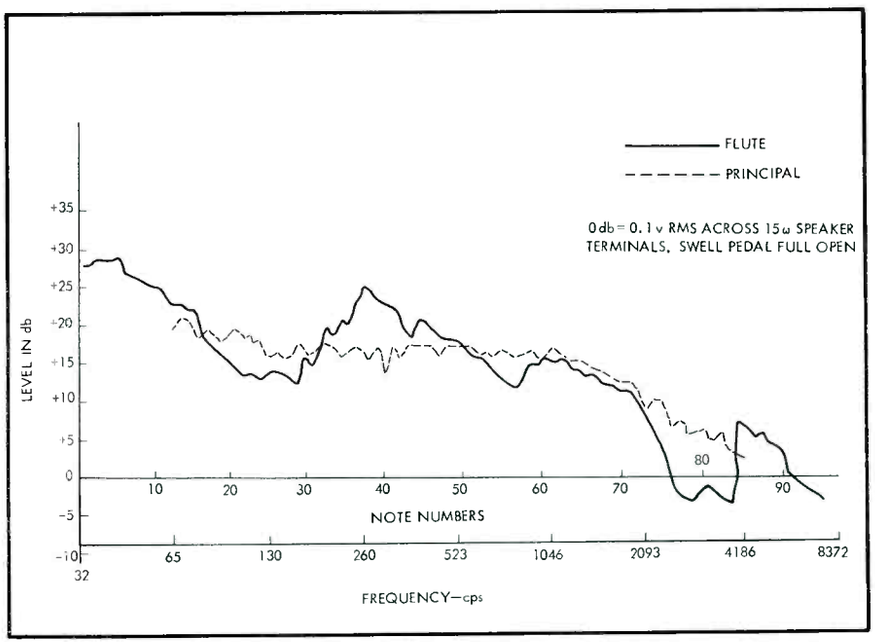

Fig. 5. Measured levels of unit ranks in a commercial electronic organ.

All Silicon Tape Playback Preamps and Recording Circuit

DR. JOHN ABAJIAN, JR.* AND DWIGHT V. JONES‡

Frequency response at 1⅞ ips of ± 2 db from 40 cps to 15 kc, with an over-all system noise figure of 53 db at less than 1% total harmonic distortion.

This article presents an economical stereo tape recording circuit and playback preamp using 22 silicon transistors and featuring multi-position equalization networks for flexibility. The record amplifier can accept a variety of inputs, either high or low level, and from either a tape head or high-impedance microphone. Mixing of high-level inputs with low-level channels is adjustable, and a VU-meter circuit is included. Precautions have been taken to maintain high signal-to-noise ratios and low distortion. The front and back view of this system are shown in *Fig.* 1. The tape transport is a pre-production Viking model 230.

In May of 1960[1] CBS laboratories described a tape cartridge system utilizing a new developmental low-noise high-frequency tape, produced by Minnesota Mining Company together with a special "playback only" head with an ultra-narrow gap of 50 microinches. The new tape system was compared with an original 15 ips tape master. For this successful demonstration, some sections of music were alternately transcribed from the original master and the 1⅞ ips narrow track version of the 15 ips half-track tape. A similar system was made available commercially by the Revere Division of 3M which compares favorably with many 7½ ips reel-to-reel machines.

The system to be described is a solid-state design using a narrow gap head with a choice of the new or conventional tapes at 1⅞, 3¾, and 7½ ips. The solid-state design necessitated the selection of some of the newer low-impedance heads manufactured by the Nortronics Company. Nortronics has introduced a new quarter-track, medium-impedance (400 mh), hyperbolic "playback only" head, with a 0.00005-in. gap. This head is designated B2Q7F. The "record only" head is B2Q4R, which has an inductance of 60 mh and a 0.0005-in. gap for record only purposes.

These heads, combined with a solid-state circuit employing General Electric low-cost silicon planar transistors, gives rise to a tape system having excellent performance. The increasing popularity of FM-stereo broadcasting has increased the desire for serious stereo recording in the home. This new circuit can make a notable contribution.

The circuit to be described permits a choice of 7½, 3¾ and 1⅞-ips operation, together with a choice of conventional oxides, such as found on 3M-190, or the new, low-noise, high-frequency tape, 3M-202. Therefore, these circuits permit five different choices of pre-equalization record currents with their corresponding post-equalization playback curves, resulting in relatively flat response.

Because of the wide prevalence of recorded tapes with the NAB 7½-ips equalization, Ampex test tape 31321-04 was used to determine a flat playback response. The pre-equalization record curve, *Fig.* 5, needed with this playback response was then worked out to make the over-all response conform to a ± 2-db variation from the 1000-cps response. The rest of the record and playback response curves were then arbitrarily chosen with the best compromise for signal-to-noise ratio, distortion, dy-

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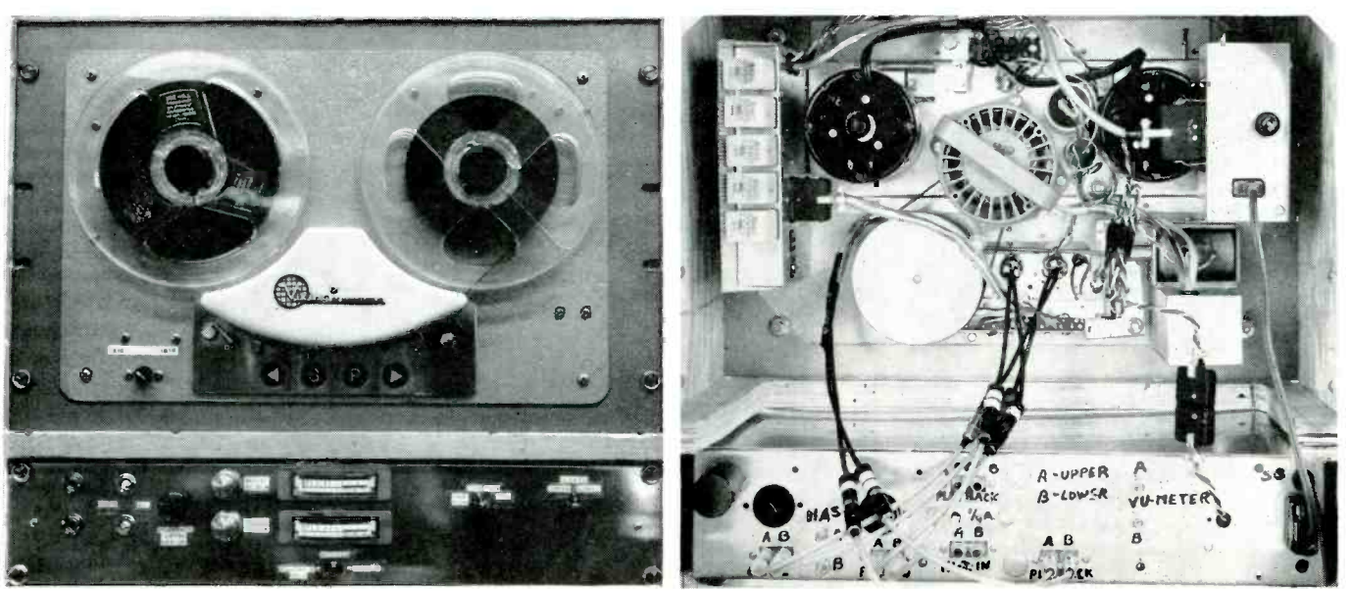

Fig. 1. Front (left) and rear (right) view of tape system.

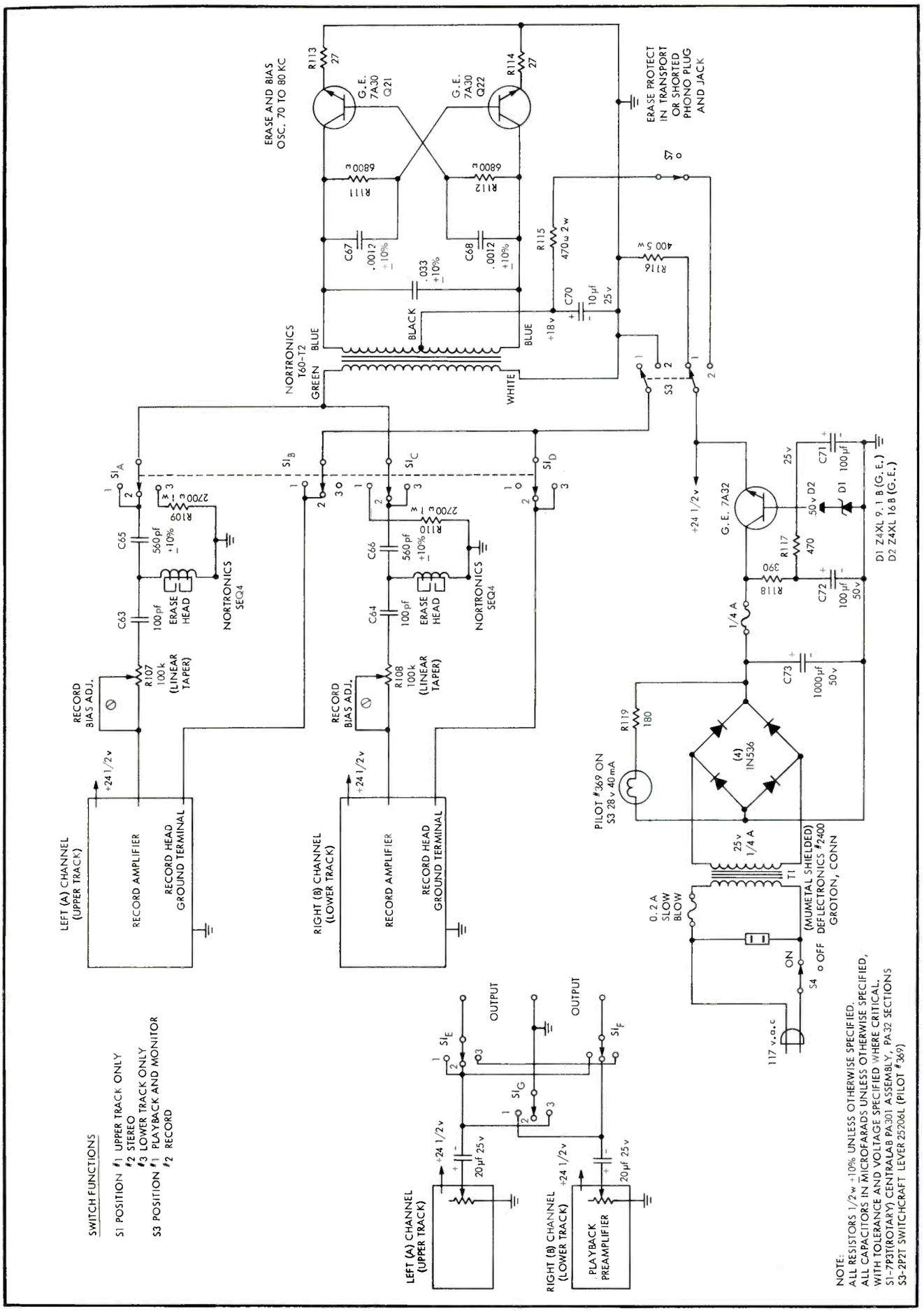

Fig. 2. Schematic of silicon transistor stereo tape recording circuit.

namic range, and frequency response. The best compromise seems to be the keynote in the design of any good tape system.

A brief review of the interdependence of frequency response, dynamic range, distortion, and signal-to-noise ratio would not be remiss. These important parameters are not only interdependent, but each in turn is very closely dependent on bias level and speed. Frequency response can be improved by using a reduced recording bias and by altering the record and playback equalization characteristic. If the above is optimum only for frequency response, the dynamic range will be limited. Therefore a good design will use the best compromise to achieve a satisfactory frequency response with the best dynamic range. The dynamic range decreases as the recording frequency is increased above 1000 cps, and is decreased even more as the tape speed decreases. The signal-to-noise ratio can be improved by recording at a higher level, but this often means increased distortion of the recorded signal.

The above design compromises resulted in a system with excellent performance as shown in *Fig.* 6.

Circuit Description

Figure 2 shows the stereo tape record playback system using generally available silicon transistors. A block diagram of the record amplifier portion is shown in *Fig.* 3 for clarity. Referring now to *Fig.* 4, we will examine the record amplifier in greater detail. The low-level preamp circuit of the record amplifier utilizes feedback components R_9 and C_7, or R_7 and C_5. The latter serve to provide NAB equalization for a 7½ ips tape head signal. The input impedance as seen by the microphone is 47k ohms, flat from 20 cps to 15 kc, and a low impedance microphone could be used with $R_9 = 330$k and $C_7 = 0.1\mu$f.

Mixing of microphone or tape head input with the high level input (perhaps from FM tuner) is controlled via the settings of R_{23} and R_{25}. The resultant record level is indicated by the VU meter driven by Q_9. (Note that prescribed voltage levels to give zero VU is presented at various points in the circuit.) The collector of Q_7, besides supplying signal to the VU driver, delivers the signal to the bass- and treble-boost filters comprised of C_{25} and R_{43}, the high-frequency boost network, and R_{47} and C_{27}, the low-frequency boost network. The signal-power level being diminished at the base of Q_{11} is re-amplified to maintain high signal-to-noise ratio. Now the signal is applied to the two-stage five-position pre-equalization network. The pre-equalization gain characteristic curve is shown in *Fig.* 5. The synthesis of the filter network is beyond the scope of this article. Basically this is a two-stage filter network with Q_{13} serving as a buffer amplifier between stages. The input response to Q_{13} is shaped with C_{37} and R_{65} giving bass boost and R_{63} and C_{35} giving treble boost. The gain of amplifier Q_{13} increases with frequency above 6.5 kc because C_{33} decreases collector-to-base feedback and also because of the emitter tuned circuit. The location of the peaks at the high frequency end of the pre-equalization curve of *Fig.* 5 is determined, in the main, by the resonant frequency of the L_1 series tuned circuit in the emitter.

Components L_3 and C_{41} are tuned to the recording bias frequency to block the bias oscillator signal from appearing at the collector of Q_{13}. The audio signal, however, is passed by the network L_3-C_{41}, and is summed with the bias current at the record head. Bias current can be measured as shown in *Fig.* 4 as a voltage drop across R_{79}.

Switch S_{2A} selects the record bias current for the different tapes and speeds. The tape erase and bias oscillator is shown in *Fig.* 2. It provides ample power to give a minimum of 60-db erasure of saturated tape (at 400 cps) with a stereo erase head. This is accomplished with at least 10 ma of 76 kc signal in the Nortronics SEQ4 erase head. The total power output of this oscillator is approximately 1½ watts with an efficiency of 60 per cent.

This erase signal increases the noise level only about 1 db on bulk erased tape. The balanced push-pull oscillator circuit has negligible d.c. or even harmonic distortion in the output waveform which is a requirement for minimum increase in tape noise during playback. The total harmonic distortion is less than 0.5 per cent.

The frequency of the oscillator circuit is set by the 0.033 μf capacitor in the resonant tank circuit. Since the efficiency of the erase head decreases above approximately 76 kc, this was chosen as the operating frequency for the oscillator. Also higher frequencies will be more difficult to handle with cable capacitance losses, circuit switching, and so on.

The 27-ohm resistors provide negative feedback which help to compensate for component variations in the circuit. The transistor interchangeability *versus* circuit performance is very good. Diffused silicon transistors are used because they offer the advantage of efficient operation with no external heat sink required. This silicon transistor is the General Electric 7A30 in the standard TO-5 package.

This circuit is a cross-coupled multivibrator with a tuned load. The erase head winding is coupled to the transformer tap with 560 pf, which series resonates with the erase head winding. Thus the load appears largely resistive on the transformer secondary winding. This permits switching a 2700-ohm resistor in place of the series-tuned erase-head load without changing the loading or the frequency of the oscillator. This permits erasing and recording on only one channel of the tape. The series resonant circuit of the erase head winding and the 560 pf capacitor has a low Q of about 1½; thus variations in either the L or the C will not alter appreciably the value of erase current in the head.

The playback preamp circuit in *Fig.* 4 provides an equalized output of about

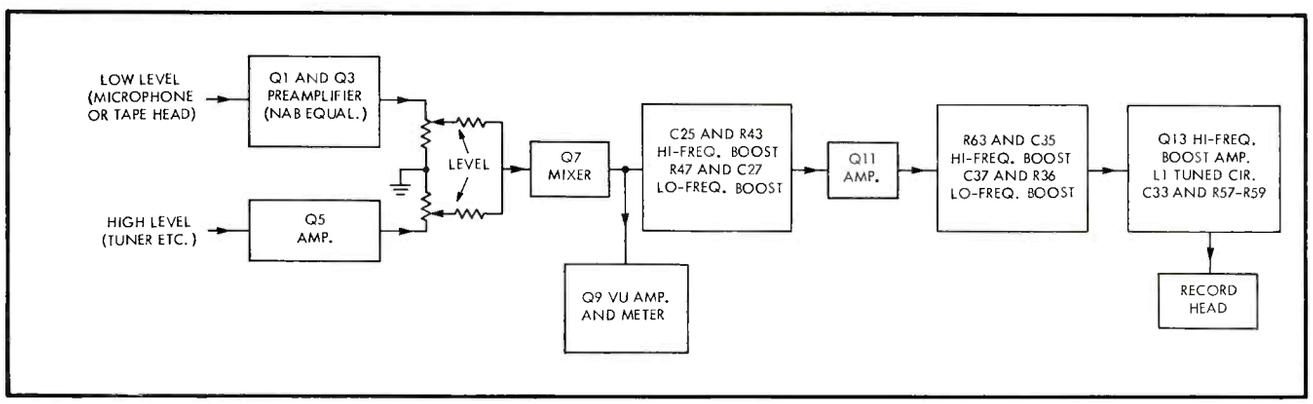

Fig. 3. Record amplifier.

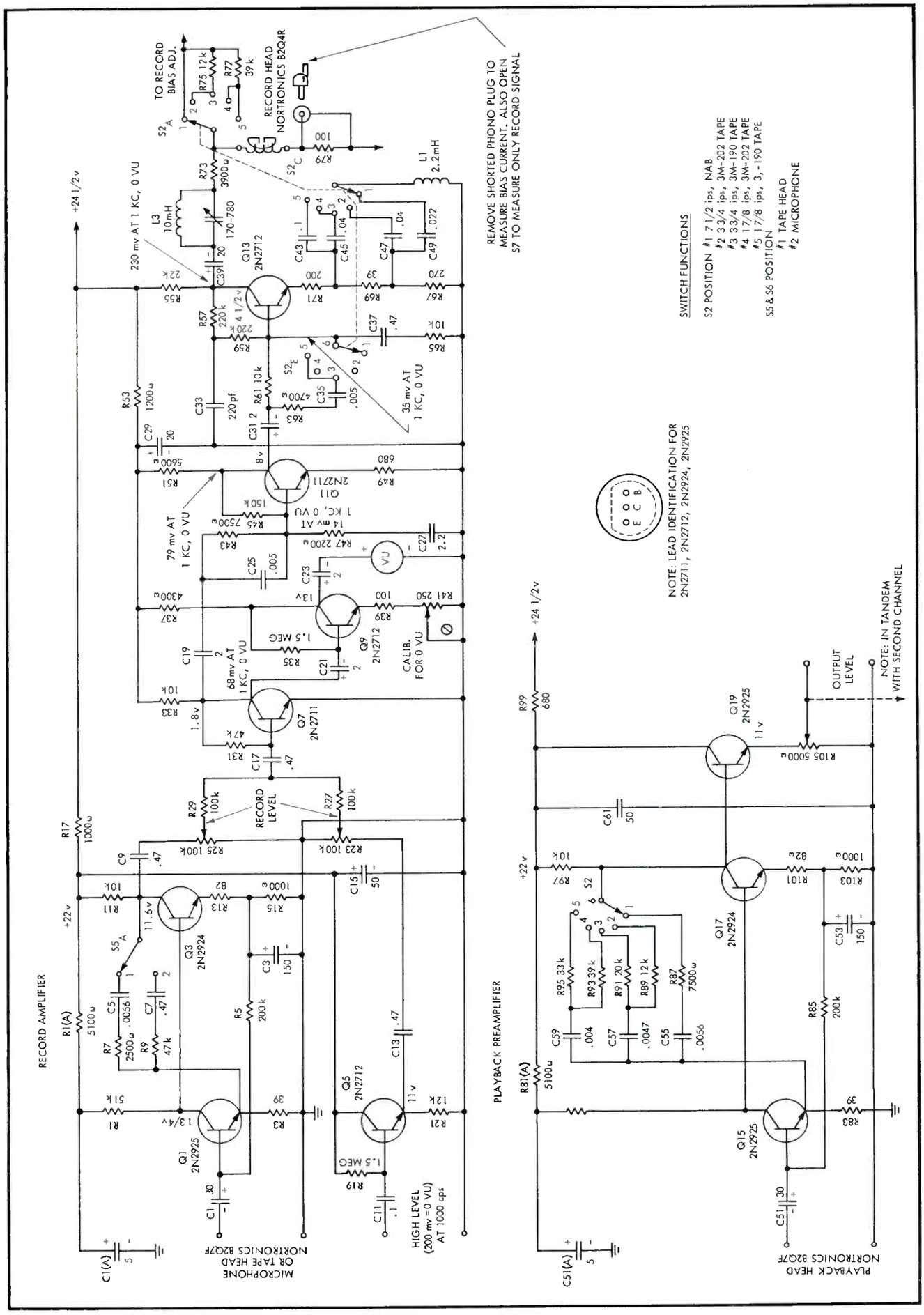

Fig. 4. Record amplifier and playback preamplifier.

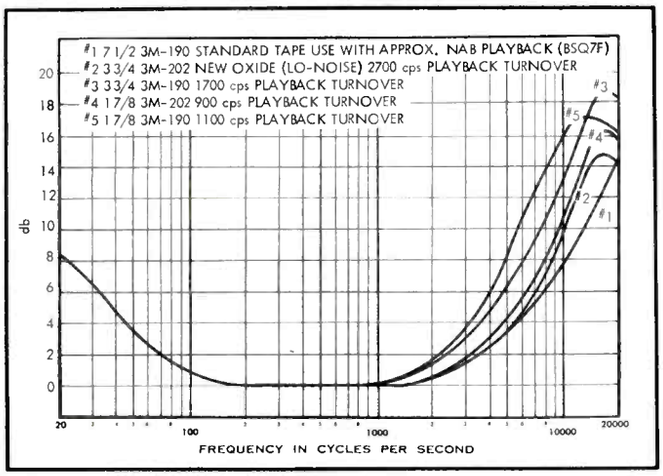

Fig. 5. Pre-equalization record current with B2Q4R.

1 volt reference level for the different tapes and speeds. The first two stages of this circuit have a feedback bias arrangement with R_{85} feeding bias current to the base of Q_{15} that is directly proportional to the emitter current of Q_{17}. This stabilizes the voltage and current bias points in the circuit for variations in both h_{FE} of the transistors and ambient temperature.

The a.c. negative feedback from the collector of Q_{17} to the emitter of Q_{15} is frequency selective to compensate for the pre-equalized recording characteristic. Approximately 0.35 ma of collector current for Q_{15} gives the best signal-to-noise ratio. R_{81A} and C_{51A} provide ripple reduction in the supply to the first stage.

For good signal-to-noise it is important that the tape head have good shielding and hum bucking. The signal-to-noise and dynamic range are improved by R_{82} in the emitter of Q_{17} which reflects a higher input impedance for this stage and thus increases the gain of Q_{15}.

The 0.4-henry playback head with this preamp circuit gives an equalized response within ± 1 db variation from 50 eps to 15 kc at 7½ ips. The noise level is 65-db below reference level output with a contour (weighted) measurement and 52-db unweighted (see *Fig.* 6). Measurement of unweighted noise even in the audio range (16 eps to 20 kc) does not give results that correlate with the low-level audible noise as heard from a speaker. For measurement of low-level noise, a filter can be used with a response that follows the Fletcher-Munson curve of equal loudness at a level of 20-db above the threshold of hearing at 1000 eps.[2] A large value for C_{51} is desirable to keep the impedance low at the base of Q_{15} for best signal-to-noise performance. All connections to the base of Q_{15} should be very short or shielded.

The preamp in the No. 1 (7½ ips) position requires 1.8 mv input signal at 1000 eps for 1.1 volts output. This level is about 14-db below maximum output. The IM distortion is less than 0.25 per cent at 1.1 volts output (reference level). The 2N2925 transistor that gives the lowest output noise should be used for Q_1 and Q_{15}, whereas a higher noise 2N2925 can be used in the non-critical Q_{19} location.

The "playback only" head selected (Nortronics B2Q7F) has a hyperbolic ground face and is meant to be used without pressure pads. When used with pressure pads, there may be more low-frequency output than desired when checked with the test tape. This can be easily adjusted by shunting C_5 and C_{55} with 560k resistors. This is a high-gain circuit and thus care should be used in layout to prevent regenerative feedback to the input. Most of the detailed discussion of the playback preamp applies also to the low level preamp (Q_1 and Q_3) section of the record amplifier.

The emitter-follower output stage of the playback preamp gives a low impedance output for a cable run to a power amplifier (transistor or tube) and acts as a buffer so that any preamp loading will not affect the equalization characteristic. The preamp output should not be loaded with less than 3k ohms and preferably about 10k or greater.

The over-all system total harmonic distortion at 1000 eps (record on tape and playback) is about 1 per cent at 0 VU. The IM distortion is about 7 per cent at 0 VU and 4 per cent at –5 VU. The IM measurement was with 60 eps and 6000 eps in 4:1 ratio.

Construction and Alignment

Construction of the amplifier should follow good, standard practices. Excessive heat should be avoided when soldering transistors and components. The power supply is located away from the input transistors as far as possible, and should definitely have a mumetal shield unless it is remotely located from the chassis. *Figure* 8 shows the printed circuit layout and the most critical point is the location of R_5 and R_{85} and its counterparts on the B channel. They must be physically as close to the bases of Q_1 and Q_{15} as possible. The rest of the printed circuit is laid out for convenience in connecting to the selector switches and controls which are obviously not mounted on the printed circuit. Numbered eyelets represent connection points with components not

SPEED(ips) AND TAPE	SYSTEM FREQ. RESPONSE ±2db, cps	SYSTEM SIGNAL-TO-NOISE			PREAMPLIFIER SIGNAL-TO-NOISE		
		CONTOUR db	HIGH PASS db	UNWEIGHTED db	CONTOUR db	HIGH PASS db	UNWEIGHTED db
7 1/2 3M-190	25-20,000	56	52	52	65	57	52
3 3/4 3M-190	30-15,000	53	47	47	61	52	49
3 3/4 3M-202	30-18,000	56	50	50	61	52	51
1 7/8 3M-190	40-8,500	52	47	47	57	48	47
1 7/8 3M-202	40-15,000	53	45	46	53	47	46

NOTES:

1. FREQUENCY RESPONSE AT A SYSTEM LEVEL OF 20-db BELOW 0 VU (7 1/2 ips AT –15 db).
2. ABOVE SIGNAL-TO-NOISE RATIOS ARE MADE IN REFERENCE TO 1 KC, 0 VU (12-db BELOW SATURATION AND TOTAL HARMONIC DISTORTION BETWEEN 0.5 AND 0.8% AT 400 cps. ADD 7-db TO ABOVE FIGURES FOR MUSIC WEIGHTED RATIO.)
3. NO HEAD SHIELDING.
4. CONTOUR FILTER: THESE FIGURES REFLECT THE APPROXIMATE FREQUENCY RESPONSE OF THE HUMAN EAR AT +20 PHONS. SYSTEM FIGURES ARE MEASURED WITH TAPE RUNNING AND EXPOSED TO BIAS OSCILLATOR.
5. HIGH PASS FILTER: 250 cps CUTOFF AT 12-db-PER-OCTAVE SLOPE.
6. UNWEIGHTED SIGNAL-TO-NOISE INCLUDES SUBSONIC LOW-FREQUENCY NOISE.
7. WITH THE NEW OXIDE (3M-202), THE BIAS AND RECORD DRIVES WERE NOT INCREASED TO OBTAIN NORMAL OUTPUT LEVEL IN ORDER TO IMPROVE DYNAMIC RANGE AT HIGHER FREQUENCIES.
8. PLAYBACK PREAMPLIFIER SIGNAL-TO-NOISE RATIOS ARE WITH TAPE STOPPED.

Fig. 6. Performance data.

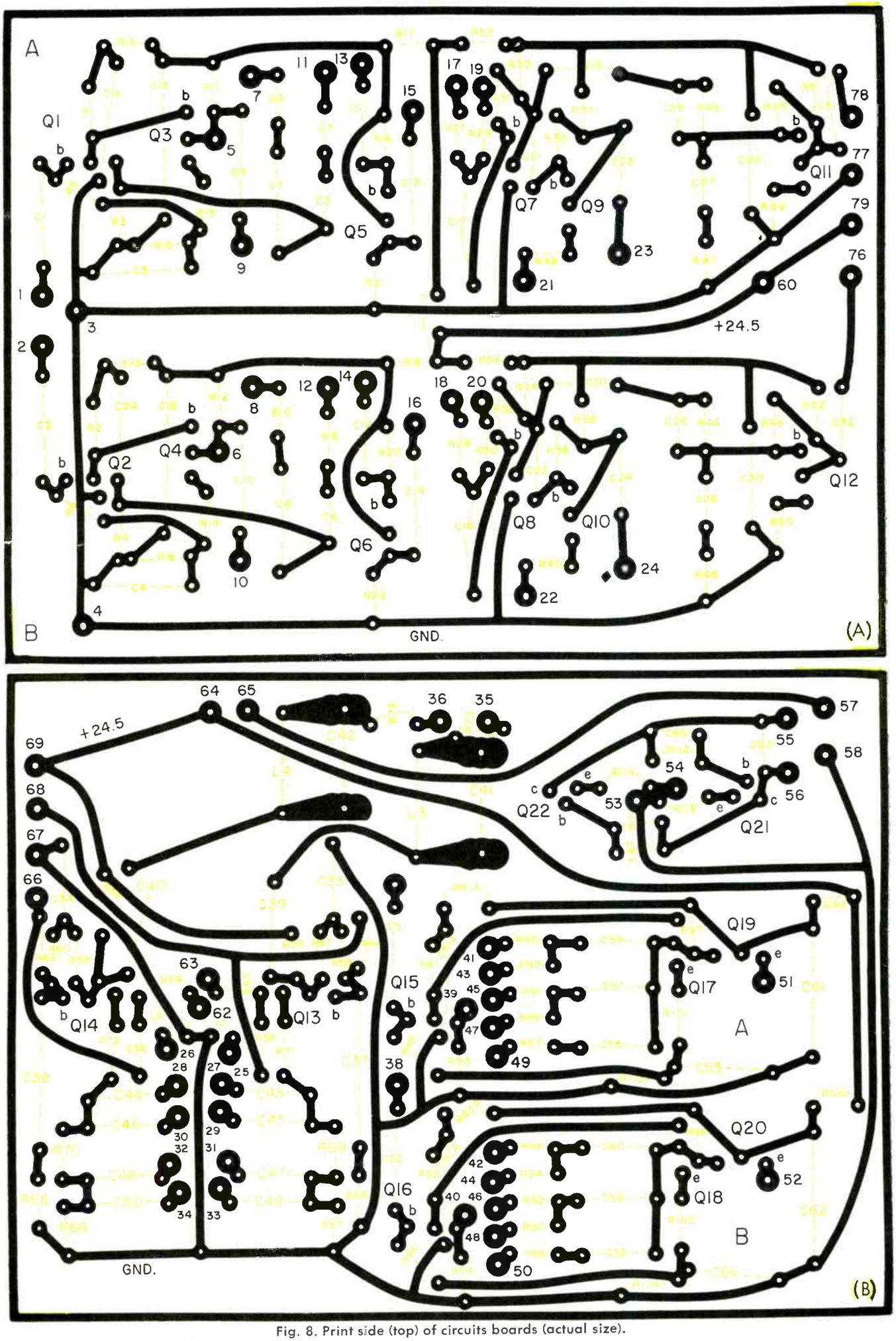

Fig. 8. Print side (top) of circuits boards (actual size).

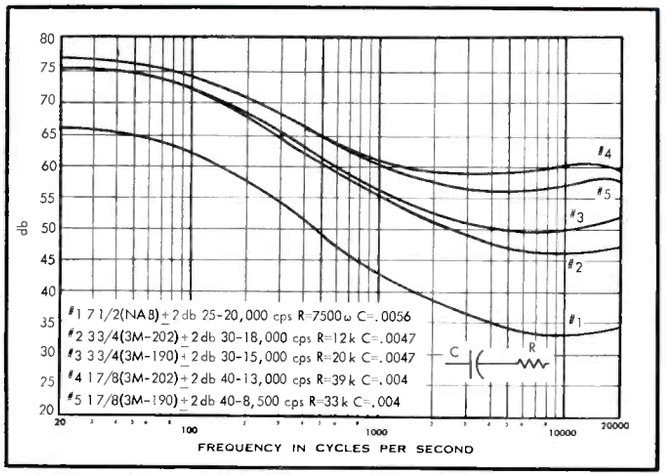

Fig. 7. Playback equalization with B2Q7F.

mounted on the printed circuit, a perusal of circuit diagram and the printed circuit will reveal which components are mounted off the printed circuit and the obvious connections to make. The circuit board components are mounted on the opposite side from the printed wiring and thus are not visible when examining the amplifier from the topside. Connections to the printed circuit board are made only to the numbered eyelets on the printed (top) side. *Figure* 9 shows both the top and bottom view of a completed assembly of circuit board (prior to development of PC board) to front and rear panel controls.

Upon completion of the construction and the connections, a VTVM should be used to see that the various collector voltages of each stage are approximately those values marked on the schematic. Following this, an oscilloscope is placed across the erase head. You must be in "record" position—that is, S_3 is thrown so that power is furnished to the bias oscillator transformer. One should see approximately 30–40 volts rms of 75–80 kc sinewave appearing across the erase head. The erase head has approximately 15 ma. erase current per side for a good 70-db erasure.

The oscilloscope is moved over to the collector of Q_{13} and its counterpart in the other channel and C_{41} and C_{42} are tuned for maximum rejection of the bias frequency appearing at the collector of the output transistor stages—Q_{13} and Q_{14}. With the traps working correctly, the null will be rather sharp and one can tune either side of it. Next turn the record level pots all the way down so that no input signal is coming through. The shorted phono plug across the 100-ohm resistors, R_{79} and R_{80}, is removed. A Ballantine a.c. voltmeter, or its equivalent, is then placed in this jack. The record bias adjustment pots, which are 100k linear controls located at the rear of the chassis, are adjusted to have approximately 0.6 ma bias current through the 100-ohm resistor with S_2 in the No. 1 position. This is done for both sides for a first approximation. Then the next approximation, the Hi-Z record level pots are turned "full open" and approximately 200 mv of 1000 cps signal is introduced into the high-Z inputs. Make sure the microphone, or tape head gain control, which is R_{25} and R_{26}, is turned all the way off and only R_{23} and R_{24} turned full on. The signal from the generator is adjusted so that you have 0.06 ma of 1000-cps current through the B2Q4R record head. When this record current measurement is made, switch S_7 must be opened to remove the bias current. After this adjustment is made for both channels, with the same signal level going in, the VU meter stages are now adjusted with the 250-ohm pots, R_{41} and R_{42}. These are adjusted so that each VU meter reads approximately zero VU. With this 1000-cps signal still on, a quick check is made to see that the 1000-cps signal at the collector of Q_7, Q_8, Q_{11}, Q_{12}, Q_{13}, and Q_{14} have the approximate values as on the schematic.

The next step is to remove the input signal. Now when you turn from stereo position to mono (upper or lower track only) and measure the bias current, as previously by removing the shorted plug, there should be almost no change. If they are not the same, the 2700-ohm dummy load resistors located on S_{1A} and S_{1C} to ground may have to be trimmed.

The next step is to recheck the bias traps, and we are ready now for a final, more definitive adjustment of the bias and record currents. A bias filter made up of an extra set of components, L_3 and C_{41}, are used to attenuate the bias signal that is coupled through the air into the playback preamp while recording. The output of Q_{19} and Q_{20} of the playback preamplifier is now, with R_{105} and R_{106} wide open, fed to the input of this filter trap (see *Fig.* 10). With the oscilloscope now at the AC-VTVM position, adjustment of this LC parallel-tuned trap (*Fig.* 10) is made for maximum rejection of the bias frequency. Reinsert a 1000-cps signal at the high-level inputs. (S_2 is still at 7½ ips.) The VU meter should read approximately zero VU, and then the record bias is increased until the AC-VTVM now reads "maximum" when the tape is running and this preamp output is somewhat greater than 1 volt rms at 1000 cps. With laminated heads, the peak bias is very close to the maximum 1000 cps output. Decreasing the record bias slightly with the bias adjust pot will increase the high-frequency output at the expense of some increase in distortion. However, slight over-biasing is usually employed and one makes up the high-frequency droop by slightly increasing the pre-emphasis at 20 kc, as we have done on this circuitry. This amount is determined by what portion of the total emitter resistor of Q_{13} and Q_{14} is bypassed by the series resonant LC circuit in parallel with this resistance.

After you have achieved approximately peak 1000-cps bias, you may measure the actual bias current on the Ballantine and increase this value by approximately 1 to 1½ db for slight overbiasing. The next requirement is to make final adjustment of the record current to the zero VU setting. The 1000 cps signal level is increased at the high-level input until the output of the Ballantine is at maximum. This should be at least 12 db, or more, than the zero VU level. In other words, what you try to do is measure the tape saturation level.

While this procedure is being done, it may be advantageous to look at the waveform coming out of Q_{19} and Q_{20}. When saturation levels are approached, it becomes obvious on the oscilloscope pattern. Once saturation level has been established, one should reduce the input signal 12-db below this level and readjust R_{51} and R_{52} (VU calibrations) to make the VU meter measure exactly zero VU.

The next step is to measure frequency response of the over-all record and playback of the tape system. As we have said before, it is a function of a large number of variables. Some of these are:

1. Recording equalization or pre-emphasis.
2. Recording head characteristics, such as shape of face and cleanliness of gap.
3. Tape contact with recording head, as controlled by degree of wrap, tape tension, absence of oxide build up on face of head, and adjustment of pressure pads, if used.
4. Bias current in recording head.
5. Recording level.
6. Tape speed.
7. Playback head core structure and gap size.

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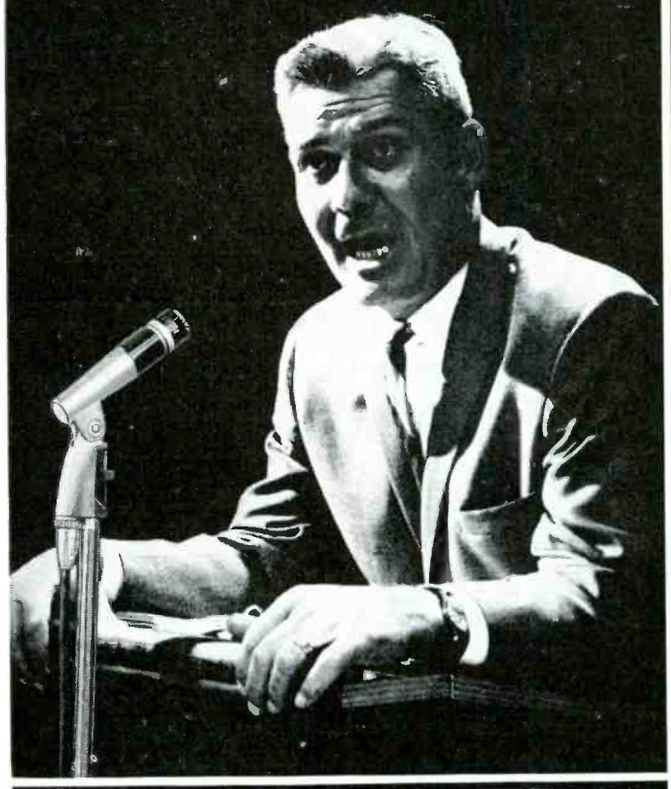

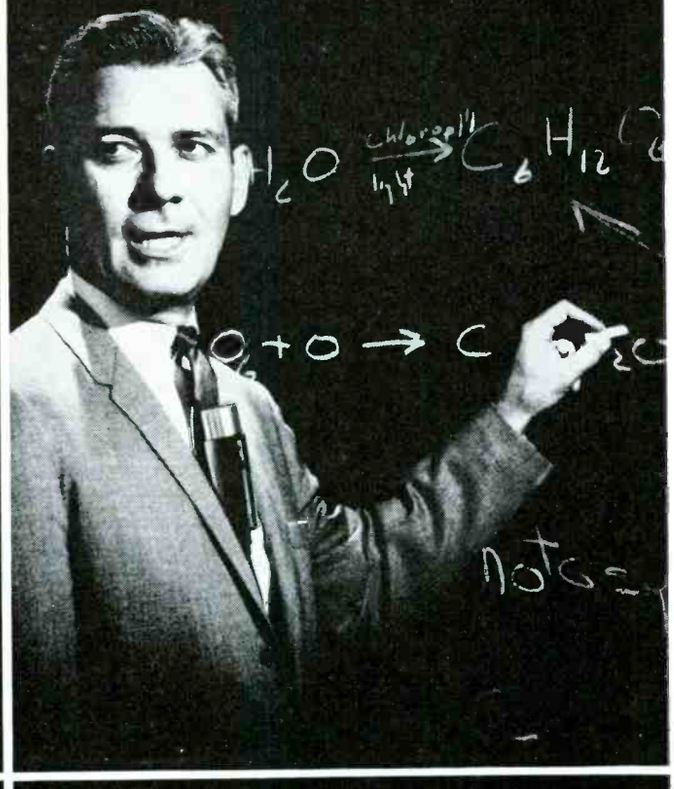

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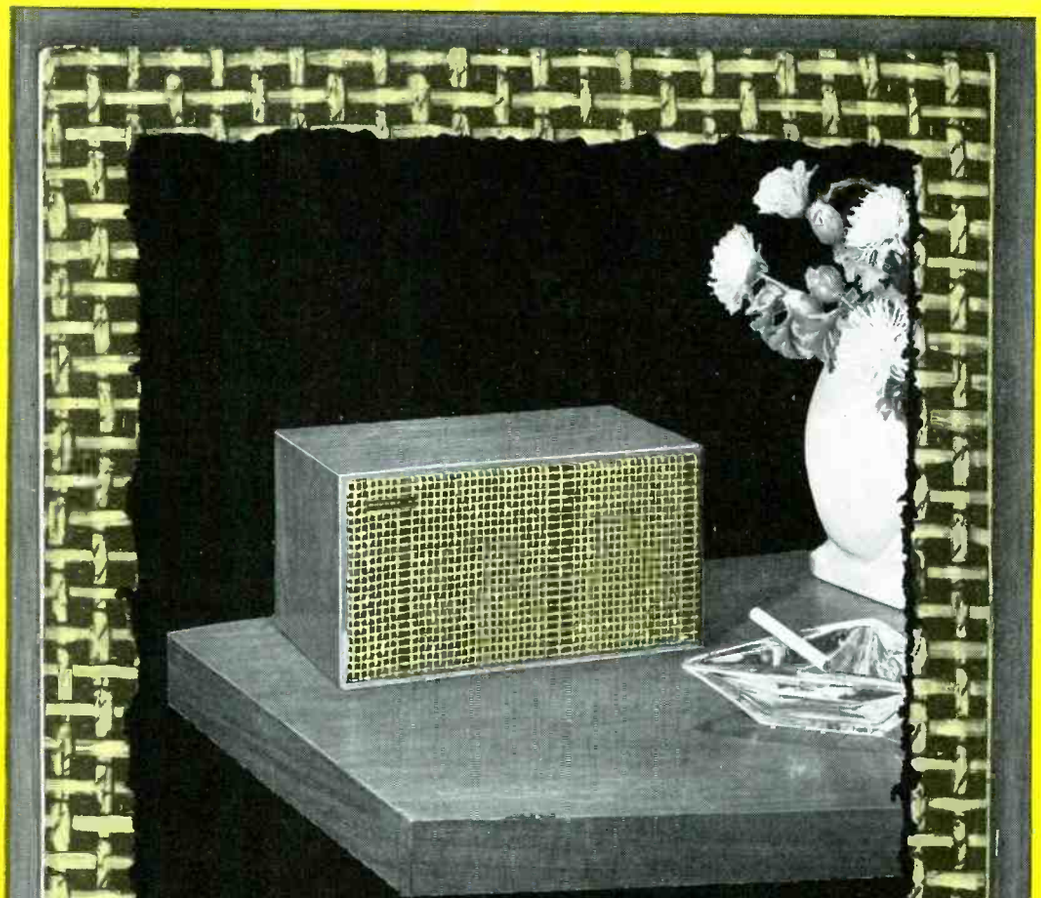

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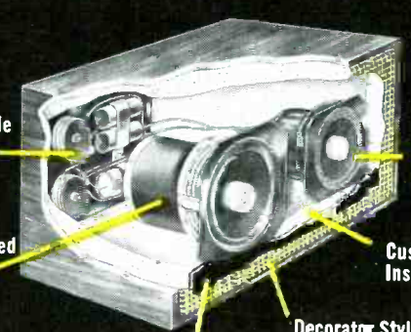

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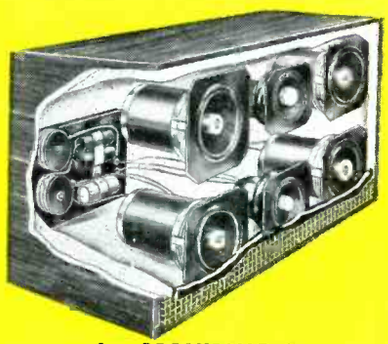

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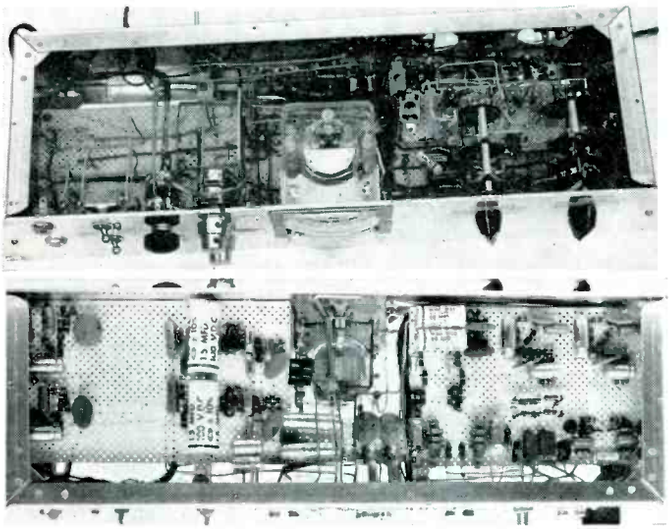

Fig. 9. Top view (left) and bottom view (right) of amplifier assembly.

8. Face curvature of playback head in conjunction with tape wrap, tension, pressure pads, and freedom from oxide deposits.
9. Correct azimuth alignment between gaps on record and playback heads.
10. Correct vertical alignment of the heads.
11. Playback equalization.

At this point, one should pay attention to the vertical position and azimuth alignment of the heads. The vertical position of the head is best achieved by first recording a little heavily using the playback head for both recording and playback, and developing the tape with Magna-See put out by Reeves Soundcraft. The picture of the proper relationship of the tracks to get maximum output and minimum cross-talk is as shown in the Magna-See folder. Other methods available are RCA alignment tapes, or Ampex quarter-track stereo alignment tape, such as 31321-04. After the playback head vertical position is set up, quick azimuth positioning may be achieved by utilizing a high-frequency tone on a test tape, and by adjusting the azimuth for maximum high-frequency response. One then moves back to the "record only" head and the procedure used for vertical position is repeated. As for the azimuth positioning, the playback output is monitored on the "playback only" head and the azimuth of the "record only" head adjusted for maximum high-frequency output. When this is done, you must be at least 15-db below zero VU at the 7½ ips speed with the signal generator in the high-level input.

The positioning of the erase head is not critical. You can quickly check for a poor erasure by running a previously recorded tape back over the erase head. Incomplete erasure can be detected and proper positioning of the tracks achieved.

One of the common errors committed when running a frequency response curve of a magnetic tape system, is to run it at too high a level. The recording equalization curve is based on the recognized fact that the intensity level of normal speech and music decreases with increasing frequencies above 2000–3000 cps. Advantage is taken of this by "boosting" higher frequencies during recording and also to correct for normal losses. However, if the test recording for frequency response is run at 0 VU, which is 12-db below saturation at 1000 cps, then the tape will go into saturation at a higher frequency due to the combination of pre-equalization, (*Fig.* 5) and because the tape saturates sooner at higher frequencies. At 7½ ips, 0 VU is only about 7-db below tape saturation at 15 kc, and since the pre-equalization is 11 db at this point, we are well into tape saturation. Therefore, always run response tests at least 15-db below the recommended zero VU level! The above limitations apply even more so at the slower tape speeds.

In order to insure that one is actually low enough in record level at the high end of the frequency response, when the frequency response is being measured, a few db increase at the input should be followed by a similar increase at the output in order to insure that one is not reaching saturation at the high-frequency end of the spectrum. When the over-all frequency response is being run, and you are at the maximum frequency point, one may alter this by a very slight change in the bias level, as the high-frequency end is extremely susceptible to slight change in bias. If the record bias change is slight, distortion need not necessarily be increased. The purpose of high-frequency bias is to make the tape characteristics linear to produce distortion-free recordings. Too little bias will result in excessive distortion of the recorded signal.

One may observe, on close examination of the pre-emphasis and apparent post-emphasis curves, a seemingly insufficient amount of preemphasis on the high end after one has adjusted the playback response for NAB. This is because the transistor record and playback circuits offer better impedance match and power transfer; also the record and playback heads are more efficient. Æ

Fig. 11. Checking the tape system, (left to right) Robert Prindle, Dr. Abajian, Dwight Jones.

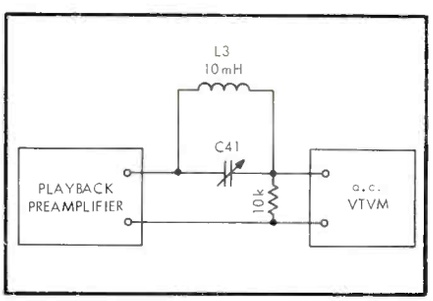

Fig. 10. Bias frequency trap.

(The authors wish to acknowledge the contributing effort of Robert Prindle, George Bisson and Carmen Fragale.)

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(*Continued on page 117*)

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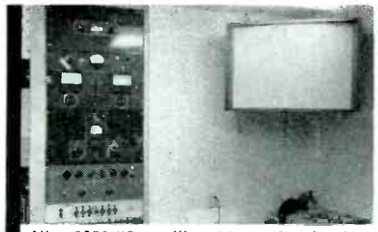
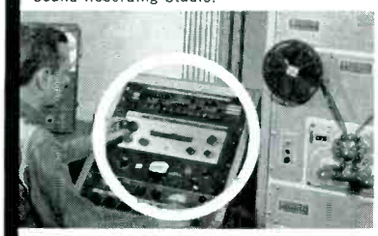


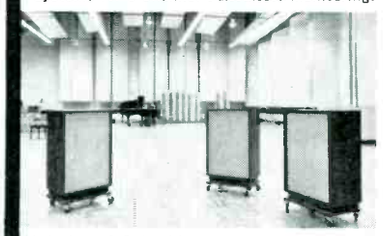
Altec **838A** "Carmel" **PLAYBACK** Speaker System is suspended from ceiling at Century Recording Co. Rack at left shows Altec power and compressor amplifiers used for recording.

Perfect partners! Rack-mounted solid-state Altec **360A** **PLAYBACK** Amplifier works with Altec **314A** FM Multiplex Tuner at Sim-C-Rama Sound Recording Studio.

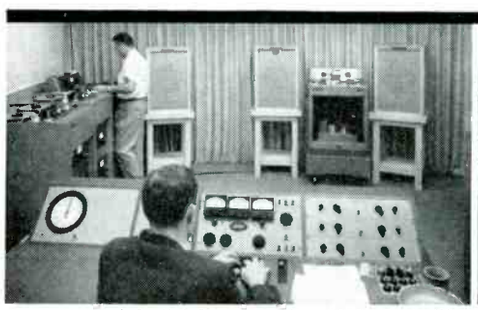


The film production service at Virginia State Department of Education relies on the all-transistor **360A** for power in conjunction with other Altec **PLAYBACK** amplifiers and controls in producing educational sound films.

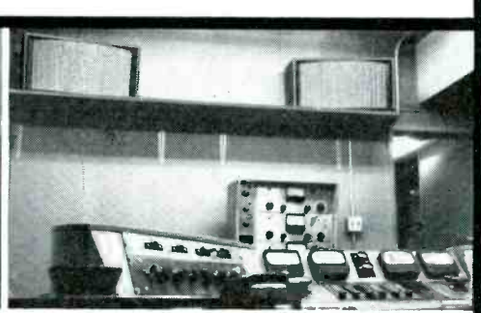
United Recording Studios (Hollywood) uses Altec **A-7** "Voice of the Theatre"® Speaker Systems for 3-Channel **PLAYBACK** monitoring.



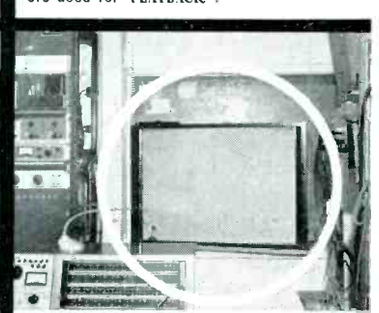
Interior of Columbia Records Studio (Hollywood) and Altec **605A** "Duplex"® Loudspeakers used for **PLAYBACK**.



PLAYBACK at Capitol Records – Altec **605A** "Duplex"® Loudspeakers verify the fine performance that has just been recorded.



Pair of Altec **836A** "Lido" Speaker Systems are shelf-mounted for stereo **PLAYBACK** monitoring at Walton Recording Studio in Chicago.



Full-size Altec speaker system, the **838A** "Carmel", is used for monitoring the famous Steve Allen Show by originating station, KTLA, Channel 5, in Los Angeles.

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Techniques of Making Live-*Versus*-Recorded Comparisons

EDGAR VILLCHUR*

Staging a live-versus-recorded concert requires an anechoic recording sensitively miked, careful placement of speakers in the concert hall, and very cooperative artists.

MY FIRST EXPERIENCE with a live-*versus*-reproduced" demonstration was in 1936, at New York's Museum of Modern Art. Color reproductions of American paintings—Eakins, Sloan, Marin, and others—were hung side-by-side with the original paintings, each in the same size and in matching frames. The reproductions had been made with the new printing process called collotype, and the fidelity was high. The differences between the paintings and their reproductions were always small, and often undetectable.

The logic of this type of comparison was so obvious that no one questioned it. There were no sage pronouncements that the presence of the original paintings and of the Museum environment introduced a subjective element, a "will to believe" that befogged the judgment of the viewers. (This kind of criticism has been made of live-*versus*-recorded musical demonstrations.)[1] No one claimed, as has been claimed in the high fidelity field, that the best way to judge a reproduction is to A-B it with another reproduction instead of with the original. He would have been laughed out of the Museum.

Some of the weaknesses of our high fidelity jargon become apparent if we carry the terms over to the field of visual reproduction. "Listener preference" is an accepted term in high fidelity, referring to individual differences in taste and in hearing. The Museum visitors would have thought it nonsensical to indicate "viewer preference" between the more brilliant and the more muted of the reproductions, or between the darker and the lighter ones, on the basis of taste. Nor did anyone suggest that certain of the reproductions were better suited for some eyes than for others because of differences in vision. The reference standard was always clear: the original painting. The reference standard in high-fidelity reproduction should be as clear: the sound of the live music.

Fig. 1. 1955 live-versus-recorded concert staged at Carnegie Hall by G. A. Briggs of Wharfedale (at podium). Musicians are from the Philadelphia Woodwind Quintet; seated at back is organist E. Power Biggs.

This article will describe some of the techniques that have been used to set up direct live-*versus*-recorded comparisons, with reproducing equipment vying against live musicians and also against "live" random noise. Such comparisons can be used to evaluate high fidelity equipment directly, or to validate other, quantitative, test methods.[2] They do not automatically solve all problems having to do with the evaluation of sound reproducing accuracy, but they do throw light into that never-never land where all high fidelity standards, other than the personal taste of each listener, are rejected.

History

Comparisons between live and recorded sound were staged as long ago as the first decade of this century. People were probably so amazed that the phonograph worked at all that they were not too critical of its literal fidelity. Advertising copywriters soberly claimed that the reproduced sound was indistinguishable from the original, although the difference was gross.

The most significant live-*versus*-recorded public concerts held in the United States, that I know of, were the Carnegie Hall concerts staged by G. A. Briggs of Wharfedale Wireless Works, the concert staged by the Audio League in St. Mark's Church, Mt. Kisco, New York, and the concerts staged periodically by AR, Dynaco, and Concertapes.

The Carnegie Hall pre-stereo concerts in 1955 and 1956 used a live woodwind quintet, piano, percussion ensemble, and pipe organ. I was not there and so can only note that the presentation as described[3,4] was straightforward; that is, it

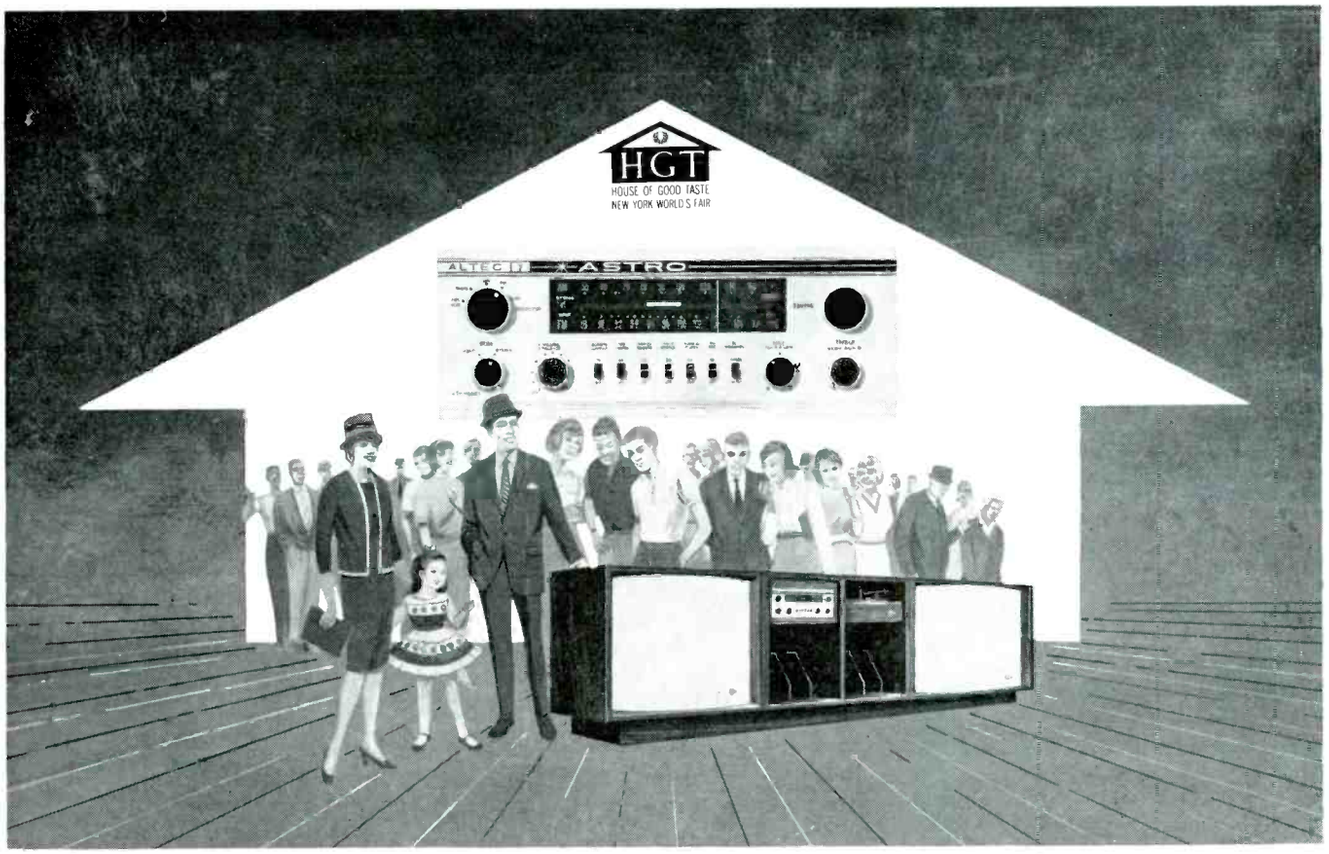
* *Acoustic Research, Inc., 24 Thorndike Street, Cambridge, Massachusetts 02141*

[1] Irving M. Friend, "The Prospects for Psychoacoustics," *High Fidelity*, April 1963, p. 49.

[2] Edgar Villchur, "High-Fidelity Measurements—Science or Chaos?", *Electronic World*, August 1964.

[3] P. J. Walker, "Technical Aspects of the Briggs' Concert," AUDIO, November 1955, p. 30.

[4] "The Briggs Concert—U. S.—1956," AUDIO, November 1956, p. 54.



Each day, thousands of visitors pass through the famed HOUSE OF GOOD TASTE *at the New York World's Fair. Most are captivated by the magnificent sound of the Altec* **PLAYBACK** *System. Desiring the same sound for their homes, many stop to ask questions. So that you, too, may learn more about the magnificent sound of Altec for* YOUR *home, we have repeated some of the typical questions and their answers below.*

WITH AN ALTEC STUDIO PLAYBACK *STEREO SYSTEM, THE NEW YORK WORLD'S FAIR*

HOUSE OF GOOD TASTE *IS ALSO A* HOUSE OF GOOD SOUND!

WHAT IS THE DIFFERENCE BETWEEN ALTEC **PLAYBACK** *EQUIPMENT AND ORDINARY HI-FI?*

PLAYBACK is a recording and broadcast industry term for sound reproducing equipment used in the studio by conductors, artists, and recording engineers to judge the quality and realism of their taped recording in comparison with the live rendition. The reason Altec stereo components can be called **PLAYBACK** is because 80% of all Altec sound equipment is specified and used by these professionals in the sound industry. Ordinary hi-fi is neither designed for, nor extensively used by, the sound industry. If you are a serious music listener, a listening comparison between **PLAYBACK** and hi-fi will make the difference between the two quite apparent.

ISN'T A COMPONENT SYSTEM LIKE THIS "TOO LOUD" FOR MY HOME?

Far from it! Just as a great orchestra can whisper or thunder, so can an Altec **PLAYBACK** System.

IS IT EXPENSIVE?

Not really. When you select an Altec Studio **PLAYBACK** system for *your* home, you're using audio components developed from over 30 years' experience in professional sound. This is the true measure of its value.

CAN I GET A STEREO **PLAYBACK** *SYSTEM IDENTICAL TO THE ONE AT THE HOUSE OF GOOD TASTE?*

The system shown above was created especially for the exhibit. An identical system is available to you in modular form so that you may make the most suitable arrangement in your home. The components that make up this system are shown at right.

IS THERE A WIDE SELECTION OF ALTEC **PLAYBACK** *EQUIPMENT?*

Absolutely! In addition to the components described here, Altec offers stereo FM tuners, solid-state control and power amplifiers, and a large variety of beautifully styled speaker systems. For do-it-yourself cabinets or custom built-in systems, you may select individual Altec speakers such as the famed Altec 605A "Duplex"® or the home size of the "Voice of the Theatre"® speaker systems which are used by more leading theatres, concert halls, and other professional music facilities than any other systems in the world.

HOW DO I GO ABOUT SELECTING AN ALTEC **PLAYBACK** *SYSTEM FOR MY HOME?*

Visit your nearest Altec Distributor (listed in the Yellow Pages). He's fully qualified to plan your **PLAYBACK** system with you. If you desire, he will also deliver and install the system in your home. With Altec, you also have the important advantage of all system components having a common design and manufacture; unlike ordinary hi-fi which may be made-up of a hodgepodge of components, you are assured that your Altec system will work well because all of its component parts are made by one manufacturer.

ALTEC PLAYBACK **COMPONENTS FEATURED AT THE HOUSE OF GOOD TASTE:**

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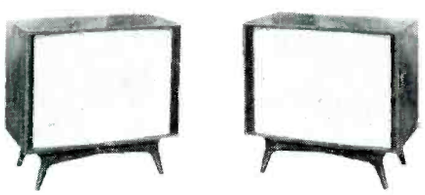

ALTEC 838A "CARMEL" SPEAKER SYSTEMS *are as pleasing visually as they are acoustically. Available in walnut or mahogany cabinets, the "Carmel" is a genuine* **PLAYBACK** *speaker system featuring professional two-way speakers, bass reflex cabinet, and a guaranteed 30-22,000 cycle frequency range. List Price: $337.50 each with round legs (decorator base shown extra).*

HEAR THE ALTEC STUDIO **PLAYBACK** *SYSTEM AT THE WORLD'S FAIR. If you can't make it, hear the same system at your Altec Distributor's. Or, for complete information, write Dept. A10B.*

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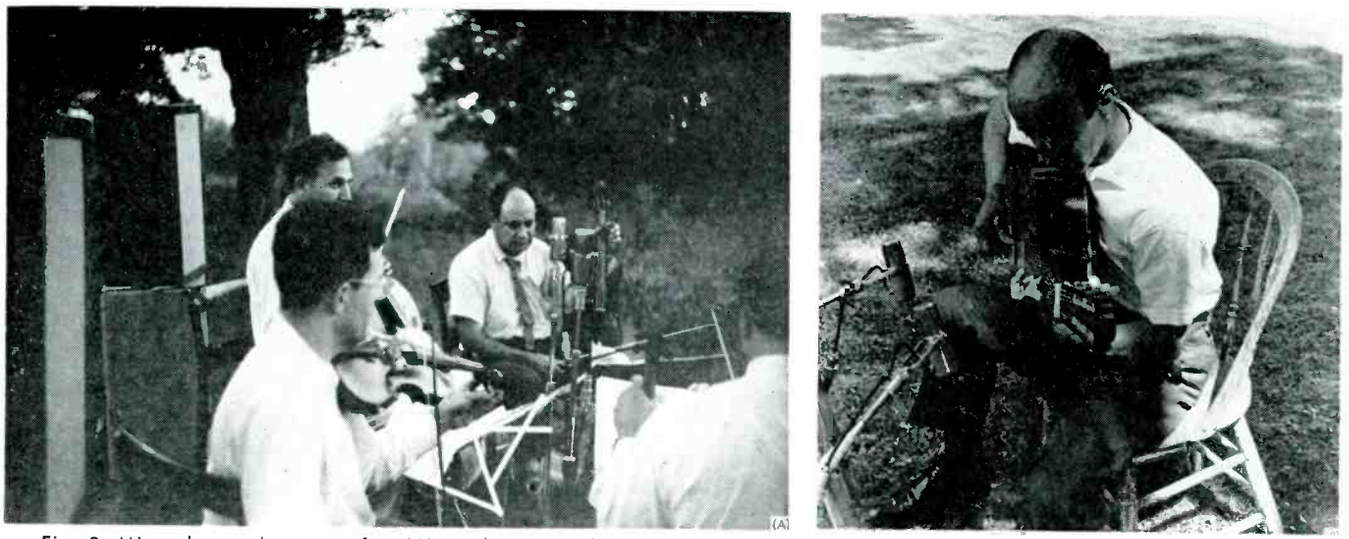

Fig. 2. Microphone placement for: (A) outdoor recording of Fine Arts Quartet (position was critical); (B) Gustavo Lopez.

was designed to facilitate the comparison between live and recorded sound rather than to mask the differences. I believe that Mr. Briggs was the first to stage a comparison of the sound of modern high fidelity components with live sound, and for this we owe him a vote of thanks. The equipment used included Quad and Leak amplifiers (the Quad in 1955), an Ampex tape machine, and Wharfedale speaker systems. (See *Fig.* 1.)

At the Audio League concert the live sound of an Aeolian-Skinner pipe organ was compared with its reproduction in both mono and stereo.[5] As in the Wharfedale concert, the presentation was straightforward. The audience was presented with alternating live and recorded sound.

The recorded stereo sound was described as usually indistinguishable from the live by reviewers who had no commercial ax to grind. I was often able to hear the difference (although I would not have been able to tell which was live and which recorded) by coloration in the midrange band. These differences were probably created by the tweeters in the then current AR-1 speakers, which shared the burden of reproducing most of the treble with the superior Janszen electrostatic tweeter.

In addition to these speakers, a Bozak B-305 was used for the organ *positif* (a rank of smaller pipes on the left). The complete reproducing system included five Fairchild 75-watt amplifiers, a Fisher 50-watt amplifier, four AR-1 speakers, and two Janszen 1-30 tweeters.

The AR-Dyna-Concertapes concerts started in 1959 when Leonard Sorkin, first violinist of the Fine Arts Quartet, walked into the AR room at the Chicago Hi-Fi Show. Concertapes-Concertdisc, which records the Fine Arts Quartet, was putting on a live-*versus*-recorded concert and we were asked if we could help. This was the beginning of a series of live-*versus*-recorded demonstrations staged in five different cities, totaling more than 75 individual concerts.

One of the pieces at the original Chicago concert was used to play a joke on the audience. The entire movement was recorded, but the musicians pretended to play some of the sections. At the end the audience was asked to indicate whether or not they could detect the change of sound from live to recorded. Half a dozen people raised their hands without hesitation, either to proclaim their expertise or because they were really misled by the apparent bowing of the musicians to "hear" a change of tone. The trick was revealed, of course. Since then the members of the Quartet have made it a practice to fake a few passes with their bows after the recorded sound has taken over, so that listeners cannot make their decisions on the basis of visual clues. If the audience is to detect differences between the live and the reproduced sound it must really hear them.

Actually, whether a blindfolded listener can detect such differences is relatively unimportant. To concentrate on this point is to miss the meaning of the comparison between live and recorded sound, whose purpose is to allow the listener to judge how close the two are, and where the differences, if any, lie. Very minor differences that would not interfere at all with truly realistic reproduction would make it possible to distinguish between the live and the recorded sound on a direct A-B switch. The difference in sound quality between various makes of electro-mechanical devices such as speakers and pickups is many times greater than the difference needed to detect the changeovers.

It is, nevertheless, of interest to note the relative degree of exact matching achieved with different kinds of musical material. The quartet concerts were reviewed widely, and most critics wrote that they were fooled most of the time. At subsequent concerts staged with guitarist Gustavo López, audiences indicated that they were able to detect the changeovers about half the time. The guitar was a more stringent test because of its lack of ensemble tone, an element which serves to confuse the issue enough to make matching less critical. Similarly, the massive ensemble tone of a pipe organ makes matching less critical, assuming that the equipment is capable of reproducing the pedal tone properly. The AR-1 speakers used at the Mt. Kisco organ concert could not produce comparable results with a string quartet or a guitar.

The least critical of tests is one in which the live and recorded sound appear simultaneously. At our concerts we used this device only for the last number on the program, as entertainment. By itself, without clear and separate presentations of live and reproduced sound, simultaneous playing of the two tends to obscure rather than illuminate the accuracy or lack thereof of the reproduced sound. It is like trying to A-B two components by listening to both of them at the same time.

The quartet and guitar concerts used the following equipment: an Ampex 350-2 stereo tape machine, two Sony C-37 capacitor microphones, a Dynaco PAS-2 stereo preamplifier and two Mark III power amplifiers, and a pair of AR-3 speakers.

Acoustical Environment of the Recording

A commercial record is meant to be played back in a living room. The typical living room makes a poor acoustical environment for most music, even a string quartet. Therefore a good recording, especially in stereo, has the acoustics of the concert hall built in. The orchestra is not brought into the living room where it doesn't belong; the listener is brought to the concert hall. The acoustical environment of the listening room cannot help but affect the sound, but the main contribution of this environment should be to provide reflected sound from different directions rather than color.

[5] Julian D. Hirsch, "True-Fidelity Organ Reproduction," AUDIO, April 1956, p. 26.

two questions:

1. I want the finest possible music system, and price is no object. What brand should I buy?

2. I want fine sound, but I have a limited budget. What brand should I buy?

one answer

DYNA

WHO SAYS SO? Editors and reviewers, test laboratories and independent consumer testing organizations.

Popular Science Editors, in choosing the PAS-2 and Stereo 70 for their finest music system, after two months of the most extensive listening tests ever made by a magazine, reported:

"It was the unanimous opinion of the panel that you could spend well over $1,000 and not get any better sound . . ."

Hi Fi Tape Systems Annual, in their **Editor's Choice of Hi Fi Systems,** unanimously recommends Dyna amplifiers and tuners for the top three categories (excluding only 'Poor-boy,' 'Compact,' and 'Rock Bottom') "which in their judgment will meet 90 percent of needs and budgets with a pretty high guarantee of performance," with the following:

"Maximum Fi: The Dyna outfit (PAS-3, Mark IIIs, FM-3) with stacked AR-3s is the least expensive way to obtain state-of-the-art performance.

Music Lovers: The Dyna (PAS-3, Stereo 70, FM-3) plus AR-3s has been recommended by more experts, and their nephews, than any other hi fi system. We don't hesitate to join the parade knowing that we run no risk whatever that anyone will be unhappy with the expenditure.

Most Fi per Dollar: This makes it three in a row for Dyna but we won't apologize. The SCA-35 is the finest low powered amplifier on the market, delivers 16 watts from 20 to 20,000 cycles at less than 1% distortion, and below 3 or 4 watts the distortion is unmeasureable."

High Fidelity Magazine, in individual test reports on Dynakits, has reported:

"We feel that the Dynakit PAS-2 is the equal of any manufactured preamplifier we have used, including some selling for several times its price."

"(The Stereo 70's) components are operated more conservatively than those in any other commercial amplifier we have tested. Its power and distortion ratings are completely conservative. Its listening quality is unsurpassed."

"On our instrument tests, the completed Mark III exceeded all its specifications by a healthy margin . . . this amplifier is an excellent choice for the kit-building music listener who considers the best present-day sound reproduction to be not quite good enough."

"The Dynatuner proved to be an outstanding performer, with measurements that generally confirmed or surpassed Dynaco's own specifications, and a quality of clear reception and clean sound which bore out these measurements. This tuner . . . should satisfy the requirements of the most critical FM listener."

"A kit-built version of the SCA-35 proved to be an outstanding performer among low power amplifiers. (It) offers performance that belies its cost, meets or exceeds its specifications, and is in general an excellent high fidelity component."

SCA-35—Combined stereo preamp-amplifier with low noise, lower distortion, and 35 watts continuous power output from 20 to 20,000 cycles below 1% distortion. Exclusive Dyna feedback circuitry and output transformers for distinctly superior sound.

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FM-3—STEREOMATIC FM tuner featuring automatic stereo/mono switching with the visual Stereocator. Super-sensitive, drift-free design with less than 0.5% distortion. Four IF-limiters, wide-band balanced bridge discriminator, and time switching multiplex.

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None of the above applies to a recording made for a live-*versus*-recorded comparison. The sound of both the live musicians and of the speakers is played back into the same acoustical environment, usually a hall. If the recorded sound already includes hall or studio acoustics it will have been shaped twice by acoustics when it reaches the ears of listeners. The double reverberation would be a false element in the reproduced sound. A live-*versus*-recorded comparison needs as "dead" a recording as possible, one lacking any reverberation.

It will be seen that the components used in a live-*versus*-recorded concert are not asked to perform precisely the same task as in home reproduction. We may assume, however, that if these components are capable of reproducing accurately the sound of the musical instruments themselves they are equally capable of reproducing this sound after it has been changed by the acoustics of the recording hall.

Techniques used to partially achieve dead recording have included very close microphoning, the use of cardioid microphone pick-up to discriminate against reflected sound, and the use of partially closed curtains and back drapes on the recording stage. A closer approach to an anechoic environment is provided by a large, open, outdoor space. In 1961 Dynakit and AR made their first outdoor recording with the Fine Arts Quartet. The almost complete absence of echo in the environment was very useful to our purpose but not magical. Microphone positioning was still critical, and there was still some reflected sound from trees and from the ground.

Passing cars, airplanes, and wind were minor inconveniences, since a combination of patience and re-recording and splicing solved the problem. The continuous accompaniment of birds and insects was a more serious matter. We used spray for the insects closest at hand, and a shotgun loaded with blank shells for the birds. The shotgun would create an awed silence for as long as five or ten minutes. Even so, very acute listeners have told us that they have occasionally heard crickets in the background of the recorded sections of our Fine Arts Quartet live-*versus*-recorded concerts.

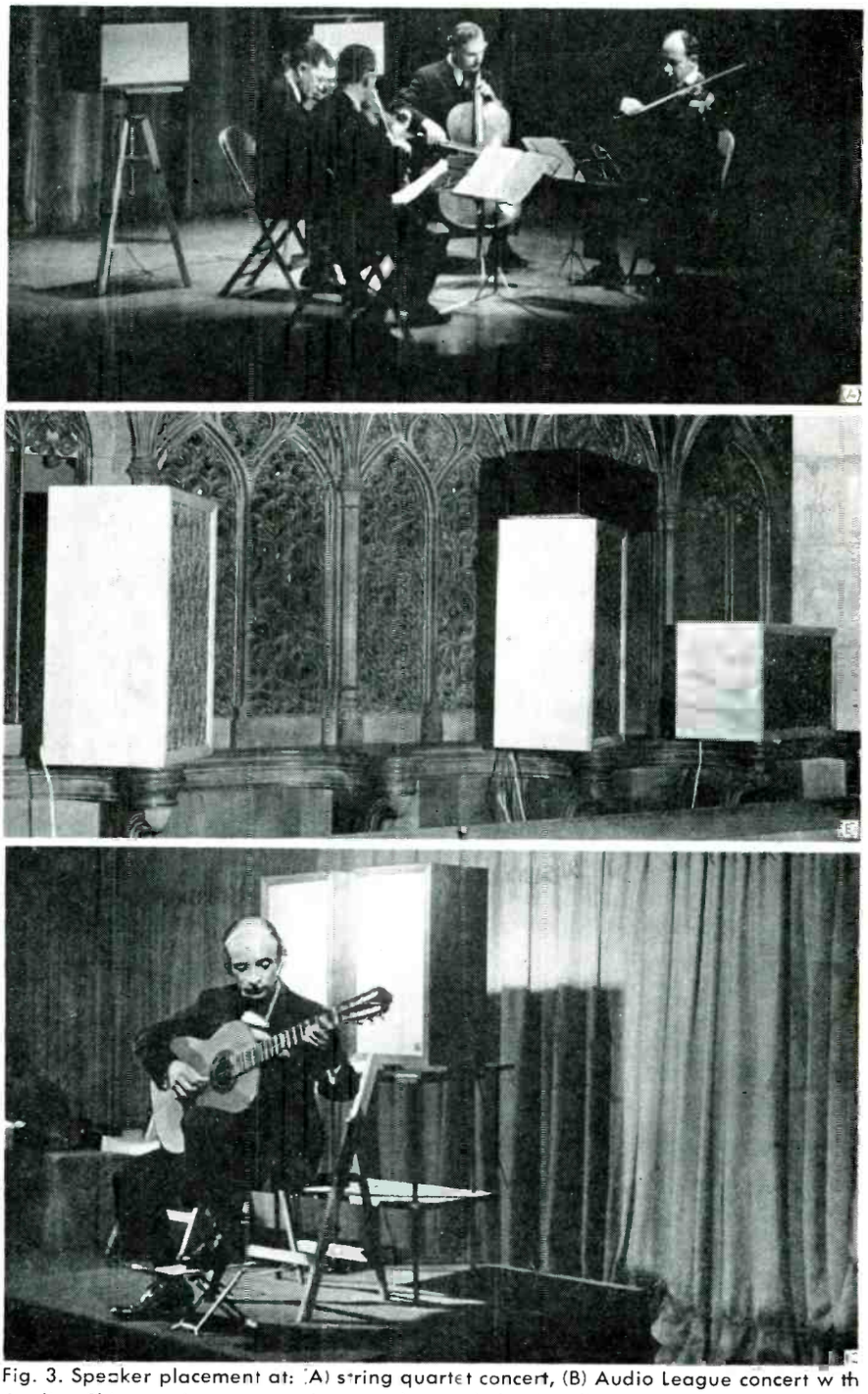


Fig. 3. Speaker placement at: (A) string quartet concert, (B) Audio League concert with Aeolian-Skinner pipe organ, pipe mouths are behind grille work; (C) guitar concert. Note that speaker spacing varies with size of the musical source.

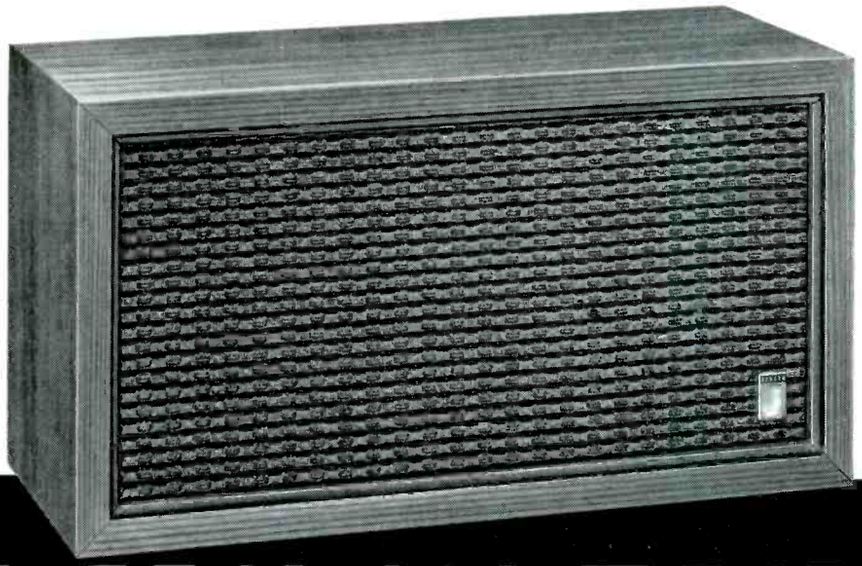
Microphone Positioning

The most critical element in preparing a live-*versus*-recorded concert, next to the quality of the recording and reproducing equipment (particularly the microphones and speakers), is the placement of the recording microphones.

The microphones must be close to the musical instruments, even in an outdoor recording, but this condition does not satisfy all requirements. Each musical instrument has its own particular spatial distribution of sound, and the dispersion pattern is not the same at all frequencies. Microphone positions must be found where the frequency distribution of sound at these points represents fairly the over-all timbre of the instrument. Since conditions are purposely designed so that the microphone does not sense any sound other than that radiated in a direct line to it, the microphone position is much more critical than in a normal recording, where both direct and reflected sound is picked up.

A particular microphone position may provide results that are too shrill or too bassy, while another may provide poor balance between two instruments. Common sense and experiment appear to be the best tools to use in determining microphone positions. It is necessary to try results constantly. Playback at the recording site may not sound as similar to the live music as at the actual concert, because the reverberation which will cloak both live and reproduced music equally is missing.

String tone poses a particularly tough challenge. The subtle texture is destroyed by high-frequency speaker or microphone peaks, which give it a steely or shrill character. The reproduced sound



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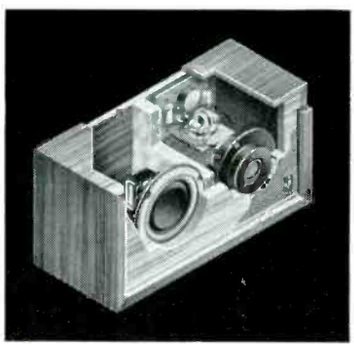

Cutaway view shows components and L/C network in a sophisticated glass fibre damped acoustic enclosure.

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Expect the inevitable.

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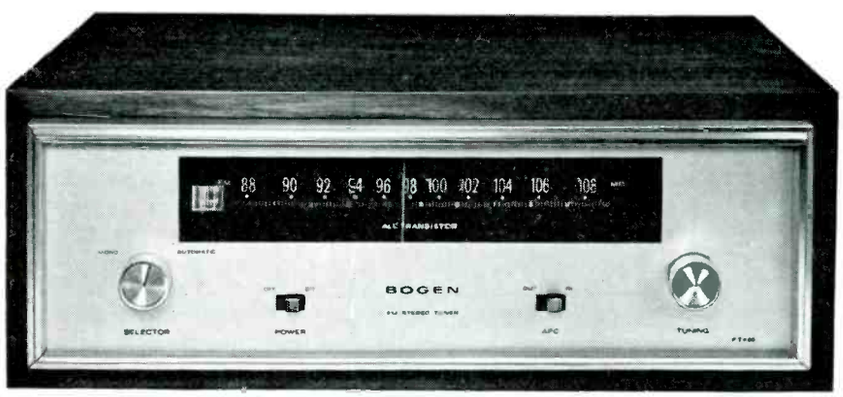

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can be shrill at the same time that the extreme highs are missing (often caused by deficiencies in speaker dispersion rather than on-axis pressure response), muffling the faint resinous edge and losing the spacious quality of the live instruments. The cello's bass is augmented at the concert through coupling to the floor, and if the recording is made with the cello tailpin resting on soft earth the bass may be too light. Speaker placement (closer to a wall) or some bass boost at the concert may have to compensate.

The two recording channels do not in this case represent the aural perspective of each ear, but rather the actual physical spread of the musical source. Microphones for the quartet were spaced farther apart than for the guitar, as shown in (A) and (B) in *Fig.* 2. In recording the organ, microphones were placed right in the chamber.

Synchronizing Live and Recorded Sections

When a changeover is made from live to recorded sound or vice versa, the musical beat should be maintained. Any audible changes which are not related to the comparison of sound character, such as changes in level, tempo, or tuning, will tend to obscure the comparison we are trying to make. If the break is smooth, and the musicians have tuned carefully to the tape beforehand, only the significant differences related to frequency and transient response, distortion, dispersion, and so on, will be apparent. The standard method of A-B'ing two reproducing components may serve here as a useful model.

In synchronizing the tape and the live music we leave the work to the performing musicians. The tape machine is started up first; the musicians have recorded a few faint, plucked tones that establish the tempo. Taking their starting cue from these tones the musicians play the opening musical section.

During the live playing the tape stays on at low level to provide cue music for the quartet, which has recorded the sections planned for live presentation 12- to 15-db down from normal. This is low enough so that the audience cannot hear it; indeed, the two musicians who are seated away from the speakers—the first violinist and the violist—often cannot hear it while they are playing. But the second violinist and the cellist are seated very close to the speakers (see (B) in *Fig.* 3), and can keep time for the other two members of the quartet.

The low-level sections have simply been recorded quietly by the musicians, with aid from the recordist who tells them when they have established the proper cue level. (At one concert with another musical group, the cue music was too loud and could be heard by some members of the audience, marring the demonstration.) In this way the musicians will have themselves established the break points, making it easier for them to cut in at the performance.

This system did not work with the guitarist. When the cue music was loud enough for him to follow, the percussive sound would have been audible to the audience as well, creating a two-instrument effect. We therefore cut the level of the cue sections of the tape an average of 25 db by re-recording, and set up an extra monophonic reproducing channel, through an amplifier-compressor to a single earphone worn by the guitarist. The cue music in the speakers is almost inaudible even on stage, but the amplifier in the earphone monitor channel builds up the level so that the musician can follow without difficulty. When the recorded section starts, and the guitarist relinquishes the stage to the speakers,

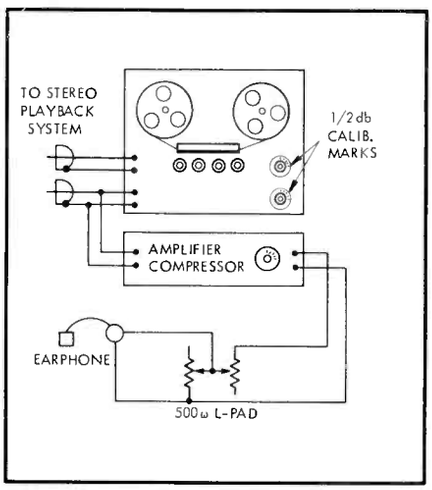


Fig. 4. Guitarists' monitoring circuit. The compressor, which prevents the loud sections of the tape from blasting, was a Gates Sta-Level.

the compressor keeps the increased tape level from blasting painfully in the earphone. The monitor circuit is shown in *Fig.* 4.

Some music lends itself to synchronization, and a skilled musician may be able to keep in sync without cue music. If the breaks from live to recorded sound and back are made at the ends of musical phrases, particularly those marked by a pause, the musician may be able to keep the tempo accurately enough to end up on time when the tape comes in. This was the method used by the Audio League. In any case, breaks should be chosen to avoid places where there is a musical change of color.

Staging the Concert

(A), (B) and (C) in *Fig.* 3 illustrates the speaker spacing that was used for three different kinds of musical instruments. It will be noted that the spacing is related not to the area that the speakers serve, as is the case in the home, but to the musical source that they represent. The two speakers for the quartet are spaced much farther apart than the speakers for the guitar because of the relative sizes of the original sources, and the speakers for the pipe organ are placed to approximate the positions of the pipe openings from which the sound is radiated. Other speakers were used near the pipes on the other side of the church. When the speakers are spaced to approximate the live source, the reflections in the hall are more likely to work on the reproduced sound in the same way as on the live, provided the speakers have good treble dispersion (all speakers have good bass dispersion).

Adjusting the level of the reproduced sound to match that of the live is more critical than one would imagine, considering the fact that the musicians cannot be expected to play at exactly the same level each time. The musicians do tend, perhaps unconsciously, to adjust the level of their playing to what they hear from the speakers during the recorded sections. It appeared during the concerts that level changes as little as half a db made audible differences in matching. Half-db steps were marked on the playback controls of the Ampex. We had a monitor seated in the audience to send light signals via a switch box to the tape machine operator, indicating needed changes of level. There was ample opportunity for such changes during the concerts, since there were usually more than ten switches back and forth during one piece.

For any readers who plan to try a live-*versus*-recorded comparison, I suggest that the level controls be calibrated, preferably in half db steps. One should not hesitate to use the tone controls. Changes in the conditions of live playing from the recording to the concert, (such as the presence of the stage floor, which does not affect the live and the reproduced sound equally), may require compensation. We have used bass boost, bass cut, and treble boost on different occasions, although in relatively small amounts. The greatest amount of equalization we ever had to use was with the guitar, where 4 to 6 db of bass cut was required.

"Live-versus-Recorded" Test with Random Noise

Our staging of public live-*versus*-recorded concerts has had two purposes. One, of course, is to show off the capabilities of the reproducing equipment, and to illustrate dramatically our design goals. A second and real value has been in exposing the strengths and weaknesses of this equipment and suggesting directions for redesign, and in providing an index of the validity of different test measurements.

The use of these comparisons is, I believe, the ultimate method of validating

(*Continued on page 120*)

A Basic Course in Commercial Sound

NORMAN H. CROWHURST

Chapter VII

Microphone Impedance and Connections.

Each variety of microphone considered in the previous installment has its "natural" impedance: the capacitor type has the reactance of a very small capacitor; the moving coil type is almost pure resistance, usually around 50 ohms; the ribbon type has a resistance that is a small fraction of an ohm; ceramics have a capacitance somewhat larger than the capacitor type; magnetics have an inductive impedance, resistive at low frequencies, inductive at high, which can be wound to any value, resistance and inductance changing proportionately; the value chosen is usually high, for feeding directly into the grid circuit of a tube amplifier. Each type of microphone may have its impedance modified by means usual to that type, so we will consider each in more detail.

Capacitor microphones have a "traditional" good name with some professional people, as possessing the highest quality. They require high voltage polarizing and the level is too low to transmit by line without amplification right at the microphone head, for which reason they always come with a head amplifier. This amplifier usually raises the level to be compatible with that from other types, and often provides the output through a cathode or emitter follower.

To connect this output to an amplifier or mixer circuit, we have two choices: (a) match to line impedance, either through a mixer, or directly into a tube or transistor input circuit; (b) feed into a high impedance input, a tube grid or its transistor equivalent. The first gives the best gain from the microphone and thus yields highest dynamic range, because it raises the level more above the noise. But the second gives the lowest distortion — a fact not generally known. Loading a cathode follower by feeding into a matching impedance, such as a line impedance mixer or input transformer, causes distortion from the follower—quite severe. Even at microphone output levels, it is enough to be measurably more than connection to high impedance.

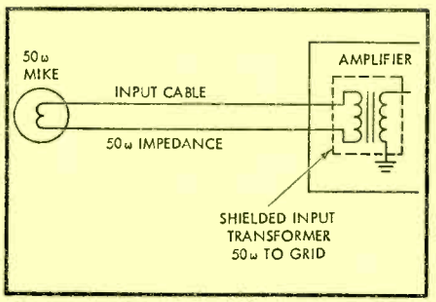


Fig. 7-1. Low-impedance moving-coil microphone input arrangement.

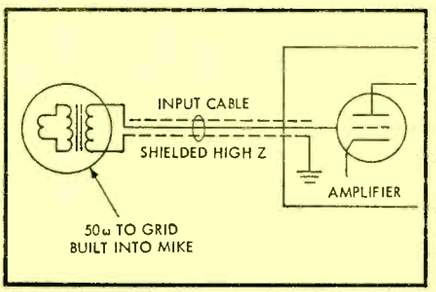


Fig. 7-2. High-impedance input arrangement.

A transistor circuit can readily be "tailored" to an impedance intermediate between these extremes—say 10,000 to 25,000 ohms, that effects a compromise as a follower load: reasonable gain with low distortion; but such a circuit is non-standard, and does not fit with the general professional aura that adheres to capacitor mikes.

The natural impedance of a moving coil microphone can easily be transformed to any desired value. For small systems, the amplifier can be provided with an input transformer from 50 ohms (*Fig.* 8–1), or if transistorized, the circuit can easily be designed to match this value without transformer. Low impedance, as the 50-ohm circuit is called, can be run considerable distances, up to hundreds of feet, *provided* it does not pass through any magnetic fields. So mike leads at this impedance must steer well clear of power transformers of all kinds, motors and anything that might radiate a magnetic field.

An alternative approach for very small systems provides the microphone with a high-impedance transformer (*Fig.* 8–2), suitable for feeding the grid input of an amplifier. This must use a shielded cable, and it has to be kept short—not more than 12 or 15 feet at the most, otherwise quality suffers due to high-frequency losses.

The professional approach with moving coil microphones provides the mike with a line-

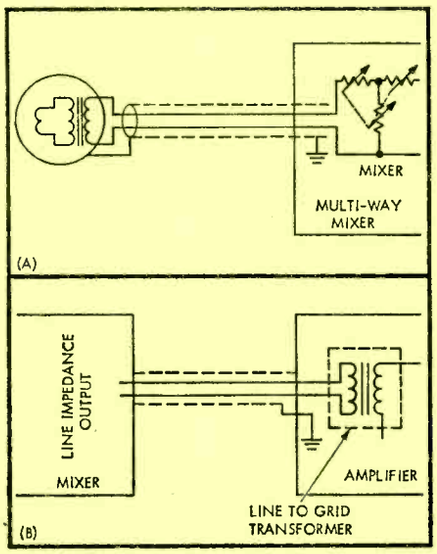


Fig. 7-3. Use of line impedance connections: (A) from microphone to mixer; (B) from mixer to amplifier.

matching transformer, impedance from 125 ohms to 600 ohms (there are 5 standards: 125, 150, 250, 500 and 600 ohms). This can feed into line-impedance mixer circuit, the output of which feeds an amplifier with line-impedance input (*Fig.* 8–3). Undoubtedly this is the most versatile method of connection, for which reason it is essential for professional systems where interchangeability is important. But for smaller systems, it may not be worth the quite considerable extra cost, when its only advantage may be a versatility that will never be needed.

Ribbon mikes, having such low natural impedance, must use a built-in transformer. As these mikes are usually for professional use, the transformer matches a line impedance. However some mikes, which give good quality for a very moderate price, provide for both line- and high-impedance output (for use with high-impedance inputs, or high-impedance mixing, which can also be used in small systems) by changing a transformer tap at the mike head.

Ceramic mikes are only practical where high-impedance input circuits can be used. Without any loading, the best thing is to connect them to an input circuit that goes directly to grid, with an input resistor of several megohms, and provide volume control following the first stage. This may cause distortion with high-level sound pickup, because ceramic mikes have a higher output than other types. The use of direct input is best where the mike is to be used for long range pickup, so that loss of gain is undesirable.

For more general use, the high level provided by ceramics can be cut down by use of parallel capacitance (*Fig.* 8–4), so that a reasonably high-impedance mixer circuit value (*R*) can be used without excessive bass loss. For example, if the recommended load for the mike is 5 megohms, this is much too high for a good mixer circuit, for which 100k is almost ideal, but 250k is acceptable. This means the mike needs terminating with a capacitance at least 20 times its own value, with a loss of about 26 db. But if this 26-db loss is too much, a compromise capacitor value may be used, with some bass loss. Try different values of capacitor, until sufficient gain is obtained without undue bass loss.

A very favorable aspect of the ceramic type is that, though it uses a high-impedance input circuit, this fact does not restrict its lead length as with other high-impedance input connections. Using parallel capacitance does not in this case attenuate highs, but the whole frequency range except bass, or lows. So lead capacitance can be part, or all, of the loading capacitance. A ceramic mike can be used successfully with 100 feet or more of shielded lead.

Magnetic types are also usually wound to high impedance, but cannot be used with long leads, because of high-frequency loss. The loss is likely to be more serious and sudden with this type than with the moving-coil type using high-impedance connections, because of the larger inductive element in the magnetic type. A length of 10 to 12 feet is an absolute maximum for this type.

Line-impedance connections are invariably twin shielded. Both connections use an inside conductor and the shielding is grounded separately and not used for a through connection (*Fig.* 8–3). For high-impedance input connections, single shielded is better, while for low impedance, such as moving coil mike without transformer at the mike end, a twisted pair, unshielded, may be quite satisfactory (not a flat pair). Using a better type of connection will not impair performance at low-impedance, it just is not necessary, as a rule.

Mixers

Small amplifiers, intended for smaller systems, provide built-in mixing facilities, usually at high impedance for tube circuits, and somewhat lower for transistor circuits. For larger systems, separate professional mixers are usually used, working at line impedance. These employ T- or ladder-type mixers, designed to maintain constant impedance reflection in all directions. This is done so response or transmission level of any one circuit cannot be changed by adjusting the level setting of any other circuit.

For small or intermediate sized systems, high-impedance mixers can save on cost considerably, with tube amplifiers at least. A corresponding type of mixer, built at lower impedance, would also save cost for transistor systems. *Figure* 8–5 shows the kind of circuit employed. The controls are simple potentiometers, usually with log taper,

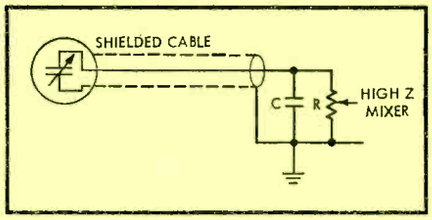


Fig. 7-4. "Loading" a ceramic mike input, to enable a practical control value to be used (see text).

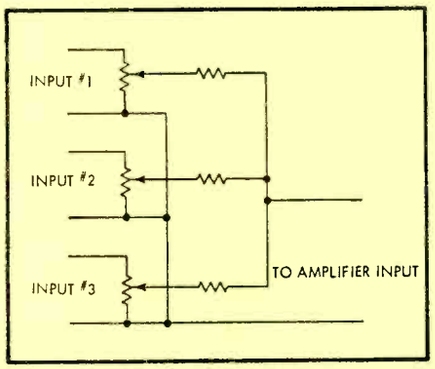


Fig. 7-5. Circuit for simple, inexpensive mixer (for values see text).

and provided with fixed resistors in their output leads (from the sliders). These resistors are there to protect against undue reflection from one circuit into another. They do not eliminate such influence, but keep it to where it is not noticeable, for practical purposes. The resistor in the sliders usually has a value of about half the potentiometer value.

Mixers all introduce loss. A six-way mixer, of professional type, has line impedance, input and output. So any one input can only be one sixth of the whole input (power) and the mixer must introduce a minimum loss (with its control "wide open") of about 16 db, as compared with direct connection without going through the mixer. With the non-professional type, using straight pots with fixed resistors, the loss averages the same, according to the number of circuits, but it will be more at some settings and less at others. And the loss in the wide open position will change according to whether other inputs have something connected or not.

Remote Mixers and Switching

In the larger systems, a problem often arises that control is not readily achieved from where the operator happens to be at the moment. There may be various reasons for this. Some mike locations may not be visible from central control and, unless telephone service is available between locations, such locations may have no means of getting the mike live when they need it. A remote control of some kind can provide this facility.

In theater installations, involving a number of stage mikes, the amplifier system will usually be somewhere back stage. It may be possible to arrange a spot where there is good visibility of the whole stage, but it will seldom be possible for the operator to hear sound that realistically represents what reaches the audience. A monitor speaker will sample the output delivered by the system, but it does not indicate whether the level is high, low, or about right in the auditorium. Also it may not satisfactorily indicate quality correction desirable in the auditorium.

So the best location for control is sometimes a "cubby-hole" out in the audience area somewhere, where the operator hears the same sound that reaches the audience, and can see the stage from the same viewpoint the audience does. To provide this would involve undue microphone and mixer wiring, unless a remote system can be installed. Such a system employs d.c. circuits to remotely control an electronic mixer located with the amplifier. Additionally, it may use electronic tone control or compensation, so quality can be adjusted from an audience listening location as well.

Figure 8–6 shows how this is achieved with tube circuits. The filtering on the d.c. circuits enables switching of microphones to be carried out, as well as level changes, without audible plops emanating from the system. A skilled operator can bring into use only mikes wanted alive at any instant, thus avoiding unnecessary pickup from other mikes. Even cross-stage dialog can be handled this way, switching on only the mike each performer uses, for the moments he is speaking. Noise and acoustic howl problems are improved and

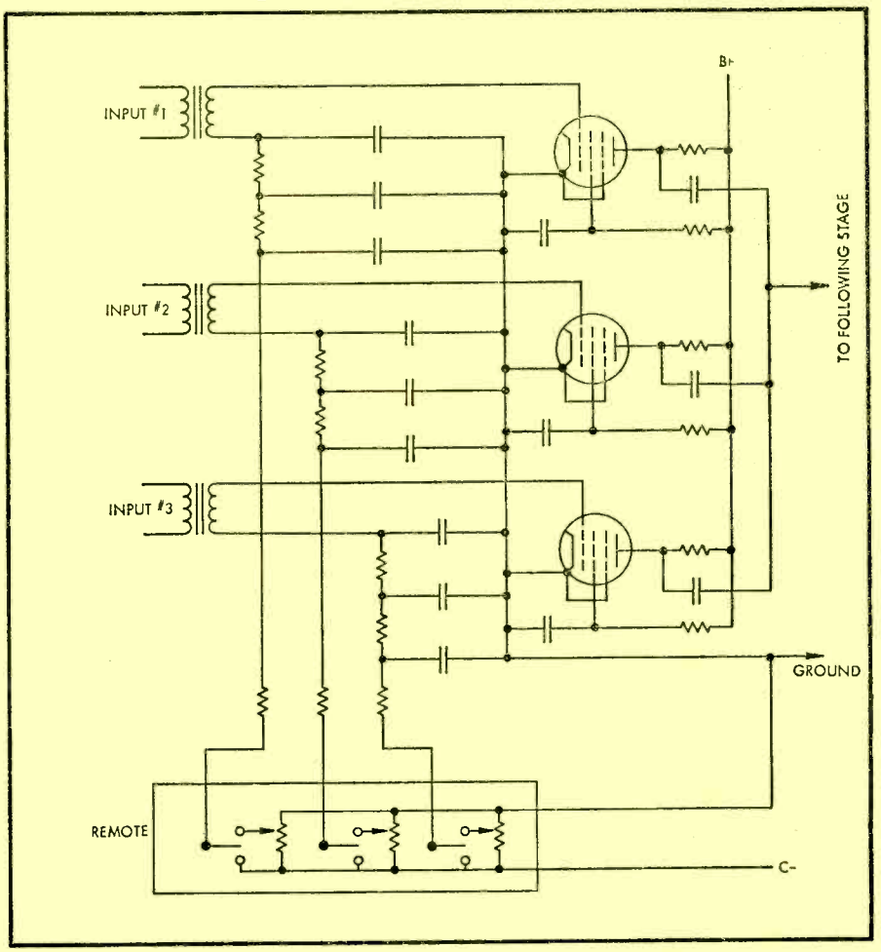


Fig. 7-6. Circuit for remote electronic mixer, using tube amplification. Suitable tubes for this circuit would be 6BH6.

nobody is aware of what is being done, except the operator—unless he goofs!

In bigger installations, the need may be to provide facilities from various remote locations, where mikes are not "on" until required. A switch at the mike is used to energize it. This can be handled in three ways, choice of which depends on detailed needs. The obvious arrangement is to switch the mike circuit itself. Many mikes come with such a switch, which may either open the circuit or short it (*Fig.* 7–7). Whether to "kill" a mike by opening or shorting it depends on circuit features at the amplifier input end.

An open line is apt to pick up electric field hum, more so than one terminated in a microphone impedance. A shorted line is more apt to pick up magnetic hum, originating from transformers, motors, lighting chokes —anything that makes a magnetic field. If either type of constant resistance attenuator (the T or ladder configurations) is used in mixer circuits, reflection mismatch is the same whether open or short circuit is applied—just the opposite direction.

If potentiometer mixers are used, open circuit will usually result in less loading on other circuits in use. And if mike inputs are simply paralleled, open circuit must be used, or switching one mike "off" kills all of them! Where other than line impedance connections are used, the short-circuit off is better for high impedance and the open-circuit better for low impedance, in the main, on the score of avoiding hum pickup.

The other methods of control do the switching other than directly in the mike circuit. The most used employs a relay that makes or breaks the connection at the equipment end. This is controlled by d.c. fed down a separate pair to the switch located on the mike (*Fig.* 8–8).

Of course, any switch, whether remotely operated or direct, that works directly in the mike circuit, will make a plop when the mike comes on, and probably again when it goes off. Whether such a plop is desirable again depends on application. If the mike serves as an annunciator, the plop will alert the audience to the fact that an announcement is coming.

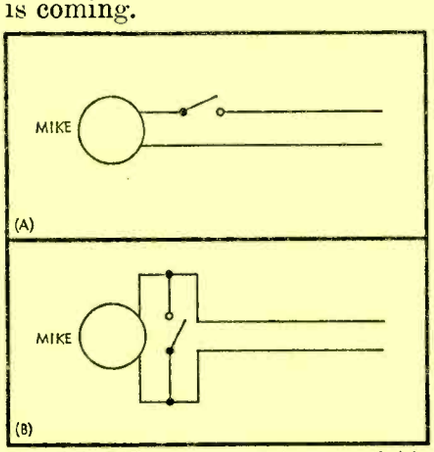


Fig. 7-7. Different connections available for the switches mounted on microphones: (A) opens circuit, (B) shorts it.

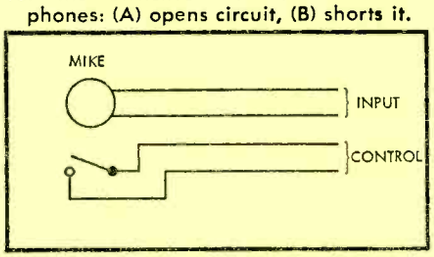


Fig. 7-8. An alternative connection for microphone switching. This allows a diversity of arrangements to be used with remote switching.

An advantage of the relay method is that, if the system also provides background music, the same relay can be used to cut the music, either dropping its level or eliminating it, when an announcement is to be made. This is a more pleasant way of achieving the alerting effect. If remote electronic mixing is used in the system, the d.c. switching can operate on it, with or without a mechanical relay. This has the advantage, for some applications, that an audible plop can be completely avoided, achieving instead a rapid fade effect.

Question—Chapter VII

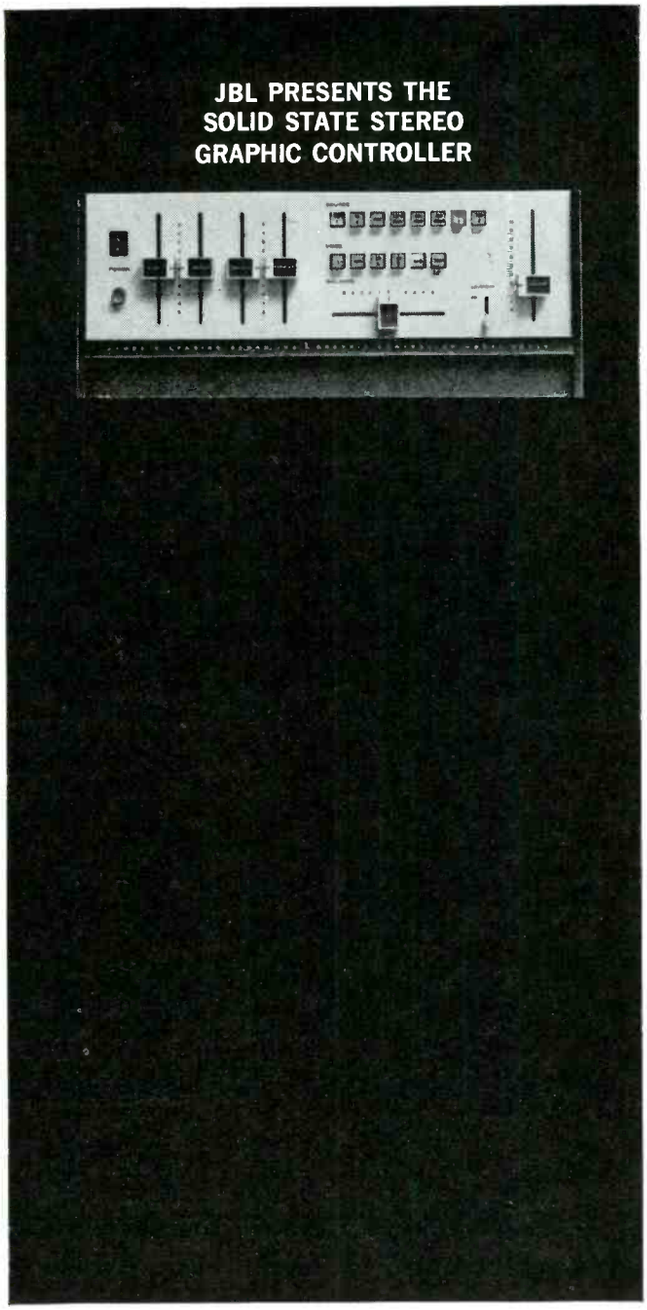
Our next installment will turn to the electronic end of the picture. Something to be thinking about, meanwhile: the question is often asked, in what way does a commercial sound amplifier differ from a high fidelity amplifier? More specifically, which type gives the better quality? After giving this some thought, see answer below.

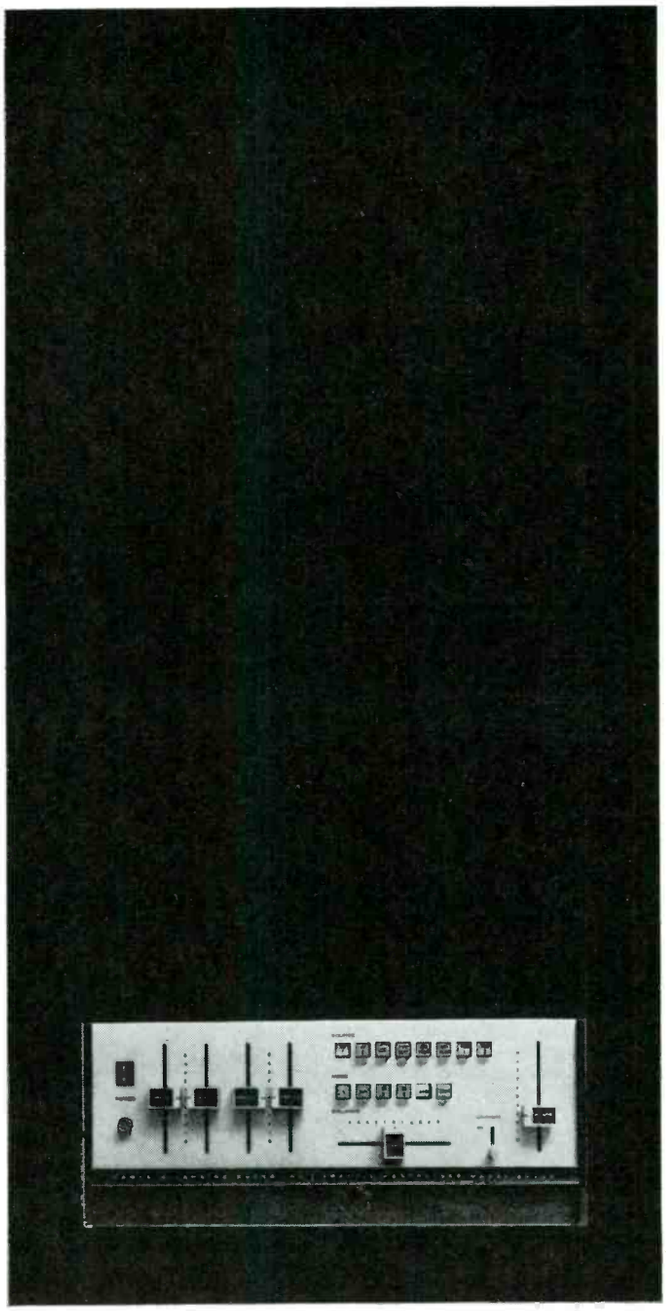
Answer—Chapter VII

This will be answered more fully in the next chapter. But, briefly, each is designed for its own purpose. For high fidelity amplifiers, the utmost in performance (for the money) is the objective: low distortion, uniformity of frequency response, wideness of dynamic range, from a whisper of sound up to a mighty crescendo; side features may include the most flexible of tone adjustments and other features.

For a commercial system, compromises must be made. First comes reliability and adaptability to the specific job, or kind of job in hand, whatever it may be. If background noise is a problem anyway, due to audience noise, for example, it is pointless to spend extra money to make an amplifier that would allow the audience to hear a pin drop somewhere in the outfield of Yankee Stadium! Rather the sound system must overcome the background sound of munching peanuts (to say the least!).

Response tailoring, or tone control, may serve a variety of functions which differ considerably from the needs of a high fidelity system: making the best of an announcer's voice; avoiding hollowness of sound, due to acoustic peculiarities of a building, and so forth. We have said enough here to set you thinking, and for you to realize that, rather than being better or not so good, the requirements are quite different. One question we shall answer in the next installment is how the electronic part of the installation can be used to improve effective acoustics.





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CIRCLE 123

New York High Fidelity Show—

WHAT TO SEE AND WHERE TO SEE IT

COMES THE FALL SEASON and with it the hi-fi season when every audiofan within an overnight hop from a High Fidelity Show makes every possible effort to attend. Generally he starts out visiting the rooms of the better-known exhibitors, or the ones showing the equipment he may have decided to purchase if the appearance and aural performance happen to come up to the dream image in the listener's mind. But if such is the case, it is likely that the visitor may possibly miss some product which he could regret not investigating before he makes an irrevocable expenditure of hard-earned cash to buy, possibly, the wrong product.

To make it possible to scan the exhibits at the New York Show without leaving your favorite armchair, we have asked every exhibitor who had, at the time of going to press, signified his intention to participate to provide us with information. A few, in every instance, will enter at the last minute, and are not listed for that reason. A few others couldn't be reached in time, or just didn't get the information to us before press time, and just maybe we overlooked some. So if you see an exhibitor at the show whose featured product is not listed here, consider it a bonus.

This year we have included the floor plans of the four exhibit floors. Every exhibitor (with possible exceptions noted previously) is included, with the room or rooms indicated at the right of the exhibitor's name. The four floors are basically the same, with only minor variations. In general, starting at the elevators and proceeding to the right will enable the visitor to encounter the exhibits in increasing numerical order. Now, read all about the featured products, then come to the Trade Show Building for the New York High Fidelity Show, October 1, October 2, October 3, and October 4—every day.

ACOUSTICA 503

One of the really unusual items in terms of appearance is the Lampshade (and lamp) Speaker manufactured by this exhibitor. In addition, they will introduce their new Omnisonic 500 AM-FM-Tuner-Amplifier for the first time.

ACOUSTECH 432, 434

The new Acoustech 10 stereo speaker-amplifier system will be shown for the first time to the public. This system consists of a pair of full-range electrostatic loudspeakers with two amplifiers built into each one, making a total of four amplifiers for the system. These Janszen designed units will be sold only as a complete two-speaker stereo system.

AMPEX 518, 522

Providing a fine opportunity for the audiofan to familiarize himself for the first time with the new 2000 Series of Ampex tape recorders, this exhibit will show all of the models. These recorders provide double capstans for constant tape tension, automatic reverse, automatic threading, and the reliability and solidity of a die cast chassis. The professional heritage of the Ampex line makes it possible to give a full year service guarantee. All this and superb styling, too.

AUDIO DYNAMICS CORP. 333

The ADC 303A "Brentwood" is the star of this room. The 303A is the latest version of this acoustic suspension speaker system. Modest price and excellent performance are key virtues. Here is a good opportunity to listen for yourself. Also listen to the rest of the ADC speakers, and of course, the ADC phono pickups and arms.

BELL SOUND 348

The Imperial 1000 solid-state receiver is unique in that the amplifier may be purchased first and the tuner bought later and just plugged in. It makes assembling a stereo system relatively painless. Performance specifications make it one of the top-quality units available. Also shown is the RT-360 stereo tape recorder and duplicator. This machine can duplicate tapes as well as perform as a full-fledged recorder.

BENJAMIN 446

Shown for the first time, a new stereo phono table console known as the Benjamin 200 Music System will be the feature of this exhibitor. The system consists of a Miracord 10 automatic turntable, housed in a furniture-finished walnut enclosure with a Plexiglas cover, and an 18-watt-per-channel solid-state amplifier. The entire unit is no larger than a housing for the turntable alone would be, yet it provides a phono system complete except for the speakers.

BOGEN 433

The featured product here will be the brand new RT-6000 60-watt FM-stereo receiver, and along with it will be shown AT-600 stereo amplifier and the FT-60 FM-stereo tuner—all solid-state models. In addition, several tube models will be shown, including the 35-watt AP35 stereo amplifier and the TP35 FM-stereo tuner. The new B62 turntable, featuring continuously variable speed control and an integrated tone arm will also be shown.

BOZAK 509, 510

As usual, the theme of the Bozak exhibit will be "Big Sound from Big Loudspeakers," and the B-410—the largest system in the line—will be featured. This model, known as the "Concert Grand," employs 4 woofers, 2 mid-range and 8 high-frequency units, and is capable of handling powers up to 200 watts. Crossovers are at 400 and 2500 cps. The unit measures 36-in. wide, 52¼-in. high, and 19-in. deep, and is available in either walnut or mahogany.

DAVID CLARK 445

The 100 Series of headphones is the featured product in the David Clark room. These phones, available in impedances of either 8, 300, or 1200 ohms, employ polyvinylchloride foam ear cushions which provide good coupling to the ears with a minimum of discomfort. They have a maximum power handling capacity of 1 watt.

CM LABORATORIES 438

Solid-state amplifiers are on view here, including the 50–50 100-watt stereo unit and the Model 35D, a 70-watt stereo amp.

CONCERTONE 441

Featured here will be the Series 800 "Reverse-O-Matic" tape recorder which records and plays in both directions continuously. These models employ six heads to avoid compromise with quality and tape handling, together with three motors and the high-speed forward and rewind time of only 40 seconds. Satellite speakers are also available for use with these models.

Can you recognize these three great stars?

The first two are obvious to movie goers: Rock Hudson and Doris Day starring in Universal's new comedy, "Send Me No Flowers." The third is ours and it's on the table. It's the Incomparable Concertone 800. This unique stereo tape recorder plays a vital role in this hilarious new movie. When the script called for a tape recorder, Universal Pictures wanted the finest, most modern machine available. That's why they selected the Concertone 800 to appear. It's as modern and sophisticated as the live stars of the movie. □ The Concertone 800 is the only stereo tape recorder with double Reverse-o-matic® and six heads—allowing you to record and play continuously without reel turnover. The 800 (portable or tape deck) is priced realistically and provides an exclusive combination of features. It starts as low as $379.95. Send for a free Concertone 800 brochure and the name of your nearest dealer. Write to Concertone, Box 3162, South El Monte, Calif.

CONCERTONE

ROCK HUDSON and DORIS DAY star in "SEND ME NO FLOWERS"

Circle 124 on Reader Service Card

FLOOR PLAN OF HIGH FIDELITY SHOW

CONCORD 614, 616

This exhibit will feature the new "R" series of tape recorders, all equipped with solid-state playback amplifiers and two 5 × 7 in. elliptical loudspeakers. This is essentially a completely new series of machines.

CROWN 442, 440

A new series of solid-state recorders is shown by this midwestern-based company. Specifications include signal-to-noise ratio of 56 db at 7½ ips with a frequency response of 50–30,000 cps ± 2 db. At 3¾ response is 30–20,000 cps with signal-to-noise ratio of 52 db. Audio circuitry is within 0.25 db from 10–100,000 cps. Plug-in circuit modules are printed on epoxy and gold plated.

DYNACO 402, 422

In addition to its complete line of kits and completed components, Dynaco will introduce a new tape recorder manufactured by Bang and Olufsen in Denmark. This unit uses a hysteresis-synchronous motor, simple "joy-stick" operation, and linear slide-type mixing controls. Two tension arms maintain control of the tape, and no pressure pads are used. A phono input is equalized for dubbing from records.

EICO 335

A new all-transistor FM-stereo tuner-amplifier simple enough for even a beginner in kit construction to assemble will be the feature at Eico's display, which will include their entire line. The new receiver, Model 3566, provides an output of 30 rms watts per channel, and the tuner section has an IHF sensitivity of 2 μv. The r.f. "front end" is pre-wired and aligned so as to ensure that the kit builder will have optimum performance with a minimum of alignment after he finishes the unit. A full complement of controls makes this receiver a complete home system with only the addition of speakers and phone and/or tape equipment.

ELECTRO-VOICE, INC. 309, 312

In addition to the extensive line of loudspeakers, microphones, and organs, this year Electro-Voice is featuring an absolutely new line of components which includes solid-state preamplifiers, amplifiers and receivers. This is the first time E-V has produced components in about 10 years.

ELPA 349

Featuring the TD-224 as the leader in its line of turntables, Elpa will also show the "old reliable" Thorens TD-124, the single-speed TD-121, and the arm-equippd TD-135. The TD-224 combines all the advantages of the automatic turntable without stacking records on the platter, thus providing all the convenience of a changer with the record-playing quality of a transcription turntable.

EMPIRE 437

Featured in the Empire exhibit will be the striking Royal Grenadier loudspeaker—the newest version of a series of loudspeakers engineered specifically for stereo listening. The familiar round cabinet has given way to an octagonal design, finished off with a round marble top for elegance in appearance. Empire turntables and the 880P and 880PE cartridges, the latter with elliptical stylus.

Manita de Plata listens to the playback of a stereo master tape which will become "Flamenco Legend" (Connoisseur CS 263). The speakers are AR-3's.

first playback after the recording: guitarist Manita de Plata listens to himself through AR-3's

Connoisseur Society makes stereo records in 12-inch 45-rpm LP's, of the very highest quality.

Connoisseur engineers recently made a European tour, taking their recording equipment with them. They recorded **Flamenco Legend** (Connoisseur CS 263) with Manita de Plata in Arles, France, where this photo was taken.

Recording engineers make critical decisions on the basis of the playback sound achieved on location. Artificial coloration in the monitor loudspeakers provides false clues to work with, and tends to perpetuate itself inversely in the record. Connoisseur engineers chose AR-3 speakers as producing the sound most faithful to the tape.

The AR-3 ($203 – $225, depending on finish) and the lower-cost AR-2a ($109 – $128) are often used professionally because of their high quality, but they are primarily designed for the home. AR-3 speakers were selected for the top stereo systems described by three magazines – the September 1963 **Popular Science**, the Fall 1963 **Bravo**, and the 1964 edition of **Hi-Fi/Tape Systems**. A five-year guarantee covers any repair costs, including freight.

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge, Massachusetts 02141

Circle 125 on Reader Service Card

ERCONA 301

The main feature of the Ercona exhibit will be the MK II version of the Leak patented Sandwich Piston-Action Speaker System. This new model has been dramatically and demonstrably improved by using another Sandwich-principle cone, which together with a small change in the crossover network results in a complete absence of fatigue and a signal which is a remarkable reproduction of the original.

FISHER 537, 539, 540, 541, 546

Dominating this exhibit will be the new 600-T receiver, with its high-performance combination of vacuum-tube and solid-state circuitry. This model has a power output of 110 music-power watts total, with distortion figures, both IM and harmonic, of less than 0.5 per cent, a power bandwidth of 12 to 35,000 cps, and a complement of controls, together with an FM multiplex tuner employing a Nuvistor and Golden Synchrode front end, five i.f. stages, five limiters, and a wide-band ratio detector. This model essentially combines the TX-300 integrated amplifier and the TFM-300 multiplex tuner into a single unit. The latter two models—both new, will also be shown separately, along with the Fisher 50 Portable, a solid-state master control amplifier combined with a Garrard record changer and two separable speaker systems. The same components are also packaged in walnut veneer housings as the model 75 Custom module.

FREEMAN 650

Seen for the first time at this show will be the new Model 800 tape recorder, a line-current operated model accommodating 7-in. reels yet weighing only 26 lbs. This unit has all the features necessary for stereo or mono recording, and is among the lightest of "full-size" recorders.

GARRARD 523, 525, 526, 531

In this portion of the British Industries exhibit will be introduced the completely new line of Garrard turntables, including the Lab 80, the first Automatic Transcription Turntable. The remainder of the line comprises the A70, the AT60, and the Model 50. The Lab 80 has such features as a new dynamically balanced, non-resonant wood arm, a bias compensator to prevent "skating," a massive non-magnetic 12-in. turntable, and a new integral cueing device.

GRADO 341

Featured in this exhibit will be the new Ultra Linear Series A cartridge, a smooth, lightweight pickup tracking at one gram and with response measurable to 50,000 cps, with 5 db separation measurable at 47,000 cps, and an average separation of 25 db up to 20,000 cps.

GROMMES 409

The A41 40-watt stereo amplifier is solid-state with drift-field power transistors and diode bias. Transformer-coupled driver, output overload protection with feedback around every stage to ensure long trouble-free operation. Also shown is the 5003 stereo receiver with "stereo sentry."

HARMAN-KARDON 308, 629

Three new all-transistor receivers will be the features of this exhibit, with attention focussed on the SR-900, which combines an improved version of the F-1000-T tuner with a dual 18-watt integrated amplifier (profiled in this issue). This unit gives fully automatic stereo switching, and the fine transparency of sound currently associated with solid-state equipment.

HARTLEY PRODUCTS 501

Full range 10", 12" and 18" high-quality louspeakers featuring "Magnetic Suspension" make beautiful music here, accompanied by a complete system with magnetic suspension 18" woofer and 10" mid-range. Full range systems in various enclosures.

INTER-MARK 639

In addition to the other models of the Cipher line of tape recorders, Inter-Mark is featuring their Cipher VI, a 4-track stereo/mono unit with a full-range stereo speaker system built into two detachable housings. This model may be used in either vertical or horizontal position, and is equipped with an automatic tape lifter to protect heads during fast forward and rewind operation. In addition, this model may be used with an external amplifier system, or as a complete public-address system.

JBL 339, 340

This exhibit features the SG520 "Graphic Controller," which uses straight-line controls for volume, tone, and balance, and illuminated push buttons for input selection, together with a number of secondary controls behind a concealing hinged panel. Among these controls is a built-in tone generator for balancing speakers. Solid-state throughout, this unit is "modernity to a maximum."

KENWOOD 401

Along with two other stereo receivers, the KT-10 all-transistor tuner amplifier will be the focus of attention. This model has an automatic protection circuit which guards against transistor damage due to accidental short circuiting of the output circuits, and switching to stereo in the presence of a stereo broadcast is automatic. The unit has an output rating of 16 watts per channel, and tuner sensitivity is claimed to be 1.5 μv.

KLH 345, 346, 347

In addition to their amplifier and the phono systems, KLH is showing the Model Seventeen acoustic suspension loudspeaker system, a "bookshelf" model comprising a 10-in. woofer and a 1¾-in. tweeter with an adjustable high-frequency level control, and an R-C-L crossover network. This model is of medium efficiency and designed to operate with amplifiers of 10 to 60 watts output per channel.

KOSS–REK-O-KUT 601

This room shows two lines, the Koss headphone line and the Rek-O-Kut turntable line. The Koss Pro-4 headphones are the feature of the headphone line, and it is a professional instrument. Frequency response from 30–20,000 cps, fluid-filled ear cushions, highest quality drivers in acoustically designed chambers.

The Rek-O-Kut B12H is a three-speed turntable featuring wow and flutter of 0.085% rms, noise level –59 db, and a heavy-duty hysteresis synchronous motor.

KSC SYSTEMS 415

The KSC-3 speaker system, only slightly larger than a bookshelf cabinet yet giving "big system" sound with 360-deg. radiation is, the item under the spotlight in this exhibit. The model is the third in the line of KSC systems, following in the footsteps of the KSC-1 and the KSC-55, already well accepted.

LESA OF AMERICA 553

Comprising a Lesa CD3/31 Automatic Turntable and an 18-watt amplifier, the SA-203B High Fidelity Stereo Modular System employs four speakers in a cabinet finished in oiled walnut. Headphones can be plugged in for private listening, and auxiliary speakers can also be used. It is equipped with a tape-recorder output, and inputs for both mono and stereo tape and for mono or stereo tuners.

MAGNECORD 620, 622

Featuring sound quality in a professional-type tape recorder at a price within the range of the audiofan's budget, the new Magnecord 1024 will be in the spotlight in this exhibit. Machine records and plays quarter-track mono and stereo at 3¾ and 7½ ips.

MARANTZ 424

The new and long-awaited Model 10 Tuner in its latest form, Model 10B, will be the main feature of this exhibit. This is the first tuner to combine vacuum-tube amplification with passive filter-type circuitry throughout the i.f. section. Built-in multipath indicator gives the user the assurance of optimum antenna positioning for best stereo quality.

MARTEL 519

The Uher Stereo 7000, a brand-new model not heretofore seen in the U. S., will be the featured item in the Martel exhibit. This model is all solid-state, and is equipped with four loudspeakers in the carrying case for optimum sound quality.

McINTOSH 507, 552

A solid-state preamplifier, Model C-24, will be the feature of the McIntosh exhibit. This unit employs silicon-planar transistors throughout, and has both harmonic and IM distortion figures of less than 0.1 per cent at normal output levels. Inputs accommodated are: phono 1, phono 2, microphone, tape head, FM-AM, FM stereo, tape, TV, and aux, and a full complement of controls provides complete flexibility.

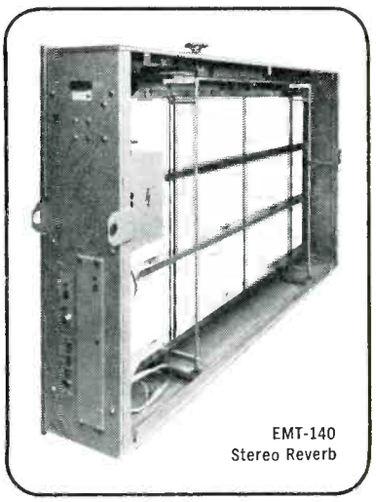
NESHAMINY 307

The Model Z-600 utilizes a pair of Janszen series 130 electrostatic mid- and high-range radiators which have been matched to within ±1 db. Each electrostatic radiator contains 176 push-pull sheathed conductors. Cone-type Model 350 woofer covers range from 30–2000 cps and is especially matched to the electrostatic high-frequency units.

(Continued on page 108)

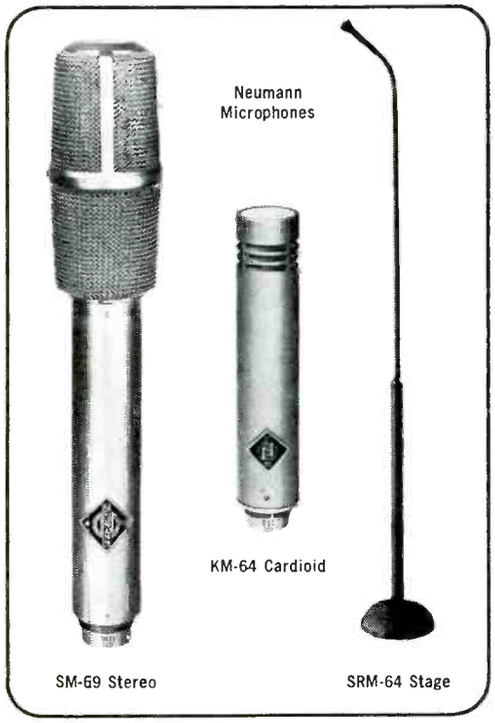
GOTHAM AUDIO SHOW

AM-32b Neumann
Mastering Lathe



EMT-140
Stereo Reverb

J-37 Studer
4-Track 1" Master Recorder

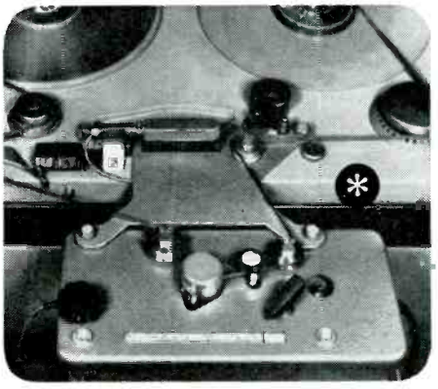


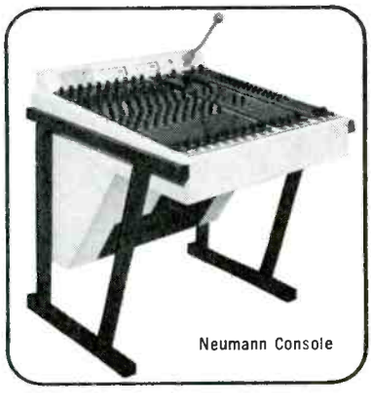
Neumann
Microphones

KM-64 Cardioid

SM-69 Stereo

SRM-64 Stage





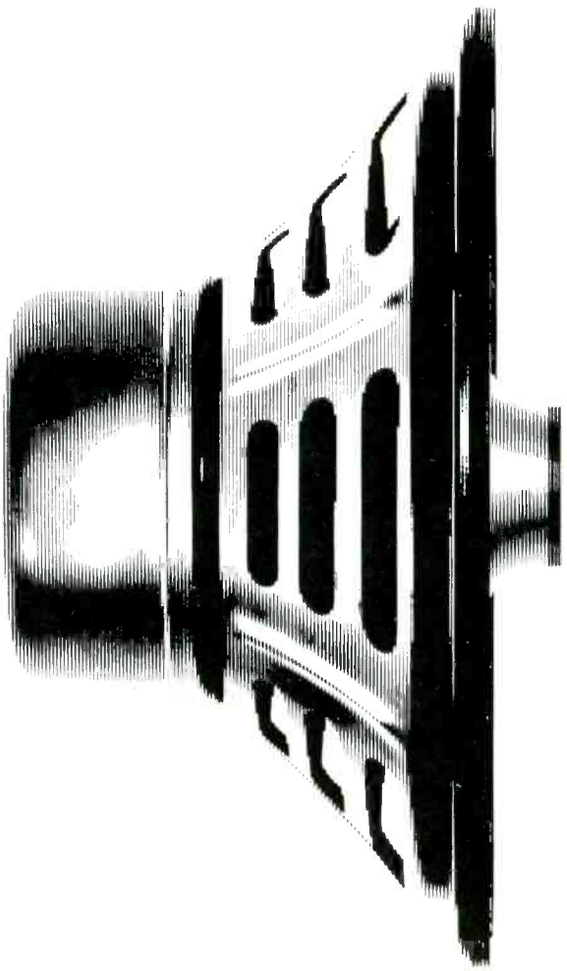
Neumann Console

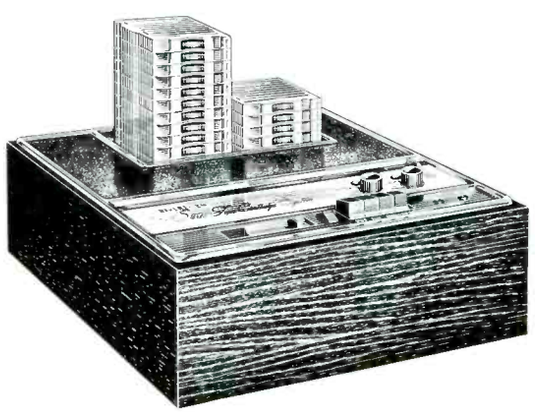
An exhibit of world famous professional equipment in action! See . . . hear . . . try the new Neumann Microphones, EMT Reverb, incredible*Eltro Tempo Regulator that changes tempo without changing pitch or vice versa. Oct. 12-16, St. Moritz Hotel (across from A.E.S. Convention) 12-8:00 p.m.

GOTHAM AUDIO CORPORATION • 2 W. 46th St., N.Y. 10036 • In Canada: J-Mar Electronics Ltd., P.O. Box 158, Don Mills, Ont.

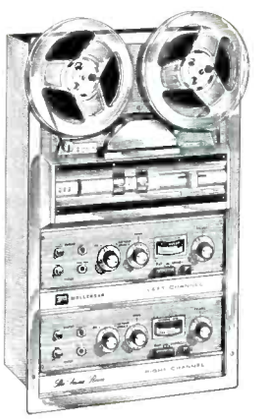
3M COMPANY

THINK YOU HAVE A GREAT SOUND SYSTEM NOW?





REVERE-WOLLENSAK M-20 AUTOMATIC STEREO TAPE DECK The newest idea in music now for custom installation! This amazing machine threads, plays, rewinds, changes tapes automatically. Up to 15 hours of uninterrupted music just by touching a button. Dual record/playback preamplifiers. Record in stereo or mono from any sound source, or choose from a wide assortment of pre-recorded tapes. Keyboard controls . . . high speed search lever . . . automatic and delayed shut-off . . . unsurpassed sound-on tape reproduction. *Also available in playback-only deck version, Model M-30.* SIZE: 14½" x 14¼" x 7". WEIGHT: 32 pounds.



WOLLENSAK 1981 "SOUND ROOM" STEREO TAPE DECK Designed for the serious tape recordist, incorporating two new module-type recording and playback amplifiers which provide 22 watts output. Superb stereo or mono recordings can be made from any sound source. Vertical or horizontal operation . . . 2 VU recording meters . . . convenient tab controls perform all playback and record functions . . . sound with sound . . . dual speed . . . automatic tape lifters . . . patented balanced tone control . . . patented head demagnetizer . . . complete professional stereophonic sound advantages. SIZE: 21¼" x 13¾" x 9$^{5}/_{16}$". WEIGHT: 42 pounds.

WAIT TILL YOU INSTALL A REVERE-WOLLENSAK TAPE DECK!

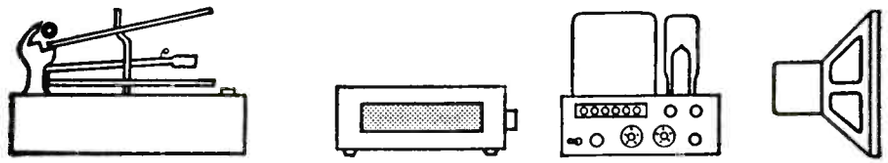
You're in for a musical revelation. In fact, you're in for several pleasant surprises when you see and hear the four different kinds of Revere-Wollensak tape decks. Want to make your sound system the most convenient custom installation in the world? Install one of the Revere-Wollensak AUTOMATIC Tape Decks that change tapes even *more* conveniently than an automatic record changer changes records. Want to make your sound system the most professional and reliable custom installation? Then use any of the three Wollensak reel-to-reel decks. You can't go wrong. Take your pick. At your nearest dealer. Reel-to-reel or automatic . . . **WHAT YOU WANT IS A REVERE-WOLLENSAK!**

WOLLENSAK 1780 STEREO TAPE DECK For the sound perfectionist who wants to incorporate top quality Wollensak stereo recording and playback facilities in an existing sound system. Can be installed either vertically or horizontally. Dual matched record/playback preamplifiers . . . automatic head demagnetizer . . . sound with sound . . . instant pause control . . . cadmium steel enclosure with chrome trim . . . easy-to-operate tab controls . . . volume control for each channel . . . automatic shutoff . . . automatic tape lifters . . . many other outstanding stereo sound-on-tape features. SIZE: 13¾" x 14" x 5½". WEIGHT: 15 pounds.

WOLLENSAK 1281 STEREO TAPE DECK Now you can have the many advantages of a fine Wollensak amplified tape deck at a new *low* price! The "1281" is a beautifully styled unit that gives you true professional sound control: 4 track stereo and mono record and playback . . . horizontal and vertical operation . . . 2 VU meters . . . 7½ and 3¾ tape speeds . . . automatic cut-off . . . convenient interlocking tab controls . . . instant pause control . . . patented self-adjusting braking system . . . independent volume and tone controls on each channel . . . many, many more quality "custom" features. SIZE: 10¼" x 15⅝" x 5¾". WEIGHT: 20 pounds.

Circle 126 on Reader Service Card

EQUIPMENT PROFILE



HARMAN-KARDON SOLID-STATE FM-STEREO RECEIVER, MODEL SR900

The "Stratophonic" Series of receivers by Harman-Kardon represents a departure for this firm which has specialized in innovation. With the introduction of this solid-state series of units they have announced that *all* Harman-Kardon high-fidelity products henceforth will be totally solid state, with not even one teeny nuvistor to mar their lineup. Of course this is not a sudden transition, after all H-K has been making solid-state other components for some time, and with clear intimations that they would eliminate tubes all the while. Now they have done it. And we have their first and foremost receiver to report.

The SR-900 is a complete stereo control center, FM-stereo tuner, and a 75-watt (IHF) stereo power amplifier, all on one chassis. Observable in *Fig.* 1 is the FM signal-strength meter, the FM-stereo indicator light, the separate tone controls for each channel, the rocker action switch for cutting tone controls completely out of the circuit, the 6-position function switch which permits selection of mono or stereo tape and FM inputs as well as phono or auxiliary inputs, the two-system speaker selector switch, the balance control, the various other rocker-action switches, and the well-placed tuning knob. Altogether the front panel is extremely handsome and conveniently laid out.

Some of these functions deserve further explanation. For instance in the FM Mono/Stereologic position the set automatically switches between mono and stereo FM broadcasts. Thus, a mono broadcast is channeled through the appropriate mono path, and when a stereo broadcast is received, the SR900 automatically channels it through the stereo decorder. A valuable feature of this circuit is that it will switch back instantly to mono reception if the stereo signal level falls below a predetermined acceptable level. Keeps distortion low, automatically.

Another valuable feature for the modern home is the facility for supplying two different speaker systems at the same time, or individually. This permits providing music to four mono speaker locations, or two stereo locations. A switch permits selection as desired, with the further option of stereo headphones (jack on front panel). With this array of speaker possibilities one can provide music almost anywhere in the home, or outside, from the central control station.

Circuit Description

FM: The FM tuner in the SR900 is very similar to the Harman-Kardon F1000T which has built an enviable reputation for itself in the year or so that it has been available. Essentially it consists of two dual-gang tuning sections, the first section being used as a "preselector" and the second section is used to tune the oscillator and mixer circuits. (Unfortunately the schematic does not label the transistors with standard numbers but rather uses a special code which is arbitrary. Thus we are unable to identify them as to type and composition in this report.) Following the front end are four i.f. stages, a ratio detector, and the multiplex decoder. The signal-strength meter obtains its signal from the next to last i.f. stage, and the automatic stereo circuit from the preceding i.f. stage. The latter circuit utilizes a zener diode in the avalanche mode to operate the 38kc doubler when sufficient 19kc signal is present; if the signal is insufficient it cuts off the doubler. An unusually simple and inexpensive method for achieving automatic differentiation between mono and stereo, and also between good and poor stereo.

Amplifier: The preamplifier section is usual insofar as the circuit is concerned, the unusual part is that the entire preamp is built on the wafers of the function switch. Here full advantage was taken of the small size and power requirements of transistors to eliminate the long runs of signal cable common to tube amplifiers. This eliminates a potential source of noise and hum.

The power amplifier is the familiar RCA configuration, utilizing a driver transformer. The output transistors are 2147's (we could observe this). Although this circuit appears very similar to the standard RCA configuration, we found it to be exceedingly rugged. We deliberately overdrove the amplifier for a long period of time, introduced a variety of transients, and even shorted the outputs briefly with no ill effects. This amplifier definitely passed the reliability test with flying colors. And without a complicated circuit.

We must take special note of the chassis. Here, perhaps for the first time in components, we see mechanical design which takes full advantage of the properties of transistors. We pointed out already the efficient location of the preamp. The same thinking governed the placement of all components. The chassis is steel with a heavy-gauge aluminum section at the rear to act as heat sink for the power transistors. The chassis layout is such that almost all available surfaces are utilized; the only surfaces not used are the outer left and right sides. Most working components are on top rather than beneath the chassis making it extremely easy to service. The small size of transistors and their attendant components, plus the use of all surfaces make one of the least cluttered rats nests we have seen for a receiver.

Performance

Amplifier: We tested the SR900 with an 8-ohm load and with both channels driven. Power output is rated at 18 watts rms. The SR900 produced rated power from 20 eps to 20,000 eps within 0.25 db. Distortion in this range varied from 0.2 per cent at 20 eps to the maximum of 0.29 per cent at 20,000 eps. In between figures were 0.17 per cent at 400 eps, 0.2 per cent at 1000 eps, and 0.21 per cent at 10,000 eps. Intermodulation measured 0.56 per cent at 4 watts using a 60 eps and 7000 eps test signal, 4 : 1 in amplitude.

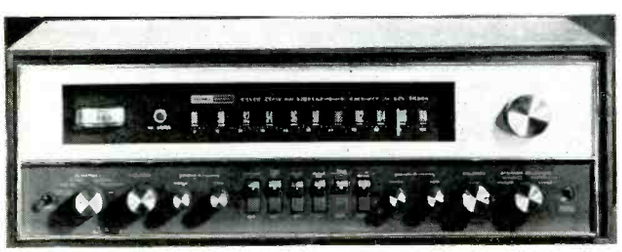
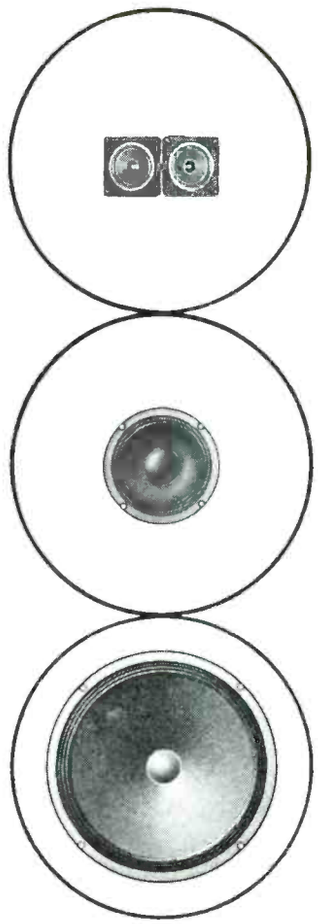


Fig. 1. Harman-Kardon Solid-State FM-Stereo Receiver, Model SR900.



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for precise re-creation of music . . .
for precision of craftsmanship . . .
for variety of mounting options . . .
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Bozak

DARIEN / CONNECTICUT / 06821

bozak / the one outstanding value in loudspeakers

Full power was delivered at 10 cps, 14 watts at 30,000 cps, 12 watts at 40,000 cps, 9.4 watts at 50,000 cps, and the output rolled off smoothly to 2.1 watts at 100,000 cps.

Frequency response was within 0.75 db from 10 cps to 100,000 cps.

Square wave rise time was less than 2.4 μs with no evidence of oscillation, with a variety of loads. Hum and noise was 90-db below rated output at the auxiliary input. Sensitivity at the auxiliary input, was 180 mv, at the phono input 2.1 mv, and at the tape head input 2.6 mv.

Tuner: The SR900 boasts an IHF sensitivity of 2.0 μv. Crossmodulation index was 83 db, capture ratio 3.9 db, selectivity 3 db, AM suppression 60 db, and stereo separation at 1000-cps was 38 db. Impulse noise rejection was excellent.

Tuning action was positive and smooth, in the excellent tradition of the Citation III.

Summary: We have confined ourselves up to now to description and reporting. We must make it clear at this point that the Harman-Kardon SR900 is a top-flight receiver, designed for those who wish the performance of components and the convenience of all-in-one construction. The SR900 is at present in a category all by itself; it is the only component-quality all-transistor receiver we know of. Surprisingly, it is also very modestly priced for a transistor unit (about $469 list), very close in price to tube units.

The SR900 shows its quality in listening tests; it produces sound as good as any we have heard. We were especially pleased with the bottom end, it added a measure of solidity to certain selections we had never before experienced. Of course the top end is excellent too, characterized mainly by its smoothness. Unfortunately our standard antenna is temporarily out of commission, but we did note that the SR900 pulled in a large number of stations loud and clear on our temporary rig. We would estimate that it is amongst the best in that department.

Altogether the Harman-Kardon is well worth the attention of the audiofan who desires all-in-one convenience.

Circle 209

OKI STEREO TAPE RECORDER, MODEL 555

The OKI 555 is a two-speed, ¼-track, stereo record and playback tape recorder utilizing transistors for all the electronics. It is completely self-contained incorporating a 6-watt playback amplifier and two satellite speaker systems. The design is such that the speakers mount over the recorder, one in front and one in back, for transporting. With the speakers mounted, the OKI 555 is a compact and neat package measuring about 12 × 14 × 12-in. and weighing about 25 lb. It accepts two high-impedance mikes and/or two auxiliary inputs.

By way of introduction we should point out that OKI Electric Industry Co. is a large Japanese company which specializes in telephone equipment. We recall a company representative stating that OKI is the largest telephone company in Japan. Having decided to enter the tape recorder market in the United States, they introduced several models and the 555 is the top of their line.

The 555 incorporates a number of interesting features. First we note from *Fig.* 2 the two VU-style meters. Below them are the record-playback volume controls, the left-channel control under the left meter, and the right-channel control under the right meter. Intelligent layout; makes it intuitively easier to control the appropriate channel.

Notice the record buttons just to the right of the level meters. They are red as is usual for record buttons. The left button is for the left stereo channel or the 1–4 tracks for mono, the right button is for the right stereo channel or the 2–3 mono tracks. Above each button is a red light which glows when the button below it is in the record mode. The playback buttons (black) just to the right of the

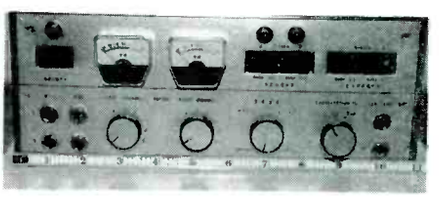

Fig. 2. OKI 555 Stereo Recorder.

record buttons repeat the functions of the record buttons, for playback. Also intelligent human engineering.

The remaining electrical controls are tone and equalization-PA. The latter control selects between 3¾ and 7½-ips equalization or the PA function, which permits the 555 to be used as a portable PA system. The on-off button is to the left of the level meters and has a light above it to indicate when power is on. An interesting feature is that there is an automatic circuit which cuts off the machine when it is in one of the running modes and there is no tape running past the heads. The circuit is triggered by a wire to the left of the erase head, which is held from completing a circuit by the tape, and completes the circuit when tape is not present.

Mechanical Operation

All running controls are located on the upper portion of the machine (the significance of this is that the electrical and mechanical sections of this machine are completely independent from each other, the electronics can be unplugged and removed *in toto*) and are mechanical. When the Run knob is pushed towards the reel, normal forward motion is started; The upper white-colored idler to the left of the takeup reel (see *Fig.* 3) is pushed against the belt from the motor pulley to the takeup reel. At the same time the brakes are released from both reels and the pinch roller-pressure pad assembly is pushed against, respectively, the capstan and the two heads.

The capstan is driven by a belt from a motor pulley below the deck shown in *Fig.* 3. This pulley is two-stepped, one for 3¾ and the other for 7½-ips. Speed selection is effected by a lever with a forked finger arrangement which forces the capstan-drive belt from one pulley diameter to the other. The capstan shaft has a rather large flywheel mounted on it.

Fast forward is effected by pushing

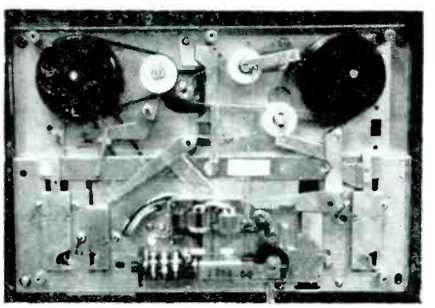

Fig. 3. Mechanical setup of OKI 555.

the lower idler near the takeup reel against the belt quite firmly, releasing the brakes at the same time. Rewind occurs when the idler close to the motor pulley is pushed against that pulley. Pushing the Pause knob lifts the pinch roller-pressure pad assembly away from their usual running positions.

Electrical Description

We did not emphasize the point previously, but the OKI 555 is completely solid state, employing 27 transistors and 6 diodes. The record circuit is quite straightforward and utilizes a two-transistor bias oscillator which oscillates at about 95 kc. The preamp utilizes two transistors for amplification and equalization and another one for a tone driver. (By the way, if you're wondering why we don't name the transistors, it is because the schematic gives Japanese transistor numbers and we were unable to translate them into American equivalents at the time of this report.) The power amplifier uses a familiar configuration known as the quasi-complementary symmetry circuit. The power output of this configuration varies with the output and driver transistors used but in this case it is 2.5 watts rms per channel. A 500 μf capacitor couples the output of the amplifier to the speakers.

(*Continued on page 112*)

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CONTROLS: Input Selector, Mode (incorporates FM stereo defeat), Volume, Balance, Bass, Treble, Loudness Compensation, Muting-off, AFC-off, Power on-off. INPUTS: Mag. Phono, tape, auxiliary, 300 Ω antenna. OUTPUTS: left and right speakers, tape, headphones. INDICATORS: Illuminated tuning dial, tuning meter, stereo program indicator light. FUSES: Line, Left Speaker, Right Speaker, SIZE (HWD): 5 x 16½ x 13¼ inches.

AMPLIFIER/PREAMPLIFIER SPECIFICATIONS: POWER: 66 watts total IHF music power output. IM DISTORTION: 2% at 30 wpc (watts per channel); 1% at 25 wpc; 0.3% at normal listening level. IHF POWER BANDWIDTH: 20-20,000 at 25 wpc, 0.5% harmonic distortion. HARMONIC DISTORTION: 0.16% at normal listening level. FREQUENCY RESPONSE: ± 1db 10-60,000 cps. HUM & NOISE: 70db below 10mV on mag. phono; 70db below rated power on other inputs. SENSITIVITY: 3mV on mag. phono, 180mV on other inputs. SPEAKER CONNECTIONS: 8-16 ohms.

FM MPX STEREO TUNER SPECIFICATIONS: SENSITIVITY: 2 microvolts for 30db quieting (IHF Standard), 2.7 microvolts for 40db quieting. IHF HARMONIC DISTORTION: 0.5%. CHANNEL SEPARATION: 38db. FREQUENCY RESPONSE: ± 1db 20-15,000 cps. IHF SIGNAL-TO-NOISE RATIO: 60db. IHF CAPTURE RATIO: 4.5db. IMAGE REJECTION: 50db. IF & SPURIOUS REJECTION: 80db. SCA REJECTION: 40db. 38 KC SUPRESSION: 55 db. 19 KC SUPRESSION: 45db.

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Tube Replacement

Q. The 12AD7 tube is no longer made, and I cannot find a proper substitute for use in my tape recorder. However, I'm using a 7025, and it works. Is there a better substitute?

A. I have checked with a couple of tube manufacturers, and they tell me that the 7025, 12AX7, and ECC83 are replacements for the 12AD7.

Larger VU Meters?

Q. My tape recorder contains two very small VU meters. Would substitution of 3½ in. VU meters provide better accuracy?

A. Naturally, the larger the VU meter the easier it is to read and therefore to make an accurate setting of recording level. However, the larger meters are not necessarily more accurate in the sense of their response to audio signals. It is possible to get good quality in a small package as well as in a large.

Static Flutter

Q. I have been bothered lately by an unusual type of flutter in my tape recorder. It is present only when playing particular tapes. I have noticed that a static charge is built up between the layers of tape as they come off the reel. This causes the tape to roll off unsmoothly and creates a terrible flutter. Is there anything I can do to eliminate this static charge? Could this charge come from too little moisture in the metal cans in which I keep my tapes?

A. I have discussed your problem with several persons in the field, and two suggestions have come out. The first, in line with your thinking, is to increase the moisture content of the tapes. This can be done by storing them for about 24 hours in a container with a moist sponge. The second suggestion is that you paint the heads with printed circuit paint so as to ground the laminations to the metal case of the head. But you must be very careful, lest you ruin an expensive head. Do not paint any portion of the head contacted by the tape. Above all, do not get any paint on the gap.

Pop-pop-pop, No Lifters on Stop

Q. I have modified my tape deck to include a third head. This is a quarter-track playback head, which is wired to the tape-head input of my audio amplifier. I have also modified the tape lifters on the deck so that they work only in the fast forward and rewind modes. That is, they no longer lift the tape in the stop mode. Since making the above modifications, I can no longer come to a stop from one of the high speed modes. If I do I superimpose a signal on the tape, a pop-pop-pop sound. This sound is erasable and is very similar to ignition noise, but slower. I suspect this could be cured by making the lifter work in the stop position, but I do not wish to do so because recording and editing is much easier with the deck as it is now. It appears that the cause is in the original electronic circuit. A set of tests made by disconnecting the various heads in all possible combinations lead me to this conclusion, since the noise occurs only when the record-playback head is in position and connected to its circuit. This is disconcerting because I normally use it as a record head, and play back through the newly installed head. Then I must disconnect the record head, which I often forget to do, before rewinding and listening to tape playback. The noise does not appear if I start or stop at the normal operating speeds. It is as if the speeding tape, coming to a stop, develops a charge, which is then discharged and leaves a signal on the tape.

A. Yours is an unusual problem. Here are a couple of thoughts. If you are mechanically ingenious, you might work out an arrangement whereby the record head is disconnected automatically whenever the mechanism is put into fast forward or reverse. To prevent the static discharge from being recorded, you might paint the record head with printed circuit paint, as discussed more fully in the answer to the preceding question.

Copying Tapes

Q. I would like to copy tapes. I own a high-quality tape recorder, which can be used to make the copies. To play the original tapes, can I get a tape deck without recording facilities? Or do I have to get a full unit that records as well as plays back?

A. There are several so-called tape players on the market, which you can buy at considerable savings over a machine that records as well as play. You would want a tape player that includes playback electronics. Some tape players are simply a tape deck, without electronics of any kind.

Maximum Recorder Frequency

Q. What limits the maximum frequency that a tape recorder can record? Is it the tape head gap width or a magnetic phenomenon?

A. The upper frequency limit in recording is governed essentially by: (1) self-demagnetization, referring to the fact that the opposing poles of each bar magnet recorded on the tape cancel each other to an increasing extent as the magnet grows shorter, i.e., as frequency rises at a given tape speed or as tape speed is reduced at a given frequency; (2) erasure due to the bias frequency, such erasure increasing as frequency rises at a given tape speed or as tape speed is reduced at a given frequency. There may also be some treble attenuation due to "iron losses," namely hysteresis and eddy current losses. These losses are generally negligible in the audio range when a record head of good quality is employed. Gap width is not a factor in treble response when recording; it is a factor only in playback.

Frequency Range of Recorded Tape

Q. What would be the frequency range of a quarter-track 7.5 ips recorded tape of a reputable company?

A. The response should be virtually flat between 40 and 15,000 cps.

Adjusting Recorder Bias

Q. I have been told that to use high output tape to best advantage one has to adjust the recorder in various ways. Would you please explain whatever adjustments are necessary. Also please explain what advantages low print-through tape offers to the home recordist.

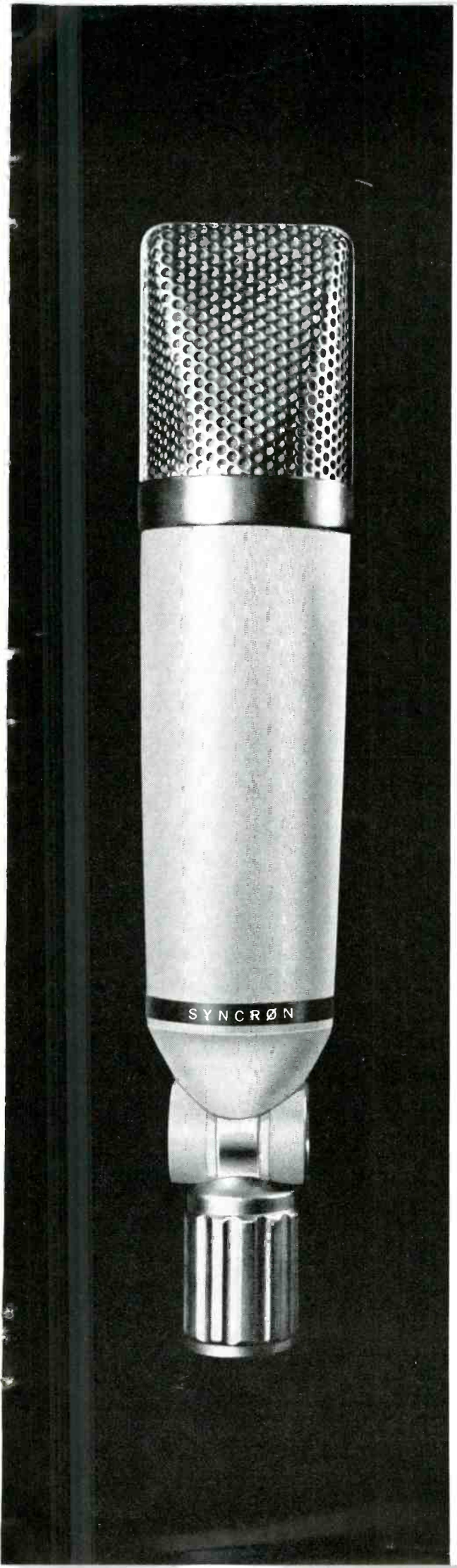
A. To use any brand and type of tape to best advantage, one should adjust bias current for minimum distortion consistent with good treble response. Ideally this is done by recording and playing back a 400-cycle tone and varying bias until minimum distortion, as measured by a harmonic distortion meter, is obtained. Frequency response is then checked. If there is too much treble loss, resulting from an increase in bias, it is necessary to reduce bias until treble response is acceptable. Usually a compromise between low distortion and extended treble response is required at speeds below 15 ips. The bias of home tape recorders is generally adjusted at the factory for optimum performance when using conventional rather than high-output tape.

I think that the advantage of low print-through tape is self explanatory. At high recording level, the signal on the tape tends to be strong enough so that it is transferred by magnetic action to the adjacent layers of tape. Hence there tends to be pre-echo and/or post-echo on loud sounds. Print-through increases with time. A recorded tape with seemingly no print-through when first played back may have discernible print-through when played back several months later. Low print-through tape—involving a special oxide, a thicker base than usual, and a thinner magnetic coating—is able to reduce print-through by about 8 db, which is enough in most cases to prevent print-through from becoming audible.

High Hum

*Q. To play a tape at a normal listening level, I have to turn the playback control of my * * * tape recorder to a position where the noise and hum are troublesome. What might be the reason?*

A. The specifications for your machine state that the noise is 45-db "below record-machine, probably accounting for your ing level." If the reference is to *maximum* recording level, such performance is about 10-db worse than provided by a top-flight problem. Æ



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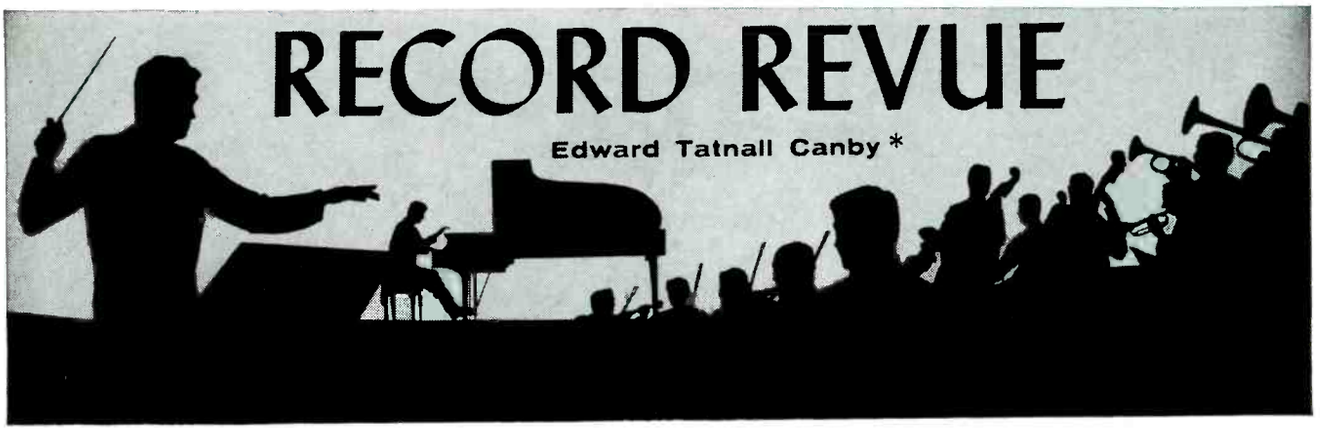


RECORD REVUE

Edward Tatnall Canby *

Electronic Re-channeling

Songs of Faith the World Around.
R. W. Steen, narr.
Philips PCC 605 electr. stereo

"This is an electronic re-processing to permit reproduction on stereo players of a performance originally recorded monophonically," says the Philips record jacket. The contents are an excellent demonstration of the usefulness of this new technique, here applied to mono field recordings made in widely separated places—from Tanganyika and Ghana to Burma, India, San Francisco, France. The tapes vary in quality, some being quite good in the fi, others of extremely restricted tonal range (battery portables and mule transportation); but to all there is added a palpable sense of life and immediacy as played on the good stereo system, without the slightest exaggeration or gimmicky feeling. The doctoring is, in fact, very gentle and mild. No violent "right-left" separation at all, just a heightened sense of clarity and space, plus the disappearance of the stuffy bump-in-the-center mono effect.

This is not one of those highs-to-the-left, lows-on-the-right systems. Indeed, the two tracks sound almost alike in tone quality. The differences would seem to be mostly in phrasing, probably at least in part via differently phased added synthetic liveness in the two channels. Significantly, the highs tend to cancel out when the tracks are combined into mono, dulling the over-all sound. A very interesting effect, this synthetic adaptation of the mono recording for stereo playback.

The recorded commentary is heavily slanted for the church trade and may annoy the general listener with its Sunday school sound. (The theme is tolerance of other peoples' Protestant missionary church music). But the assorted singing comes through interestingly even so, especially when it is free of the dead weight of our own church music traditions. (Ugh—what dreadful things Protestants can do to good music, with the best of intentions!)

BIG STUFF

Beethoven: Piano Concerto No. 3, Op. 37; Choral Fantasy, Op. 80. Rudolf Serkin, Westminster Choir, N.Y. Philharmonic, Bernstein.
Columbia MS 6616 stereo

Beethoven: Triple Concerto, Op. 56. R. Serkin, pf., J. Laredo, vl., Leslie Parnas, cello; Marlboro Festival Orch., Schneider.
Columbia MS 6564 stereo

Steady stream of Serkin-inspired music from Columbia these days, much of it Beethoven, with the wiry, energetic master of the Marlboro Festival always at the piano. Here he tackles two of those "impossible" pieces that Beethoven composed now and then, between his very "possible" symphonies, quartets, sonatas, concertos. Neither of these ever seems to come off in performance; but if anybody can breathe life and musical unity into them, it is the indefatigible Serkin. His piano is, as the ancient phrase goes, electric. Each time he enters the music, energy changes build up and scintillate. . . .

The Third Piano concerto is actually the "extra" piece here, an unusual role for the familiar music. It gets a big, aimable, sabre-rattling, blowsy performance in huge stereo from Bernstein's orchestra, held together thanks to Serkin's incisive, lean pianistic musicianship. Good Beethoven in the all-over.

The Choral Fantasia is a study-piece for the famous last movement of the Ninth Symphony—it must have unintentional, if we can go by the music itself! It sounds astonishingly like the Ninth, but such a clumsy, oafish version of the Ninth as you can only believe if you know Beethoven's unique way of composing over the years, so often starting with the most banal ideas and naively uncouth construction, ending up with the very opposite. This piece begins with a flossy piano solo "improvisation," then hauls in the orchestra and finally soloists and chorus. Not even Serkin (and definitely not the Westminster Choir) can make it sound much better than preposterous—with superb moments sprinkled in everywhere.

As for the Triple Concerto, it is a much more finished middle-period concerto but the problems of the *concertante*, the concerto for a group of instruments, were more than Beethoven's dramatic instinct could cope with successfully (where Mozart wrote superb *concertante* music). This big, fat, sprawling piece has noble Beethoven themes and a grand layout on a heroic scale—but somehow (again in spite of Serkin's best) it seems to go in one ear and out the other. Just plain not dramatic enough for its own weight.

—All of which makes these two discs unusually interesting for anybody who is anxious as to how the curious Beethoven musical machinery works. You learn a whale of a lot about the *other* (and better) pieces.

R. Strauss: Arabella (1933). Della Casa, Rothenberger, Fischer-Dieskau et al., Bavarian State Orch., Keilberth.
Deutsche Gramm. 138 883/5 (3) stereo

I can only say about this opera that, as the Romantic period moves away from us in time, "Arabella" is going to emerge as one of the greatest operas of the end of that period. No matter that in 1933 we were already "modern" by many a year! Strauss is of another time—yet, in retrospect, a surprisingly modern time as compared with, say, Richard Wagner, whose music this Strauss only *very* superficially resembles.

It is distressing to read the printed comments by older critics on Strauss's decline—they started saying that around 1900 and never gave up until his death in 1949. His musical language did not move forward in outward style, nor his basically Romantic approach. But the refinement of an immense talent went forward to the end. "Arabella" is an opera like no other (except, perhaps, the best of Puccini) in the perfection of its vocal style and its musical characterization. What a superb writer for the voice! What poetic, sensitive, alive stage-music, so personal, so vivid in the play of human feelings, so near to actual speech and yet so superbly tuneful!

Just follow the libretto (you *must* do that) in this new DG recording, made at a performance, featuring the fabulous Fischer-Dieskau and the singer most intimately associated with the role of Arabella herself, Lisa della Casa, plus a superb younger sister, Zdenka, in Anneliese Rothenberger. You can't help but "fall" for the touching, poetic yet modern story of Vienna in 1860, carried forward in such utterly natural and modern-sounding dialogue that you will forget (as you follow the words) that it is music—yet revel in the music at the same time. I'm crazy about it, myself.

Yes, London has an earlier complete "Arabella," made in the first stereo days. I tried a bit just to see, and found that indeed Lisa della Casa sounds a good deal younger, more pure in voice, less wobbly, in a title role. And London's production is more stable in sound, since the new one is from a stage performance in 1963 at Munich. The new one, also, shows the inevitable ragged details here and there that one expects in a stage performance with no very good chance for corrections. (Probably this is several performances combined). Nevertheless—the new recording breathes drama and excitement and it has Fischer-Dieskau as the leading male. Mandryka. So it can be heartily recommended. A gorgeous three-language book comes along, plus the complete libretto in German and English, as part of the big album.

Klemperer Conducts German Opera Overtures. Philharmonia Orch.
Angel 36175 stereo

Klemperer Conducts Music of Wagner (Same)
Angel 36188 stereo

Berlioz: Symphonie Fantastique. (Same)
Angel 36196 stereo

The Klemperer discs roll forth in profusion, some of them superb—for Klemperer is one of the few remaining *really* elder-generation conductors, out of the Romantic period. Bruno Walter, Toscanini, Monteux and many more—all gone. But, again, Klemperer is not exactly infallible.

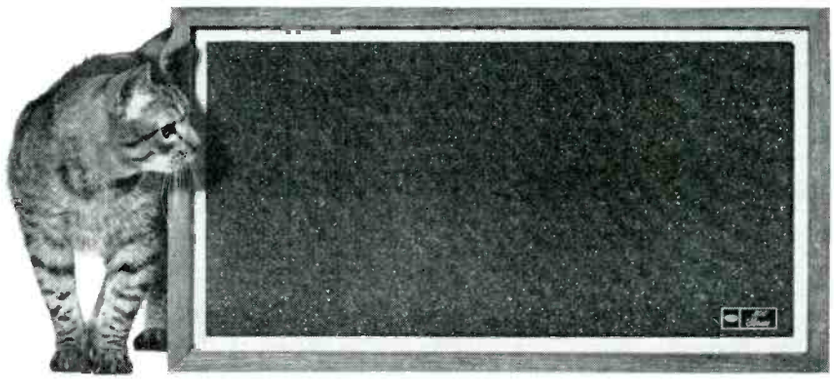
The German Opera Overtures are wonderful—"Hansel und Gretel," three of the great Weber overtures, the Wagnerized version (arranged by Wagner himself) of Gluck's "Iphigenie en Aulide." Practically nobody can do these high-Romantic works nowadays with the sweeping conviction that goes into a Klemperer performance. Same with his Wagner disc, the standard instrumental excerpts from "Lohengrin," "Meistersinger," "Tristan," "Götterdämmerung."

The Berlioz "Fantasic" is something else again. A discreet English orchestra and a solidly Germanic conductor for this music—no! It lacks the bristling excitement, the hair-raising mystery, the wild-eyed fanaticism that the French-minded conductor and orchestra can still give to this revolutionary score. The very qualities that make the Philharmonia-Klemperer combo so excellent for German

(Continued on page 111)

"By all means listen to this $95 speaker... This is not 'just another box.'"

HiFi/Stereo Review



THE ADC 303A BRENTWOOD

"After the lab measurements had been made, and I had a chance to analyze the data, I began to appreciate how unusual this speaker system really is."

So writes Julian D. Hirsch of Hirsch-Houck Laboratories, in his "Technical Talk" column in *HiFi/Stereo Review*.

The measurements that evoked his enthusiastic comments revealed surprising qualities in a speaker so compact as the new ADC 303A. Here is how Julian Hirsch describes it:

"For one thing, my tests confirmed the manufacturer's claimed frequency response of 35 to 20,000 cps ±3 db measured in an average listening room."

". . . the Brentwood has a true, effective response down to at least 33 cps, with lower distortion than I have measured on many larger and more costly speaker systems, under similar conditions."

"The system's resonance is 48 cps, and ADC states that it delivers true bass response to at least 38 cps. This it certainly does, with ease. The Model 303A is a very successful application of the acoustic-suspension principle, achieved without excessive loss of efficiency."

What Mr. Hirsch found in his laboratory was impressive; what he heard in his listening room was equally so. This is the way he sums it up:

"As for sound, the ADC 303A is very live and open. It has presence, but without the peaked unnatural response usually associated with that term."

". . . this speaker brings the music right into your listening room . . . as contrasted to some in which the sound never seems to get out of the speaker enclosure."

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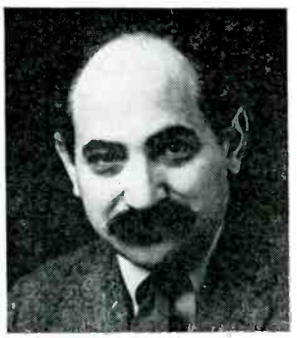


Charlie Mingus: Mingus Plays Piano
Impulse Mono A-60

In his first disc devoted entirely to piano solos, Charlie Mingus follows the example set by his chief influence, Art Tatum, and dispenses with the rhythm background commonly encountered on jazz piano discs. The resulting recording, although very much Mingus and of tremendous interest to all admirers of this highly creative jazz bassist, is not really jazz —unless one subscribes to the definition that jazz is any music performed by a jazz musician. What emerges from this recital is a group of richly harmonic improvisations that closely resemble the compositions of Albeniz and Debussy. These are impressionist performances, steeped with the color of early twentieth century piano writing. They are also fascinatingly like the melodic bass line of Mingus' playing in his highly charged polyphonic ensemble pieces. As a pianist, Mingus performs with a good technique, a large, round tone and an unfortunate tendency to select the most obvious left hand chords. As always, he has the knack for making simple, direct and meaningful statements. Only in two of his lengthier pieces, *Myself When I am Real* and *Compositional Theme Story: Medleys, Anthems and Folklore* does he indulge in a bit of aimless rambling, the sort of disorder never encountered in his compositions. The other nine numbers are less ambitious in scope and vastly more successful. It may not be jazz, but it is very interesting music, worth hearing and rehearing, and the Mingus stamp is evident.

The Three Sounds: Live at the Living Room
Mercury Stereo SR 60921

One of the brightest, breeziest and most thoroughly enjoyable of all jazz groups, The Three Sounds are that rarest of phenomena, a happy modern jazz group. It's a delight to encounter this trio in a new waxing, but the present release is a mixed blessing because of the sound quality. This is another one of those "live" recordings that have become so popular in recent years under the belief (generally false) that musicians play better in their natural habitat than in a recording studio. That the present group does not require audience stimulation is abundantly clear in their last release, *Some Like it Modern*, a record that was as outstanding for its clean sound as for its fine music making. Their newest disc is on the same high musical level, but bits of audience participation creep in at the least appropriate moments, and the sound is a faithful recreation of a nightclub performance. Stereo separation is first rate, but it applies equally to Messrs Harris, Dowdy and Simpkins and to the waiter rattling the coffee cups.

Mary Lou Williams: Presents
Mary Stereo FS 32843

Mary Lou Williams has only recently returned to the jazz scene following an absence that involved a deeply felt religious conversion. In her first disc in many years, she has included several of her own compositions that are a direct result of that new found faith. The balance of the platter is made up of six piano solos with rhythm in Miss Williams' familiar manner, *It Ain't Necessarily So, My Blue Heaven, A Grand Nite for Swinging, Dirge Blues, A Fungus Amungus* and *Miss D. D.* The other selections were arranged and conducted by Melba Liston, and they employ a chorus as well as instrumental forces. These religious works are synthetic concoctions, interesting only as curiosities, but the piano solos make it clear that Miss Williams' musicianly qualities are unimpaired. Her solid technique and airily poised rhythms are most welcome again. It is to be hoped that this album will be followed by more solo recordings

Lu Watters: Blues Over Bodega
Fantasy Mono 5016

Controversy over a proposed atomic power plant at Bodega Head in northern California has brought Lu Watters out of his self-imposed retirement in an effort to call attention to what he, and many other Californians, consider a serious danger. The Pacific Gas and Electric Company has announced plans to build this plant on top of an earthquake fault, the San Andreas Rift, site of a major earthquake in 1906. Bodega Head is a beautiful, unspoiled promontory on the Pacific coast, about fifty miles north of San Francisco. It was in San Francisco, during the forties, that Watters and his Yerba Buena Jazz Band commenced their own earth shaking activities which sparked the West Coast traditional jazz revival. Rough, ready enthusiasm was the outstanding characteristic of the Watters' style in those days, and that is still the dominant quality in the new recording. Included in the present collection are two Watters originals composed for the occasion, *San Andreas Fault and Blues Over Bodega*. Their tongue-in-cheek vocals are belted out in stylish manner by Barbara Dane who enunciates their anti-atom message clearly. Miss Dane is also heard in Jesse Fuller's *San Francisco Bay Blues* and *See See Rider*. A third Watters composition, *Emperor Norton's Hunch*, is one of the real pleasures on this disc whose contents are rounded out with several more traditional numbers, including *Willie the Weeper, The Villain* and *Some of These Days*. A full coterie of West Coast traditionalists are included: Wally Rose, piano, Bob Mielke, trombone, Thad Vandan, drums, Bob Short, tuba and bass, and Bob Helm, clarinet. Sound on the mono version is a bit lacking in resonance with rather weak bass.

Stan Getz, Zoot Sims, Paul Quinichette, Wardell Gray: Tenors Anyone?
Dawn Mono DLP 1126

Al Cohn: Cohn on the Telephone
Dawn Mono DLP 1110

Les Modes: Mood in Scarlet
Dawn Mono DLP 1117

Zoot Sims, Mat Mathews, Gene Roland Octet, Etc.: Jazz for Hi-Fi Lovers
Dawn Mono DLP 1124

Hardly new releases, these four discs are part of a series of pazz recordings brought out by the Latin American label, Seeco, during the fifties. Long withdrawn from the Schwann Catalog, this former $4.98 series is now being made available as budget price releases. They represent not only some first class performances, but also quite acceptable mono sound, just a shade below the quality of the best present day engineering. The Al Cohn disc offers ten tenor solos with a combo consisting of Hank Jones, piano, Osie Johnson, drums, Milt Hinton, bass, and Frank Rehak, trombone. Les Modes turns out to be a group consisting of Julius Watkins, French horn, Charlie Rouse, tenor, Martin Rivera, bass, Ron Jefferson, drums, Chino Pozo, bongos, and pre-trio Gildo Mahones, piano. A couple of experimental numbers feature wordless soprano vocals by Eileen Gilbert, but her contributions are brief enough to avoid serious disaster, and the Rouse and Mahones solos are very much worth having. The two remaining discs provide several different groups on each platter, probably because the original sessions were planned for cutting singles, rather than lp's. In any event, "Tenors Anyone?" is outstanding for four Getz solos with Al Haig, piano, Jimmy Raney, guitar, Gene Ramey, bass, Charlie Perry, drums, and Carlos Vidal, conga drums and for two tunes by the late Wardell Gray with the same group. "Jazz for Hi-Fi Lovers" offers eight tunes by eight different groups. Among them are units headed by Gene Roland Zoot Sims Mat Mathews and Paul Quinichette. At the time these discs were cut they represented very advanced tastes. Today, they seem much more mellow, but there is nothing dated or *old hat* about them. Indeed, several of these musicians are presently coasting on reputations made during this period.

Francois Rabbath: Bass Ball
Philips Stereo 600-128

Billed as a new sound in jazz, this disc offers a collection of clever, often amusing, but intellectually slight arrangements for double bass and drums. Monsieur Rabbath, a Frenchman who has not been encountered here before, reveals himself as an adept performer on the bowed bass, and in numbers like *Walpurgis*, electronic assistance helps to produce some eerie sounds that substantially increase the effectiveness of his instrument. In the following *Ode D'Espagne*, we are subjected to flamenco like music strummed on the bass as if it were a guitar. This is a technique that might well be shelved until such time as guitars are in somewhat shorter supply.

The Max Roach Quintet: The Many Sides of Max
Mercury Stereo SR 60911

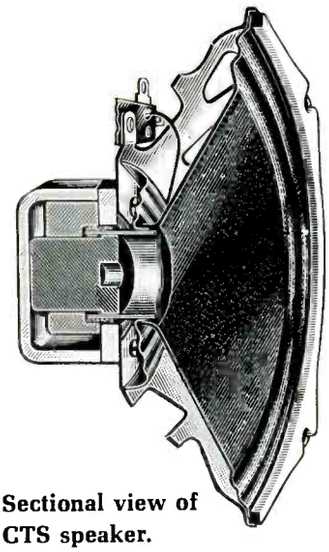
The unusual feature of the present disc is its consistent excellence. That Roach is one of the greatest of jazz drummers is something we have long come to accept. However, we have also come to expect somewhat variable output from his group. Happily the present disc is an exception. From start to finish, this is a collection of bright extrovert numbers performed with style and full of meaningful content. Best of all, Roach provides himself with enough elbow room to demonstrate the color and variety of his fanciful work. His own composition, *Tympanalli*, is a particularly fine sample of his ability to generate crisp, rapid sounds in a broad spectrum of percussive timbre.

The Gable-Airs: I'm Saved and I Know It
Battle Mono 6141

A gospel sextet that really rocks, the Gable-Airs are accompanied by a somewhat distant piano and rhythm group on this, their first record. A rough, rather than slick, ensemble, these boys have more than enough spirit and ringing sincerity to overcome any lack of polish. They are at their best in up-tempo numbers like *Travellin' Shoes* and *I'm Saved and I Know It*. The recording, made in Chicago's Universal Sound Studios, is crisp, close up, and does a great deal to help transmit the excitement of a live prayer meeting.

Hank Mobley: No Room for Squares
Blue Note Mono 4149

Four tunes by Mobley and two by Lee Morgan get thorough going treatment on this splendid sounding platter. Mobley's tenor has on varying occasions been associated with Miles Davis, Art Blakey and Max Roach. His latest release finds him in happy collaboration with drummer Philly Joe Jones. On four numbers this duo is abetted by Morgan on trumpet, Andrew Hill, piano, and John Ore, bass. The balance of the set offers two more numbers with trumpet, piano and bass turned over to Donald Byrd, Herbie Hancock and Butch Warren. The results are brisk and alert with special attention due Jones for his buoyant pacing and broad pallet of coloristic effects. As usual, Blue Note's first rate music is matched by engineering of comparable quality.



Sectional view of CTS speaker.

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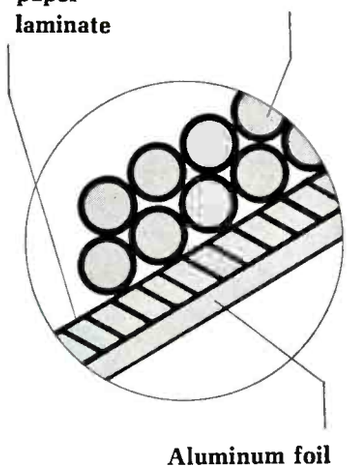

Magnified section of bobbin and coil

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The average wattage rating of a CTS loudspeaker is about 50% greater than conventional types because of an exclusive advanced design aluminum-paper coil (Patent Pending). For extra cool operation, the bobbin acts as a heat sink, allowing voice coil dissipated watts to be distributed evenly over the entire bobbin area. It gives better performance, too, since it acts as an insulator providing additional electrical clearance. The special paper design also provides a base which permits maximum penetration of voice coil cement for permanent placement of voice coil windings. Rugged CTS aluminum-paper bobbin retains its shape and size under overload and environmental changes to insure perfect voice coil alignment and uniform high quality performance.

There is a complete line of CTS loudspeakers—ovals, standard, or shallow from 3- to 15-inch diameters. All are available with heavy-duty housings in rustproof and corrosion-resistant finishes. Supplied with all standard and special type terminals in a multitude of sizes and configurations. The exclusive CTS "vermin-proof" housing which prevents rodent damage is also available. CTS loudspeakers are warranted to meet all EIA standards.

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Hot Stuff on the Asphalt!
Battle Mono 6133
Chrome on the Range!
Battle Mono 6135
Sports Car Caravan
Battle Mono 6137
Road Racing America
Battle Mono 6139

Designed for the motoring and miscellaneous noise audiences, it is likely that these four releases will be of greater interest to the latter, since there is a lack of any identification of specific cars or events on either the liners or labels. Both "Hot Stuff on the Asphalt!" and "Chrome on the Range! are devoted to the sound of hot rod drag races. They include a succession of sounds of engines idling, being revved up and roaring into the distance to the accompaniment of their straight through exhausts. More sensitive ears than mine will doubtless detect infinite variety in the sounds of their overhead camshafts and multiple carburetors. The remaining two examples of high speed at 33⅓ rpm offer sounds of racing sports cars, similarly unidentified. Background noises include some unrecognizable PA announcements, a phrase or two in Italian and what sounds suspiciously like a bit of RF interference on the tape of "Sports Car Caravan." In the foreground are the sounds of straining engines, low note exhausts, rapid cornering and burning rubber. No doubt the stereo versions of these platters hold a greater degree of excitement than their mono siblings. Listening via earphones, after the heartfelt complaints of a music oriented spouse, I was surprised to note that there was a close resemblance between these vibrations and those one encounters in a dentists' chair.

Jean Carignan
Elektra Stereo EKS 87266

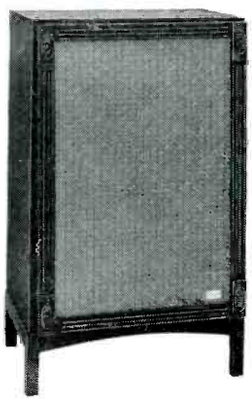
Billed as "The Folk Fiddler who Electrified the Newport Folk Festival," Carignan is a dazzling technician whose performances of French-Canadian reels combine rough-hewn vigor with enough inventive imagination to avoid monotony. The recording was made not at the Newport Festival but in a Canadian studio. The resulting sound is well balanced, and only a bit of foot clogging in the background is ever obscured. Accordion, piano, guitar and bass are all heard at various times in the accompaniments to the sixteen French-Canadian, Irish and Scottish dances, and one of the pleasures to be found in this lively collection is the variety of background achieved through different groupings of accompanying instruments.

Hampton Hawes Trio: The Green Leaves of Summer
Contemporary Stereo S7614

One of the truly important present day pianists, Hawes has not released a record since 1961. It is particularly pleasant to have him back on wax again because his new collection is an effective demonstration of the variety of his talents as well as an indication that this already impressive musical talent is continuing to develop and mature. Monk Montgomery, on bass, and Steve Ellington, drums, provide a tasteful, subdued background, with Montgomery a trifle too subdued. Hawes offers extended treatment of several familiar ballads, including *The Green Leaves of Summer* and *Secret Love*. In addition, he includes *Wierd Blues* by Miles Davis, *St. Thomas*, a calypso-tinged tune by Sonny Rollins, and *G. K. Blues*, a free-swinging number improvised by Hawes at the session. I suspect that this disc may actually sound better in mono than it does in stereo, since the stereo version places the piano entirely in the left speaker with the percussion way across at the right speaker. What little center fill there is comes from the bass. Aside from the disc's extreme directionality, the sound is clean and bright. AE

"A Medallion... 1

is a Medallion... 2



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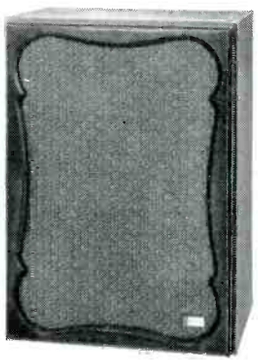
is a Medallion... 4



is a Medallion" 5

1. *Swedish Modern*
2. *Contemporary*
3. *Italian Provincial*
4. *Early American*
5. *French Provincial*

U-43

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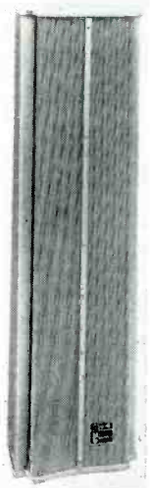
NEW PRODUCTS

● **Indoor-Outdoor Sound Columns.** University Loudspeakers has an array of new outdoor sound columns. The first, the CSO-4 (shown) with four extended-range, high-compliance, weatherproof and fungicide-treated 8 in. speakers, capable of handling 80-watts integrated program material, has a frequency range of 70–17,000 cps. Utilizing acoustic tapering, sound is



projected in a 120 deg. horizontal pattern and a 22 deg. vertical pattern. The CSO-6 with six, high-compliance, long-throw, 8-in. speakers, weatherproofed and fungicide treated, and capable of handling 120 watts of integrated program material, has a frequency range of 65–14,000 cps. Acoustic tapering gives the CSO-6 a horizontal pattern of 120 deg. and a vertical pattern of 16 deg. **Circle 196**

● **Empire Elliptical Stylus.** Empire Scientific Corporation recently began distribution of its new 880PE elliptical stylus cartridge and elliptical stylus replacement. The new 880PE carries all the standard features of the 880P plus some new ones. Specifications are: Frequency range, 8 to 30,000 cps; output voltage, 8.0 millivolts

per channel; channel separation, more than 30 db; load impedance, 47,000 ohms; weight, 10 grams; compliance, 20×10^{-6} cm/dyne; tracking force, ½ to 4 grams; stylus, 0.2 × 0.9-mil bi-radial elliptical hand-polished diamond; 4-terminal output; standard 7/16- or ½-inch mounting centers; 15-deg. vertical tracking angle. Retails for $14.95. **Circle 197**

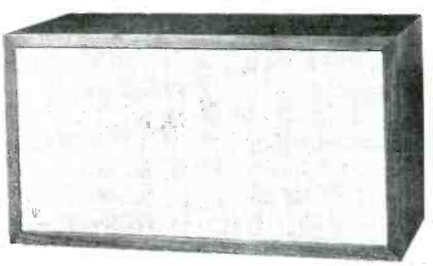
● **Tuner-Amplifier.** A new all-transistor FM-stereo tuner-amplifier kit, the EICO Model 3566, will be available in kit form for $229.95 and in factory-wired form for $349.95. The Model 3566 consists of an FM-stereo tuner and an amplifier on a single heavy-gauge aluminum chassis that can be mounted in a console or in an oiled walnut cabinet which is available for $9.95 extra. The tuner-amplifier may be used independently with a pair of loudspeakers for FM stereo and mono radio reception. Input jacks are provided to

enable use with a magnetic record player or changer and a tape deck. Output jacks are provided for connection to a tape recorder to enable the user to record FM radio programs. An output jack for stereo headphones is provided on the front panel. The all-transistor FM "front-end" and the four-stage i.f. amplifier-limiter assemblies are furnished pre-wired and aligned with the kit, minimizing the time required to assemble the instrument. The instrument is designed for operation from 115 volts a.c. It can be used on boats by providing a d.c.-to-a.c. inverter. **Circle 198**

● **Light-Weight Stereophone.** Superex Electronics Corporation announced a new model Light-Weight stereophone, Model SX-800. This new slim-line design offers crisp tonal reproduction through a specially-designed sound capsule. It is housed

in high-impact plastic ear cups with high-density poly-foam ear cushions to shut out background noise. Fully adjustable head band and separate adjustment centers give the wearer a custom fit. Phones weigh 6 ounces. Frequency response is 30 to 15,000 cps. Strain-relieved cord and standard stereo-plug termination are included. Price $21.95. **Circle 199**

● **Acoustic Research AR-4.** The AR-4, Acoustic Research's new speaker model, is $57 in an oiled walnut enclosure, $51 in unfinished pine. Dimensions are 19" × 10" ×



9". The AR-4, like all other AR speakers, is an acoustic suspension speaker. It has an 8-inch woofer and a 3½-inch wide-dispersion tweeter. Suggested amplifier power (rms) is 15 watts per channel. Impedance is 8 ohms. Frequency response and distortion curves are available on request. Prices are 5 per cent higher in the West and deep South. **Circle 200**

● **Transistor Tape Recorder.** Martel Electronics has recently introduced a fully transistorized "solid state" tape recorder called the Uher Universal 5000. This fully automatic dictating-transcribing unit has numerous commercial and industrial applications. Price is $299.95. The Universal 5000 will run the equivalent of a 10-hour working day without having to change a reel. Other features are: Separate record and playback volume controls; tone control; 3-digit resetable index counter; automatic stop with metalized leaders; automatic volume control; jam-proof piano-type keyboard; automatic rewind; remote

control of tape motion; low-impedance input; high-impedance input for microphone, telephone pick-up and radio-phono; plays back through microphone or internal speaker; built-in transmitter to operate automatic slide projectors (accessory required); all bearings oil-sealed. Specifications are: Frequency response, 40–4000 at 15/16, 40–8000 at 1⅞, 40–16,000 at 3¾; signal-to-noise, 50 db; flutter, 0.2%; output, 2 watts; weight, approximately 16 pounds; dimensions, approximately 6" × 10" × 13"; reel size, up to 6 in. Hartel Electronics. **Circle 201**

● **Microphone Addition.** AKG of American has added the D-119CS to its line of microphones. The D-119CS has a frequency range of 40–16,000 cps with a deviation of only ± 3 db. The true cardioid characteristics of this microphone give an effective front-to-back discrimination of approximately 15 db. The sensitivity is listed at

0.18 mV/μ-bar (−75 db) (1 v/dyne/cm²). The unit is provided with such features as bass attenuation switch (−10 db at 50 cps) and a noiseless on-off switch. Delivered with matching connector, stand adapter, 15-foot cable and wind protection bag. Impedance: 200 ohms. High-impedance transformer (AKG U-212) available. **Circle 202**

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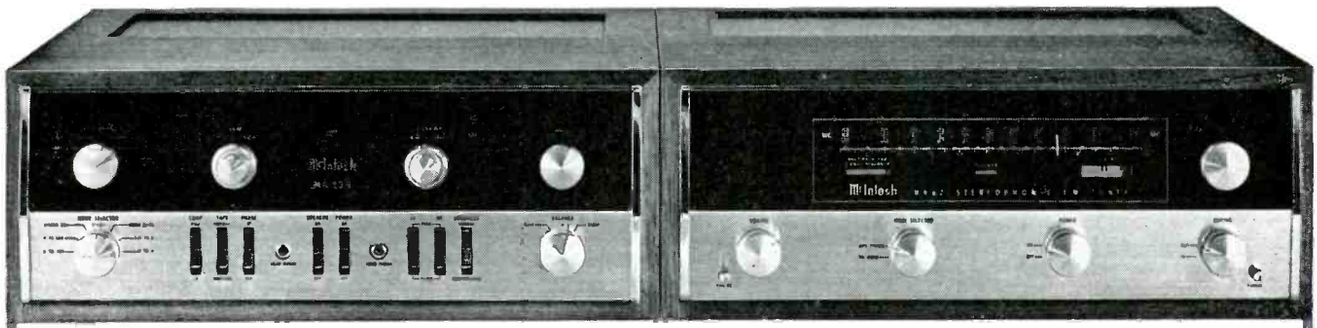

MA 230

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MR 67

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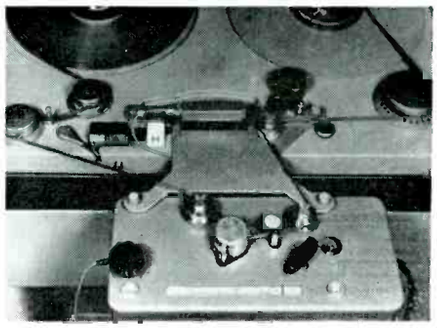
● **Tempo Regulator.** A unique device capable of changing the tempo of a tape recording without affecting its pitch and, conversely, changing the pitch without affecting the tempo, has been introduced to the market under the name of Eltro. The Model MLR 38/15, briefly available in this country some five years ago, has changed manfacturers and been re-engineered throughout. The device, invented by Dr. Anton Springer of West Germany,



is placed ahead of any professional tape recorder using its wind motors and playback amplifier(s). It features a rotating head assembly and a variable speed capstan drive which permit a tempo range of 50–180 per cent of normal speed without change of pitch, and a pitch change of approximately seven half-tones above, and over three octaves below, normal without change of tempo. The unit is available on special order for stereo, three track and four track tape with widths up to one inch. Gotham Audio Corporation. **Circle 203**

● **Acoustic Materials.** The Soundsorber, a blend of acoustic materials for the treatment of high fidelity speaker systems, is now available from Hartley Products Co. of New York. The use of the Soundsorber in a speaker system helps to eliminate air resonance and cabinet boom, and at the same time absorb the rear sound waves. The Soundsorber is a combination of two acoustic materials of varying densities, interwoven in a jelly-roll pattern. Sound from the rear of the speaker penetrates the more open material, which has a low

absorbency factor, and is then almost completely absorbed by the other material which is highly absorbent. The two materials act together to effectively damp the rear sound wave by reducing its output 65 db. A Standard Soundsorber module contains approximately 35 square feet of acoustic materials, which is sufficient to treat an enclosure up to 3 cubic feet in volume. Standard modules are available direct from Hartley Products Co. at $6.50 per unit. Larger-sized modules for use in bigger enclosures are also available at special prices. Hartley Products Co., 519 E. 162 St., Bronx, N. Y. **Circle 204**

NEW LITERATURE

● **Hi-Fi Catalog.** Elpa Marketing Industries is distributing a new 16-page high-fidelity catalog listing the latest Thorens, Ortofon, and Watts products. The two-color catalog, designed for dealer and audiofan use, illustrates and describes the full line of Thorens turntables and bases, Ortofon cartridges and tone arms, and Cecil E. Watts recording maintenance equipment. Included is the new Thorens TD-224 turntable and automatic record changer and the recently announced Thorens base and dust cover, a turntable enclosure made of plexiglas and walnut. The Ortofon elliptical stylus is described in detail, along with the full line of Ortofon professional stereo cartridges and tone arms. Among the Cecil E. Watts products featured are the new Preener, the Parastat, and the new Changer Dust Bug, designed to offer the same "clean-while-you-play" action that the original Dust Bug offered for transcription turntables. A full line of parts and accessories for Thorens equipment is illustrated and described on the back cover. Copies of the catalog may be obtained without cost. **Circle 205**

● **Lafayette 1965 Catalog.** Lafayette Radio announces its new 1965 catalog, with the latest in electronics and stereo high-fidelity, is now available free to everyone upon request. The 1965 catalog contains 516 pages and is the largest and most comprehensive in Lafayette's 44-year history. Items offered include a complete selection in stereo hi-fi, citizens band, tape recorders, ham gear, test equipment, radios, TV's and accessories, camera, optics, marine equipment, auto accessories, tools, books, and so on. Featured are all manufacturers plus Lafayette's own components. The free Lafayette 1965 catalog #650 may be obtained by writing to: Lafayette Radio Electronics Corp., P. O. Box 10, Dept. PR, Syosset, N. Y. 11791. **Circle 206**

● **Oscilloscope Catalog.** A completely new 92-page scientific instrument catalog has been published by Fairchild Camera and Instrument Corporation's Du Mont Laboratories. It contains detailed specifications on all of the company's newest high-frequency, solid-state oscilloscopes, newly developed plug-ins, low-frequency instruments, signal generators, and an instruction section on techniques and available equipment for oscilloscope photography. The manufacturer advises that the new catalog is available only to those writing on company letterhead. Write to: Scientific Instrument Department, Fairchild Camera and Instrument Corporation, Du Mont Laboratories Division, Clifton, N. J. **Circle 207**

● **Information Kit.** Available through dealers carrying Sherwood high fidelity components is an "Information Kit" of interest to those preparing to buy their first equipment, as well as the experienced audiofan. Of special interest to the neophyte is the second edition of the informative 64-page book, "An Introduction to Hi-Fi & Stereo," published by the Institute of High Fidelity. Filled with practical information about the makeup and features of a component system, the book is a perfect starting point for those about to take their first steps toward owning a high fidelity music system. How others have used high fidelity components to decorate their homes with music is shown in Sherwood's "Photo File" of music systems. Shown and described are component systems ranging from the most simple to the very sophisticated. A comprehensive "FM & FM Stereo Station Finder" is also included, giving the frequencies of current stations as well as those which will be broadcasting in the near future. A "Time-Saver Shopping Guide" is another of the kit units. The "guide" provides detailed comparative specifications for components offered by major manufacturers. The "Information Kit" is conservatively valued at $1.00 but is available free-of-charge at Sherwood dealers. Where an individual prefers, the kit may be obtained, together with descriptive literature, by sending 25 cents in coin direct to Sherwood Electronic Laboratories, Inc., 4300 North California Avenue, Chicago, Ill. **Circle 208**

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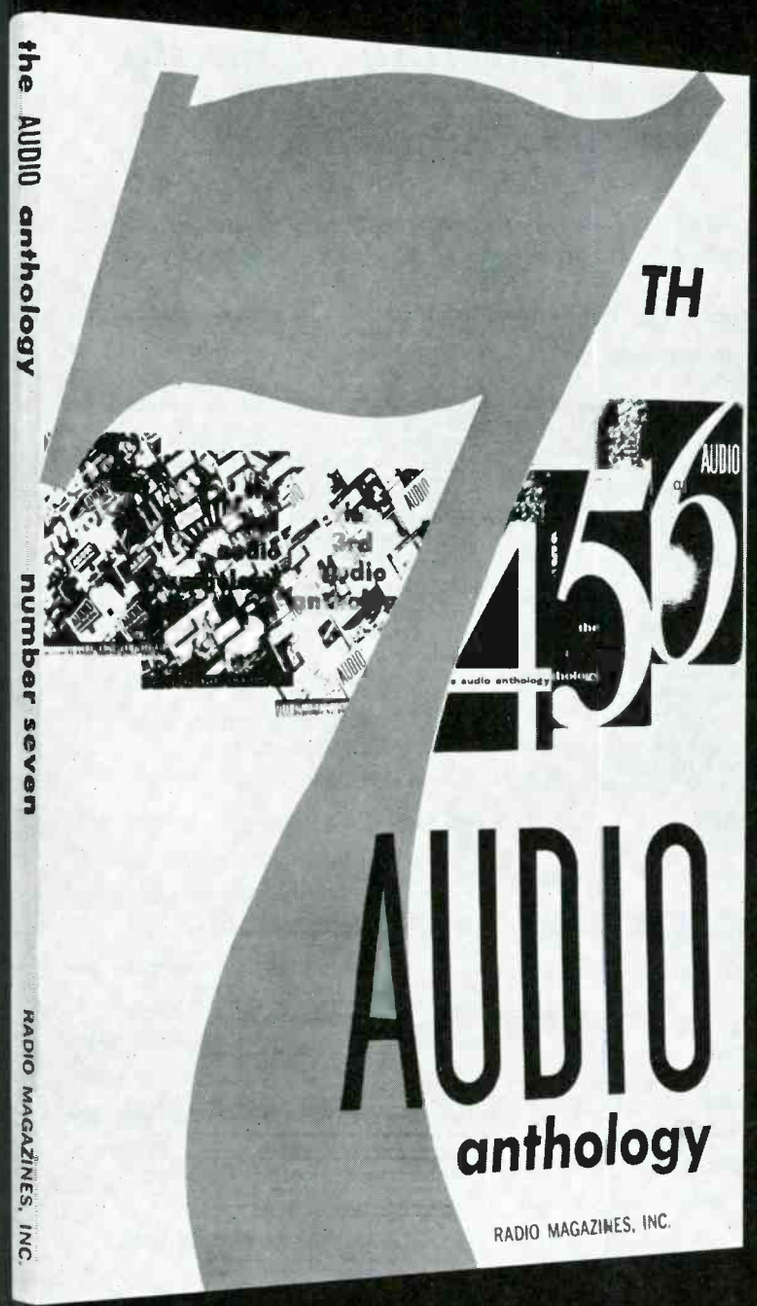

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Audio Engineering Society

SIXTEENTH ANNUAL CONVENTION

Following is a complete list of papers to be presented at the fourteen technical sessions.

Monday, October 12, 1964

9:30 a.m. MICROPHONES AND EARPHONES

Donald W. Powers, Roanwell Corporation, Chairman

Artificial Head for Speech-Communication Devices
Fred P. Beguin, American Optical Co.

History and Status of Miniature Variable-Reluctance Balance-Armature Transducers
Richard W. Carlisle, Dyna Magnetic Devices, Inc.

Considerations in the Design of a New Studio Boom Microphone
R. W. Carr and C. E. Seeler, Shure Brothers, Inc.

Close Talking Microphone Measurement Techniques and Standardization
Michel Copel, U. S. Naval Applied Science Laboratory

The Use of Noise Cancellation in Modern Telephone Practice and Design
Gaston A. Marchand, Roanwell Corporation

Transistor Microphone
M. E. Sikorski, Bell Telephone Laboratories, Inc.

Circuits of Transistorized RF Condenser Microphones
Hans J. Griese, Sennheiser Electronic

Proximaural Loudspeakers ("Nearphones")
Peter W. Tappan, Bolt Beranek and Newman, Inc.

1:30 p.m. ARCHITECTURAL ACOUSTICS

Lewis S. Goodfriend, Goodfriend and Associates, Chairman

Applications of Digital Computers in Acoustics Research
M. R. Schroeder, Bell Telephone Laboratories, Inc.

Testing of Concert Halls Using Digital Computers
G. M. Sessler, B. S. Atal, M. R. Schroeder and J. E. West, Bell Telephone Laboratories, Inc.

Subjective Effects Related to Hearing in Reverberant Rooms
B. S. Atal and M. R. Schroeder, Bell Telephone Laboratories, Inc.

The Balance Between Reverberant and Early Sound in a Concert Hall
T. J. Schultz, Bolt Beranek and Newman, Inc.

The Acoustical Design of Recently Completed Multi-Purpose Auditoriums
Russell Johnson, Bolt Beranek and Newman, Inc.

A Description of Cedar Knolls Acoustical Laboratories
Ralph Huntley, Cedar Knolls Acoustical Laboratories

Sound Induced Vibration of Walls, Partitions and Windows
A. R. Soffel, The Bissett-Berman Corporation

Acoustical Considerations Concerning New York State Theater
Vilhelm Lassen Jordan

7:30 p.m. SOUND REINFORCEMENT

David Klepper, Bolt Beranek and Newman, Chairman

The Sound System at the New York State Theater
Irving W. Wood and Joel S. Fichman, Sound Systems, Inc.

Design of Complex Directional Loudspeaker Clusters
Wilfred Malmlund, Bolt Beranek and Newman, Inc.

The "Anavac"—Ambient-Noise-Automatic-Volume-Adjustment-Control
Abraham B. Cohen, Executone, Inc.

Considerations for Naturalness in Portable Sound Reinforcement Systems
Daniel Queen, Ampli-Vox Audio Products Div., Perma-Power Co.

A Conference System Using Proximity Stereo Loudspeakers
F. K. Harvey, Bell Telephone Laboratories

Audio Techniques for a Business Video Conference System
Stevens H. Harrison, Bankers Trust Company Methods Research Dept.

Tuesday, October 13, 1964

9:30 a.m. DISC RECORDING AND REPRODUCING

J. G. Woodward, RCA Laboratories, chairman

The New Haeco Stereodisc Cutting System
Howard S. Holzer, Holzer Audio Engineering Co.

An Improved Disc for Master Recording
John E. Jackson, Audio Devices, Inc.

Design and Use of Recording Styli
Richard Marcucci, Capps & Co., Inc.

A New Method of Disc Recording for Low-Distortion Reproduction
H. G. Redlich and H. J. Klemp, Telefunken-Decca

Measurement of Vertical Recorded Angle in Stereodisc Recording
Daniel H. T. Ong, and H. D. Ward, Radio Corporation of America

Interaction of Tracing and Tracking Error
Duane M. Cooper, Electrical Engineering Dept., University of Illinois

Record Contamination Causes and Cure
Percy Wilson, The Gramophone

1:30 p.m. MAGNETIC RECORDING REPRODUCING

William H. Miltenburg, NPM Associates, Chairman

The Measurement and Minimization of Print-Through of Magnetic Sound Recording Tape
Edward P. Koeppe, RCA Victor Record Division

Precision Performance Measurements of a New Sound Recording Tape
Joseph Kempler, Audio Devices, Inc.

Design Considerations for Short Term Audio Recording on Flexible Magnetic Discs
Erling P. Skov and Charles Vogel, Ampex Corporation

Noise Limitations in Tape Reproducers
Erling P. Skov, Ampex Corporation

A New Reversible Continuous Loop Cartridge System
K. Rey Smith, II. KRS Electronics

Advanced Tape Mastering System—Electronic Features
John T. Mullin, Minnesota Mining & Mfg. Co.

Advanced Tape Mastering System—Mechanical Features
Kenneth Clunis, Minnesota Mining & Mfg. Co.

An Improved Brake System for Tape Transports
Arthur E. Gruber, Scully Recording Instruments Corp.

7:30 p.m. CONSOLES AND CONTROLS

John D. Colvin, Commercial Radio-Sound Corp., Chairman

Photoconductors for Sound System Control
Robert C. Coffeen, Swanson Engineering and Mfg.

Balance Requirements for Communications Channels
L. LeRoy Swan, Illinois Bell Telephone Co.

Essentials of Transmission Practice Pertaining to Stereo Console Design
Arthur C. Davis, Altec Lansing Corporation

Audio Program Mixing Systems
John P. Jarvis, Langevin Division of Sonotec, Inc.

Custom Studio Recording Console
William G. Dilley

The New Audio Console for CBS Broadcast Center
C. A. Palmquist and D. R. Wells, CBS Television Network

Wednesday, October 14, 1964

9:30 a.m. MUSIC AND ELECTRONICS

Harald Bode, Chairman

The Brandeis University Electronic Music Studio
Robert M. Voss, Brandeis University Electronic Music Studio

A Wide-Range Oscillator with Vibrato
David C. Freeman

Voltage-Controlled Electronic Music Modules
Robert A. Moog, R. A. Moog Company

The Harmonic Tone Generator, A Voltage-Controlled Device for Additive Synthesis of Audio Harmonic Spectra
James W. Beauchamp, School of Music, University of Illinois

An Integrated Electronic Music Console
L. A. Hiller, Jr., School of Music, University of Illinois

The Spectrogram Approach to the Fabrication of Sounds for Electronic Music Compositions
Hugh LeCaine, National Research Council of Canada

Speaking Time of Organ Pipes
Norman C. Pickering, Astrosonics, Inc.

1:30 p.m. SPEECH PROCESSING

Homer Dudley, Chairman

A New Multiple-Choice Word Test for Evaluating Speech Intelligibility
Michael H. L. Hecker, Bolt Beranek and Newman, Inc.

Improved Vocoders
Lawrence E. Cassel and David M. Jurenko, Philco Corp.

A Novel Vocoder Synthesizer
Caldwell P. Smith, Air Force Cambridge Research Laboratories, CRBS

A Digital Spectrum Manipulator
Norman B. Reilly, Haskins Laboratories, Inc.

Performance of a Code Operated Speech Synthesizer
Harry F. Olson and Herbert Belar, RCA Laboratories

Spoken Digit Recognizer for Japanese Language
Kuniichi Nagata, Yasuo Kato and Seibi Chiba, Nippon Electric Co.

Format Tracking with Fixed Narrow Band Filters
Raimo Bakis, International Business Machines

Application of the Sceptron Pattern Recognizer to Speech Signal Processing
Robert D. Hawkins, Sperry Gyroscope Company

Automatic Recognizers and Synthetic Speakers
Peter B. Denes, Bell Telephone Laboratories, Inc.

7:30 p.m. AUDIO AND MAN

Benjamin B. Bauer, CBS Laboratories, Chairman

Artist, Conductor, and Audio Engineer
Leopold Stokowski

The Objective and Subjective Aspects of Sound Reproduction
Harry F. Olson, RCA Laboratories

Audio Augmentation to Natural Acoustics
Leo L. Beranek, Bolt Beranek and Newman, Inc.

Pitfalls of Preference Testing
W. Dixon Ward, University of Minnesota

Perception of Low Pattern Frequency and Low Pitch
Newman Guttman, Bell Telephone Laboratories, Inc.

Thursday, October 15, 1964

9:30 a.m. AUDIO AMPLIFICATION

Daniel von Recklinghausen, H. H. Scott, Inc., Chairman

A Solid-State Amplifier with Current Generator Drive for Magnetic Tape Heads
Richard Sieron, Chester Electronic Laboratories, Inc.

Noise Considerations in Low-Level, High-Input Impedance Transistor Amplifiers
David B. Jepsen, Ampex Corporation

High-Frequency Performance Limitations of Class-B Power Amplifiers Using Alloy Junction Output Transistors
George A. Hellwarth, Paralan Electronics Corporation

Transistor Bridge Amplifiers and Push-Pull Drivers
Murray Barlowe, Amperex Electronic Corporation

Power Bandwidth, Frequency Response and Music Spectra
Victor Brociner, H. H. Scott, Inc.

1:30 p.m. SOLID-STATE FM STEREO

William H. Beaubien, Radio Products Division, Warwick Electronics Inc., Chairman

A Survey of Performance Requirements and Design Techniques for Highest Quality FM-Multiplex Reception
F. L. Mergner, Fisher Radio Corporation

Stereophonic Broadcasting Conditions Change Emphasis in FM Tuner Specifications
Daniel von Recklinghausen, H. H. Scott, Inc.

Transistorized FM Tuner Design Using Epitaxial Stripe Mesa Transistors
Wendel C. Harrison, Texas Instruments, Inc.

Design Considerations for Silicon Transistors in AM/FM Multiplex Receivers
R. V. Fournier, R.C.A. Semiconductor Division

Dynamic Range Problems in Transistorized FM Receivers
J. A. Schultz, R.C.A. Home Instrument Division

AGC Circuits Controlling Overload in Solid-State FM Tuners
George A. Hellwarth, Paralan Electronics Corporation

A Minimum Rider Circuit for Noise Immunity in a Stereo FM Demodulator
Les Golonski, Motorola, Inc.

A Technical Contribution for Adding Stereo to Mass Market FM Receivers
A. Csicsatka and R. Linz, General Electric Co.

Friday, October 16, 1964

9:30 a.m. LOUDSPEAKERS

Harry F. Olson, RCA Laboratories, Chairman

Medieval to Modern Loudspeakers
Paul W. Klipsch, Klipsch and Associates, Inc.

Radial Column Loudspeakers
Klaas Hoogendoorn, LTV-University Division

Microphones and Loudspeakers for Studies of Long-Range Acoustic Propagation
John K. Hilliard, LTV Research Center, Western Division

A New Analysis of the Performance of a Direct-Radiator Loudspeaker in a "Ported" Cabinet
Bart N. Locanthi, James B. Lansing Sound, Inc.

A Ported Loudspeaker for Organ Reenforcement at Mormon Tabernacle
Bart Locanthi, Edward May and George Augspurger, James B. Lansing Sound, Inc.

Jump Distortion in Woofers
Saul J. White, Dyna-Empire Co.

Response and Efficiency Relationships in Direct-Radiator Loudspeaker Systems
Roy F. Allison, Acoustic Reserach, Inc.

The Response of Loudspeakers to Tone Bursts
Victor J. Kaminsky, Electro-Voice, Inc.

1:30 p.m. AUDIO AT THE NEW YORK WORLD'S FAIR

Robert A. Langer, Hamel and Langer, Chairman

Sound Distribution System for the New York World's Fairground
Arthur W. Schneider, Commercial Radio-Sound Corp.

"Conical Wave" Loudspeaker System for the New York World's Fairground
John E. Volkmann, Adolph R. Morgan and Harry F. Olson, RCA Laboratories

Synchronized Programmer for Sound System for Fountain of the Planets
Arthur W. Schneider, Commercial Radio-Sound Corp.

"Cylindrical Wave" Loudspeaker System for Fountain of the Planets
John E. Volkmann and Harry F. Olson, RCA Laboratories

A Completely Automated Multi-Channel Sound System
Irving W. Wood, and Robert Lin, Sound Systems, Inc.

A Village Sound System
E. G. Dyett, Jr., H. H. Scott, Inc.

Acoustics and Sound System Design for the Chrysler Pavilion
W. Ranger Farrell and David L. Klepper, Bolt Beranek and Newman, Inc.

Audio Systems at the General Motors and Bell System "Rides" at the New York World's Fair
Michael W. Chitty, Reevesound Company, Inc.

ABOUT MUSIC

(*from page 11*)

glass panel belied the fact that only 22 musicians were playing; it seemed more like 32. The explanation for the group's rich sonorities lay in the scoring generally, and in the use of "doublers" specifically. In orchestral terminology, a doubler is a musician who plays more than one instrument at the same session. The three wind players in the present recording, for example, were reed doublers. The first player handled piccolo, flute, and B-Flat clarinet; the second played flute, oboe, B-Flat clarinet and alto saxophone; and the third switched from two clarinets (B-Flat and E-Flat) to baritone saxophone.

It is a treat to see a first-class doubler like Phil Bodner in action, as he sight-reads a tricky passage for oboe, slips the instrument into its holder, puts an alto saxophone to his lips and, without a moment's hesitation, takes up the next phrase. The A.F.M. contract with the recording companies gives the doubler an extra fee for each additional instrument played during a session: 15 per cent for the first double and 10 per cent for each succeeding double.

During the run through of Gershwin's spirited march, everything was wrong. The piccolo was too piercing; a close-to pickup on the French horns caused intermodulation distortion in thickly-written passages; the double bass was dull and thumpy; trombones lacked resonance; etc. Otherwise, as the French popular song goes, *"Tout va très bien, Madame La Marquise."*

Where to begin? "Would you give us another run through, please?" I asked Fennell. While the second test was in progress, microphones were adjusted, levels were altered on the board, notes were made in the production score for further corrections. Not all the imbalances, however, were due to levels and microphone placement. Some could only be rectified in performance; and here, teamwork between conductor and control booth would be essential.

Gradually the sound began to fall into place, and order was brought out of chaos. By the time the trumpet replacement arrived, we were ready for our first legitimate "take." Æ

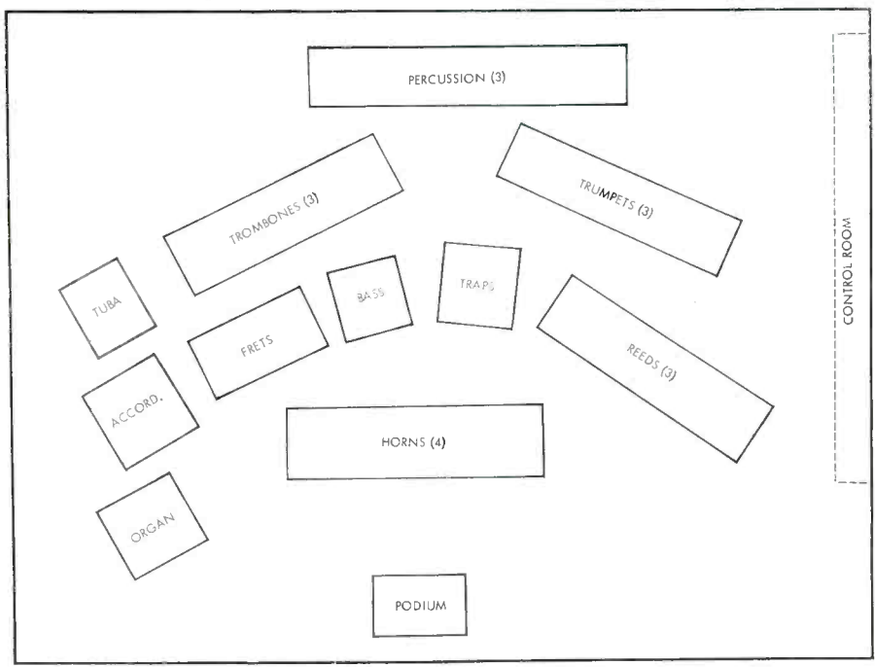

Fig. 2. Placement of orchestra in studio.

Hi-Fi Show

(from page 84)

NORELCO 542, 544

The new Norelco Carry-Corder 150, the first tape recorder specifically designed for the general public, will be the featured product here amongst the several already familiar Norelco models and a line of loudspeakers. The "150" is a transistorized pocketable unit measuring only 7⅔ × 4½ × 2⅛ in. Its 300-ft tape capacity is carried in a cartridge which can be inserted into the machine in a single motion to provide 30 minutes of 1⅞-ips recording on each of its two channels for lectures, interviews, and on-the-spot applications.

OKI 429, 431

Featured in the OKI exhibit will be the Model 555 transistorized stereo tape recorder, a unit with separable slim-line loudspeakers. This model operates at 7½ and 3¾ ips, records and plays 4-track stereo or mono, and is equipped with automatic shut-off, digital index counter, pause control, and sound-on-sound and sound-with-sound facilities. Output power of 3 watts per channel provides adequate level for the efficient speakers employed.

PICKERING 640

The latest model of the now-famous V-15 phono cartridge—known as the "Engineered Application Cartridge"—will be shown to the public for the first time. Designed especially for low-mass tone arm systems, and employing the "Floating Stylus" and patented V-Guard assembly, this model is the ultimate in the company's line. A new loudspeaker system, comprising a dynamic woofer and electrostatic mid- and high-frequency units will be unveiled.

PILOT 633, 635

The R1000 110-watt AM-FM-stereo receiver is a solid-state unit with 4 i. f. stages, metering tuning indicator, response in the FM tuner section of ±1 db from 20–20,000 cps and ±2 db from 10–30,000 cps in the amplifier. Facilities are complete as an audio control center. Also shown are amplifiers, tuners, and speaker systems.

REVERE-WOLLENSAK-3M 416, 418

With three separate lines, the audiofan will be able to choose a reel-to-reel Wollensak portable recorder or a tape deck, or a Revere stereo tape cartridge system portable or deck, as well as the "Scotch" brand tape to play on them. One could browse here for hours if at all interested in tape and tape recorders.

ROBERTS 408

Featured here will be the new model 400 Full Stereo Reversible Recorder, which employs three heads, solenoid-operated motors, separate bass and treble tone controls, and offers the flexibility of four inputs for each channel. These models permit recording or playback in either direction, with automatic reversal at the end of the reel.

SCOPE 619, 621

Comprising a 19 x 14 in. hand-made elliptical woofer and four die-cast high frequency units mounted on the front frame of the low-frequency unit, and mounted in a floor model cabinet measuring 34 in. high, 28 in. wide, and 19¾ in. deep, the new "Buckingham" system will be the *pièce de resistance* in the Scope exhibit. The woofer of this new unit has a free-air resonance of 15 cps, and the over-all response is said to be clean from 30 to 20,000 cps. The crossover frequency is 1800 cps, and controls are provided for mid- and high-frequency ranges.

H. H. SCOTT 627, 628

The Model 312 solid-state FM-stereo tuner is the star of this room. This tuner has performance and features which make this one of the outstanding Scott products to date. Performance, reported in AUDIO in July 1964, includes: Crossmodulation index, 82 db; stereo frequency response 0.7 db 30–15,000 cps; signal-to-noise ratio, 65 db; capture ratio 4 db; selectivity, 34 db; IHF usable sensitivity 2.0 μv; stereo separation, 36 db. In addition to the 312, Scott is showing one of the most extensive component lines to date.

SHERWOOD 524

Sherwood introduces the Model S-9000 solid-state integrated stereo amplifier which delivers 150 watts of music power at less than 0.5% harmonic distortion. Military-grade silicon transistors are used throughout plus exclusive transistor short-circuit protection. Also featured is the new Tanglewood 4-way speaker system, a 6-speaker unit which handles 75 watts of program material. Over-all response is 29–17,500 cps ±2.5 db.

SHURE 623

There are two main attractions in this room: the V-15 cartridge and the Model 100 phono systems. The V-15 is a 15-deg. cartridge with a biradial elliptical stylus which is literally handmade. Designed for tone arms which track at 1.5 grams or less. Definitely the "top of the line." The M100L and M100W are respectively, luggage and walnut encased versions of this phono package. The system contains a V-15 cartridge, a solid-state integrated amplifier, a Dual automatic turntable, and Shure-designed loudspeakers.

SONOTONE 520, 521

Sonotone will demonstrate its new, truly compact speaker system. This model, the Sonomaster RM-1, measures only 14½ x 10½ x 7¼ in., and is finished in hand-rubbed oiled walnut. It uses a 6 in. high-compliance woofer together with a tweeter, the latter equipped with a calibrated level control which permits the listener to adjust highs to his individual preference.

STANTON 637

Continuing in its policy of improving performance, Stanton Magnetics is planning to feature the Model 581 Calibration Standard phono cartridge—a new version of the present Model 481, which has achieved enthusiastic acceptance throughout the music-conscious listening fraternity.

SUPEREX 631

A brand- new product, the ST-Pro headset, is being introduced at this show. This stereo headset is of the woofer-tweeter design, and employs a total of four transducers in the two phones. It has a frequency response which is flat within 3 db from 18 to 18,000 cps. It is available in impedances to work from speaker outputs, or from 600 to 2000 ohms, or from 25,000 and 50,000 ohms.

SUPERSCOPE-SONY 428, 430

The Sony line of tape recorders is shown in this room. Top of the line is the Model 777S-4. It is transistorized; available for either 4- or 2-track stereo recording. Bilateral head accomplishes 4- & 2-track stereo or mono playback with no head shifting, track width or alignment compromise. Sound-on-sound; tape/source comparison monitoring; mike and line mixing; 3 motors, 2-speed hysteresis-synchronous drive motor; push-button solenoid-activated operation; remote control; relay operated pause control and military type modular plug-in transistorized electronic circuitry. Complete with portable case and remote control.

TANDBERG 330

In addition to the present complete line of Tandberg tape recorders, the new Model 74B will be featured. This model incorporates two internal speakers with the necessary output amplifiers, together with two cathode-follower outputs. Machine operates at three speeds as 4-track stereo or mono recorder. Built-in versatile speaker switch provides a variety of combinations of internal or external loudspeakers.

TANNOY 343

In line with the trend toward larger loudspeakers, Tannoy is this year featuring the GRF model, which incorporates the 15-in. Dual Concentric unit in a rear-horn-loaded enclosure which is effective below 350 cps. Above this frequency, the range to 1000 cps is provided by front radiation by means of a new acoustic coupling device, and from 1000 cps up the non-directional horn-loaded high-frequency unit takes over to give a smooth coverage of the entire audio spectrum.

UNITED AUDIO 534

This exhibit will feature the Dual 1009 automatic record changer, a model which combines a low-rumble performance with completely automatic handling of records in either automatic or manual positions. An effectively simple cartridge slide accommodates any existing cartridge.

UNIVERSITY 407, 447

This exhibitor, with a wide variety of loudspeakers in every price range and also in a wide variety of styling, will feature the Medallion, a three-way speaker system with "Select-A-Style" grilles that snap into place to match any decor, and which may be used vertically or horizontally to accommodate the available space.

UTAH 547

The C8JC-3 Celesta is a 3-element, 8" speaker with heavy die-cast frame. Internal dust cap protects the voice coil gap from "stray whiskers." Other versions include a 12" model with a 20 oz. magnet. The Heritage III (HS3-W) contains eight speakers in a ducted port enclosure. Reflex port extends across the total width of the cabinet and vents toward the floor. Each mid-range speaker and each tweeter is mounted in its own housing to eliminate interaction. The mid-range speakers are separately "tuned" (by use of different voice coil diameters) for complementary response curves. The same technique is used in the tweeter construction.

UTC SOUND 328

Claimed to be the world's smallest True High Fidelity Speaker System, the Maximus I makes its debut in this exhibit. Measuring only $10\frac{1}{2} \times 5\frac{1}{2} \times 7\frac{1}{4}$ in., this unit will accommodate 15 watts of power and cover a frequency range of 45 to 20,000 cps. It employs a Cushioned Air Pneumatic Suspension (CAPS), which is said to give exceptionally uniform linear response. The woofer uses a 3½-lb magnet, and crossover is at 1900 cps to a backloaded wide-range high-frequency unit.

VIKING 325

The tape recorders featured in this room include the new Studio 96, a two-speed transport with automatic sequence braking, choice of hyperbolic head configurations, hysteresis capstan drive, heavy-duty reel motors, remote control jacks, and 10½" reel capacity. Another featured recorder is the Retromatic 220 which plays in both directions automatically through silence sensor or photocell reversing, or manually with pushbuttons.

WEATHERS 600

A brand-new low-silhouette turntable will be featured in the Weathers exhibit. This model employs the small motor and a lightweight platter that has been characteristic of the Weathers models heretofore. The new model employs a wood arm, and is available with a Weathers pickup integrally mounted.

WHARFEDALE 527, 528, 529

This section of the British Industries exhibit feature all-new versions of the Wharfedale Achromatic Speaker Systems, ranging 6-speaker W90 model fitted in a sand-filled enclosure with separate controls for each range—low, mid, and high—through the three-speaker W70 and the two two-speaker models, W60 and W40. The last two are fairly large "bookshelf" models, while the W70 and W90 are floor-standing models.

RECORDS

(*from page 94*)

music militates quite honestly against the Berlioz.

I think it is a complement to these performers' honesty that they cannot play *everything*, as the publicity department would have it. When they are good they are very good, with conviction, not mere virtuoso polish.

Schubert: Symphony No. 5; Symphony No. 8 ("Unfinished"). Philharmonia Orch., Klemperer.

Angel 36164 stereo

Distinguished elder statesmen of conducting such as Otto Klemperer are supposed to be infallible but of course they are not, nor are their players. This is a perfectly good performance of both symphonies but neither is in any way outstanding. Both are just a wee shade tired sounding here and there, as if (in the case of the "Unfinished") played too often, or (the Number 5) as if the music really weren't all that important.

The players and the conductor are much too good to miscalculate in any but a very minor way. You won't go wrong. But others take the little B Flat symphony more seriously—and hence in a more sprightly fashion—and a contemporary such as the late Bruno Walter can turn out a more subtle, more carefully shaped and more dramatic "Unfinished" than this. See Columbia.

MIDDLE BAROQUE

Buxtehude: Sonatas, Op. 1; Suite No. 12 for harpsichord; Canzonettas in C, G. Robert Brink, vl., Judith Davidoff, vla. da gamba, Daniel Pinkham, harps.

Music Guild S-57 stereo

Mostly, Dietrich Buxtehude is known for his jolly, expansive North German Baroque organ music and for the many vocal and instrumental works he composed for church use. His "chamber music," a not-too-appropriate term, is now emerging thanks to new editing, not to mention rediscovering of music long lost in dusty files.

These three good Boston musicians turn out four sonatas for violin, viola da gamba and harpsichord, interspersed for variety with a couple of short organ pieces, played on an improbable portable hand organ called a regal, plus a harpsichord dance suite, played on a plain ordinary harpsichord.

(*Continued on page 114*)

PROFILE

(*from page 90*)

Performance

The OKI 555 incorporates a very linear amplifier whose 2.5 watts output per channel is unusually clean and free from distortion. Record and playback distortion was 1.9 per cent at 1000 cps. Wow and flutter were quite good, measuring 0.12 per cent at 7½ ips. Speed accuracy was within 0.1 per cent at 7½ ips. Signal-to-noise ratio at 7½ ips was 47 db, and 42 db at 3¾ ips. Record and playback frequency response was as follows:

frequency (cps)	7½ ips (db)	3¾ ips (db)
40	−4.0	
50	−2.0	−3.0
70	−1.5	−3.0
100	−1.0	−1.0
300	−0.5	+2.0
500	+0.5	+1.5
700	0.0	+1.0
1000	0.0	0.0
2000	0.0	−0.8
3000	0.0	−2.0
5000	0.0	−1.5
7000	+0.5	−1.0
10,000	+0.8	−3.5
12,000	−1.6	
14,000	−2.8	
16,000	−4.8	

Tape handling was quite positive albeit less accurate and smooth than a professional machine.

Altogether the OKI 555 is a fine machine intended for the home recordist and at a surprisingly modest price (about $370). Its facilities for stereo, sound-on-sound, and sound-with-sound recording make it very versatile, and its human-engineered layout make it extremely easy to use. Circle 210

ELECTRO-VOICE MODEL 644 DIRECTIONAL MICROPHONE

For about 90 per cent of the applications for microphones, the usual cardioid pattern is ideal—in fact, perfectly satisfactory. Then there are applications where the omni-directional model is the most desirable, such as in conference recording where the microphone is placed in the center of a group about equidistant from each person, or possibly favoring the one with the weakest voice.

There are other applications, however, in which a much more directional pattern is needed than that offered by the usual cardioid. One of the first of these to come to mind is the recording of a lecture, such as might be desired by a student, or the recording of a comedian at a night club, which might *not* be desired by either management or performer. In fact, it is not likely that it would be permitted, unless the recordist was a special friend of either management or performer, or both.

It was just such an application as the latter that gave us the idea. During the L.A. High Fidelity Show last March, several of the exhibitors were excited over a comedian in one of the clubs, and proposed recording him. It seemed to this observer that it would be impossible to get acceptable quality with a conventional microphone, so the 644 was suggested. Actually, the comedian was never recorded by any of the group, but the idea remained.

The 644 is one excellent solution to the problem of recording with suitable quality when it is impractical to locate the microphone sufficiently close to the source of sound. With it, one can record a voice at 15 to 20 feet away from the speaker with quality which is equivalent to that obtained with a conventional cardioid microphone at 3 feet. Thus for recording in the classroom or at lectures, the 644 is ideal.

One other advantage of this highly directional unit is the latitude it offers in the placement of loudspeakers with respect to the mike. Since the angle of coverage for frequencies above 700 cps is approximately 45 deg. each side of the axis, there is considerably less interfer-

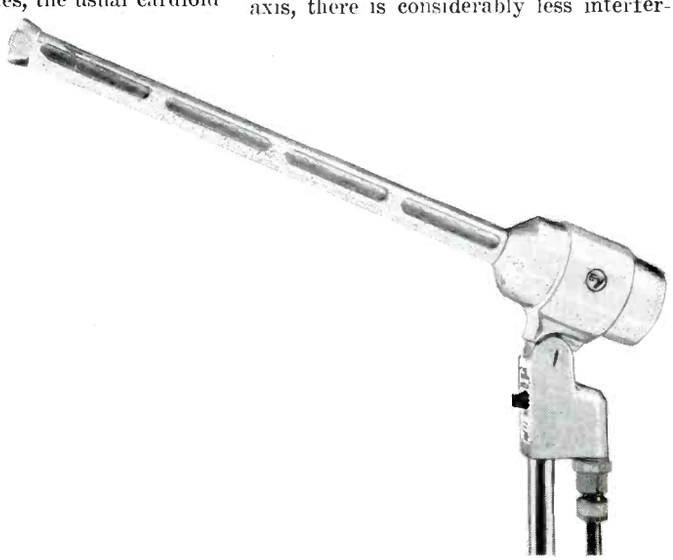

Fig. 4. Electro-Voice Model 644 Microphone

ence from feedback and reverberation than with most microphones. Below 700 cps, the directivity is comparable to the usual cardioid unit. The directionality also provides a reduced sensitivity to wind noise.

Specifications

The 644 microphone offers two output impedances, "high" and 150 ohms, the latter ungrounded so as to be used as a balanced line when feeding a center-tapped input transformer. Impedances are selectable at the cable connector simply by changing lead connections. The "high" output is suitable for feeding vacuum-tube amplifiers or recorders, but the low impedance is most desirable for transistorized equipment. Sensitivity is 53 db below 1 volt for a sound level of 1 dyne/cm^2 in the high-impedance connection.

Frequency response measured essentially flat from 40 to 12,000 cps as compared with a high-quality condenser microphone. At 90 deg. off axis, the response dropped better than 15 db at all frequencies above 800 cps, while from the rear, response was down at least 15 db at all frequencies above 300 cps.

The "line" effect of the microphone is caused by the long tube on the axis. Along the side of the tube are a number of ports. Sound impinging on the microphone from the front passes down the tube directly, and any sound waves entering the ports from a signal on the axis remain in phase with the signal entering the end of the tube. With a sound source at the side, however, the pressure waves enter both at the end and through the ports, but the wave from the end mixes with the waves entering through the ports, resulting in an out-of-phase signal reaching the diaphragm, thus cancelling out the signal to a large extent. This explanation is necessarily simplified—a full analysis would take up this entire issue—but that is the basic idea.

Electro-Voice makes two other line-type microphones—Model 642, which is a professional model similar to the 644, and about four times the price, and Model 643—the 7-foot model often seen on TV at Presidential news conferences, and at about 15 times the price of the 644. Due to its much greater length (the 642 and 644 are some 16 inches long) it is considerably more directional, and thus suitable for pick-up of sound at distances of 50 feet or more.

For the average user who is interested in making good recordings with less-than-ideal microphone placement, and for many public-address applications where feedback reduction is important, the 644 offers one quick and valuable solution to the microphone problem.

Circle 211

RECORDS

(*from page 111*)

The regal is an instrument that sounds like a cross between a bagpipe and a miniature steam calliope. Take 2 doz. bagpipe pipes, seal up the holes so each plays one pitch, attach to a keyboard valve system plus hand-pumped bellows, and you have a regal. It is nominally a mediaeval instrument but serves very nicely here to make buzzing, crow-like harmonies out of Buxtehude's little canzonettas!

Performance is informed, musical and withal a bit austere, notably in the sonatas. The violin is the one who doesn't shine enough; he has a curious lunging style, somehow lacking in a melodic sense that would bring out the force of the lines he plays. Don't have to be romantic or anything like that—just better phrased, in longer melodic shapes. The other two, gamba and harpsichord, are impeccable.

Henry Purcell: Trio Sonatas (Second Set, posth.) Ciompi, Torkanowsky, violins, Koutzen, cello, H. Chessid, harps.
Dover HCR 5224 mono

Here's an excellent representative of a large new catalogue of mono discs from Dover that sell for a mere two bucks apiece. My impression is, judging from the artists involved, that these are mostly reissues in modern processing from the vast earlier Vox catalogue of mono recordings. In any case, the Dover label offers excellent material in considerable variety, redone with care, good technical quality, handsome packaging and sensible notes. Couldn't ask for more.

This late Purcell chamber music (published after his death, in 1697) is played in very good style with an appropriate string tone color in the violins and the cello (replacing the original gamba) and an intelligent continuo accompaniment from the harpsicord. (Note that Baroque trio sonatas often require four players since the harmonic accompaniment is shared by the keyboard and the bass player.) The sound is very acceptable, only a slight modesty in the high end and a bit of tubbiness in the harpsichord suggesting any age in the recording.

Oddly, these late works, because they were very modern in their time, sound less like the familiar Purcell and more like Bach and Handel than we might expect from the English composer. Paradoxically, the strange, dissonant harmonies that we so love in earlier Purcell are largely missing here—for they had already become old-fashioned and were considered as crudities, left over from an unpolished earlier style.

J. J. Froberger, Organ and Harpsichord pieces. Gustav Leonhardt.
Cambridge CRS 1509 stereo

J. J. Froberger was one of the earlier "pre-Bach" Baroque composers (that's what we used to call them), an imaginative, somewhat dreamy experimenter who learned much from the Italian Frescobaldi as anyone knowing the two will discover. In these works, on the organ on side 1 and a magnificent big harpsichord (what a bass!) on side 2, Froberger is the Italian-influenced German through and through. Stolid, rather heavy in outward effect, his music is internally full of dramatic and strange changes of harmony, pixie-like runs and trills and elaborations, straight out of the early 17th century Italian experiments in dramatic music for instruments.

A little goes a long way, for Froberger is not a lively composer, preferring to dream his way through semi-improvised fantasias and toccatas that rarely show a strong "beat." Part of the effect here, however, may be in Leonhardt's own playing, which tends to avoid the "beat" like the plague.

This is Bach without the beat, then Froberger died 18 years before Bach was born—a very early form of Baroque music and highly progressive too.

Odd engineering note. Side 1, recorded in Holland, is to the CCIR characteristic, uncompensated. Side 2, made in Massachusetts, is normal U.S. NAB-RIAA. Says to right on the jacket.

FORWARD WITH CHORAL MUSIC

Dufay: Motets. Le Petit Ensemble Vocal de Montreal, ensemble of viols, G. Little.
Vox STDL 500.990 stereo

Dufay: Mass, "Se la face ay pale." Obrecht: Mass, "Sub Tuum Praesidium." Musica Antiqua of Vienna, Cienna Ch. Ch. Choir, Gillesberger.
Vanguard BGS 70653 stereo

Here's old Dufay, one of the earliest "great" composers, represented on two recent discs. Well—fairly recent. I didn't get around to Vox's superb Dufay ensemble, issued late in 1963, until just the other day. More fool me! Vox has here the finest specialized vocal ensemble of its sort in America and one of the best in the world. Vanguard's Viennese group is good too, but not in quite such a sensational fashion.

The difference between the two groups is in sheer vocal blend and tuning. The Viennese follow a normal modern principle—a voice is a voice, for any music. Like our own New York Pro Musica, they use normal modern trained voices, full of throaty wobbles and operatic carrying power. Too bad that they are unsuitable for this older music, that in other times people sang in other ways; for nothing much can be done about it. Voices are voices. The Viennese voices are good ones but they do wobble and they don't blend very well. Strictly normal.

Well, something can be done about it. Look for voices to suit the music. They are rare, but they do exist. (People aren't *that* much changed, over the centuries.) Voices with pure, unwobbly tone, beautiful rather than powerful, voice with perfect blending and absolutely accurate untempered pitch, tuning the harmonies precisely, as fundamentals and overtones, adjusting the melodic pitches upward or downward to suit the direction of the melody. . . .

Where Mr. George Little finds such voices in Montreal I do not know, but here they are. (Perhaps their French background helps.) In any case, the Vox recording of Dufay is gentle, yet immediately communicative—for any ear, whether you have heard of Dufay or not. A lovely, convincing sound.

The Viennese music makes a lot of sense too, if on a larger scale, with lots more wobbles and a less perfect blend. The two Masses are more formal and bigger than the more personal, intimate Dufay motets. With the help of instruments, they are quite impressive here. Sung in choral form, rather than the solo-voice music on the Montreal Dufay record.

Dufay, for your info, belongs in the early 15th century. Obrecht was some 50 years younger—doesn't seem to make much difference at this long remove in time. He's late 15th century, a more complex, more outward personality than Dufay. Both, as the kids say today, are the biggest with the mostest.

Philippe de Monte: Madrigals. Jacob Handl: Motets. Prague Madrigal Choir, Venhoda.
Vanguard BGS 70655 stereo

Two interesting late-16th century composers, sung by the wobbliest-voiced choir I have ever heard, and yet sung quite beautifully even so.

Such a batch of wildly jiggling vibratos you can't believe! Musical Saint Vitus' dance. It's sort of like a photograph taken from a vibrating platform; all the details are doubled-up lines and blurs; yet if you squint a bit a look at it the right way you'll see a fine picture. Curious; for in most cases the wobbly-voiced choirs are also sloppy, out of style and generally inaccurate. Not these people. They project a fine sense for the musical phrases.

(*Continued on page 118*)

AN ELECTRONIC ORGAN DESIGN

(from page 21)

oscillators. One can arrange to play a unit rank at one loudness when it is used at one pitch level and at a different loudness when it is used at other pitch levels.

time. Though this circuit has 10 times the current consumption (20 ma) of the oscillator alone, this still is only about 10 per cent of the current normally con-

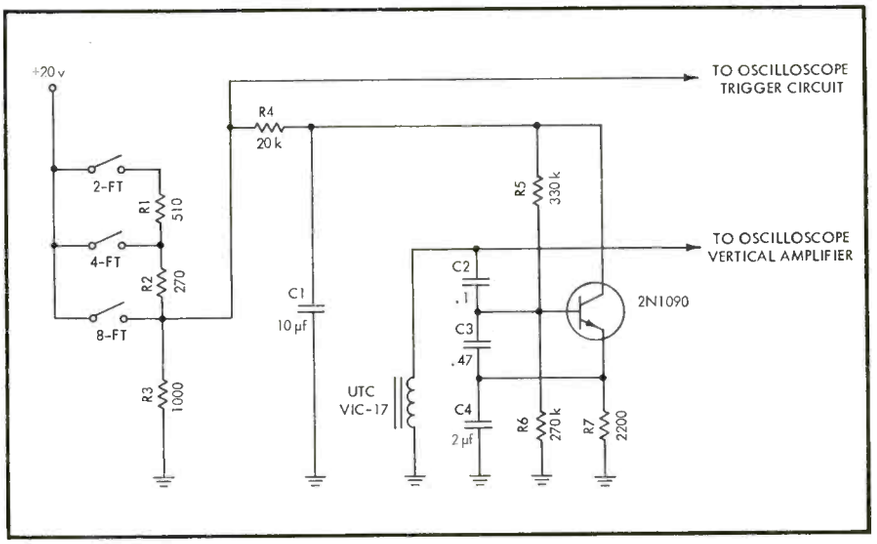

Fig. 6. An oscillator in which different amplitudes may be produced by different keying voltages.

One manufacturer (Gulbransen) has done this in a commercial instrument by using key contact supply voltage bus bars at different voltage levels for each different pitch.[3] Isolating diodes must be used in series with the key contacts to prevent shorting the bus bars together when an oscillator is simultaneously keyed from more than one. The same result could also be achieved with all bus bars at the same voltage and Zener diodes of different voltages in series with the switch contacts. Another solution, which is probably cheaper, is shown in *Fig.* 6. The waveforms produced by this purely experimental circuit are depicted in *Fig.* 7. Readers should be cautioned that this oscillator is not necessarily a good one for an electronic organ. It was assembled from available components merely for the purpose of demonstrating the keying circuit. In *Fig.* 6, resistors R_1, R_2, and R_3 form a voltage divider. The key contacts apply voltage to it at different points. The 8-ft. contact applies full voltage to the oscillator. The contacts for the higher pitches (which would be on other keys of the keyboard) apply reduced voltages. By making the divider current appreciably (10 times) higher than the oscillator current, the impedance at the input to the attack control filter may be kept low, so that no matter which contact is operated there is negligible variation in the oscillator attack

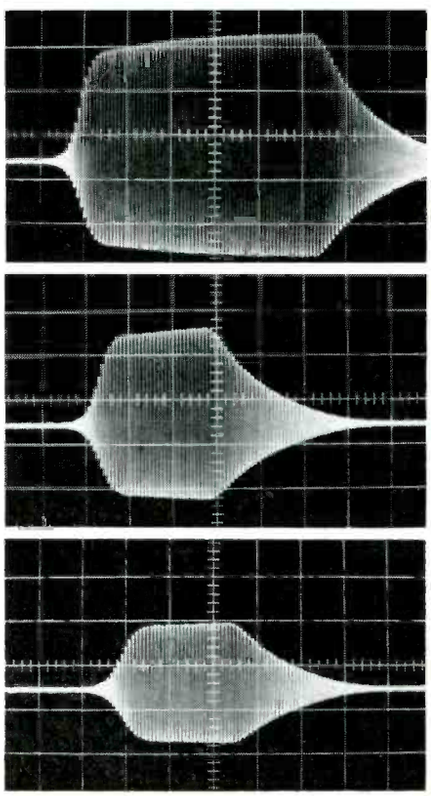

Fig. 7. Waveforms produced by the oscillator of Fig. 7: (A) when keyed from the 8-ft. contact; (B) when keyed from the 4-ft. contact; (C) when keyed from the 2-ft. contact.

sumed by pipe organ action magnets and is well within the capabilities of normal organ contact assemblies.

By using a judicious combination of such unit ranks with other non-unit ranks of oscillators, a surprisingly versatile organ can be contrived with no more than two to five ranks. In the concluding portion of this paper I shall propose a stop list for such an organ, indicate how each stop is derived, suggest a progressive assembly schedule to spread the cost out over a period of time and dwell briefly on the registration possibilities of the organ.

[1] Dorf, Richard H., "Electronic Musical Instruments," Radio Magazines Inc., Mineola, New York.

[2] Douglas, Alan, "The Electrical Production of Music," Philosophical Library, New York.

[3] Douglas, Alan, "Transistorized Organ Generators," *Electronic Engineering*, Volume 34, Page 388, June 1962.

[4] Douglas, Alan, "An Electronic Organ for Home Constructors," Sir Isaac Pitman and Sons Ltd., London.

[5] Douglas, Alan, "Improvements in Electronic Music Generators," *Electronic Engineering*, Volume 33, Page 574, Sept. 1961.

[6] Jamison, James Blaine, "Organ Design and Appraisal," H. W. Gray, New York, Page 163.

ALL SILICON TAPE PLAYBACK

(*from page 32*)

PARTS LIST

Note: All even number components for second channel. All resistors ½ w, ±10% unless otherwise indicated. All capacitors in microfarads unless otherwise indicated.

$R_{1, 2, 81, 28}$—51k, 5%, deposited carbon
$R_{1A, 2A, 81A, 82A}$—5.1k, 5%
$R_{5, 6, 85, 86}$,—200k, 5% deposited carbon
$R_{7, 8, 43, 44, 87, 88}$—7.5k, 5%
$R_{23, 24, 25, 26}$—100k each section, audio taper, concentric
$R_{105, 106}$—5k, audio taper, dual control
$R_{37, 38}$—4.3k, 5%
$R_{75, 76, 89, 90}$—12k, 5%
$R_{77, 78, 93, 94}$—39k, 5%
$R_{91, 92}$,—20k, 5%
$R_{95, 96}$—33k, 5%

$C_{1, 2, 51, 52}$—30/6v electrolytic
$C_{1A, 2A, 51A, 52A}$—5/25v electrolytic
$C_{3, 4, 53, 54}$—150/3v electrolytic
$C_{5, 6, 55, 56}$—0.0056 10%
$C_{25, 26, 35, 36}$—0.005, 10%
$C_{15, 16, 61, 62}$—50/25v electrolytic
$C_{19, 20, 21, 22, 23, 24, 31, 32}$—2/15v electrolytic
$C_{27, 28}$—2.2/3v Sprague Hypercon
$C_{29, 30}$—20/25v electrolytic
$C_{37, 38}$—0.47, 10%
$C_{41, 42}$—Arco-Elmenco trimmer 469
$C_{43, 44}$—0.1, 10%
$C_{45, 46, 47, 48}$—0.04, 10%
$C_{49, 50}$—0.022, 10%
$C_{39, 40}$—20/15v electrolytic
$C_{57, 58}$—0.0047, 10%
$C_{59, 60}$—0.004, 10%

$L_{1, 2}$—2.2 mh, Delevan 2530–32
$L_{3, 4}$,—10 mh, Delevan 3500–42

$Q_{1, 2, 15, 16, 19, 20}$—2N2925 G.E.
$Q_{3, 4, 17, 18}$—2N2924 G.E.
$Q_{5, 6, 9, 10, 13, 14}$—2N2712 G.E.
$Q_{7, 8, 11, 12}$—2N2711 G.E.

S_2—8P5T (rotary)
$S_{5, 6}$—SPDT toggle switch

VU—Lafayette TM–23

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RECORDS

(*from page 115*)

the meanings of the words and the words themselves, they sing with sincerity and with care. It's just those incredible wobbles. . . .

Some of the music is instrumental, played by the Vienna Musica Antiqua heard on Vanguard's Obrecht-Dufay record (BGS 70653).

John Taverner: Church Music. Choir King's College, Cambridge, Willcocks

Argo ZRG 5316 stereo

Orlando Gibbons: Tudo Church Music, Vol. 2. King's College Choir, Jacobean Consort of Viols, Willcocks.

Argo ZRG 5151 stereo

Handel: Coronation Anthems. Choir of King's College, English Chamber Orch., Willcocks.

Argo ZRG 5369 stereo

These three imported discs, samples sent me from a recent large batch brought in for American distribution, share a special sound —that of the ultra-British King's College Choir of Cambridge, England, performing in the spacious Chapel of the College, a long, thin, high, English-style Gothic building with enormously live acoustics.

Taverner, contemporary of Jozequin Des Près on the continent, opens up a new perspective of British music for those of us who thought that "old" music in England meant late-Elizabethan, the Shakespeare period. It is lovely, reserved (for our ears), floridly lyric choral music; the main item here is a Mass called "Western Wind," based upon a melody vaguely like the famous English traditional love song. The second side is filled out with three shorter motets. Unearthly is the best word for the first impression you will get. (But oddly enough, Taverner went over to Protestantism after 1530 and acted as a "cruel and fanatical agent" in the suppression of the Catholic monasteries. He professed himself much ashamed of his earlier music to "Popish ditties"—i.e., this music.)

Orlando Gibbons, born almost 100 years later, was a young genius at the end of the Elizabethan period and through the reign of King James I, dying young in 1625. He was in the thick of the new Anglican church music along with the older William Byrd; but he was too early for the mature "Baroque," too young to write true Renaissance music and, like Purcell, he has remained revered but somewhat isolated, between periods. His poignant, complex style is well illustrated here in works for double choirs, solos, viols, organ.

Finally, we have the four splendid anthems that Handel composed for the coronation of George II, still another century later, in 1725. The music is immensely impressive, all big spectacle (for Westminster Abbey)—but evidently the Coronation itself was bungled in many details, including a sonic tie-up in one of the anthems and assorted missed cues that brought another in at the wrong moment. There were 47 singers, boys and men, plus a perfectly huge orchestra, perhaps as many as 160; that sound is reflected in these performances, done in a similar acoustic situation.

The sound of this famous choir, in all three discs, is unlike anything American or, for that matter, continental, big mass of piping, flutey treble boys' voices, singing high against a handful of close-to, wobbly, throaty adult solos, bass, tenor and high countertenor. Weird is the word—but lovely. If you are an Anglophile, you'll swoon with joy at these. You'll like them, too, if you like old church music, which most people do.

Handel: The Dettingen Te Deum. Pütz, Lisken, Altmeyer, Crass, South German Madrigal Choir, S.W. German Chamber Orch., Gönnenwein.

Angel 36194 stereo

Again, Handel in German. How strange to hear! But what is perhaps even stranger is that, aside from the language, this German performance of a big Handel celebration-piece is much more "normal" in style for our ears than the British performances (such as Argo's four Coronation Anthems), with their peculiar choir sound, all hooty boy-sopranos and wavering alto-voiced countertenors. This one is sung by plain sopranos and altos, female, and tenors and basses, male. Maybe Handel didn't do it that way but it sounds good.

The German, very well matched up to the music, nevertheless is unpleasant for the ear used to Handel's magnificant English settings. The original English words are available as a "translation" of the sung German text. Imagine, Handel writing "Herr, Gott! Dir sei Lob!" (We praise Thee, O God.) Crazy, even if the old man *was* born a German.

MISCELLANY

Wagner: Piano Music (complete). Martin Galling.

Vox SVUX 52022 stereo

Here's an interesting oddity! You didn't know the great Richard Wagner wrote for piano?

Well, he didn't write anything of importance—though it is said he wrote out much of his opera music in piano score en route to its completion. His genuine piano stuff is (a) a batch of early works, still trying to be Schumann, Beethoven and what-have-you, plus (b) a group of occasional piano pieces of later date, written for friends. The piano was *not* Wagner's instrument.

It is decidedly interesting to follow these works chronologically and to hear the noisy, long-winded youthful imitations of other composers give way to a recognizably Wagnerian sound. But Wagner's ideas, good or bad, seldom came in small packages and his piano music is as might be expected—awfully long. Two whole LPs of it here.

Martin Galling struggles manfully with this mountain of material and gets everything out of it there is to get. Fortunately, Vox's "Twin" series doesn't cost you much for the pair of LPs. That helps a lot.

Haydn: Trumpet Concerto; Divertimento in D for Flute and Orch.; "Echo" Divertimento in E Flat; Serenade (Op. 3 No. 5). Pro Arte Ch. Orch. of Munich, Redel.

Angel 36148 stereo

Haydn is sprouting everywhere these days, especially the little-known middle and early Haydn. Am I glad. This one comes from Munich via Paris and features the (now) well-known Trumpet Concerto along with three very early works, two of which are "doubtful." They are pleasant pieces, even if maybe Haydn didn't write them; he could have, since they are doubtful merely in that positive proof of his authorship is lacking. (In those days of Haydn's fame not all that carried his name was his. Music sold *much* better with his name attached, after all.)

The Trumpet piece gets a nice, juicy performance, the trumpeter playing with a mellow vibrato that sounds like a cornet solo in a Goldman band concert in New York's Central Park. Nice, just the same. The flute Divertimento is a rich bit of nothing much, exactly what it should be——to entertain and divert. The echo piece has two groups of strings, the second echoing the end of every phrase straight through the piece. Quite ingenious. The Serenade is that familiar and lovely violin melody, to plucked *pizzicato* strings, that often shows up in high-grade background music programs. Good record.

Music for Glass Harmonica. Bruno Hoffman; instrumental ensemble.

Vox STDL 501.110 stereo

What a strange sound! Fascinating. This is the unusual music, composed in the latter 18th century, for that aetherial and unlikely musical instrument, the musical glasses. Benjamin Franklin mechanized them, placing concentric glass saucers on a spindle turned by foot power like a sewing machine, the wet fingers resting on the saucers' edges to produce the weird, howling tones of the scale. But this "glass harmonica" is the original form, high-quality glass goblets tuned to the scale and mounted so that the fingers can stroke their rims to produce the tones.

Most of us have tried glass music at some time or another in our childhood. It is astonishing to discover the piercing, unearthly tone that a good glass will produce under the finger's stroke. This performer, like those in the 18th century, plays whole chords and counterpoint on his glasses—complete music. And it is good music, too. The Mozart Adagio and Rondo, K. 617, was one of his last works and a great work too. It is usually played on an organ or a celesta—here is the original sound in all its spine-chilling effectiveness. The other music, by lesser composers, is also interesting though too much glass harmonica at a sitting is bad for jumpy nerves. Give you nightmares and hallucinations.

"Platero and I." (Ponce: Sonata Romantica. Castelnuovo-Tedesco: Platero and I, 2nd Series. Andrés Segovia, guitar.

Decca DL 710093 stereo

Segovia has had more music composed for him than any other living performer. Reams of it, and it all sounds very much like Segovia, of course, exploiting that rich, sensuous, highly colored guitar technique we've all admired for a quarter century. Neither work is very "modern"—they never are, these Segovia pieces. And so both are easy listening, unpretentious and yet virtuoso too. Nothing of any great importance—but the guitar never was a heavy-weight instrument except in the hands of beginners.

There's more of "Platero and I" (Platero is a donkey) on an earlier disc, DL 710054 stereo. AE

LIVE-VERSUS-RECORDED

(*from page 42*)

audio test procedures. Since it is impractical to have a musical group make constant visits to the testing laboratory, we use an effective substitute for musical sound, random noise. This substitute has its own advantages in that, being produced mechanically, it is the same each time.

A detailed description of the test method using live-*versus*-recorded comparisons of random noise has appeared elsewhere,[6] but in brief the method involves recording random noise anechoically and then playing it back through speakers under test, switching back and forth between the sound of the original generator and the reproduced sound. This system has proved especially effective in helping in the design of speaker crossover networks. While values for the components of such networks can be calculated roughly, the final values must be determined on the basis of the dynamic characteristics of the individual speakers. The presence of the original sound as reference removes a large element of conjecture from the choice, and has resulted in much closer agreement among those listening and making the decisions. Æ

[6] Edgar Villchur, "A Method of Testing Loudspeakers with Random Noise Input," *Journal of the Audio Engineering Society*, October 1962. Reprints of this article are available on request from Acoustic Research, Inc., 24 Thorndike Street, Cambridge, Massachusetts 02141.

AUDIO ETC

(*from page 8*)

sound. Only those sounds which are identical in both channels appear in the middle of the curtain. The rest—and all the subtle effects of stereo reverberation—are placed in spatial relationship by the stereo recording itself.

But the mono record has no stereo clues for the ear. When played on stereo equipment all the sounds are identical in both speakers. Therefore it is forcibly squeezed into the middle. All of it comes straight at you from a synthetic "virtual image" point-source, straight ahead. That is a highly unnatural and very unmusical effect as most stereo listeners soon discover for themselves, ads or no ads.

(Of course if your stereo playback system is so inefficient you can't tell stereo from mono, it isn't going to matter. But why bother with stereo in the first place, then?)

Mono via Mono

Well, you may ask, what about the good old mono days? How come the old fashioned mono hi-fi system sounded so

good—and still does?

A good mono system, with its single channel of sound, is inevitably set up so that the music is spread out for the ear *by reflection and diffusion within the listening room*. This is a generalized, non-directional, external effect, that can very nicely simulate a "real" side-to-side spread in the supposed source—a symphony orchestra laid out before you. (If not, then your mono system is a point-source at the speaker and you suffer. You always have.) Reams have been written on the proper room set-up for best mono sound—we've lived with it and studied it for a half century.

The mono owner, to be sure, usually depends on intuition and beginner's luck in setting up his home hi fi. Luck did many a fine job for him and his lower-fi ancestors in the mono age. Be that as it may, a good mono set-up sounds good because most of the sound comes to you via indirect reflection. More often than not, the loudspeaker does not even face the listener.

Mono gets its spread by external means, via the room itself. The recording does not help. It provides depth—yes. But no built-in sidewise dimension whatsoever. The room must do that.

The stereo system, in contrast—as haven't we found out?—is very different. It must be set up not for optimum room reflection but for optimum *direct* sound from its two speakers. Room reflection, though present, is now secondary. (It is accounted for to some extent in the acoustics of the normal stereo recording.) The sound spread no longer depends on it. Stereo itself provides the sidewise dimension, which is now internal, within the recording itself.

Set up your stereo system like mono, with plenty of indirect sound, and you spoil your stereo. You get mono instead.

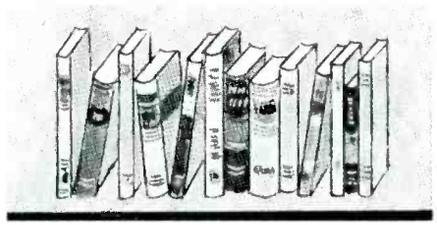
Too many people still imagine that a pair of well-separated speakers guarantees a sound-spread. Far from it! The ear doesn't work that way. Instead, it guarantees a bunched-up, center-point sound, even more of a point-source than a single speaker placed in the middle. That is, *unless* the record contains built-in stereo sound differences, in volume and phase, to produce the stereo sound-spread from side to side.

Many perceptive stereo listeners deliberately throw their stereo speakers out of phase when playing mono records in order to do away with that oppressive, squashed-up center image. It helps. But not enough. There's a better way.

The Better Way

The better way, I think you now will see, is the deliberate creation of *synthetic* differences in phase and in volume between the sounds in each speaker, out of the single mono original, in order to "induce" a more natural spread of sound as the record is played on the stereo sys-

THE AUDIO BOOKSHELF



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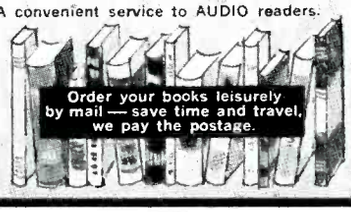

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Joseph Marshall

A valuable reference for anyone whose living or hobby is servicing hi-fi equipment. Outlines the professional approach for servicing all types of hi-fi components. Covers trouble-shooting of electronic, mechanical and acoustic problems. 224 pages.

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Jeff Markel

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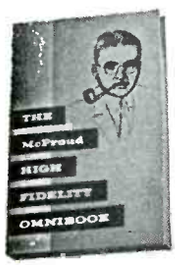

Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's, and when to's, written so plainly that both engineer and layman can appreciate its valuable context. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfect guide.

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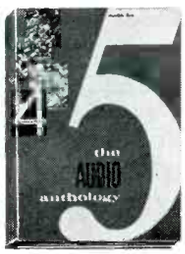

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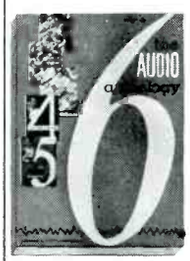

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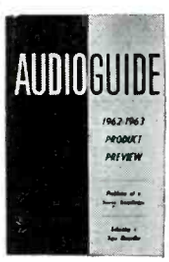

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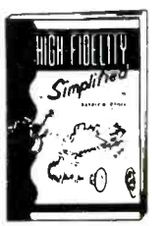
The complete hi-fi story — answers all questions about tuners, changers, amplifiers, tape recorders, speakers, record players, etc. Lots of ideas for custom installations. Tells how to achieve concert hall reception in your home. 216 pages.



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Getting The Most Out Of Your Tape Recorder
Herman Burstein

Written in "plain talk" for the man who has, or wishes to buy, a tape recorder. It answers the myriad questions raised by tape recording enthusiasts. Its chapters cover every phase of operation and maintenance—from adding a tape recorder to the hi-fi system, to a thorough dissertation on microphones. Lots of practical information on how to buy. 176 pages.

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tem.

Whatever its form—and the process can get extremely complicated in detail—the first intent of the re-channeling is thus to adapt mono to the stereo playback system. It grabs that squashed-in, center-point sound and pulls it out sidewise in both directions. Absolutely essential, I say, if your stereo system is worth its salt.

To re-state it in the familiar analogy, if stereo recording creates a "sound-curtain," the mono record on the stereo system snaps the curtain rudely into the center, all furled up and bunched, about a foot wide. There it hangs, foolishly! That's mono on the stereo "stage." How nice to be able to pull it back out again to its full spread, from one side to the other. That's what synthetic re-channeling does.

Simulation?

Yes, you can get some remarkable simulations of real stereo if you are tricky with your synthesizing. Shift the apparent treble towards the left speaker and the bass towards the right (via volume differences and maybe phasing changes too) and you can almost hear the classical symphony orchestra in its stereo layout, the violins on the left, the bass to the right. Mix in a bit of stereo reverb, two different channels of it, and you get an enhanced hall-sense. Fun.

These deliberate simulations can be very useful, as in the Beecham recordings. I'm all for them, done with taste and care. I've heard a good many (including some that are "fraudulently" issued as true stereo) in which the trick is astonishingly succesful as an imitation of the real thing. You can spot most of them easily enough—just swing the balance control all the way from side to side. The right channel by itself has a fat, tubby bass and almost no highs. The left channel is all tinny, shrill treble and violently lacking in bass. Awful. But play them both together, each from its own speaker, and the recording jumps to life! Really marvelous. Almost like real stereo. (But—remember—we aren't making direct comparisons.)

There isn't the slightest doubt in my mind—and I *have* made direct comparisons between the straight mono and re-channeled versions of the same recording—that re-channeling is useful and even necessary today if a mono recording is to have its optimum value on present playing equipment. Let's hope that as our confidence in the process grows with understanding we will soon be using it in routine fashion, an adjunct to the stereo process itself and a vital factor in the present modernization of older valued recordings.

Note: You can make a relatively crude simulation of the re-channeled mono record on your own stereo system if you have separate tone controls for each channel. Just roll off the bass on the left

channel and boost the highs a bit; roll the highs 'way down on the right channel and boost up the bass. Then put on a mono record and play it. Be sure the controls are set for stereo! With a bit of dickering you may get quite a novel improvement over straight mono reproduction.

P.S.: Economics

Just a few paragraphs on economics. With the present dollar premium on stereo records (I hate it, I hate it), it is a question whether a re-channeled mono record will be acceptable—and sell—at the regular stereo price. It *is* worth it, definitely, if you value your stereo system and understand its assets and liabilities. But a certain commercial reluctance is understandable, what with that extra smacker.

However, more and more companies today are quietly going over to the one-price system, same price for stereo or mono. Then, you see, the choice is fair and square! You can have your pick, the original mono or the re-channeled synthetic stereo, without prejudice. So I particularly recommend this process to those companies who offer a one-price policy for their records.

And I must add a further addendum. One of these days, I hope-I-hope, we're quietly going to abolish the dual mono-stereo release for good, in favor of a very slightly compatible single release. Stereo, but playable on the mono players currently being used. Things aren't now standing still. First, an awful lot of mono players use stereo cartridges these days. It's simpler. And second, those mono cartridges still being made are increasingly likely to have the vertical compliance necessary to "take" the stereo disc.

Yes—I know that ideally the mono release is a different recording, made through separate mikes. How often, in actual practice? Big companies, of course. Not the rest. And as mono recedes in importance in the quality sphere, the need for a special "ideal" mono recording grows less. Who'd know the difference on a screaming beach portable?

Final addendum. I very much disapprove of re-channeled mono records which are released, *without qualification*, as stereo discs. That, to my mind, is fraud—even though (considering that there is no stereo version available) the electronic job may be an excellent one and often is. Excellent, but not true stereo. It is dishonest to call it so and unfair to the competition which spends money on true stereo recordings. Unfair to the listener, too, because it is a falsifying of the facts.

With honest labeling the fakery vanishes and we have a highly worthwhile technological improvement. Good mono for the stereo listener! I'm all for it. Æ

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FOR SALE,: EICO #HF85 stereo preamplifier, $25; Heath #AA111 stereo power amplifier, $35. Write Milton Hollander, 1005 Eastern Parkway, Brooklyn, New York 11213

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World leader in high fidelity is holding fall backfield tryouts. If you can "carry the ball" in product design of audio or r.f. transistor circuitry send confidential resume to: Chief Scout, c/o AUDIO, P. O. Box 629, Mineola, N. Y. "An Equal Opportunity Employer."

Industry Notes . . .

• **Component Marketers Rep OKI.** Component Marketers, Inc., of Montclair, New Jersey, has been named, by Chancellor Electronics, Newark, New Jersey, as the sales respresentative in New York and New Jersey for the new OKI line of Japanese tape recorders. Principals in Component Marketers are Jack Fields, President, Jack Simon, Philip Fields, and Gerald Kaplan. An extensive campaign is under way to introduce the new OKI line to dealers, including regional showings to acquaint them with marketing plans.

• **Marantz Names Kuby, Wins UL.** Leon Kuby, formerly sales manager of Harman-Kardon, has been appointed National Sales Manager of the Marantz Company, it was announced by Saul Marantz, President. "Mr. Kuby's appointment is our first important move in stepping up promotion of the Marantz line of quality products." Mr. Marantz stated. "His responsibilities will include management of all Marantz field activities, marketing, dealer promotion as well as product planning." Also, all models of the Marantz line have been awarded permission to carry the Underwriters' Laboratories, Inc. Seal of Approval. The four models manufactured by Marantz are: Model 7, stereo preamplifier: Model 8B, stereo power amplifier; Model 9, monophonic power amplifier; and Model 10B, new stereo FM tuner.

• **Superscope Appoints Russ Molloy.** Joseph S. Tushinsky, President of Sony/Superscope, announced the introduction into the United States of Sony Professional Magnetic Recording Tape and the appointment of Russ Molloy as manager of Superscope's new Sony Tape Division. Mr. Molloy is well known for his pioneering exploits in tape. He founded the Bel Canto stereo prerecorded tape company in 1955, in time capturing 35 per cent of the national market. Most recently, Molloy headed Bel Canto for Thompson-Ramo-Wooldridge's Bell Sound Division in Columbus, Ohio. Mr. Molloy is a member of the Magnetic Recording Industry Association and has served on its board of directors. He is also a member of the RIAA.

• **Crestmark Adds Stereo Component Packages.** Crestmark Electronics, Inc. has announced that their 1964–65 line of high-fidelity equipment will be highlighted by "modular packages." These "packages" are complete stereo component systems consisting of separate receivers, amplifiers, speakers and record changers integrated to fit in hand-finished cabinetry. The introductory line of "modular packages" includes both tube-type and solid-state phono systems and an AM-FM-Stereo modular system. They range in price from $99 through $300 at retail.

• **International Electronics To Build New Plant.** Mr. B. B. Grossman, President of International Electronics Corporation, has announced the company's plans for construction of a new plant in Melville, Long Island. Construction of this modern, fully air-conditioned plant of 40,000 square feet, began in April and is scheduled for completion by next Fall. Facing the Long Island Expressway and adjacent to Route 110 in Melville, Long Island, the new building will house International Electronics Corporation's expanded operations, which will include quality control, processing and packaging of electron tubes, semiconductors and other electronic components.

• **Petersen Leaves TRW Bell.** Ken Peter-Ramo Wooldridge's Columbus Division, sen, Marketing Manager of Thompson Columbus, Ohio, has resigned. He has been responsible for all Columbus marketing activities including Bell Sound hi fi equipment, tape recorders, and public address equipment as well as TRW Language Laboratory products. Mr. Petersen has announced no plans.

COVER INSTALLATION

The system featured on this month's cover is housed in a room 15 × 30 ft. with a 14 ft. cathedral ceiling and a carpeted floor. One end was reserved for the music system which was designed to reach from wall to wall. The home built cabinets are of walnut with black Formica tops. The right cabinet contains browsing bins for records and space for future tape deck. The left cabinet contains the turntable. Storage for other equipment is available in the bottom halves of these cabinets. The speaker systems are in 13 cubic foot bass reflex enclosures. Components in each are: two 15-in. Altec Lansing woofers, 500-cps dividing network and an Altec 511 horn. These are driven by a kit-built Harman-Kardon Citation 2 basic amplifier with added input level controls. Preamplifier is a Scott 130. Tuner is a Scott 350 (multiplex). Antenna is a 10-element Finco Yagi with Alliance rotator. Turntable is a Gray 500 with a ¼-in. steel motor board and 18-lb. platter driven by a hysteresis motor. Arm is a Gray 216 holding an early model Shure M3D cartridge. Signal from the center channel of the preamplifier is used to drive a Heath W6-A, 70-watt amplifier which, in turn, drives four 12-in. speakers to provide music outdoors. Not shown is the organ speaker loft. This is concealed behind a flush grille at the highest point on one wall. It contains a Hammond PR40 tone cabinet with reverberation unit. Heavy wood louvres were built in front of the speaker openings to break up and deflect the sound. Speakers used are Hammond, two 15-in. and two 12-in. The Hammond amplifier is rated at 40 watts. The system is in the home of T. H. Kuykendall of Charlottesville, Va.

ADVERTISING INDEX

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Give yourself the thrilling new experience of *Sound Unbound*, yours only in the new STRATOPHONIC Series solid-state FM stereo receivers by Harman-Kardon. Never before have you heard such magnificent sound from a receiver. In full-power frequency response, FM sensitivity, freedom from distortion, and sheer listening pleasure, Stratophonic Sound is unsurpassed.

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Stratophonic prices: Model SR900 (illustrated), $469; Model SR600, $389; Model SR300, $279. At these prices, practically *everyone* can afford Stratophonic Sound.

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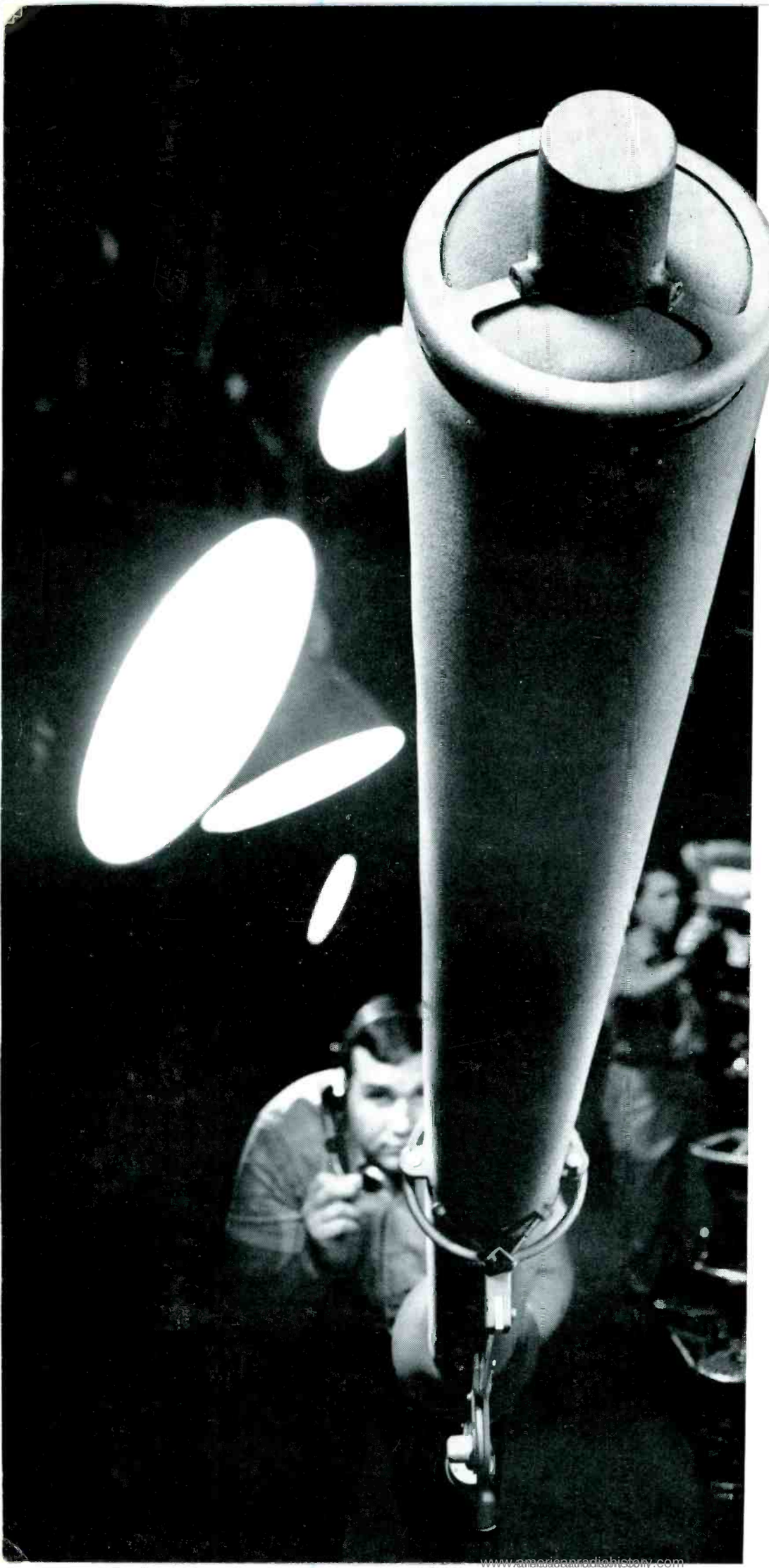

How does this 7 FOOT MONSTER help solve your sound problems?

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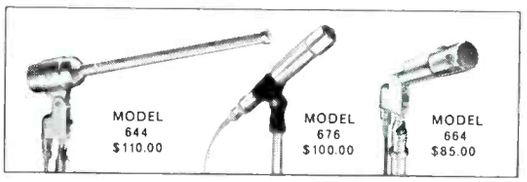
And this same basic research stimulated the development of our new Model 676 cardioid microphone. It uses the Continuously Variable-D® cardioid principle (a creative development from our exclusive Variable-D patent*) to provide smoother cardioid action—in a smaller unit—than any other comparable model.



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*Cardiline Patent No. 3095084, Variable-D® Patent No. 3115207

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