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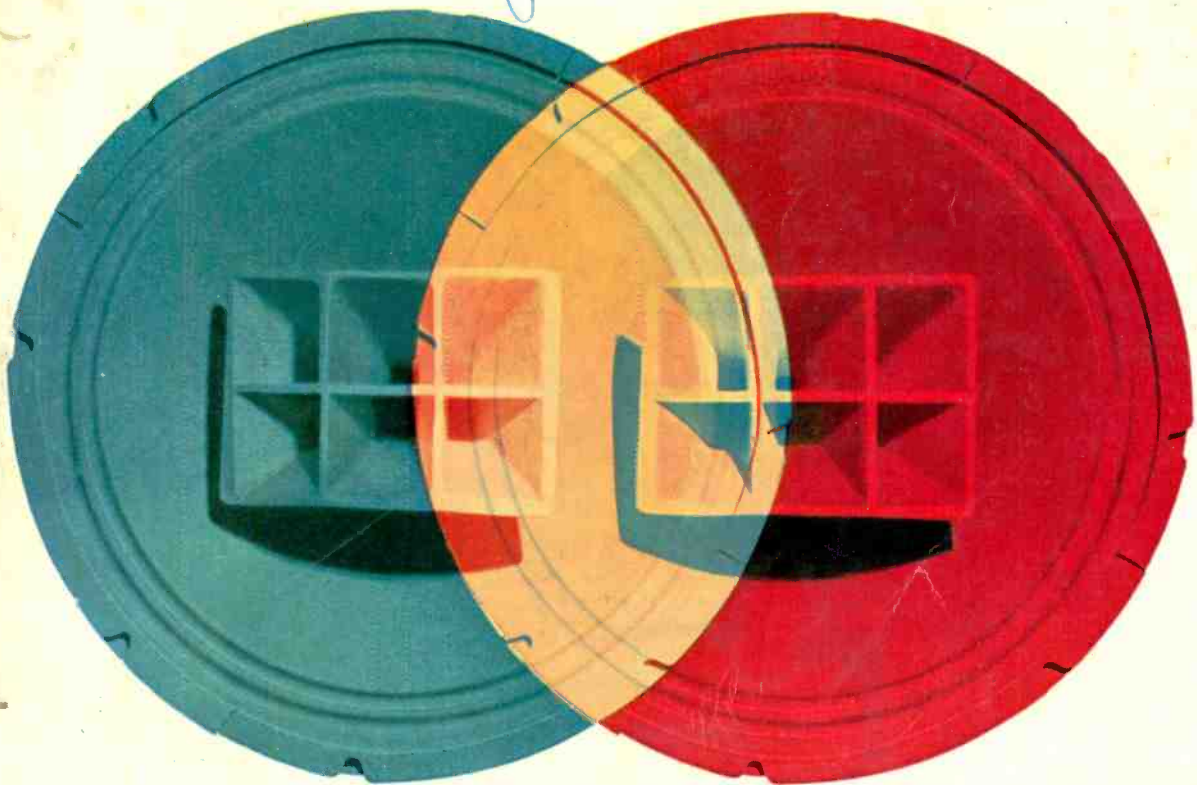
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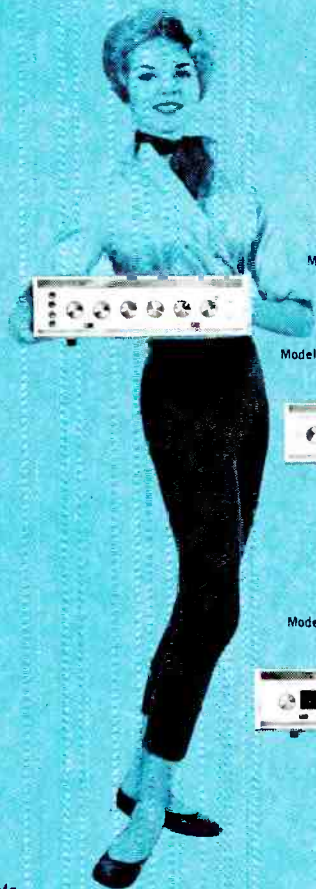
# STEREO

# HANDBOOK





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30. A "must" for any record library



40. "Hallelujah", "Finlandia", etc.



27. Granada, La Paloma, 11 more



49. That's All Over, One More Ride, etc.

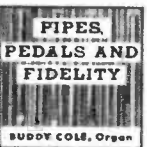
The Columbia  Record Club  
Terre Haute Indiana



3. Didn't It Rain, God Is Real, etc.



21. Four dashing, fiery rhapsodies



22. Organist Cole plays 11 hit tunes



12. Let's Dance, Jubilee, 7 more



29. High-spirited, gay symphonies



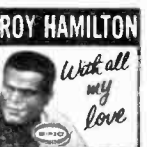
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33. 11 beautiful, immortal melodies



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**NOTE:** Stereo records must be played only on a stereo record player

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Dealer's Name.....  
Dealer's Address..... 302

**CIRCLE 6 NUMBERS:**

1	21
2	22
3	24
5	25
6	27
7	29
8	30
9	31
10	33
11	37
12	40
15	49
16	50
19	

F-85

# HI-FI STEREO HANDBOOK

*by Edward A. Campbell*

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# A SHORT GLOSSARY OF HI-FI TERMS

**AES**—Audio Engineering Society. At one time, the letters AES were used to designate the disc-reproduction equalization recommended as a standard by that society.

**AMPLIFIER**—An electronic device whose output is an enlarged reproduction of its input. (See *Audio Frequency, Preamplifier, Power Amplifier, RF Amplifier.*)

**ATTENUATOR**—A device, usually resistive, that reduces the strength of the signal a desired amount, preferably without distortion; it is sometimes called a “pad.” L-pads, H-pads and T-pads are attenuators with different wiring arrangements.

**AUDIO FREQUENCY (AF)**—A frequency corresponding to an audible sound wave. Although the extremes vary widely, the range of audible frequencies for people with normal hearing is generally taken to be 15-15,000 cycles. An *Audio (AF) amplifier* is designed to handle this frequency range. The amplifier’s capabilities may, of course, extend beyond the audible range.

**BAFFLE**—A flat surface, box or horn used with a loudspeaker to increase the effective length of the air path from the front of the speaker to the back, reducing the cancellation that could result from the interaction between the out-of-phase sound waves emanating from those two areas. The baffle is necessary to prevent cancellation at low (bass) frequencies. An un baffled speaker has extremely poor bass response.

**BASS (frequencies)**—Low audio frequencies, generally considered to be below 300 cycles. It is interesting to note that Middle C on the piano (262) is therefore considered a “bass” note by audiophiles.

**BINAURAL**—Having two ears, or the effect of hearing with two ears. Rather ineptly used as a name for two-channel sound, it now can be considered synonymous with stereo, although it once implied listening with earphones.

**CROSSOVER NETWORK**—An electrical filter to separate different bands of audio frequencies (as, for instance, bass and treble) to feed a multispeaker system. *Crossover frequency* or crossover point is the point in the audio spectrum at which the network divides the bands.

**DAMPING**—In the audio context, a shutting off of vibrations. Both pickups and speakers are damped to prevent extraneous electrical signals and sounds. The output from an amplifier should control the speaker, and some amps provide *variable damping*, which allows slightly more precise direction of speaker vibrations.

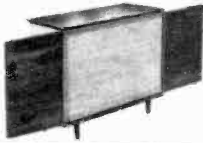
**DECIBEL (DB)**—One-tenth of a bel, the unit for logarithmic expression of ratios of power, voltage or loudness, named after Alexander Graham Bell. While DB expresses a ratio, it may imply an actual level if the reference level is zero.

**DISTORTION**—Alteration in the form of a signal (audio, for example) either by disproportionate amplitude changes or by the addition of frequencies (usually harmonics of the desired frequency) which were not present in the original signal. (See *Flutter, Harmonic Distortion, Hum, Hangover Effect, Intermodulation Distortion, Rumble and Wow.*)

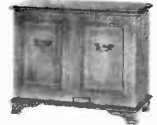
**ENCLOSURE**—A loudspeaker mounting that prevents the rear waves of the speaker from interfering with the front waves. Most good enclosures act to reinforce the bass response of the speaker.

**FEEDBACK**—Essentially a graphic expression, exactly describing an existing phenomenon. *Acoustical feedback* occurs when the vibrations from the speaker cone influence the action of record player or amplifier. *Electrical feedback* is a circuit in the amplifier that takes impulses from a later stage and feeds them back into an

*continued*

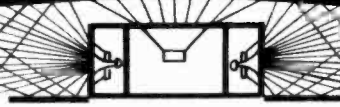


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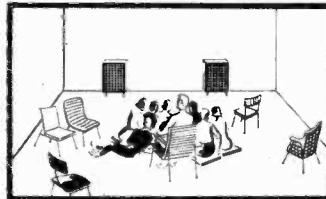
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## GLOSSARY

earlier stage. *Negative feedback* decreases power and corrects distortion. *Positive feedback* increases power and distortion.

**FLUTTER**—Flutter is the very short, rapid variations in the speed of movement of tape or disc which show up as fluctuations in the pitch of the reproduced sound.

**FREQUENCY RANGE**—The range between the highest and lowest frequencies that a sound system can reproduce.

**FREQUENCY RESPONSE**—The measure of an audio system's ability to reproduce all frequencies within a given range with equal efficiency. Rather than "equal efficiency," frequency response (or sometimes, just "response") over the given range is usually stated as falling within certain limits of deviation. Example: plus or minus 2 DB, 50-12,000 cycles.

**GAIN**—The degree of input-signal magnification achieved in each stage of amplifier.

**HANGOVER EFFECT**—The tendency of the loudspeaker to continue to vibrate at bass frequencies after the exciting frequency has been cut off. The effect is a "mushy" sound in the bass register. Corrected by proper damping, by either electronic or acoustic means, or a combination of the two. A speaker can be over-damped; the ideal situation is called "critical damping."

**HARMONIC DISTORTION**—The occurrence in the output of an audio system of a harmonic (or harmonics) of an input frequency. A harmonic is an integral multiple of the fundamental frequency, as 32, 64, 128, 256, and so forth.

**HUM**—Low-frequency noise or distortion in an audio system, usually from the unwanted pickup of the power-line frequency (60 or 120 cycles).

**IMPEDANCE**—The total opposition in a circuit to the flow of alternating current. It varies with the frequency. This term, as used in audio work, usually implies the

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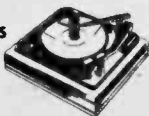
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## GLOSSARY

"characteristic impedance" (the impedance at a given frequency). Loudspeaker impedance is computed at 400 cycles. For most efficient power transfer between circuits, impedances should be "matched."

**INTERMODULATION DISTORTION**—The occurrence in the output of an audio system of frequencies equal to the sums and differences of harmonics of the component frequencies in the input. Such frequencies are also called "beat frequency products." For example, the two frequencies 500 and 2,000 cycles could produce a sum of 2,500 cycles and a difference of 1,500 cycles.

**LOADING**—A way of increasing the sound from a loudspeaker by coupling the sound-producing source more efficiently to the air. *Front-loading* couples by means of the waves from the front of the speaker (in practice, the Klipsch design); *rear-loading* couples by means of the waves from the rear of the speaker.

**LOUDNESS CONTROL**—A volume control that automatically compensates for the response characteristics of the ear.

**LOUDSPEAKER**—A device that transforms electrical impulses into sound waves.

**MAGNETIC PICKUP**—A phonograph pickup (cartridge) in which movement of the needle moves a coil or coils in the field of a magnet to vary the amount of flux in step with an audio-frequency signal. Characterized by low impedance and low-level output.

**NARTB**—National Association of Radio and Television Broadcasters. Like AES and RIAA, the initials NARTB often imply a standard recording and reproducing characteristic recommended by this association.

**PEAK**—(A) The maximum instantaneous value of a varying voltage or current. (B) An unusual or disproportionate deviation in the frequency response of an audio device that is otherwise linear or uniform.

**PHASE**—In acoustics, a part of the sound wave—increasing compression or rarefac-

tion. Two sound sources are *in phase* when they are both compressing the air at the same time; they are said to be *out of phase* when one is compressing and one rarefying. Since the sound wave of each frequency has a different length, spatial considerations strongly influence phase relations.

**PICKUP**—A device that translates into electrical energy the physical motions of a stylus tracking the waving grooves of a turning phonograph record. *Magnetic* and *dynamic* pickups have a constant-velocity response, *piezoelectric* and *capacitance* pickups a constant-amplitude response. (See *Magnetic Pickup*, *Piezoelectric Pickup*.)

**PIEZOELECTRIC PICKUP**—An organic or synthetic (usually ceramic) crystal used in a phono cartridge. This type of crystal has the property of producing a voltage when twisted mechanically (as by a needle) or of producing mechanical force when actuated by a voltage. Characterized by a higher impedance and output than that of a magnetic cartridge.

**POWER AMPLIFIER**—An amplifier designed to deliver power (see *Preamplifier*, below). In audio, the power amplifier provides the energy to activate the loudspeaker.

**POWER OUTPUT**—The output in watts delivered to the load; in audio, the power delivered to the speaker. This is electrical power. The power output of a speaker is acoustical power, and its relation to power delivered to it is determined by the efficiency of the speaker.

**PREAMPLIFIER**—In the strict technical sense, merely a voltage-amplification stage or device. In hi-fi, the term has come to imply a unit that incorporates various equalization and audio control circuits.

**RF AMPLIFIER**—An amplifier designed to handle a specific band of frequencies in the radio spectrum; generally considered to extend from 10 KC to 30,000 MC.

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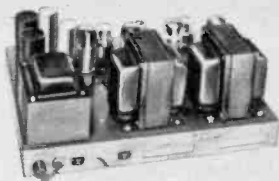
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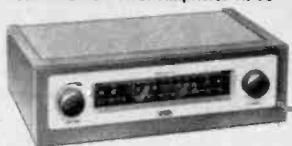
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**FM Tuner HFT90  
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**Stereo Integrated Amplifier AF4**



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50, 30, & 20W (use 2 for stereo)**



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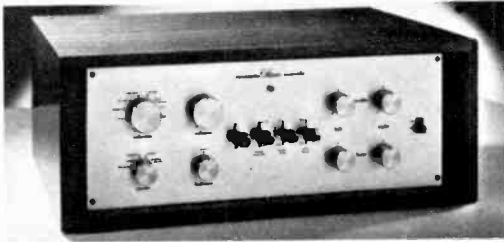
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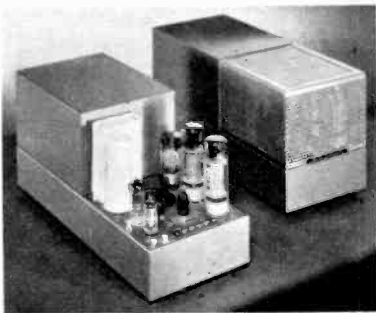
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Slightly higher in West

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## GLOSSARY

**RESONANCE**—The natural period of vibration of a physical body. Some familiar physical bodies that have a natural resonance point are tone arms, loudspeakers, piano strings. Often a resonance can cause an undesired peak in the response of a device.

**RESPONSE**—The measurement of how a phonograph (or any of its parts) reproduces sound. The *response curve* measures the reproduction at all frequencies. A *flat response* indicates that it handles all frequencies alike, as it should.

**REVERBERATION**—Reflection or ricochet of sound waves. A smooth (i.e., regular) surface reflects more than a rough (irregular) surface. Regular surfaces are smooth plaster walls or ceilings; irregular surfaces include such things as heavy-pile carpets and velvet drapes.

**RIAA**—Record Industry Association of America, the association of phonograph record manufacturers or producers. The initials also refer to the standard recording and reproducing characteristic sponsored by that group. Since 1954, this has been the accepted standard of the American industry. Since the move toward uniformity became widespread, it has been possible to simplify record compensators (as well as the playing of records). Although slightly different in some details from previously accepted standards, the RIAA characteristic includes the treble and bass pre-emphasis which has become more or less routine. When "de-emphasized" in playback, it results in reduction of the apparent level of surface noise (treble) and turntable rumble (bass).

**RUMBLE**—An undesirable low-frequency noise component in sound reproduced from records, caused by motor vibrations transmitted to the turntable. Rumble is primarily a vertical force or vibration, and could be greatly reduced by pickups designed to have no vertical compliance. Stereo discs,



however, are recorded with a vertical component and require pickups with vertical compliance. Besides bass pre-emphasis (see *RIAA*), better motor design and mounting can keep rumble to a minimum. **STEREOPHONIC SOUND**—This is a method of sound reproduction (commonly called “stereo”) that uses two separate channels from the broadcasting studio or recording to the listener’s ears. Ideally, the original sound pickup devices and the ultimate sound reproducers (the loudspeakers) are somewhat separated from each other in space, so that the two sound channels are not identical. (Also see *Binaural*.)

**STYLUS TIP**—That part of a phonograph needle or stylus which actually engages the grooves of the record. Since the groove is approximately two to three thousandths of an inch deep, the tip need not be any longer than that. That part of the needle which engages the cartridge (and to which the tip is attached) is called the “shank.”

**SURFACE NOISE**—Sounds created by imperfections or dust on the surface of a record. **TIP RADIUS**—The radius of curvature of the stylus tip, as seen in cross section through the vertical plane.

**TONE ARM**—Properly, the pickup arm. This holds the pickup over the record.

**TRACKING ERROR**—The difference between the arc made by a pivoting arm over a record and the straight line of the bar that held the cutting stylus.

**TRACKING WEIGHT**—The effective downward pressure of stylus on record groove.

**TRANSIENT RESPONSE**—The ability of a phonograph to react instantly to the start or the end of a recorded sound.

**TWEETER**—A loudspeaker designed to create high-frequency sounds only.

**WOOFER**—A loudspeaker designed to create low-frequency sounds only.

**WOW**—Distorted sound due to speed variations of record turntable or tape reel.



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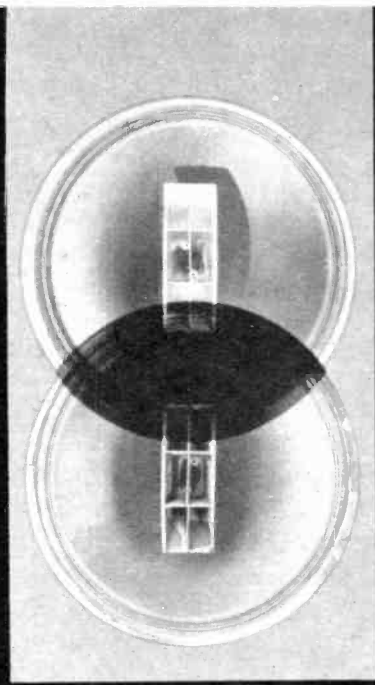
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11



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BRAIN FUSE THEM INTO A SINGLE WAVE OF RICH  
MUSICAL EXCITEMENT ■ WITH ONE FLICK OF A  
KNOB, A SYMPHONY ORCHESTRA IS BROUGHT  
RIGHT INTO YOUR HOME ■ THIS IS **STEREO**

## CHAPTER 1

In Cole Porter's 1955 musical, *Silk Stockings*, Gretchen Wyler told the film industry something they already knew: "Ya gotta have glorious Technicolor, breath-taking Cinemascope and Stereophonic Sound!" A casual glance at any hi-fi journal today will convince you she was right, and not just for the movie industry. Today, *you* gotta have stereophonic sound!

So what is stereo and how do you get it? And does its arrival in your home mean the end of your trusty Atwater Kent and your treasured original recordings of Caruso and the Mound City Blue Blowers? These are fairly big questions. To start getting at the answers, it may be wise to honor custom and go back to the word the Greeks had for it.

To the Greeks, *stereos* meant solid. Our present concept of the word, however, stems from its misuse in connection with photography. 'Way

## STEREO



This is a stereopticon of the type that could be found in any parlor 50 years or so ago. "Stereo" was a misnomer here, but it makes very good sense when applied to sound systems

back before we were born, people were getting a charge out of a hand-held 3-D kind of viewer known as a stereoscope. This gave an illusion of depth by means of what we now call a "stereo pair" of photos, each of which was viewed by only one eye. The photos were not identical; they were taken from slightly different vantage points approximating the distance between the eyes. The brain fused the two into one picture, with intriguing results.

How does this apply to what we're talking about? Well, we're talking about binaural, or two-eared, sound. Two sound pick-ups, somewhat separated in space, produce two sound channels which are reproduced separately and fed to our separated ears from left and right channels. The brain fuses the two into one sound that has "depth." Some clever person—maybe in the prerecorded tape business—realized that "stereophonic sound" was apt to make a greater impression on the public than "binaural sound," and began substituting the term. "Stereophonic" was shortened to "stereo," and here we are. Actually, the substitution was rather fortunate because "stereophonic" is a much more flexible word than "binaural." We are not limited to two channels in home sound reproduction, so "stereo" will be descriptive even when we have more.

Stereo is new, in a way, because it exploded in the hi-fi field late in 1957 with the introduction of compatible stereo discs (we'll discuss what they're compatible with later). It's also old, in a way, because engineers were fooling around with it 30 years ago. Even the movie industry's bold sally into stereo in the 1950's was an idea dredged up from its own past. Walt Disney's pre-World War II *Fantasia* had utilized multi-channel recording and reproduction successfully to provide a startling and enjoyable auditory experience. So stereo, if you want to split hairs technically, is not new. But from the standpoint of home-entertainment equipment, stereo was a laboratory experiment yesterday; today it is a commercial reality.

What's the relationship between stereo and hi-fi? Well, hi-fi might be defined as sound reproduced by means of certain high-quality equipment



with which the two-channel technique may be used. You will also find stereo reproduction offered in very ordinary equipment, and there seems to be no agreement on whether or not stereo and hi-fi need to go hand in hand. Some experts believe that you *must* have hi-fi equipment for the reproduction of stereo; others feel that stereo adds something, even to mediocre equipment. If there is no general agreement, even among experts, why do we have stereo now? Well, ever since the art of audio began, sound engineers have been concerned with the fact that sound-collection equipment (such as microphones) and sound-reproduction equipment (such as loudspeakers) are essentially "monaural" in nature. As you are very likely aware—or can guess—monaural means one-eared.

The shortcoming, if any, stems from the fact that normal people are surrounded with sound as they might be surrounded by water if they put their heads into a full rain barrel, plus the fact of the distance between their ears. Because the ears are oriented differently in space, the sound entering each ear is slightly different. It is this neat arrangement that lets us detect the direction from which a sound comes. It is also claimed—by extension from the binocular-vision phenomenon, which is supposed to enable us to perceive depth—that binaural hearing enables us to hear depth. However, this cannot be the whole of the matter, for when we listen to an ordinary sound system, the sound comes to us from a single point, as it might if we were listening through a hole in the wall.

## STEREO'S TWO-EARED SOUND

This "point source of sound" theory of monaural sound is somewhat exaggerated because it overlooks room reverberation, which tends to restore the "surrounded by sound" situation. Also, the use of two or more loudspeakers with a monaural sound system creates quite a pleasing illusion of depth and realism—a situation most of those who used them were very proud of three or four years ago. Whatever the physics of the matter, the conclusion is inescapable that stereo adds something to even the finest hi-fi system.

It is probably clear by now that while written explanations of stereo may contain some unprovable and even illogical assertions, the physical fact of listening to two sound channels proves that it is worth-while. Perhaps the contradiction only underscores the fact that there is a lot we don't know yet about human hearing.

Another claim that may prove confusing is that stereo, especially in hi-fi, captures the true nature of the original sound. As a matter of fact, the true nature of the original sound—reality, if you will—is *not* sought after, nor would it be appreciated if it were achieved. The acoustical volume of a symphony orchestra, for example, or a full-sized dance band could never be accommodated in an ordinary living room. This is one obvious "reality" you could live without. Another facet of the problem is that your home has different reverberational qualities from those of a concert hall.

# STEREO

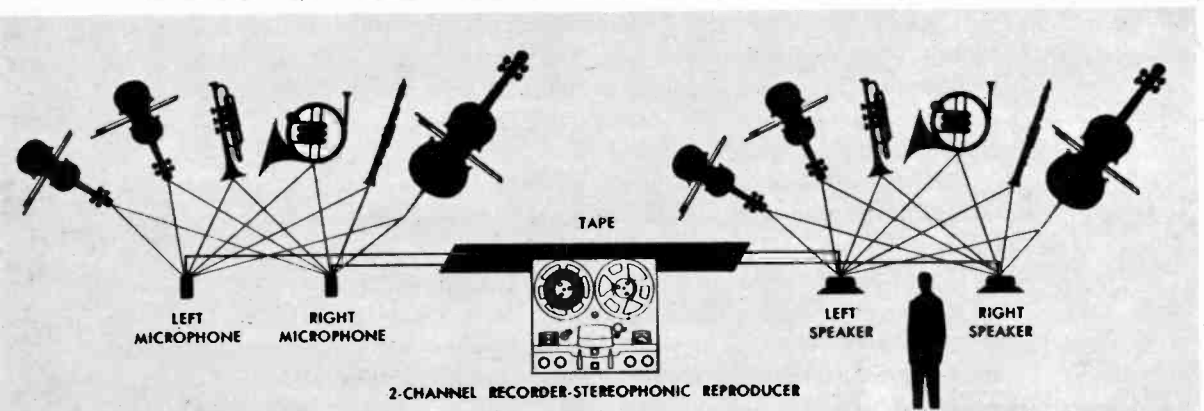
Is this departure from reality a bad thing? Of course not. The bass emphasis which is characteristic of most jukebox sounds pleases most of the people who listen to jukeboxes, yet it is most certainly not true to the tonal balances of the original performance. Nor is the upper-frequency brilliance so characteristic of many of today's symphonic recordings an accurate reconstruction of the tonal balances involved, yet musically sophisticated listeners enjoy them.

To put fidelity to original tonal qualities directly into the realm of stereo, we find that the most striking demonstrations of stereo are those in which exaggerated spatial effects and relationships are established. That is, you are aware when listening that the kettle drums are *here* while the piccolos are *there*. But in real life you rarely notice such things at all. As in a well-prepared sauce, the ingredient sounds of an orchestral passage are so blended that you don't detect them individually; yet they blend together to produce a most pleasing whole.

Nevertheless, the exaggeration of spatial effects of stereo reproduction is fascinating, and you probably will hear much more of it as time goes on. This is especially true because such obvious devices are almost necessary to create interesting effects with a very small musical group and to allow the stereo feeling to get across even in single-unit stereo systems.

The ability to distinguish the physical location (or apparent location) of different elements in the program material should not be the only virtue of stereo, even though it provides the most dramatic demonstration of it. Our two eyes do not tell us merely that the girl is on the left and the boy on the right, or that a car is about 50 feet away from us. The eyes also help us distinguish between a sphere and a flat disc; between velvet and linen, between pink roses and yellow. Similarly, we should get from stereo—and do—such information as presence, brilliance and dynamic range.

For stereo reproduction sound is picked up by two microphones, then goes into two channels on stereo disc or tape. In home music systems, channels of sound are played through separate speakers



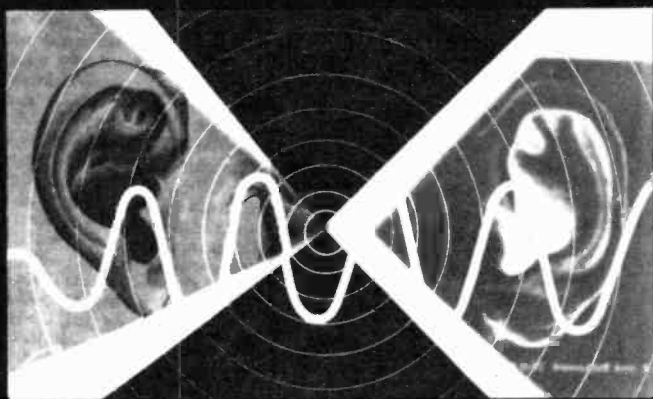
Difficulties with stereo? Sure, lots of them, although none seems insurmountable. You probably have heard people fretting about speaker placement, balancing and phasing, about the matching of components, about troubles with turntable rumble, about a "hole in the middle," about occasional ear-shattering distortion. Many of these difficulties, however, were due to earlier inexperience in the preparation of equipment or, in some cases, to the purchase of inferior equipment; to the lack of knowledge in the use of it; to poor programs on tape or discs. Today you can get—well, that's precisely why we have prepared this book: to tell you what you can get, what to do with it, how to enjoy it.

As a sort of preview of what's coming, we have provided below a few of the many questions being asked about stereo, with references showing where the answers appear in this book. Though the questions do not cover the whole subject, they should be a valuable guide as you read on.

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## FREQUENTLY ASKED QUESTIONS ABOUT STEREO

Can I convert to stereo or must I start from scratch and buy all new equipment?	See Chapter 10
Can I buy an all-in-one-piece stereo unit or must I assemble separate pieces?	See Chapter 2
How far apart must the loudspeakers be?	See Chapter 7
Must all components, including speakers, be of exactly the same quality and matched?	See Chapter 12
Will a record changer handle stereo discs or should I have a transcription turntable?	See Chapter 4
What's the difference between "binaural" and "stereophonic" reproduction?	See Chapter 2
What is the meaning of the terms "wired for stereo" and "ready for stereo"?	See Chapter 2
How much power do you need for stereo?	See Chapter 3
Must you sit in one spot to hear stereo?	See Chapter 7
What is three-channel stereo?	See Chapter 7
How many additional controls do I need for stereo and where should I put them?	See Chapter 8
How much does stereo cost?	See Chapter 12
Can a single phono cartridge handle all my present 78, LP and 45 monophonic discs as well as the new stereo discs?	See Chapter 4



THE BASIC PRECEPTS OF HI-FI QUALITY APPLY  
TO BOTH MONO AND STEREO SYSTEMS ■ YOUR  
GOAL IS THE COMPLETE RANGE OF RICH SOUND,  
BUT THERE IS NO FORMULA THAT ENSURES THE  
FIDELITY YOU SEEK ■ FINAL PROOF IS IN THE  
LISTENING THAT PUTS

**HI-FI IN FOCUS**



## CHAPTER 2

In the field of home entertainment, the terms hi-fi and stereo do not name specific pieces of equipment as do words like TV and phonograph. Rather they represent qualities of such equipment, in the sense that color is a quality of a photograph. The specific generic term to cover what we are talking about is sound, or more properly, reproduced sound. Audio (Latin for "I hear") is often used instead of sound in referring to equipment.

The sources of the sound in home entertainment include radio, the sound portion of TV, phonograph records, tape recordings and the sound from a movie projector. These are called program sources. The program material would be the original sound source: orchestra, solo musician or singer, and so forth. Edison can be considered the granddaddy of reproduced sound, having invented, besides the light bulb, the phonograph, movies and the

electronic tube that ultimately made radio possible. So although you could have fun tracing this science back into antiquity, audio as we know it is a product of the twentieth century. While the phonograph predates the radio and enjoyed a tremendous vogue before anybody had a crystal set, it didn't come into its own from an audio standpoint until the 30's, when electronic recording was developed and the stage was set for the enormous advances that were to follow before very long.

### THE ADVENT OF LP'S

Probably the most significant single advance was the development of LP records by Columbia in 1948. This innovation accomplished much: it provided more music time on discs, nipping an incipient trend toward tape recorders; and it called for lightweight pickups and low tracking pressures, as well as much-higher-quality phonograph motors (to run steadily at the slower speed), thereby triggering the production of many new and improved pieces of equipment. Finally, Columbia placed an emphasis, in its publicity on the LP, on high fidelity: greater dynamic range, wider frequency range, higher quality than previous 78-rpm discs. And, of course, all the LP's were of vinyl plastic, a material that had been used for very few 78's.

Not only did the LP's set off a great expansion of the recorded repertory but they heightened the public's interest in recorded music. Hi-fi, too, got a push, but in 1948 its main appeal was to hobbyists. There were two reasons other than high-quality sound for this. One was that assembling your own system from individually purchased components could be cheaper than purchasing a ready-made unit. And very few ready-made units, mostly from makers such as Capehart and Magnavox, were available. The second reason was that you could "build-in" the hi-fi system to suit your taste and your space, which would not only save the cost of a cabinet but avoid the necessity of staring at a decal of Philippine mahogany superimposed on gum plywood.

So hi-fi began to mean something that you *must* assemble from components and build into a storage wall. The term also conveyed overtones of hobbyists, audio bugs and odd-balls. I suppose if this development had come a few years later, it would have turned up as one of the activities Viceroy smokers were engaged in during early 1959. But suddenly—perhaps because the radio-TV-phonograph industry was temporarily in the doldrums—hi-fi became a commercial reality and moved out of the hobbyist category. While many people may have misunderstood the significance of the term *high fidelity* when it was exclusively associated with hobbyists, they are as nothing to the people who misunderstand it today. This is because everything from a \$19.95 portable radio on up was labeled "hi-fi" in order to cash in on the craze. We use "was" advisedly. This year everything is labeled "stereo." As one manufacturer remarked, "Without stereo, you're dead," and it is very possible that monophonic (that is, non-stereo) equipment may not even be offered for sale in another year. At least, that's how it looks to the experts.



Stacked high above Dr. Peter Goldmark, chief researcher at Columbia Records, are discs cut at 78 rpm. In his hands he holds the same music on 33-rpm recordings. One bonus was the smaller storage space required; LP's greater fidelity was the big advantage to the listener

## HI-FI AND STEREO

It is easier to define stereo, as the term applies to equipment, than it is to define hi-fi. Stereo equipment must provide two channels of reproduced sound (regardless of quality). High fidelity, on the other hand, is a goal rather than a measurable fact. Some people will tell you that, to qualify for the term, equipment should be capable of reproducing the audible range with a minimal amount of distortion, noise and hum and at least 20 watts of power. Others will say that the audible-frequency range isn't sufficient, and that 20 watts isn't enough to handle transient peaks without distortion. Still others will concentrate on equipment, saying that you must have a rim-driven turntable cushioned in sand, or a series of loudspeakers which break up the audio spectrum into four or more segments. Purists generally concede that you must have a tuner for radio (by which FM is meant; the term *tuner* was hardly known 20 years ago) and that you're dead without a tape deck.

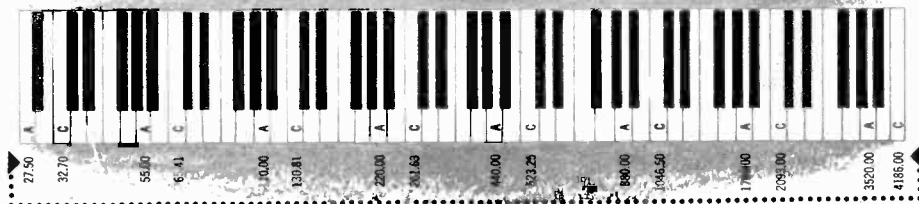
Meanwhile, the \$19.95 complete-in-a-unit "hi-fi" set continues to be available—and to find purchasers by the tens of thousands.

Easy to define or not, let's discuss some of the qualities of high fidelity, because there really is such a thing. Most people are able to distinguish audio frequencies from as low as 60 cycles (a very low hum) to 15,000 cycles (a very high whistle). People with normal hearing, that is. As we get older, our high-frequency cut-off gets lower. It has been established by a number of experimenters, notable among whom is Dr. Harry F. Olson of RCA, that people prefer full-range musical reproduction if no marked distortion is involved. So we might establish as one of the criteria of high fidelity that the equipment be capable of reproducing the complete audible range, at least. Some units go far beyond that today, especially at the high end.

### THE PROBLEM OF DISTORTION

Surprisingly enough, it's possible, in theory at least, to reproduce this entire range in a small table radio. But that's overlooking the matter of distortion. The commonest type of distortion is amplitude distortion. To explain this, let's suppose that we feed into our theoretical table radio five frequencies, each of the same order of power: 60; 600; 6,000; 10,000 and 15,000 cps. We might discover that the output varies tremendously from these inputs. If we assigned to 6,000 cps the arbitrary output quantity equal to 100, the five frequencies might reproduce like this: 10, 75, 100, 40, 10. Assuming equal input, this would represent amplitude distortion. If we drew a graph of the results, we would have a chart of the frequency response.

Harmonic, or intermodulation, distortion (IM) provides something in the reproduced sound that didn't exist to start with, namely a "beat frequency" or harmonic product. With reasonable care, distortion of these types can be confined to low limits at moderate power. But at full power we have another story. The full power of an amplifier might be 20 watts, but the power with negligible distortion might be only 5 watts. On a table radio, which might



The frequencies of musical sounds for the notes on a piano keyboard are illustrated above in cycles per second. The note to which all Occidental orchestral instruments are tuned is A, at 440 cps

have a maximum audio power output of four watts, the temptation would be to turn it up into the area of high distortion, where we would say it was overloaded, simply to get a big enough sound.

Brilliance is a term that connotes bell-like clarity in the upper register. Good or clean bass or depth implies concise reproduction of different bass-register tones as opposed to the mushy thump that is apparent in some equipment. Presence conveys a quality of three-dimensional realism and is said to depend on clean reproduction in the mid-range (500 to 5,000). Dynamic range is the range between loud and soft passages. The equipment should be capable of reproducing the widest possible dynamic range, but this range is often limited by the sound engineers who are monitoring a broadcast or a recording, as well as by broadcast and recording techniques.

These qualities (brilliance, depth, presence, etc.) are *listening* terms. No matter what the maker claims, or even builds into his equipment, you have to hear them before they exist. The point is, though, that you can hear them, and that hi-fi, despite problems of definition, has audible qualities, and is not just a label. But when you venture into a discussion of what equipment is needed to get these qualities, you will find more than two schools of thought. There is the tuner vs. receiver controversy; the turntable vs. the changer; the wide-range vs. several narrow-range speakers; prerecorded tapes vs. discs, etc. And now that we are in this area, perhaps we should first consider the chain of equipment from program source to your ear(s).

## THE CHAIN OF SOUND

All audio-reproduction equipment has units in common—namely, an audio-frequency power amplifier and something to convert this power into sound, either a loudspeaker or headphones. In the home, the audio-frequency voltage to be amplified and reproduced comes from a tuner, a record player or a tape playback; these three are the program sources. Tape heads and magnetic phono cartridges require a preamplifier to bring the signal up to a level where it can be handled by the power amplifier. Every table radio contains a tuner, an audio amplifier and a loudspeaker. When a tuner and an amplifier and their power supply are combined on one chassis, the unit is called a receiver. A receiver is not necessarily provided with a loudspeaker, although it needs one, of course, if its signals are to be converted into sounds.

A self-contained tape recorder includes the tape deck (tape-transport mechanism, record and reproduction heads, plus various controls and indicators), preamplifier, power amplifier and speaker. A self-contained phonograph includes a turntable or changer, tone arm, stylus, cartridge, power amplifier and speaker (sometimes a preamp too). These components—tuner, tape deck, record player, preamplifier, power amplifier and loudspeaker(s)—need not be separate, though they often are, especially in hi-fi rigs. Separate components give the user more latitude in selecting the items and the types, brands or price ranges he wants. They also give him flexibility in adding or changing compo-

## HI-FI IN FOCUS



This well-designed, built-in stereo system utilizes a Scott tuner and preamp, J. B. Lansing speaker system, McIntosh basic amp and Rek-O-Kut turntable with arm. Rig looks, sounds good

nents. Finally, in the case of preamp, power and loudspeaker(s), there is an economy because we are using the same components for all program sources, instead of having separate items for each.

## MEASURES OF QUALITY

Each item in the chain of equipment has its own measure of quality: tuners must have good sensitivity and selectivity; record players and tape decks must boast an absence of wow, flutter and rumble, amplifiers will register claims for high power with low distortion, etc. We shan't go into great detail about equipment at this point except to add that all signal-carrying components (tuners, amplifiers, preamplifiers, cartridges, speakers, etc.) should be capable—at some control setting—of passing along the signal in the same form in which it was received. Virtually nothing has a perfect, 100 per cent “flat response,” but many items of better quality approach it.

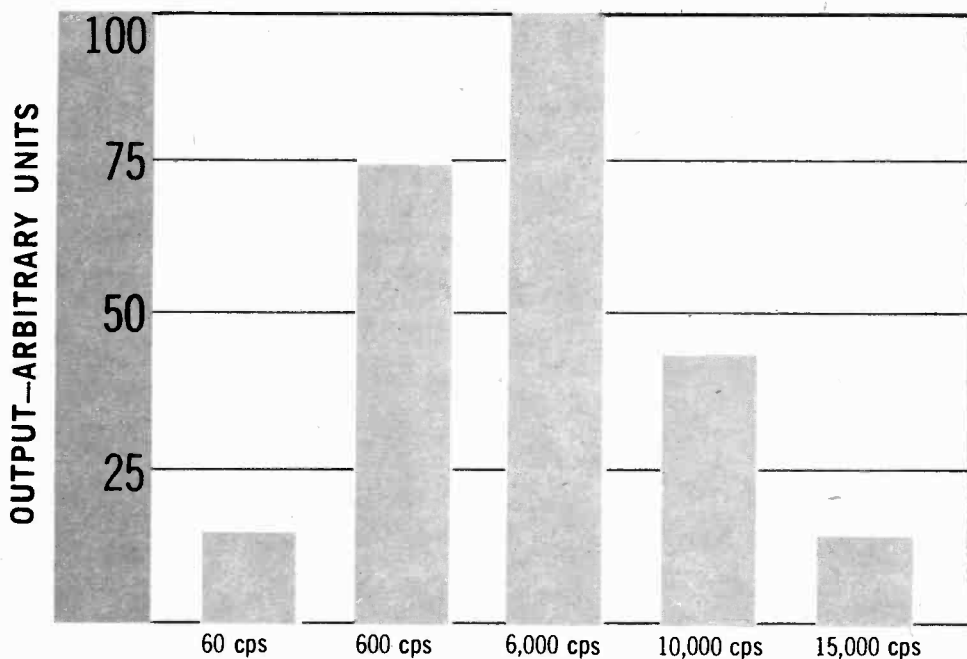
The final link in the chain is the mind of the listener as it interprets the sounds his ear receives. His tastes enter in, and only he can learn to cater to them. He may feel that Toscanini's recordings of Haydn, though brilliant, lack depth; or that Mengelberg's César Franck is at too fast a tempo. Not everyone will agree on points like these, of course, any more than they will agree on the setting of bass and treble controls. We mention them only to underscore the fact that there is no *absolute* in this matter of hi-fi. We can make recommenda-



tions and give you good reasons for them, but in the last analysis, the proof of the pudding must be *your*—the listener's—proof.

## BACK TO STEREO

So far we have been addressing ourselves not so much to stereo as to audio equipment in general. As we mentioned earlier, stereo is a method of reproducing sound that provides two separate and different sound channels from the source to your ear; two channels now, probably more later. Stereo equipment this year is available at prices ranging from \$30 to \$3,000. At any price, it doesn't have to be *good* to be labeled stereo. The distinguishing feature about stereo is that you have to have two of almost everything: two ears, two loudspeakers (or sets of speakers), two amplifiers (although these can be on one chassis), two sound sources or channels, each producing a slightly different variation of the original program material. To combine stereo and hi-fi, the same sort of high-quality equipment is required as for conventional (monophonic) hi-fi, but doubled in most instances. Some of this equipment is peculiar to stereo; that is, you can't just use two tape recorders or two phonographs. You must have a stereo recorder or a stereo tone arm, cartridge and stylus for



The bar graph shows possible amplifier performance over a five-test frequency range at constant voltage signals. With 50 as the arbitrary listening level, the amplifier's range is actually only 600-6,000 cps

## HI-FI IN FOCUS

disc reproduction. Some new controls are also needed to control the additional sound channel as well as to balance the sound output from the speakers, provide for the simultaneous reception of two different radio signals, and the like.

This, then, is stereo: a refinement of existing sound-reproduction techniques so great that it amounts to a new technique. It requires some special equipment, but it can provide a listening experience which is head and shoulders above that derived from the best available monophonic rig.

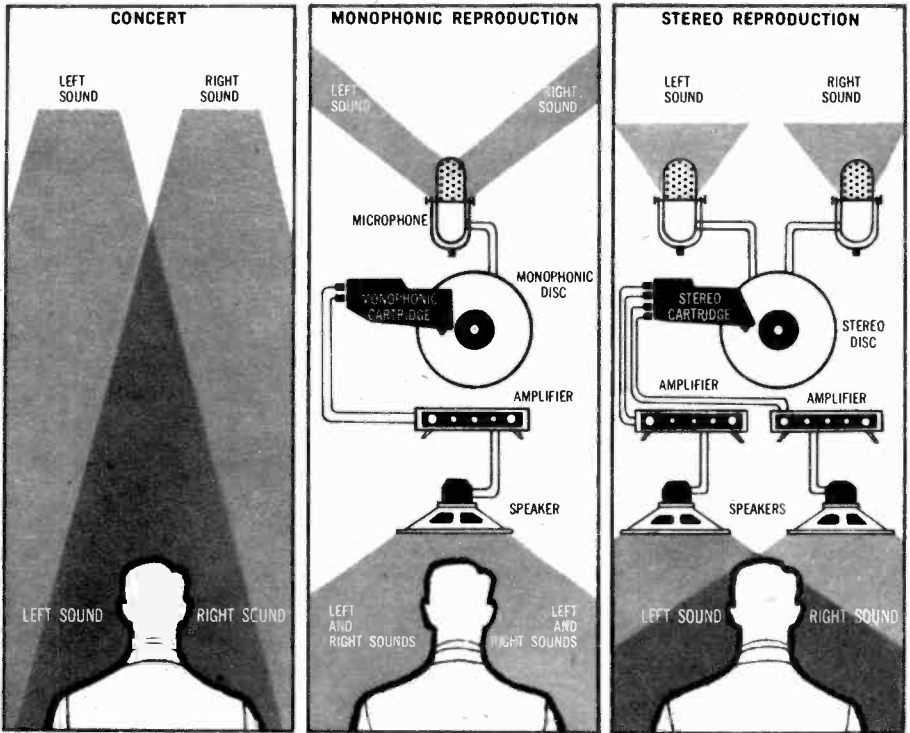
### MANY SOUNDS, MANY METHODS

The reader may not only wonder what stereo sounds like; after he has heard it he will wonder what it *should* sound like. Stereo is not a single, absolute entity. There are many different ways to record stereo and there has been a great variety in the results obtained from different methods used in the last few years (starting with Emory Cook's double-grooved binaural records in the early 1950's and proceeding through stereo tapes to the present compatible stereo discs). It is not even true that one recording principle governs all of a company's products, for different types of program material call for different treatments. When you listen to a stereo demonstration, don't try to judge it by a single example. Unless you are familiar with the material, you won't be able to tell whether the quality is above or below average.

Prevalent in hi-fi stereo stores is the gimmick record that features sounds made by trains and jet airplanes. Such records don't tell you much about stereo and should be considered for what they are: stunts. Musical records that keep your attention jumping back and forth from one speaker to the other, no matter how fine the program material may be, become tiresome because they



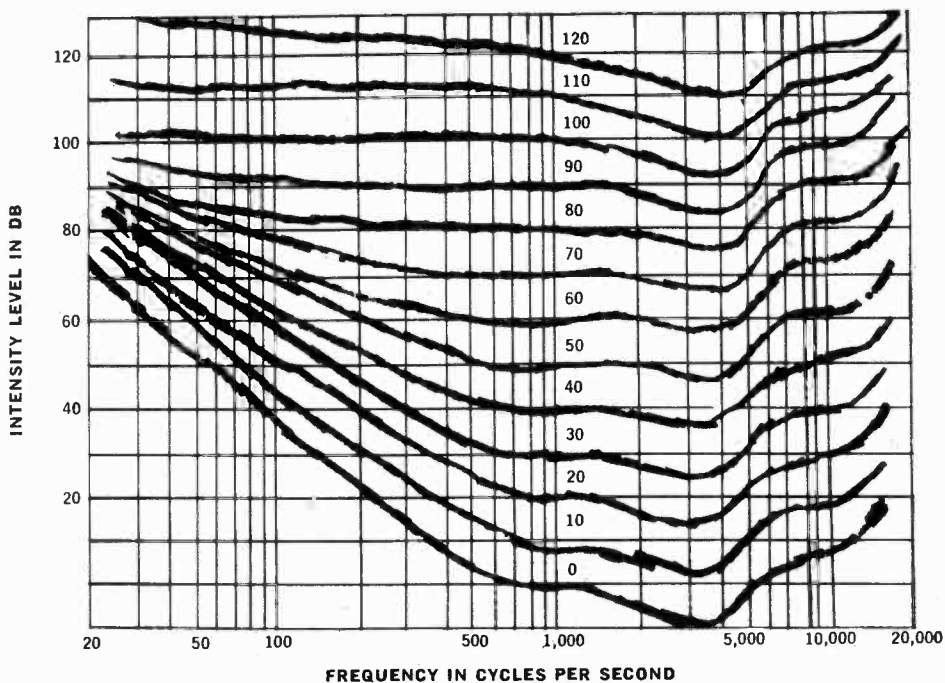
Two fine stereo components are shown here: on the left, the Roberts Stereo Recorder, Model 90-C, and, right, the Roberts Stereo Amplifier, Model A-901. The two units may be purchased for \$499.00



Stereo reproduction brings listener closer approximation of concert-hall sound than does a monophonic recording. Stereo's two microphones, amplifiers and speaker—two sound tracks—give depth and fullness that are unattainable in a mono rig

are unnatural. This technique is known as the “ping-pong effect.” When overdone, it, too, can result in a stunt record.

With good stereo, you should not be aware that there are two separate speakers, one on your left and the other on your right. What you should hear is a well-integrated whole. We have heard demonstrations in which the sound seemed to be coming from a speaker placed in the center, although none was there. Shaw once remarked that witnessing a drama requires a “willful suspension of disbelief.” We know that the actual event is not taking place on the stage, that these are just actors going through their lines. But we must put this thought out of our minds if we are to enjoy the play. Then our enjoyment will depend on how successfully the dramatist, director, scene designer and actors have created the illusion. By the same token, listening to music electronically reproduced is—or should be—the creation of an illusion that the musicians are really present. In the early days of radio, advertisements used to say that “it sounds as if it was in the next room.” Today we want it to sound as if it were in *this* room.

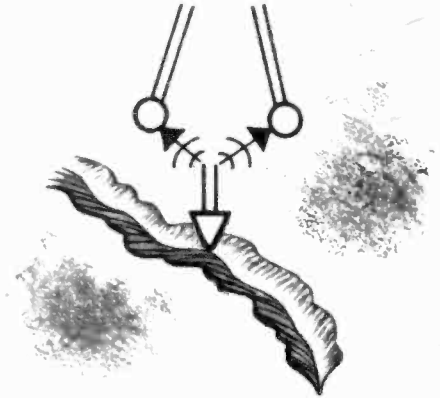


In the diagram above, each curve on the graph shows the sound intensity that is required at any frequency to produce a loudness equal to that resulting from the 1,000-cycle intensity indicated

## THE SENSE OF IMMEDIACY

But in recorded or electronically reproduced music we do not attempt to "hold the mirror up to nature." The illusion created is the one to which we have become accustomed; for most of us are more used to getting our music "canned" than to hearing it "live." We have developed certain tastes and preferences. And besides, the results have to suit the situation, which is a living room in the home. To understand how the listening situation affects program material, consider for a moment television and the typical audience reactions to it. In spite of the vast popularity of Westerns, vast panoramas of western scenery seldom come across on the small TV screen, a fact that has led to the development of the "Adult Western," where people in Stetsons talk to each other in quite ordinary backgrounds and settings. Similarly, interview and panel shows have been a great hit mainly because they involve a few people sitting and talking as people might sit and talk in your own living room.

In the recorded music that we hear at home we like to get closer to the source than we would be in a concert hall. For this reason, recording engineers have emphasized things like the tinkle of a glockenspiel or the sonorous majesty of the bass viol, so that these instruments seem close to us. The engineers sometimes go so far as to pick up the scraping sound of violin bow on strings, the sound of a singer drawing a breath, the humming of Toscanini as he



For stereo recording (at left), sound from many mikes is blended by an engineer at the sound board. The resultant disc (at right) has two independent sound tracks; the cartridge, with two signal-generating elements, uses only one stylus

conducted and the mechanical noises of the harpsichord as Landowska plays it. These subtleties give a sense of immediacy to the recording and make the listener feel that he was present when it was made, just as movie close-ups interspersed with long shots can make an audience feel intimately involved in the action taking place on even the widest of the new screens.

This is not to imply that such devices are faults or shortcomings, or that they are the tricks of an unscrupulous recording engineer. We all enjoy recorded music more because of the engineers—the good ones. The point is, we should be aware that they exist, and that they are not slavishly attempting to create, somehow, an exact duplicate of live music. They are trying to provide an enjoyable performance. So stereo is not “supposed to be” one thing in particular. It is a two-channel recording technique which, it has been found, can create an even more pleasurable listening experience than monophonic recording, an even greater illusion.

At least temporarily, we might sum it up this way: Stereo should—and when it is good, it does—sound a great deal better than mono. There is an illusion of presence, of more reverberation, greater reality. Stereo, further, should not have faults like a “hole in the middle,” obvious imbalances or grating distortion. The recording technique should not result in a performance that seems unnatural. Viewed in this light, stereo can be evaluated by any layman, for in the last analysis it is to be purchased and listened to by laymen.



THE HEART OF ANY STEREO SYSTEM IS THE PLACE  
WHERE ALL THE INPUTS MEET ALL THE OUTPUTS

■ THIS STAGE IS PURELY ELECTRONIC—THE TINY  
IMPULSES MUST BE MAGNIFIED A MILLION TIMES

■ THE UNITS ENGINEERS HAVE DESIGNED FOR  
THE JOB ARE

## **AMPS & PREAMPS**



## CHAPTER 3

**M**ore so than most other purveyors of consumer goods, manufacturers of hi-fi equipment throw a lot of technical and pseudo-technical terms at their prospective customers. This is especially true of amplifiers and preamps, and many hi-fi enthusiasts have become glib with terms such as impedance, negative feedback, odd-harmonic distortion and DC-operated filaments. Much of the technical jargon is unnecessary to the reader who merely wishes to make a good purchase, but a little bit of introductory explanation will help to put things in their proper place later on.

Amplifiers are an essential part of all electronic equipment. As a matter of fact, it was the development of the amplification principle—via an electron or vacuum tube—that really started radio (and its various offspring) on its way. To amplify is to enlarge or magnify. An amplifier draws energy from

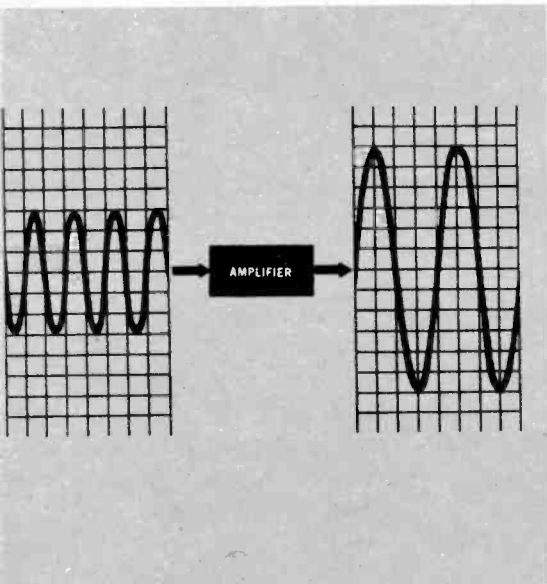
## AMPS AND PREAMPS

a source of electric power and causes this energy to assume the form and proportions of the original signal, which is therefore apparently amplified. This is an example of the old principle that "energy is neither created nor destroyed, it is only transformed."

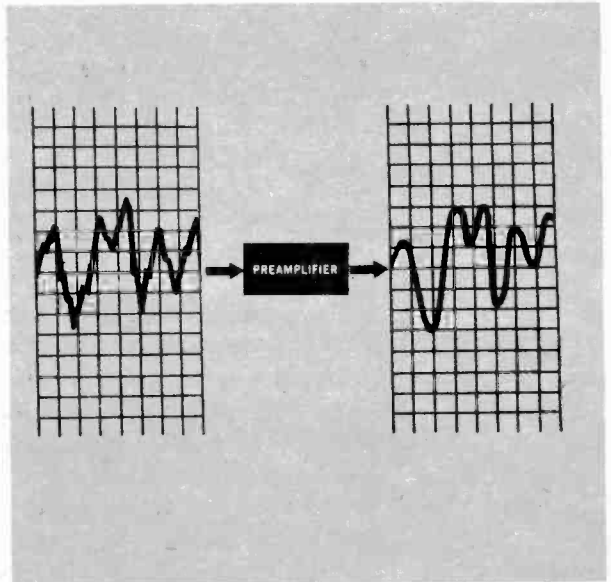
Amplifiers are used in countless applications and one way to classify them is by the range of frequencies which they can handle efficiently. Thus an audio amplifier handles audio frequencies. The electrical requirements of an amplifier can include both AC and DC over a wide range of voltages, from as low as 6 volts to as high as 600. That stage or part of the equipment which supplies these various needs is called the "power supply." Power is expressed in watts, and is the ability to do work of some sort. In the case of the audio amplifier, the work to be done is driving a loudspeaker.

## PREAMPS

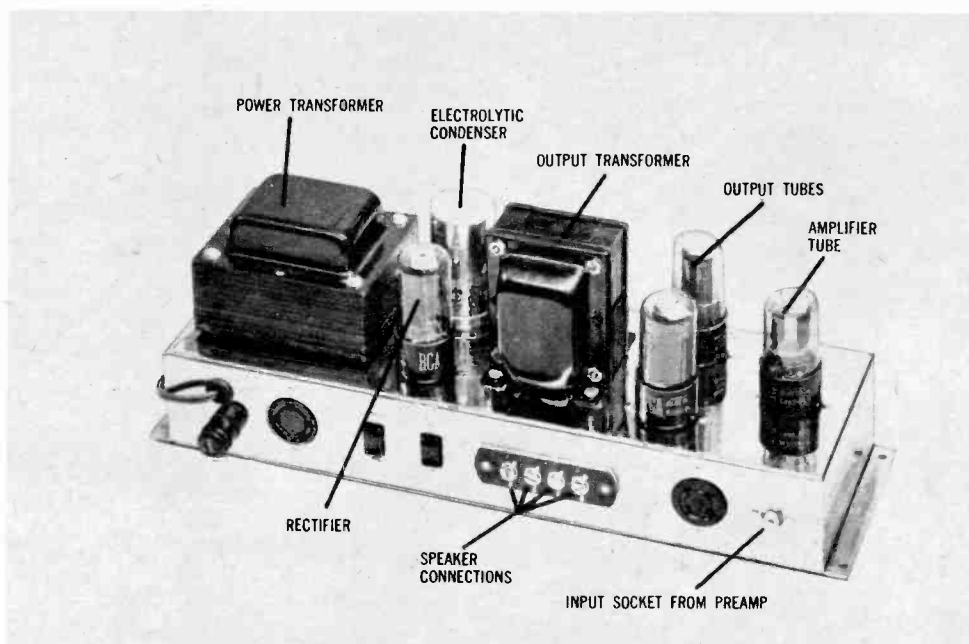
The job of the preamp is to take a very low signal and boost it till it is high enough to be accepted by an amplifier. A preamp might take the .025-volt (25 millivolt) output of a phono cartridge and raise it to 2 volts, at which level it would be suitable for delivery to a power amplifier. Preamps first became known to audio fans when the GE variable-reluctance pickup and other "magnetic" types appeared on the scene about eleven years ago.



The amp merely enlarges audio supplied to it by the preamp. Amplifier should not change shape of curve



A preamp takes signals from the sound source, removes ragged edges, reconstitutes highs, lows, adds emphasis to the bass and treble



Size and weight of transformers, plus number of amp output tubes, are trustworthy indications of amplifier quality. Stereo power amps consist of two monophonic amps (above) mounted on same chassis

Up to that time, most common or garden variety pickups were crystal with an output of about one volt, which could be fed directly into an amplifier stage. With but a fraction of that output, the new pickups required a preamplifier in order to raise the voltage to the input requirements of the average amplifier. Since these pickups also required special equalization (compensation for portions of the signal which were not accurate reproductions), it was convenient to provide such equalization in the preamp.

The various present-day forms of magnetic pickups have a low-level output requiring preamplification, and also a more markedly non-linear response, requiring equalization. The subject of equalization is a bit too involved for a full discussion here, but it is well to be aware of this fact: virtually no piece of equipment in the audio field has a linear or "flat" response *before equalization*. With proper equalization, *almost* any equipment can be provided with a flat response. This statement presumes (1) sufficient power available so that some of it can be dissipated in equalization circuits and still have enough left at the end and (2) that the output of the equipment is consistent (as opposed to erratic) and is free of unusual and extreme irregularities. By this latter phrase, we mean peaks or resonance points. A rather appropriate analogy is this: that in spite of the wide variation in vision capabilities of people, *most* people can be brought up to 20/20 with correction (i.e., glasses).

As recording techniques began to exhibit great variations, it became desirable to provide some controls on the preamp, to select different degrees or types of equalization. This is how the unit as we know it today evolved.

## AMPS AND PREAMPS



Bogen ST 10-AG stereo adapter contains dual preamps and 10-watt mono power amplifier for add-on use



Bogen STA 1 stereo adapter includes mono-stereo switch, reverse stereo control and volume dial



Stereo conversion unit for 20-watt amplifiers is Harman-Kardon AX20, which has dual preamp

To many users today, the preamp is a control unit, because that's how it serves them. Basically, however, it is a voltage-amplification device, and as such it was known for years by people who used a microphone, which is also a low-level signal source. Preamplifier stages are a routine part of sound equipment used with microphones. Tape recording and reproducing heads also have a low-level output and require preamplification. Phono pickups, microphones and tape heads all require different types of equalization.

## HOW MUCH TOGETHERNESS?

For stereo it is possible, just as it was with mono, to purchase receivers such as the Fisher 600 or the Harman-Kardon TA-230 which contain pre-amplifier and power amplifier, with integral power supply, on a single-chassis tuner. It is also possible to get all these components separately, or in various other combinations such as tuner and preamp (Fisher 90-T) or preamp and power amp (Stromberg-Carlson ASR-444). Which way is best?

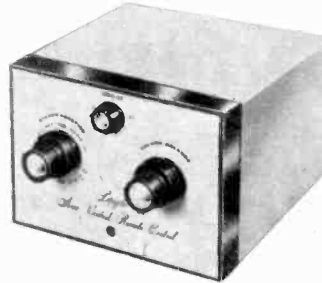
So far as quality goes, there is absolutely no difference. That is, quality is not diminished by combining several services on one chassis. Other factors besides quality should be considered, however. One is flexibility. A collection of separate components is more flexible, of course, both from the standpoint of initial choice and subsequent changes or additions. A second factor is control. As a rule, the more separate pieces of equipment you have,



Stromberg-Carlson ASR 433 stereo unit has generous number of controls for tone, volume



Scott Stereo Adapter lets users operate system monophonically, for stereo and stereo reverse



Stereo control unit from Lafayette can be used with a wide variety of amplifier makes

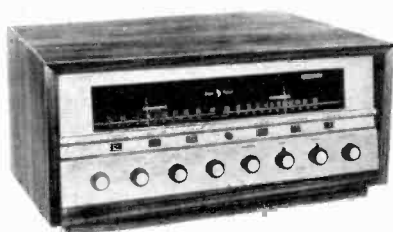
the more knobs there are to turn. Some people are fascinated by a multiplicity of knobs; some are genuinely capable of making very subtle adjustments with such a variety; some are bewildered and annoyed by it.

A third factor is physical space and convenience. From the standpoint of physical space, it may or may not be more convenient to have separate components, depending on your own situation. From the standpoint of convenience, many people find it most practical to adjust sound from the listening position rather than from the equipment location. This is especially true of stereo. This factor suggests the practicality of the remotely located preamp-control unit—"remote" in this sense implying at the listening position. It is of course possible in some homes to have the entire equipment setup at the listening position with the exception of the loudspeakers. In this case, there would be no particular advantage to a separate preamp.

## HOW MUCH POWER?

The question of power requirements may be considered next—audio power output, not electrical power consumption. The "watts" in both instances represent the same sort of units of measure, but one is input watts, the other output watts. Incidentally, no device is 100 per cent efficient (in which case output would equal input). The heat which is dissipated from electronic equipment is one of the losses that reduce efficiency. If we were

## AMPS AND PREAMPS



Harman-Kardon stereo three-in-one (above) combines dual stereo preamps plus power amps (upper right) and stereo AM-FM tuner (right). Three-in-one offers space and cost economies, is ideal for non-permanent set-up. Unit needs only a speaker to become a full stereo system



to start out by saying, "What is the least amount of audio power one could get by with," we would be asking an academic question. For although it is theoretically possible, it is not practical at present to produce a high-quality audio amplifier (that is, one with wide frequency range, good frequency response and negligible distortion) without using a pair of output tubes that yield a combined output of at least 10 watts. Since a stereo amplifier is really two complete amplifiers, this means that the least we could expect to find in a good stereo amplifier is 10 watts per channel, or a total of 20 watts.

The author has conducted tests in which the output power was measured with a meter and has demonstrated that if 20 watts of power were actually delivered, the sound level would be unbearable except outdoors or in a large hall. The secret is that the amplifier is virtually never run "wide open"; 20 watts implies plenty of "spare" power. In spite of this known fact, there are 60-watt amplifiers for home use, as well as people who advance apparently unassailable arguments for the necessity of that much power. One of these arguments claims that transient peaks in music attain a level of 10 times the average level of loud passages. If an amp doesn't have the capability to handle this power, it is said, distortion will result. This point is well taken, but it concerns only the perfectionist. For most people, once a certain level of quality has been attained, increments of improvement will not be in proportion to the money spent. So, in answer to the question, "How many watts?" we reply that 20 watts (with negligible distortion) from a stereo amplifier is plenty for high-fidelity results. Higher-powered amplifiers of equal or better quality can provide some improvements (plus considerable pride of ownership), but it is important to understand that high wattage output is not *per se* high fidelity.

So far, we've discussed preamps and amps in a general way, without specific attention to stereo. Stereo, of course, is a two-channel system. It follows that we must have a two-channel preamp and two amplifiers or a dual amplifier (stereo amplifiers on a single chassis). We have already



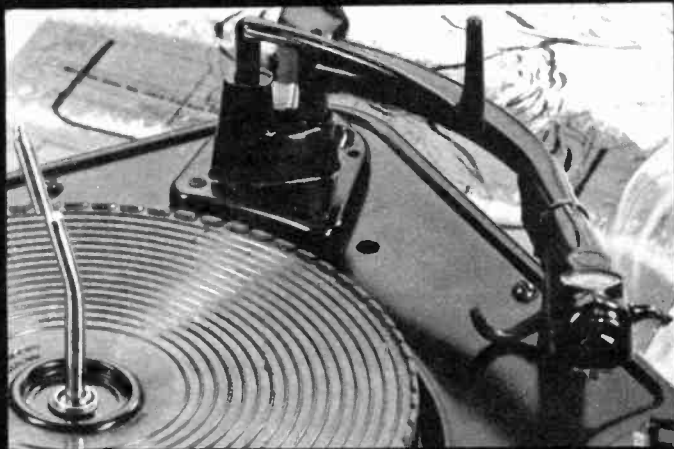
established the fact that it is more convenient to have the control of loud-speaker output available at the listening position. This could be simply a control unit, or a preamp control. It should be possible at the listening position to (1) balance or equalize the output from both channels, (2) control the over-all volume level without changing the balance and (3) reverse the connections (phasing) of the two speakers or speaker systems.

Control units usually provide for a monophonic connection, for use with the old-style recordings or radio programs, plus controls for equalizing the phono preamp to match the recording characteristic of the program material. These functions need not be at a remote position, however, since it is unlikely that the program source could be changed (for instance, from stereo disc to monophonic disc) without walking over to the equipment. As for a change in the recording characteristic, this could occur if you use a record changer, in which case you would like to have record compensation available at the remote-control position. But if a manual (single-play turntable is used, you can change the compensation when you change the record. Examples of simple control units are the Scott Stereo-Daptor (about \$25) and the Bogen Stereo Adapter STA1 (about \$16). Simple control units are also available from Lafayette, Knight and other manufacturers.

## WHAT TO SPEND FOR PREAMPS

In discussing the relative merits of separate components vs. components combined on the same chassis, we mentioned (1) quality, (2) flexibility, (3) control and (4) physical space and convenience. We did not mention cost. A good preamp costs money and you may not consider it feasible to purchase it separately. The Stromberg-Carlson ASR-444, a combination preamp and stereo amplifier with two 30-watt channels, sells for about \$169.95. The Stromberg-Carlson ASE-434 stereo preamp is \$99.95; the ASP-422 stereo amplifier with two 20-watt channels is also \$99.95. Therefore the two separate units cost \$30 more than the one-piece unit and provide less power. The Scott stereo preamp 130 is \$169.95; the combination preamp and amplifier with two 20-watt channels is \$199.95. The Fisher stereo preamp 400-C is \$169.50; the combination preamp and 40-watt amplifier (two 20-watt channels) is \$189.50.

These three examples should make it obvious that it is more economical to get the preamp and power amplifier on one chassis. The choice is actually complicated by whether you are buying all new equipment or adding to what you already have. We shall consider this question in a later chapter; right now we need only point out that in regard to the amplifier you have two choices. You can start from scratch by buying a combination stereo preamp-control unit and stereo power amplifier. Or you can convert an existing mono rig by adding a second preamp, second power amp and stereo adapter; a stereo preamp and a second power amp, available as a single unit in some lines. Good stereo can be had with either choice.



PHONOGRAPH RECORDS ARE THE BASIS OF MOST  
STEREO LISTENING ■ IN ORDER TO HEAR THEM  
PROPERLY, YOU NEED A GOOD CARTRIDGE AND  
NEEDLE PLUS CHANGER OR SEPARATE TONE ARM  
AND TURNTABLE ■ KEEPING SPEED CONSTANT IS  
A MAJOR JOB OF **RECORD PLAYERS**

## CHAPTER 4

The sudden emergence of the Westrex 45-45 compatible stereo disc in the spring of 1958 marks the real beginning of stereo as a popular, commercial product. (Westrex is not in the record business. It is a division of Western Electric, the research and manufacturing subsidiary of Bell Telephone.) Prior to that, it was a matter of mild curiosity, observable in some AM-FM and AM-TV simulcasts and in the homes of the relatively few enthusiasts who had the money to invest in stereo tape recorders and high-priced prerecorded stereo tapes. With stereo discs to offer, the industry could tap the potential of the 40 million phonograph owners, an audience worthy of their all-out efforts.

The terminology applied to the discs is worth examining; "45-45" refers to the angular relationship between the vertical and horizontal forces involved in the recording and playback processes. "Compatible" implies that the equip-

## RECORD PLAYERS



American-made Glaser-Steers GS-77 record changer boasts several desirable operating innovations



Garrard RC121/11 changer, made in Britain, is an attractive, economical four-speed unit



British-built Collaro TC 99 record changer has detachable head, manual-automatic switch

ment used in playback can also be used to play conventional monophonic records. It is important to know that "compatible" does *not* mean that equipment for playing conventional records can also play stereo discs.

Stereo discs are 33 $\frac{1}{3}$ - or 45-rpm microgroove records having the same dimensional standards and recording characteristics as conventional, or monophonic, LP's and 45's. The difference is that the stereo groove contains two sound channels instead of one; and that a special stereo cartridge with a smaller needle, or stylus, is needed to play it. The word "compatibility" is usually not extended to 78-rpm discs, which call for a stylus of 3-mil tip radius. Nevertheless, some stereo cartridges are available with two styli, and these are capable of playing sterec and monophonic 33- and 45-rpm microgroove records as well as monophonic 78's.

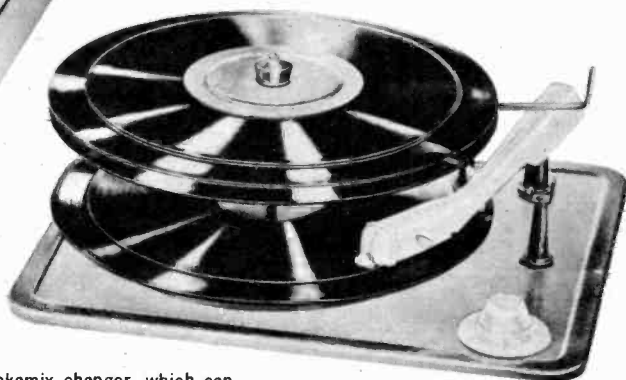
The term phonograph (Webcor spells it Fonograf) implies a complete unit with amplifier and loudspeaker(s), usually portable. It may be equipped with a record changer or a manual player. The term record changer is well understood: it is a device to play a "stack" of records automatically. Assuming that a stereo cartridge is provided, the other elements of stereo disc reproducing equipment are the same as for monophonic, except that in certain instances higher standards of excellence must be maintained.



Miracord XS-200, a West German import, has 4½-pound turntable, four speeds, repeat and pause



Thorens CD-43 operates at only three speeds. It's one of the most expensive changers on the market



Dekamix changer, which can play mixed sizes of LP's, 78-rpm discs and 45's, is British import

## TYPES OF RECORD PLAYBACK EQUIPMENT

An electric motor drives a turntable, usually indirectly, through an idler wheel or belt drive. The motor runs at constant speed in most units, with speed change (33-45-78) effected by a change in the idler wheel-drive linkage. A few models change the speed of the motor electrically.

The term transcription turntable is meant to imply a unit of professional quality, suitable for manual playing of one record at a time. A tone arm and pickup cartridge are extra accessories. The terms player, record player and manual player usually indicate that a tone arm is included (the cartridge may or may not be). Players run the full gamut of quality. Both turntables and players may provide one, two, three or four speeds. The fourth speed, 16½ rpm, is little used at present except for spoken-word recordings. A record stays in position on the turntable because its center hole fits over a spindle. The spindle may turn with the record or it may be stationary, with the record turning around it. Two different spindles are needed to play all four speeds. One plays 45's, the other 33's, 78's and the slow-playing 16's.

The cartridge is the transducing element which translates the mechanical motion of the stylus into electrical signals. The stylus is usually provided with

## RECORD PLAYERS



Rek-O-Kut N-33H Rondine features modernistic styling



Presto Promenade works equally well with any pickup arm



Another special-for-stereo unit is Pickering's Gyropoise 800



Fairchild three-speed unit is powered by belt under turntable



Collaro 4TR 200 turntable plays all four record speeds



Swiss-made Thorens table needs only a tone arm to make music



Weathers K730 player is designed for use with Weathers arm



Gray turntable is shown with Gray viscous-damped tone arm



the cartridge. Although still replaceable, styli today are considered semi-permanent, as opposed to the steel needles of the old days, which were replaced after two or three plays of a 78 (5 to 10 minutes). Stylus tips now are usually either sapphire or diamond. It is generally conceded that the harder materials (especially diamonds) are preferable because they last longer and wear more evenly. A badly worn needle can cause irreparable damage to the modulated grooves of the vinyl-plastic disc.

The tone arm is the vehicle that carries the cartridge-stylus assembly across the record. It also contains the wiring that carries the signal from the cartridge to the rest of the system.

## TONE ARMS

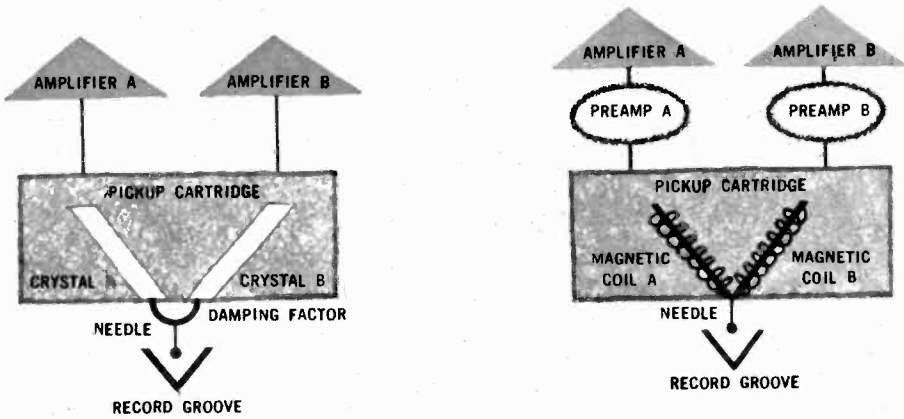
If you decide in favor of a turntable, you'll need a separate tone arm. For just as the turntable is sold as a separate mechanism to perform only the function of rotating the record at a constant speed, the tone arm performs only the function of supporting the cartridge and allowing it to work its way across your records with a minimum of outside interference. Pickup arms wired for stereo start at about \$12 for some Japanese and European imports and run up to \$114 for the Weathers integrated arm and cartridge. The standard sizes are 12- and 16-inch, although some popular models fall in between.

The proper matching of arm and cartridge was a tenet of hi-fi buffs in monophonic days; today it is a fact of life for stereo owners. We have learned during the first year of stereo discs that some cartridges wear records faster than others; that putting heavy-wear cartridges in different arms affects the rate of record wear. A rule of thumb is that tone-arm manufacturers who also make cartridges probably have closely matched units. The Grado, Shure, Electro-Sonic, Pickering and General Electric combinations are cases in point. Your high-fidelity dealer can give you guidance with product combinations from different manufacturers.

Tone arms, like other physical bodies, tend to resonate at certain pitches. When they do, they pull their cartridges erratically out of the record groove. Fortunately, most arms are designed to resonate at tones well below those engraved on your records. Most arms, too, are equipped with screw adjustments for tracking weight and for the height of the arm. Stereo cartridges generally track in the two-to-four gram range. On some arms, it's a matter of shifting a counterweight. On others, there's a spring to be tightened. In any case, be sure that the arm you select can have its tracking weight adjusted easily. Then, after the system is in use, make it your business to check tracking weight periodically to be certain it remains correct for the cartridge you use. Tone arms generally are precision-mounted on their bases to allow them to move freely. The degree to which stiffness at this point hinders movement indicates a bad arm.

When you look at tone arms, you'll notice that they bend sharply at a point just before the cartridge mounting. In the case of the General Electric, the

## RECORD PLAYERS



Two popular cartridge designs are the piezoelectric, left, and the magnetic. Former produces signals by applying force to crystal elements. In magnetics, stylus vibrations cause changing magnetic fields in coils, feeding signals to preamps

arm is straight, but the cartridge mounting is held at an angle. These are attempts to reduce tracking error across the face of the record as much as possible. A straight arm, moving slowly from the outside to the inside across a record would describe a small arc; only at one point in the arc would the relationship of the needle and cartridge to the groove be correct. By bending the arm and the cartridge, and by careful placement of the base, tone-arm makers have eliminated part of the arc, thus reducing tracking error.

Some arms have plug-in heads; others do not. The chief advantage of the former is that the plug-in head allows for fast, convenient change of cartridges. If, for example, you want to switch from stereo discs to 78-rpm records, it's a simple matter to unplug the shell containing your stereo cartridge and plug in a three-speed monophonic cartridge. If your collection includes primarily microgroove and stereo discs, this may not be necessary.

## RECORD CHANGERS VS. PLAYERS

All record changers include some or all of the following features: (1) ability to play either three or four speeds; (2) provision of two styli, for 78 and microgroove records; (3) ability to handle 7-, 10- and 12-inch discs; (4) ability to play these record sizes intermixed; (5) ability to play both sides of the disc without turning it over; (6) ability to play manually as well as automatically; (7) muting during change cycle; (8) automatic shut-off after the last record is played; and (9) interchangeable spindles for 45's and the

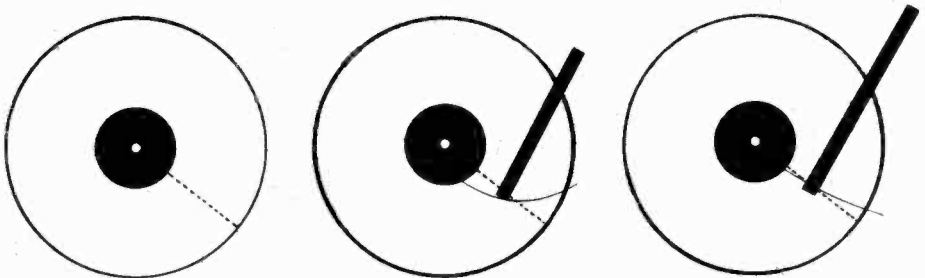
conventional center-hole discs. This is not by any means an exhaustive list.

It seems obvious that it would be difficult to engineer all these features into a single piece of equipment and provide the same standards of quality in all respects that could be incorporated into such a relatively uncomplicated piece of equipment as a transcription turntable or a high-quality player. This is even more obvious when one observes that all these features are available in a record changer at a price equal to or lower than that of most turntable-only units. It is for this reason that many hi-fi enthusiasts feel that single-play equipment is the only choice for high-quality record reproduction, despite the fact that a changer can provide more than three hours of uninterrupted entertainment. Perhaps the ideal answer to the changer-or-turntable question is to have a record changer for "background music" and parties and a high-quality manual player for critical listening.

## CRITERIA FOR PLAYBACK COMPONENTS

The motor of any record player must be a husky one, capable of maintaining accurate and constant speed. Variations in speed will result in pitch variations in the reproduced sound, called "wow" and "flutter." The motor should be quiet and vibration-free. Vibrations transmitted from the motor to the turntable will be reproduced electrically in a wide-range system as "rumble."

The arm should permit smooth and errorless tracking. The cartridge should respond faithfully to the movements of the stylus. If a cartridge is too stiff to respond, it lacks "compliance." The stylus should be of the proper size (tip radius), in proper position on the disc, and not excessively worn. Adjustment of the arm should provide recommended tracking pressure on the record. Playing the record should involve minimum possible wear and damage to the



During recording, the stylus moves across the record in a straight line (left). In playback, the tone arm moves stylus across the record in an arc. The difference creates tracking error (center). The longer the arm, the smaller the tracking error.



Garrard 4HF turntable can be had with or without 12-inch tone arm on single-unit plate



Miraphon four-speed player has plug-in head, design features of Miracord record changers

Collaro TP 59 manual player features similar arm, turntable motor to that in changer



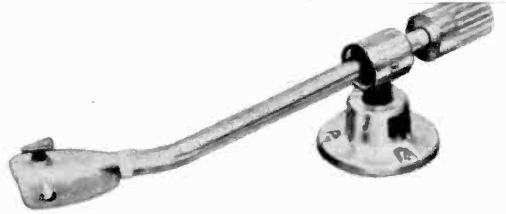
disc, including its center hole. Enlargement of the center hole is almost certain to cause eccentric rotation.

## SPECIAL DEMANDS OF STEREO

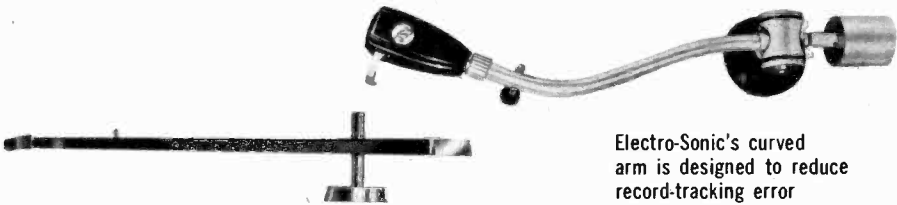
The monophonic record has its groove modulated in a lateral (side to side) direction only, tracing a path something like a snake. Both sides of the groove are the same for this single-channel recording. Monophonic cartridges have virtually no vertical compliance and so are relatively insensitive to rumble.

The stereo disc has a separate and different sound channel recorded on each of the two sides of its grooves. The result is that the groove is narrower in some places, wider in others. When the groove is narrow, the stylus is forced to ride high in it; when the groove is wide, it drops. Thus the stylus has vertical as well as horizontal motion. These two motions are usually combined, so that the stylus may move up and to the left, down and to the right, etc.

Rek-O-Kut's Audak tone arm has adjustable counterweight at rear of arm, plug-in heads



London-Scott stereo arm and cartridge are sold as matched stereo unit. The head is angled



Electro-Sonic's curved arm is designed to reduce record-tracking error

Shure Dynetic Reproducer is integrated arm and cartridge combination for stereo

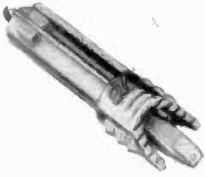


Another integrated arm and cartridge combination is Pickering's Unipoise

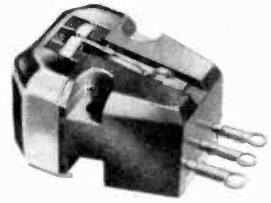
Since the stereo cartridge has both vertical and horizontal compliance, it seems to be more sensitive to rumble than a mono cartridge. There are two solutions to this—in addition to just putting up with the rumble: attenuate the low-frequency response of the system, thus attenuating the rumble; or buy a turntable in which rumble is at an absolute minimum. Because there is more danger of overcutting the groove (so that it runs into the next groove) in the 45-45 stereo system than in lateral monophonic recording, the recording level on the discs has been lowered and the output of the stereo cartridges is therefore lower. In some instances, the impedance of stereo cartridges differs from monophonic counterparts and therefore requires special adjustment.

Another difference in stereo cartridges is the stylus. The Record Industry Association of America (RIAA) standards for monophonic microgroove reproduction call for a stylus of 1-mil tip radius. Tolerance extends from .0011 to .00098 inch. The RIAA further recommends that "the desirable tip radius for reproducing stereophonic phonograph records be .5 mils." We find, how-

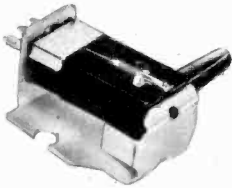
## RECORD PLAYERS



Ceramic Electro-Voice stereo Power Point cartridge (left), Ronette's Binofluid crystal are among the more popular non-magnetic types of cartridges available for stereophonic systems



The Tannoy Vari-Twin, a British import, comes with four terminals for U.S. market



The Electro-Voice 21 MD (at left) and the Sonotone Model 8-T ceramic stereo cartridges are able to play 78-rpm records as well as mono long-playing records and stereo discs

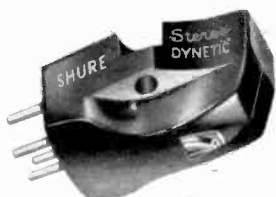


Pickering stereo pickup has four terminals, resembles the monophonic Pickering

ever, that most of the so-called compatible equipment is provided with a .7-mil stylus, said to be suitable for both the stereo discs and regular LP discs. This .7-mil tip radius is apparently a compromise between the 1 mil recommended for mono LP's and the .5 mil recommended for stereo discs. The compromise needle is 30 per cent smaller than the standard for mono LP's and 40 per cent larger than the desirable size for stereo discs. Actually, of 36 cartridges surveyed, 25 provide a .7-mil stylus for stereo, only four offer a .5-mil stylus, three are .6-mil, three are .75-mil and one is .8-mil. This variety of offerings is probably an example of the somewhat experimental nature of stereo cartridges and styli. It also represents compromises between desirable and obtainable tracking pressures for the different sizes, since the smaller the tip, the less the tracking force should be. It has been our experience that the .7-mil stylus in a stereo cartridge produces good results on both stereo and mono discs. With 70 per cent of equipment currently offered being of that size, it seems likely that it will become the standard, provided no objectionable side effects are encountered in another year of observation.

## CHOICE OF EQUIPMENT: CARTRIDGES

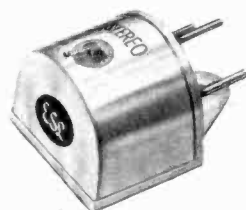
In the chapter on amplifiers, we alluded briefly to the different types of cartridges: magnetic and piezoelectric. Between 1948 and 1958 it was generally true that most popular, moderately priced equipment employed ceramic



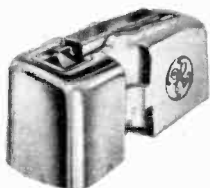
A popular magnetic is Shure Stereo Dynetic; it can track at three grams, costs \$45



Fairchild's Model 232 costs \$49.50, employs dual rotating coil, tracks as low as two grams



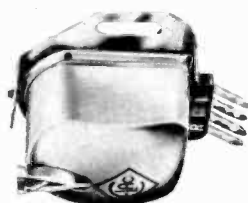
Electro-Sonic Labs' Gyro Jewel stereo cartridge is made for use in ESL or other tone arms



GE's GC-5 and GC-7 are stereo versions of familiar variable-reluctance units



Fairchild XP4, now retired, was early stereo cartridge, cost as much as \$250 a year ago



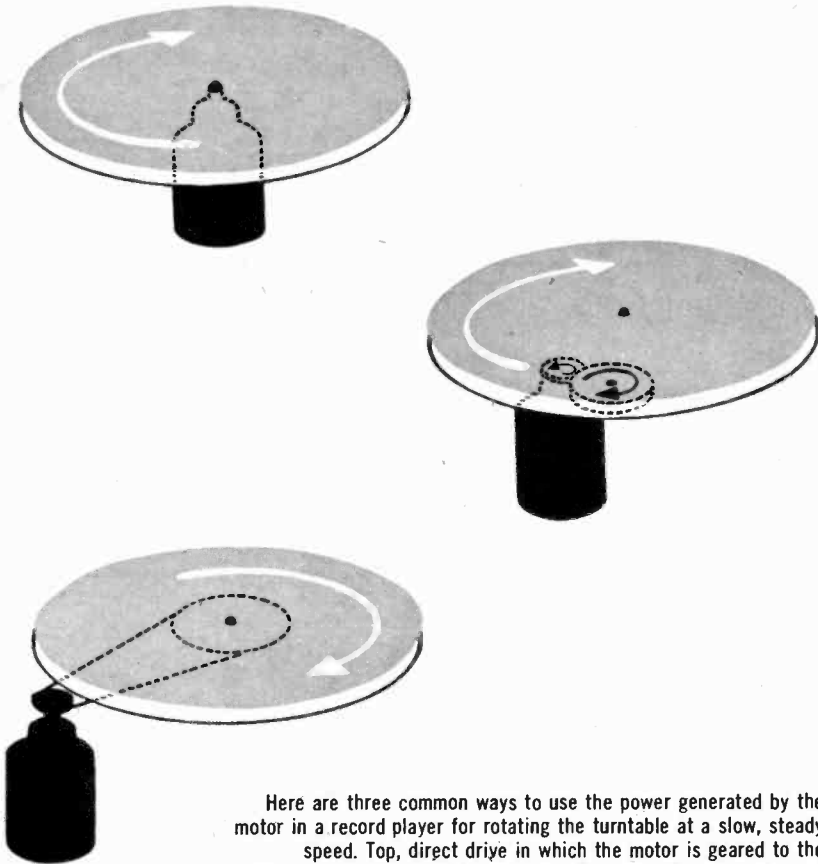
Square Audiogersh Stereotwin 210D cartridge also employs magnetic principle for stereo reproduction

pickups while most hi-fi owners chose magnetics. Today, the picture may be changing. If you want a single cartridge for stereo, and for mono LP's, 45's and 78's, the choice is narrow. Of the 36 cartridges surveyed, only 13 provided this complete service, and of these, 12 are ceramic or crystal (piezoelectric). At the present writing, only the Recoton-Goldring cartridge provided the dual service with a magnetic cartridge, although GE is expected to come out with a stereo version of its popular "triple play" cartridge. The choice between ceramic or magnetic need no longer be influenced by decisions about whether or not to buy a preamplifier. Preamps are now assumed to be part of the usual complement of hi-fi and/or stereo equipment, and, with the lower output from stereo discs, many ceramic cartridges also require preamplification.

## CHOICE OF EQUIPMENT: RECORD CHANGERS

Generally speaking, any record changer sold by a hi-fi dealer will do all the things it is supposed to do. Statistics on wow, flutter, rumble and tracking distortion are subject to dispute, and are apt to vary from unit to unit within the same brand. We believe a good turntable will give better results than the best record changer in these respects, although the changers we have seen turned in creditable results on the initial observation. What happens over a period of time seems to be more important. The writer has lived through several record changers and has had these experiences: one widely known

## RECORD PLAYERS



Here are three common ways to use the power generated by the motor in a record player for rotating the turntable at a slow, steady speed. Top, direct drive in which the motor is geared to the turntable. Center, rim drive using an idler wheel. Bottom, belt drive

changer tended to be erratic, over a long period of time, in the matter of going through the change cycle flawlessly on different sizes and types of discs. It took servicing to correct the difficulty. On the other hand, a quality import performed consistently and flawlessly in this respect but suffered occasional speed troubles because of dried-out or broken idler belts. Happily, these are easily replaced. Some of the annoyances that have cropped up in the past have been corrected by new models. Early models of some players did not provide for manual playing; others were not provided with the condenser needed to absorb the audible "pop" that occurs when the record changer shuts itself off automatically. Generally speaking, these defects have been corrected.

A final point before leaving the subject of changers: a person who does not have a steady hand can do more damage to an expensive disc on one manual play than a changer will ever do to it. If youngsters, extreme oldsters or just plain careless people are going to be operating your music system, a changer can be an important protection for your discs.



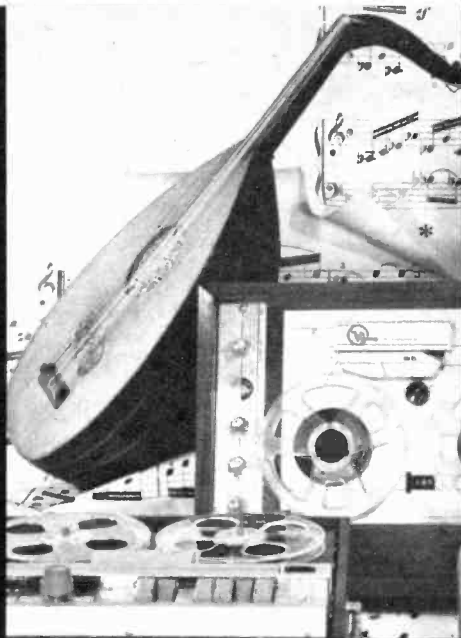
It does not follow that a piece of equipment designed to play only one record at a time will be flawless and foolproof. Nevertheless, the use of a good turntable—Rek-O-Kut, Presto, Gray, among others—can provide superior performance with respect to the quality features of wow, flutter, rumble and the like. In general, the turntable-only units will have more extensive motors, heavier aluminum disc tables and superior engineering throughout. Although there is room for disagreement, the writer feels that the mechanical selection of a pre-set speed change on a constant-speed motor is more accurate and reliable than an electric change of motor speed, and more apt to give trouble-free service. Some manual players made by record-changer manufacturers are the same basic equipment minus the changing mechanism. A clue is that the price is lower than the comparable changer. These are not likely to provide results superior to that of the equivalent changer.

### THE END RESULT—PLAYING RECORDS

There are today at least 10 types of records in use. These include 7-, 10- and 12-inch 78's (people still buy 7-inch 78 children's records); 7-inch 45's; 10- and 12-inch LP's and stereo discs. In addition, most early stereo discs were 12-inch 33's, although there were some 10-inch 33's; stereo 45's are appearing now; and some 7-inch mono 33's have appeared in the past.

The choice of equipment should emphasize the most important service to the purchaser. If you never play 78's, don't push compatibility to extremes. If your only use for 78's is on kiddie discs, perhaps an inexpensive child's phonograph is the answer. Your preference in program material should also be considered. Orchestral music is more demanding in most respects than popular music. The single, sustained tones found in instrumental and vocal solos, on the other hand, will reveal wow much sooner than will any form of orchestral music. Whatever the choice, there will be ups and downs in recording quality and standards. This is especially true of stereo, which must still be considered a new art within which we can expect much experimenting by both recording artists and engineers.

Care of records is not a new or special subject in the field of stereo, but bears repetition. Discs should be kept free of dust, should be handled carefully and stored safely. It will pay in the long run to make a habit of putting discs back in their jackets and back on the shelf as soon as they come off the turntable. Some record collectors find it worth while to use a record brush on the end of the tone arm—not only to keep the disc clean but to keep the needle from getting clogged up. The small stereo stylus can reach a point of distortion and even groove-skipping within a half hour's playing, because of accumulated "fuzz" from dirty discs. The writer has found it advantageous to clean records. There are patented record cleaners on the market for this. Or, you may use lukewarm water with a small amount of detergent in it. Rather than clean them all at once, at our house we clean them right after they've been played, noting on the jacket the date this was done.



YOU CAN BUY STEREO ON PRERECORDED TAPES  
OR YOU CAN RECORD YOUR OWN STEREO FROM  
BROADCASTS AND RECORDS ■ NATURALLY, THE  
BETTER YOUR EQUIPMENT, THE BETTER YOUR  
RESULTS ■ THE STARTING POINT, OF COURSE,  
COMES WITH THE **TAPE RECORDERS**

## CHAPTER 5

**F**or all practical purposes, the magnetic tape recorder can be considered to have begun after World War II. In the short space of 12 or 13 years, the term "tape recorder" has become so widely known that it is necessary to stress here that this unit in the home-entertainment system is *both a tape recorder and playback device*. In fact, since the advent of prerecorded tapes, and especially stereo tapes, the playback feature has come to assume major importance.

In the relatively short time since its introduction, the home tape recorder has undergone many changes, some of which were outstanding improvements. As originally introduced for home use, it was a single-track machine of doubtful fidelity and many mechanical difficulties. Home machines operated at 15 inches per second (hereafter abbreviated as ips) and it was generally stated (though often difficult to prove) that frequency range could be evalu-

## TAPE RECORDERS



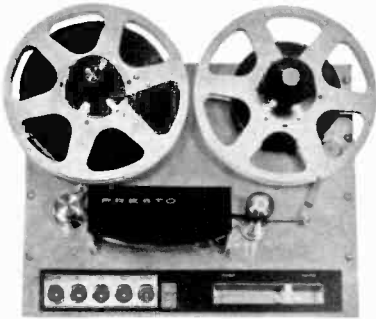
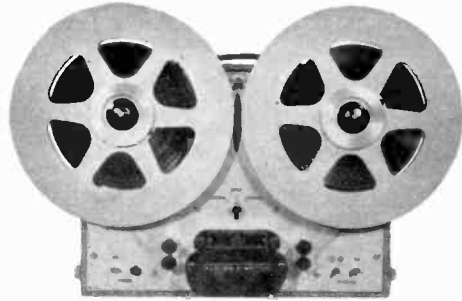
Stereo on tape is easily portable, can be taken outdoors or to the beach. Most stereo units consist of tape record and playback unit (center foreground), two playback amps and speaker systems to reproduce taped signals

ated at 1 kilocycle (KC) per inch. That is, 15 ips should go out to 15,000 cycles and any slower speed than that would give proportionately reduced frequency range. Actually, in those early days, only professional equipment could attain this goal. Today 2 KC per inch (15,000 cycles at 7½ ips) is not uncommon.

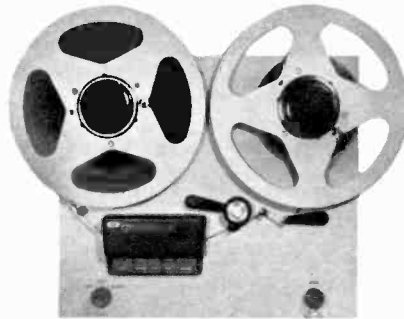
Home recording proved to be a novelty whose fascination before long wore off, and the home recorder might have died right then if it hadn't been for the fact that, with improved fidelity, it came to be looked upon as a good instrument for the reproduction of music. Professionally, magnetic tape took over the broadcast and recording fields and many hi-fi purists began to believe that this was the only proper medium for high-fidelity music reproduction.

For a brief moment, tape enjoyed a tremendous superiority over records; then LP's appeared, providing more playing time for less money and in a considerably more familiar medium. Dual-track tape at 7½ ips, but of a quality at least equal to the 15-ips machines of a while back, came along for home use in 1949, and this was a partial answer to the playing-time problem. The availability of dual tracks suggested the feasibility of putting stereo on tape, and thus the tape-recorder industry became the pioneer in making stereo available for home use. This development took place in 1952 or thereabouts,

Crown stereo recorder is typical of rugged professional models; it has separate preamps, speakers



Presto professional tape deck has push-button controls that light when in use, facilities for tape editing



American Concertone tape deck comes with auxiliary units for recording and playback, for professional use

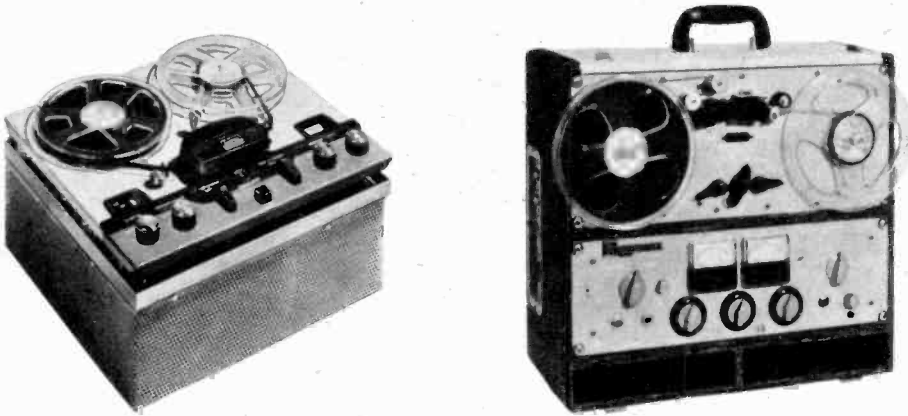
and once again, tape enjoyed a clear superiority over discs—for a while. With the large-scale advent of stereo discs in 1958, this superiority evaporated, and the tape industry once again looked for a technological improvement. Four tracks instead of two, 3¾ ips and a magazine-loading machine were some of the answers. We'll examine these as we go along, but first let's look at the nature, advantages and disadvantages of tape recording and playback.

## HOW TAPE WORKS

Reduced to its barest essentials, tape is a narrow plastic ribbon, to one side of which is applied a thin coating of iron oxide. Transported past a magnet energized by an audio-frequency current, the iron on the tape is magnetized in accord with the audio signal. Transported past a playback magnet, or tape head, the tape sends its information back into an audio-reproduction system. The information is not thereby removed from the tape, however, and can be played back an infinite number of times.

Compared with a disc system, this is simplicity itself. As a matter of fact, no practical home disc-recording equipment exists and so the tape machine in

## TAPE RECORDERS



Ampex two-speed tape recorder-stereophonic reproducer (at left) can be used by itself or as part of an integrated stereo system. Magnecordette, at right, is portable—it has a handle—stereo tape-record and playback unit, plus dual VU meters for adjusting levels

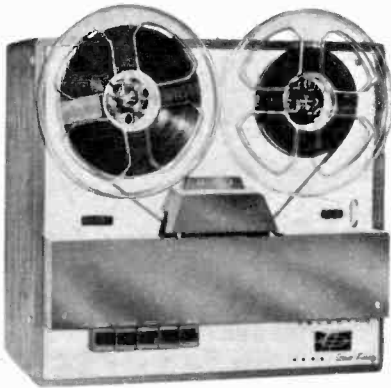
the home was unique, at least as a recording device. It was ideal as a playback machine, too. No problem here of tracking force, cartridge compliances, tracking error, stylus-tip radius, stylus wear or record wear. The tape is erasable, re-usable and spliceable; it is also long-lasting.

On the minus side are the facts that many of the tape machines are relatively bulky and that it takes some skill to operate a tape deck properly. Threading tape is more difficult than putting on a record and it isn't easy to spot a particular point on two- or four-channel tapes. Less of the musical repertory is available on tape than on discs and, as an added hazard, you can record right over an existing recording if you are careless. Also good tape equipment costs more than good disc equipment, and so do prerecorded tapes.

Evaluating all these plusses and minuses, we can describe the audio purist who prefers tape as a person who is willing to pay more, and suffer a few physical inconveniences, in order to get higher-quality sound through a medium that will not deteriorate with use. This is a very tenable position, buttressed by the fact that owners of tape equipment not only enjoy the playback features of it but can also record broadcasts over radio and TV (including stereo, with the right equipment), copy disc recordings while they are still new and have suffered no deterioration, copy their 78-rpm discs to preserve the music and conserve space, and make live recordings when it suits them.

## THESE ARE THE COMPONENTS

Let's take a look at the equipment itself, which can be broken down into mechanical and electrical, or electronic, components. Mechanically, the tape-transport mechanism is something like a movie projector. There are two reels: supply and take-up. Tape winds from supply reel to take-up reel, and must eventually be rewound if it is to be used again for supply; this operation



A budget-priced stereo tape deck is the Telectro, at left, which utilizes piano-key controls. Shown on the right is the Ferrograph, a professional portable stereo tape unit that features single VU meter, separate controls for each stereo channel, editing facilities

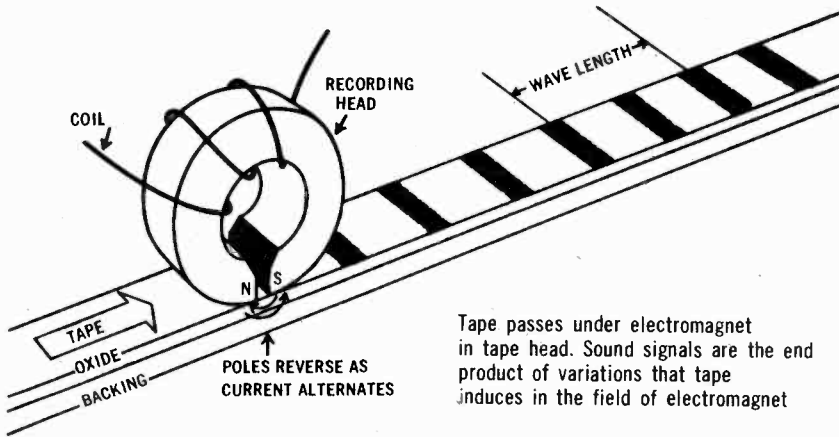
may be powered by one, two or three electric motors. The requirements of unvarying velocity are similar to those for disc equipment, and a minimum of wow is, again, one measure of quality. Mechanical facilities for starting, stopping, fast rewind and fast forward, revolution counting, automatic shut-off when the supply reel is empty, and speed-change mechanisms more or less complete the equipment. Electronically, we have a recording head and recording preamp, playback head, playback preamp, power amplifier and loudspeaker. The same preamp may be used for both recording and playback, and the power amplifier may be used to monitor while recording. Recording level indicators, volume and tone controls, input circuit for an external signal source (such as a tuner) and output circuits for external speakers and/or external power amplifier and speakers round out the list of principal electronic elements.

## THE ALL-INCLUSIVE TAPE DECK

Since it is rare to find a really high-quality sound-reproduction system in a popular-priced, portable tape recorder, the hi-fi enthusiast usually feeds the tape signal into an external hi-fi system. This gives rise to the "tape deck." Essentially, this is the mechanical, or tape-transport, equipment only. It may be provided on a mounting plate for rack or cabinet installation, or it may come in its own free-standing case. To this must be added the preamp, power amplifier and loudspeaker system. A microphone must be added for live recording. A vast variety of facilities can be provided in a tape deck: single-track, dual-track, four-track, monophonic, stereo (two types, as we'll explain in a moment), and tape speeds of 15, 7½, 3¾ and even 1⅞ ips.

Considerably more equipment is available to play back stereo than to record it. Thus we find (1) straight monophonic equipment for playback; (2) mono for record and playback; (3) mono and stereo playback; (4) mono record and

## TAPE RECORDERS

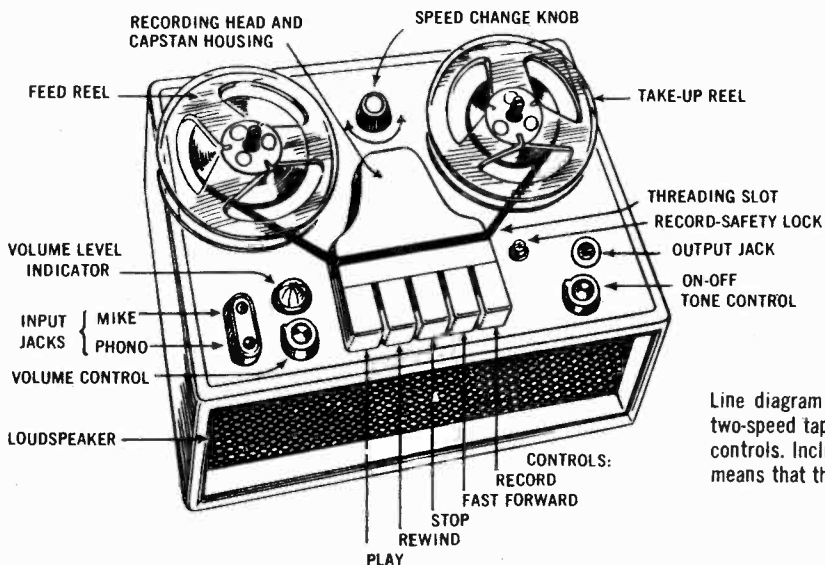


playback plus stereo playback; (5) record and playback of both mono and stereo; (6) straight stereo playback; and (7) stereo record and playback. Your choice of equipment will depend on the uses you plan to put it to. Choose a type that provides some flexibility and ease of modification, to permit you to change your mind about features you want and also to modernize as changes or improvements are announced. It is also well to be aware of the fact that many so-called stereo tape recorders will not actually record stereo, although they do play it back. This confusion in nomenclature is due to the acceptance of the term tape recorder, as mentioned in the opening paragraphs of this chapter. In addition, the buyer should be aware of the fact that some so-called stereo units do not have the complete dual audio system needed for stereo and require supplementary amplifiers, preamps and/or speakers. Another point to remember: buy the record or record-playback preamps that were designed to go with your tape deck. These are more apt to provide optimum equalization and voltage gain than another manufacturer's equipment.

When stereo tape first got started, monophonic equipment was converted to stereo by adding another head a little distance from the first one (to record on the second track of dual-track tape). These were called staggered heads. Newer equipment features all-in-one stereo tape heads which are referred to as "stacked" or "in-line." Prerecorded tapes must be designated for one or the other arrangement; they won't work on both.

Before assessing the currently available stereo equipment, we should like to digress for a moment and discuss the long-heralded but little seen RCA machine featuring a tape magazine or cartridge. This machine was designed to obviate the difficulty and inconvenience of threading and also to make possible a lower cost per minute of recording time on stereo. A quarter-inch tape is used and yet four tracks are provided. Operating at only  $3\frac{3}{4}$  ips, these tapes can provide two hours of mono or one hour of stereo program. This indicates about 600 feet of tape in the magazine. By comparison, the





standard seven-inch reel contains 1,200 feet and would, if recording four-track stereo at  $3\frac{3}{4}$  ips, provide slightly over two hours of entertainment. Using the extra-long-playing or "super thin" tape (2,400 feet on a seven-inch reel) would provide  $4\frac{1}{4}$  hours under the same conditions.

Two models—SCP2 and SCP3—have been described but only one has been shown, and even this is yet to be proved from the consumer point of view. If successful, it might bring about great changes in the tape and tape-recorder industry, but at this writing, it is really too early to know what it will do.

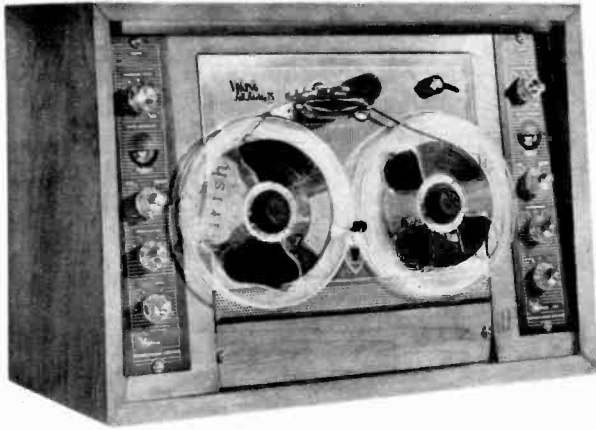
## PORTABLE VS. NON-PORTABLE

Prior to stereo, there could be considerable discussion of the relative merits of buying a complete unit (probably portable) vs. buying a tape deck and associated components individually, for custom (and permanent) installation. With stereo, however, virtually no direct comparison is possible. A complete unit would consist of the tape deck plus two record-playback preamps, two power amplifiers (or one dual amp) and two loudspeakers or loudspeaker systems. To be comparable to the portable monophonic tape recorder, all this has to be enclosed in a single carrying case. It is unlikely that such units will ever be sales leaders. Much more likely to be popular are units that are somewhat smaller and anywhere from 25 per cent to 75 per cent complete.

If you want to carry the equipment around, or if you do not have room in your rig for permanently installed tape-recording equipment, you will want equipment in carrying cases. If, on the other hand, you are able to put the tape recorder into your custom hi-fi installation and connect it to your existing set of amps, preamps and speakers, or into one of the large equipment cabinets now available for stereo use, then you can choose tape equipment that does not duplicate these audio functions.

Besides the more obvious features incorporated into tape recorders, there

## TAPE RECORDERS



Viking 75 is shown in wood cabinet designed especially for it. Unit operates at  $7\frac{1}{2}$  ips, convertible to  $3\frac{3}{4}$  ips

are a number of accessories and refinements that you may consider necessary, advisable or at least desirable. The machine is rare that does not include a recording level indicator. This is a must, and if you buy a machine without one, you should add it as an accessory. The recording-level indicator tells you when the input level is high enough and warns you when it is too high. The device can be either a neon flasher or a meter that actually measures the input. Meters are more expensive; though desirable, they are not essential.

A revolution counter enables you to find a particular passage on the tape, note where speed changes have been made, and so forth. To pinpoint a spot on the tape, it is necessary to be able to listen (or monitor) while you are looking. Elaborate editing facilities are desirable only if you plan to do extensive and critical recording.

To minimize head wear, it is desirable to have means for lifting the tape off (or away from) the heads during rewind and fast-forward operation. Tape lifters are available on many recorders, either as original or accessory equipment. For instance, the Viking 85 series tape decks include tape lifters, while this feature may be added on the 75 series for an additional \$5.50. The popular Bell T-200 deck includes lifters, and virtually all of the more expensive units such as Ampex include this feature as a matter of course.

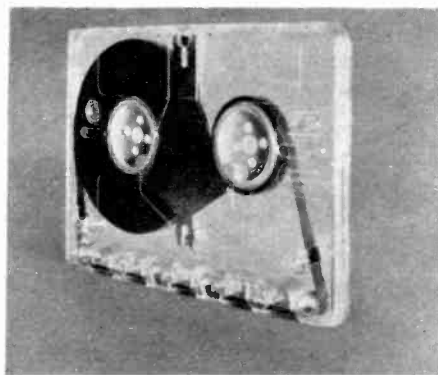
Most tape recorders have combination record-playback heads. A refinement on more expensive machines is to have separate heads for each function. This provides slightly better quality plus the ability to monitor while recording, another feature we would classify as desirable but not necessary for average home use. The number of heads provided is, of course, complicated by the services offered (mono, stereo, half-track, quarter-track, etc.). The American Concertone 30 series, for instance, is provided with five heads, to which a sixth can be added for stereo playback. The Ampex 900 series has three heads—one each for erase, record and playback, of either mono or stereo.

It is possible to provide for all transport needs with one motor plus appropriate belt linkage and switching facilities, or to have as many as three motors. Additional motors tend to be used in the finest equipment, but a good machine can be designed around a single motor—the Ampex 900 for one.

## THE QUESTION OF PRICE

How much shall you spend on a tape recorder? This is an area where the range is very wide and the sky's the limit. Good units for home use range from a low of around \$100 to a high in the neighborhood of \$1,000. Units for professional use are even costlier. Bell provides a popular, versatile and high-quality line in the T-200 series. The basic tape transport is available with different head combinations for approximately \$110-\$150, with the \$150 unit able to record as well as play back stereo. The RP-120 record-playback preamp is about \$60, of which two are needed for stereo recording. The complete unit without sound system or mike, therefore, is about \$270. An equivalent Viking unit, the 85 series with two RP-61 record-playback preamps, comes to about \$298. The Pentron TM-4 tape deck with two record-playback preamps is approximately the same price as the Bell unit with equivalent equipment: \$270.

The Ampro 758 provides a complete sound system for mono only (with loudspeaker) for about \$285. To make stereo playback possible, an additional power amplifier and speaker would be needed, while to record stereo, another record-playback amplifier is called for. The Webster 290 at about \$380 has two



At left is the Pentron Model X-8 stereo recorder. Above is the RCA tape magazine. Unit is roughly the size of this book, plays at speed of  $3\frac{3}{4}$  ips

## TAPE RECORDERS



At left is Norelco's Stereo Continental; unit costs \$299.50 with carrying case



Tandberg portable stereo unit, left, is available with extension speakers. Bell portable 406, above, uses new four-track stereo cartridges, costs \$299.95

amplifiers, needs one additional loudspeaker to play back stereo and an amplifier to record stereo. The Ampex A122, priced at \$495, has no sound system, can play back stereo but needs an additional preamp. These examples illustrate the fact that tape-recorder prices are frequently difficult to compare because of the wide variety of possible features.

In this chapter, we have told you some things you should know if you are planning to buy a tape recorder. Before leaving the subject of tape recorders, we owe it to the reader to dwell at least lightly on the question: Should you buy one? Remembering that this is a book about stereo, the answer must depend on the relation between tape and stereo. The two areas of discussion are playback and recording. Let's look first at playback.

In stereo playback, we are principally concerned with prerecorded tapes. A large and varied repertory is available on tapes, having been building for a period of six or seven years, as opposed to less than two for the stereo disc. Music on stereo tapes ranges from the popular symphonies of Beethoven and Brahms to the more esoteric works of the modern and the pre-Bach composers. Stereo tapes also offer a wide range of material designed to show off your rig to the best advantage—trains, planes, Trinidad steel bands and earthquakes. Although at this time (June, 1959) new tapes are not being issued or distributed on the scale they were a year or two ago, it is likely that the better estab-

lished companies will continue to supply them when the stereo-disc market has settled down into a discernible pattern. Prerecorded stereo tapes offer owners economy in storage space, if not in price. They can be spliced if they break; never become warped or scratched, as records do. And, unlike records, they won't wear out with repeated playings.

## VARIOUS PROS AND CONS

Prerecorded stereo tapes, however, are expensive. Up to now, at least, they have been recorded at 7½ ips on a two-track tape, using one track for each channel. From the standpoint of time duration, they are equivalent to single-track tapes and have a potential of one-half hour on a 1,200-foot reel. Cost per minute of these prerecorded stereo tapes is about twice that of stereo discs. Stereo discs of 12 inches list for about \$5.95, while a comparable quantity of music on stereo tape will usually be in the neighborhood of \$11.95. It can be expected that the price of prerecorded tapes will come down, especially now that RCA has brought out its magazine-loaded tapes. These are four-track tapes that operate at 3¾ ips. Used for stereo, they can yield up to two hours of playing time on a 1,200-foot reel. This will cut down on the amount of raw material that goes into a tape and will reduce the cost of the finished product substantially. The magazine-loaded tapes will cost from \$4.95 to \$8.95.

Another matter worth considering is the resurgence of quarter-track, 7½-ips reel-to-reel tapes. Fidelity at this speed seems to approximate the quality that is possible with only two tracks, and from all indications a fine library of program material should be available in a very short time. It seems likely that in the near future cartridges will be something of a mass medium, while quarter-track reel-to-reel will be a quality medium.

Should you consider any new unit designed to handle the tape magazines? That question is still difficult to answer. Remember that in its present form it will accept *only* the magazine it was designed for. This closes the door to all previously recorded material, as well as to future recordings on larger reels of tape. However, if it becomes available as a universal unit—one able to play both reels and magazines—it may well be worth your serious attention. So far, also, this unit is not available as to tape deck; it can be bought only as a complete unit, including a so-so amplifier.

Turning now to recording, we find that there are at least three uses for stereo recorders in the home. You can record stereo broadcasts, if you have a stereo tuner; you can tape someone else's stereo discs, if you've a mind to; and you can make live stereo recordings. We believe the last use is unlikely for the average owner. The technique is complicated, and there would be little occasion to do so in most homes. The other two uses will be somewhat less infrequent, but are still apt to be quite limited because of the time and expertise necessary to do the job properly.

This, then, is the story on stereo tape: not necessarily part of a "starter" assembly of a stereo system, but a good buy "for the man who has everything."



WITH HIGH FIDELITY, YOU'RE NOT LIMITED TO STEREO FROM TAPES OR RECORDS ■ YOU CAN, IN FACT, RECEIVE FINE STEREO OFF THE AIR AT ADDITIONAL COST—AND EVEN MAKE YOUR OWN STEREO TAPES ■ YOU WILL FIND AVAILABLE AN EXCELLENT CHOICE OF STEREO

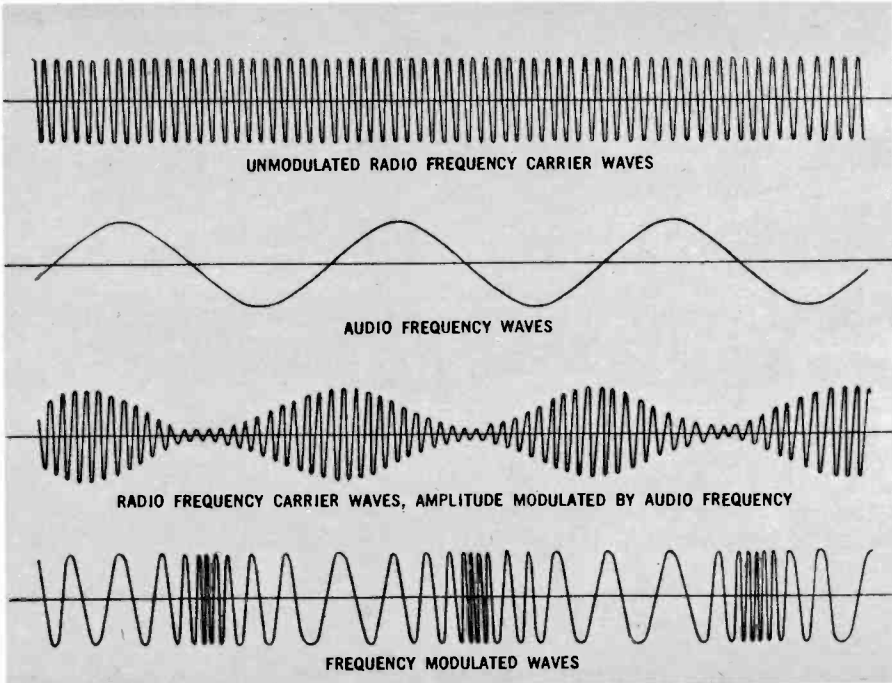
## TUNERS

## CHAPTER 6

It is hard to imagine a home-entertainment system without a radio, although some audio enthusiasts start building a hi-fi system around a phonograph and an amplifier. This, from our point of view, is overlooking a tremendous quantity of excellent free entertainment. FM added a new note of quality to radio, and stereocasting presents many new vistas.

For years, FM was the stepchild of American broadcasting. Developed just prior to World War II, few commercial outlets were able to build before war-time controls put an end to building. At the conclusion of the war, the FM band was pushed aside to make room for television. In so doing, every FM set in the country (there were few, and they were expensive) was rendered obsolete. Then, as new stations opened in the new band, AM owners began duplicating their programs on both AM and FM, throwing the latter in free

## TUNERS



Unmodulated radio-frequency carrier waves, both AM and FM, have constant frequency and amplitude (top). Audio-frequency programs are superimposed on the carrier waves to give amplitude modulation (AM), line 3, and frequency modulation (FM), line 4

as an inducement to advertisers. Simultaneously, however, a few FM licensees began broadcasting good music and other programs aimed at a minority audience. They sprang up first in the larger cities. Today, however, there are several hundred scattered throughout the United States. Educational broadcasters, in the form of school boards and universities, also took to the FM band (Congress had wisely reserved a portion of it solely for educational use).

It was these outlets—both commercial and non-commercial—that showed the way originally in high-fidelity FM transmission of serious music, plays and public-affairs programs, and these are the stations that now account for much of the nation's stereocasting. Since educational stations aren't bothered about selling time, they can and do work with commercial stations in their areas to produce FM-AM and FM-TV stereo. Lehigh University's FM station, for example, frequently operates with commercial stations in the Allentown-Bethlehem area to provide Pennsylvania listeners with stereo. In Chicago, WFMT and the city's educational television outlet do a similar job. Live concerts by the Boston Symphony are broadcast stereophonically by the city's good music stations in conjunction with one or more educational broadcasters. The bulk of AM-FM stereo is being done by such frankly commercial stations

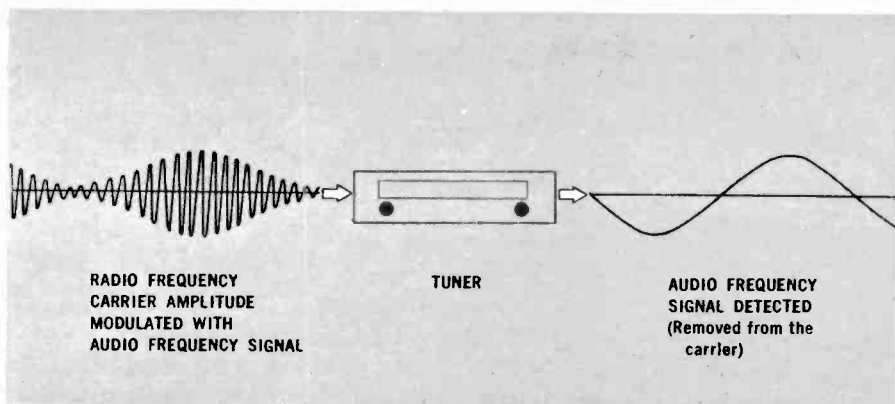


as WFLN in Philadelphia. WQXR in New York and WCRB in Boston. Before buying a tuner, you should check on listening conditions in your area.

## THE NEED FOR SELECTIVITY

Before proceeding into the realm of stereo, though, we should pause a moment to consider what functions radios and tuners perform. The AM stations broadcast in the band between 540 and 1,600 kilocycles; FM is between 88 and 108 megacycles. Each station has an assigned carrier frequency, which, as its name implies, is merely a vehicle to transport sound (audio frequency) programs to you. It is this carrier frequency that your tuner "tunes in." The first thing that the tuner must do, therefore, is to select one station at a time, rejecting all other stations and noises. Its ability to do so depends on its selectivity, combined with external conditions such as the strength of the particular station's signal in your locality, the size and quality of your tuner, the aerial and the weather conditions during the broadcast. The ability to tune in weak signals satisfactorily is a measure of the tuner's sensitivity. "Sharp" tuning increases sensitivity but somewhat degrades fidelity. Therefore, tuners often have a broad-sharp sensitivity switch, permitting full fidelity on normal-strength stations and full sensitivity on weak ones.

The carrier frequency that has been tuned in has superimposed upon it the audio-frequency program information; another way to say this is that the carrier has been modulated with an audio-frequency signal. At the tuning stage, the radio isn't concerned with this modulation, which represents a relatively small amount of plus-and-minus change in the basic carrier frequency. The first thing it wants to do is amplify this signal. To do so, it converts all carrier frequencies to a single, lower frequency, known as the

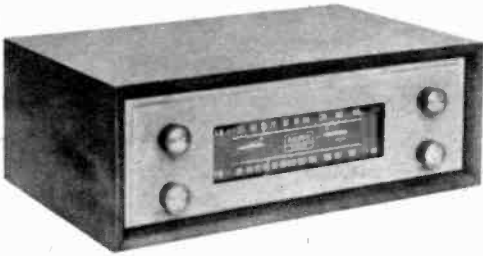


A tuner receives a carrier frequency modulated by an audio signal. The tuner detects the audio signal, separates it from the carrier frequency and eliminates some of the distortion, then passes the audio signal along to the stereo amplifier

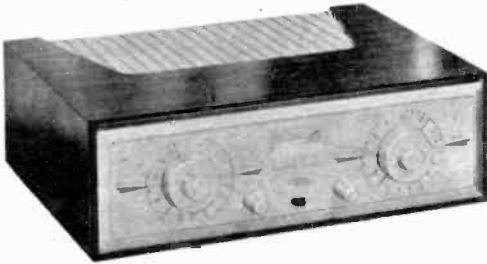
## TUNERS



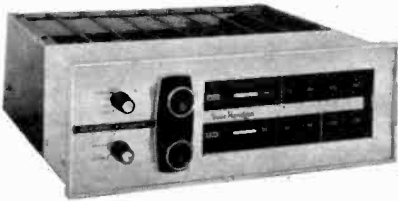
Fisher AM-FM stereo tuner has separate tuning, tuning indicators for AM and FM broadcast bands



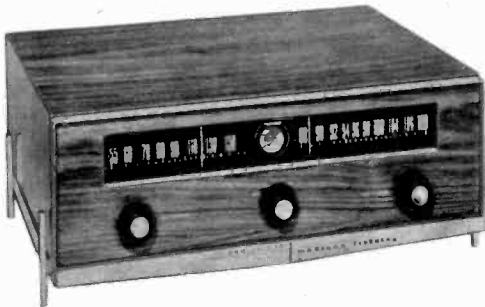
Priced in the deluxe class (\$250), Ampex stereo tuner comes in hardwood case or uncased



Scott 330-C stereo tuner has separate AM and FM dials, common meter for the proper stereo adjustments



A moderately priced unit, Sargent-Rayment stereo tuner offers a minimum of stereo controls



Madison Fielding 330 tuner comes with its own wood cabinet, metal bracket and legs

intermediate frequency. (In AM, this is 456 KC; in FM it is 10.7 megacycles; in TV receivers it is 40 megacycles.) At this stage, the signal is subjected to substantial voltage amplification. Next, the process of detection strips off the audio information from the intermediate frequency. We now have an audio signal and we have finished with the tuner. The audio signal passes into an audio amplifier where, after power amplification, it goes to the loudspeaker.

The term AM is short for amplitude modulation, which means that the carrier frequency varies in volume. In FM, the variations are not in the volume, but in the frequency itself. Because of this, and because of the much wider broadcast band, a full-frequency response is possible in FM broadcasting. In addition, FM is relatively impervious to noise and static. In an urban or suburban area—that is, an area close to where most broadcasting stations are located—FM on a good tuner is usually more brilliant than AM in tonal quality. In rural areas, where signal strength is apt to be low, FM's ability to ignore static and other air-borne electrical noise, as well as signals from other stations, provides a reception quality greatly superior to AM.

Radio in the hi-fi rig can assume several forms and several functions. In form, there can be a tuner only, with separate preamp and amplifier; or there can be a complete receiver that includes all three functions. We have observed earlier that there is no good reason why an all-in-one unit cannot provide nearly as good quality as separately assembled components. On the other hand, the latter choice provides greater flexibility which, to some people, may outweigh the simplicity of purchasing and installing a single unit. Suffice it to say at this point that several possibilities present themselves for the distribution of control knobs and functions. They include the following: (a) complete receiver; (b) tuner plus combination preamp-amp; (c) combined tuner/preamp, plus power amp; (d) separate tuner, preamp and power amp.

A point worth remembering about the installation of any sort of tuner is that for the really good reception most tuners are designed to give, you must have a good antenna. You can get double duty from your TV antenna, although if you want to listen to both TV and FM radio at the same time, you will need a switching device. If you install a separate FM antenna, be sure that it is oriented to pick up your favorite stations; experiment first.

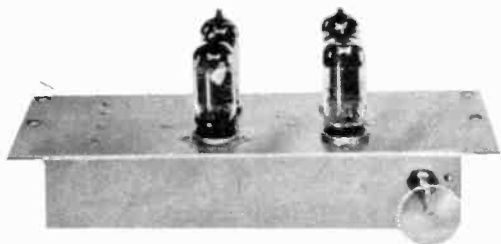
## STEREO BROADCASTING

One of the earliest forms of stereo experimentation was the AM-FM simulcast, in which two radio transmitters were used to broadcast the two sound channels (one on AM, one on FM) and two receivers were used to receive it. Simultaneous stereo broadcasting using TV instead of FM as one of the sound channels has also been employed. No matter what is broadcast by these methods, there is bound to be a real question about the quality of the stereo that can be received and heard in the home. The question arises from the obvious mismatch of most of the equipment used and the haphazard speaker placement that results from the convenient positioning of the mono receivers.

## RECORD PLAYERS

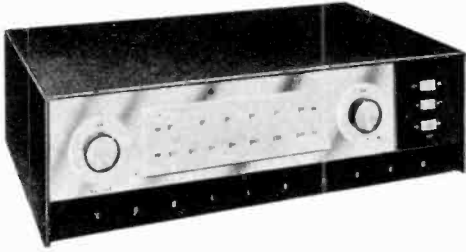


Madison Fielding MX 100 and Harman-Kardon MX 20 multiplex adapters can be used with tuners of most manufacturers; are designed for use with Crosby system of multiplexing, although they can readily be converted to other stereo systems

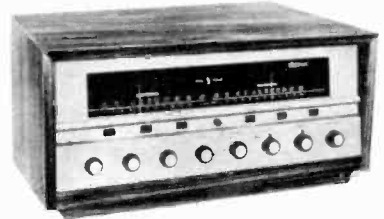


The Fisher MPX 10 adapter features maximum of controls and functions in minimum of space; the Harman-Kardon MA 250 adapter is specially designed to plug into the H-K stereo tuner, which has allowance of space on chassis for it

Multiplexing offers the possibility of true stereo broadcasting with a compatible system, using only one transmitter—an important consideration for the broadcaster. If you're a regular FM listener, you may have noticed two faint signals, one on either side of the main signal of your favorite FM station. These signals, called side bands, generally carry the same program material as the main band. It's possible, however, to split one of these bands off and transmit a complementary stereo signal, or even an entirely different program, over it. But if stereo utilizes one of these bands for the left channel and the main broadcast band for right, FM listeners not equipped for stereo hear only half the show. There are a number of systems designed to overcome this problem and provide compatibility. The front runner at this time, and the one most likely to become standard, is the Crosby system. Crosby's main channel contains the sum of the two stereo channels (Channel A plus Channel B), while the side band contains a phase-inverted A minus B signal. A multiplex adapter splits the side band off the main channel, subtracts it from the main signal and provides a reconstituted pair of stereo signals. All FM tuners receive both signals now; if yours doesn't have provision for a multiplex adapter, you can have an outlet added by your serviceman for about \$10.



Bogen TC 200 (left) and H. H. Scott Model 320 are two budget-priced stereo tuners. The former is equipped for AM-FM stereocasts, the latter for FM multiplex. Both cost roughly what medium-priced non-stereo tuners cost a year or so ago



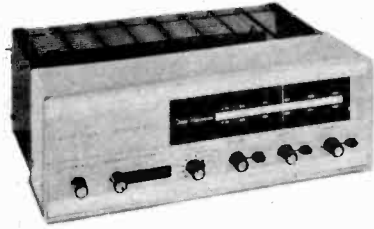
First three-in-ones to make their appearance are Fisher 600 (left), which features stereo 40-watt amplifier; Harman-Kardon TA 230, AM-FM stereo tuner, dual preamps and 20-watt stereo amplifier. These units require only the addition of speakers

Multiplex adapters are available from several manufacturers, including Harman-Kardon, Sherwood, Madison Fielding, Karg and Fisher. Prices range from \$50 to \$70. Basically, though, the stereo tuners now on the market are designed to receive AM/FM stereo.

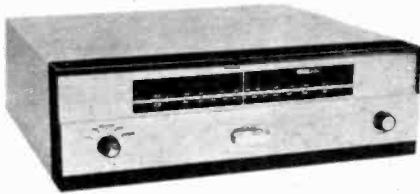
It sounds relatively simple to receive both AM and FM on an AM-FM tuner. But equipment to receive them *both at the same time* is a horse of a different color. Thus the stereo tuner for AM/FM stereocasts is really two complete, separate tuners on one chassis, with two tuning pointers and two tuning knobs. Such tuners are described as being capable of "simultaneous reception" of both AM and FM, or as having "separate channels" for AM and FM.

Referring back to our list of the four forms in which we can buy tuners, we find, therefore, that the tuner-only must be a stereo tuner; and a piece of equipment that includes preamplifiers and power amplifiers must have dual preamps and dual amplifiers for stereo. A stereo receiver, then, is really a complete system for stereo, except for the loudspeakers. Tuners incorporating preamps, or preamps plus power amplifiers (that is, receivers), include among their controls individual tonal adjustments and balancing for each channel. All the better units provide either a "tuning eye" or tuning meter,

## TUNERS



Pilot and Sargent-Rayment have stereo tuners equipped with stereo preamps. Pilot FA 690, shown at left, has full tuner and preamp controls, separate AM and FM tuning bars; the S-R tuner uses a combination of dials and buttons for controls



The Harman-Kardon T 250 AM-FM stereo tuner has space on chassis for plug-in FM multiplex adapter. The Bogen ST 662 features AM-FM stereo too, but owners can convert to multiplex simply by attaching a multiplex converter

considered a *sine qua non* for FM. A tuning meter has the advantage of being more accurate and easier to use than the "eye," other things being equal; but many meters are so tiny that they are hard to read, so a tuning eye (really a small cathode ray tube) might be preferable. As with other hi-fi components, the more units you combine on one chassis the lower the proportionate cost of each, because of the economy of the single chassis and case. At the same time, some flexibility is sacrificed.

The biggest virtue of the stereo tuner is that simply by working properly it receives AM/FM stereo simulcasts the way they should be received—on equipment of identical quality. That is, two receivers of the same high quality but located in one spot, easy to use and convenient to tune, and all ready to go whenever such a broadcast comes along.

Multiplexing is extremely limited at this time, for a good reason. The Federal Communications Commission must approve new techniques in broadcasting. Although the FCC has licensed a few broadcasters to conduct experimental stereocasts (mostly during the daylight hours or late at night), it has not yet approved multiplexing in any form. In the event it approves some system other than the Crosby (there are nearly twenty competitors), those adapters which work only with the Crosby system will become obsolete. Most units made for hi-fi use, however, are easily convertible to other systems.



Karg FM-only tuner must be adjusted for each owner, since this set has no tuning dial. Karg also has a stereo multiplex adapter.

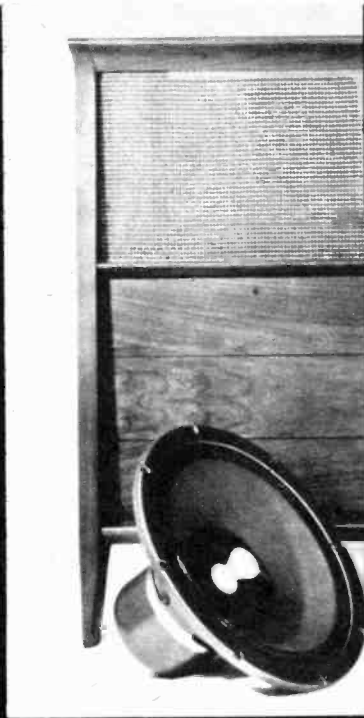
Heath AM-FM tuner kit is one of several on market that can be used as integral part of stereo system. Kit is easy to build, inexpensive.



Before rushing out and buying a tuner, it will pay to find out what kind of broadcasting is being done in your area. If, for example, there is no FM station in your listening area, there's little point in buying an AM-FM stereo rig. If, on the other hand, your local AM stations duplicate all their programming on FM—sans stereo—then you can save money by buying an FM-only tuner and hoping for multiplex. Listeners in the larger metropolitan centers, though, will want a good AM-FM stereo tuner with provision for multiplex adapter, for there is sufficient program material available now in such areas as Boston, New York, Philadelphia, Washington, Miami, Chicago and San Francisco—to name just a few—to make such an investment worth while.

To get back to tuners, we believe in this line of reasoning: If you're starting out from scratch, and have stereocasting in your area now, by all means get a stereo tuner. If you already have a good tuner, you don't need to replace it unless you really desire to listen to stereo broadcasts. Check the stations in your locality first and see how much is available and what it is.

If you are going to buy a tuner, which of the four choices should you make (tuner only, tuner plus preamp, etc.)? This is again a matter of economics, plus convenience. Single units give you everything in one place and represent a better dollar value, but offer less in the way of flexibility in selection and physical placement than do the other alternatives.



A GOOD LOUDSPEAKER CAN'T DO ANYTHING TO IMPROVE THE PROGRAM MATERIAL THAT'S FED INTO IT, BUT A POOR SPEAKER IS PRACTICALLY CERTAIN TO RUIN LISTENING PLEASURE ■ SO KEEP IN MIND THE PAY-OFF END OF YOUR STEREO PLAYBACK SYSTEM —

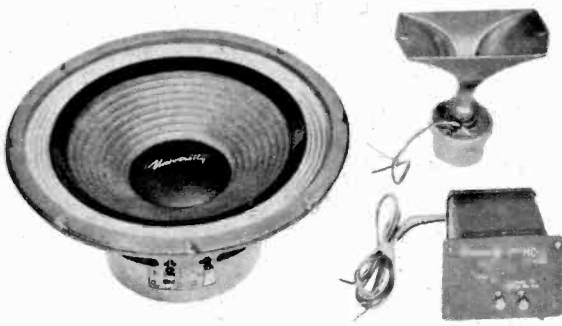
# LOUDSPEAKERS



## CHAPTER 7

**T**he loudspeaker is the business end of the audio chain—it is what brings the sound to your ears by converting audio-frequency electrical energy into sound waves. The commonest and most basic type of loudspeaker is the cone, which gets its name from the fact that it employs a heavy paper cone to set up vibrations in the air. Audio-frequency electrical energy flows through a coil of wire known as the voice coil. Situated in the air gap of a permanent magnet, the coil moves in and out, imparting this movement to the cone. The conversion efficiency of this device (from electrical watts to acoustical watts of sound pressure) is generally low. The normal expectancy is about 5 to 10 per cent efficiency; 25 per cent is considered very good. It is important to know that this relatively low efficiency is the nature of the beast in general, not a shortcoming of a particular product.

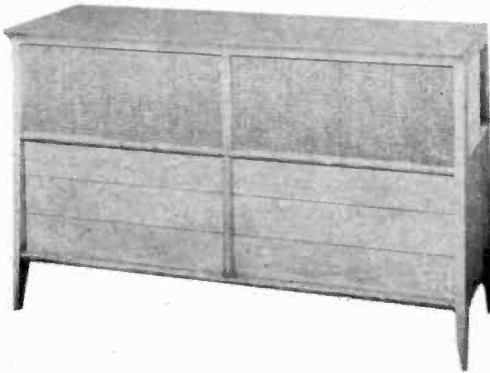
## LOUDSPEAKERS



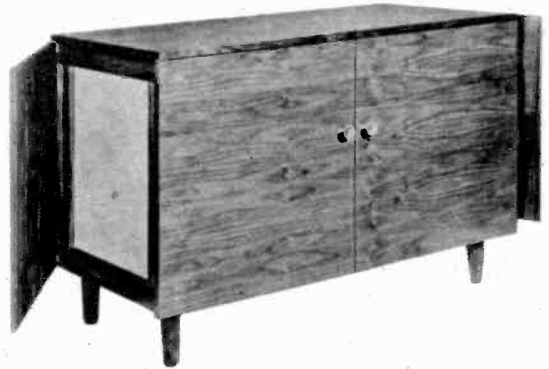
Elements of a two-way speaker system by University include dual-voice coil woofer, tweeter and crossover network



Electro-Voice's Stereo speaker is one answer to stereo's second-channel problem



Set in modern surroundings, Jensen's DS 100 Dual Stereo system allows listener to direct sound to any room area

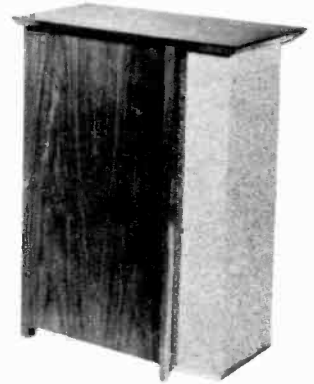


Bozak's B-304 binaural cabinet has speaker systems facing opposite ends. Doors open to any angle, permitting deflection of sound

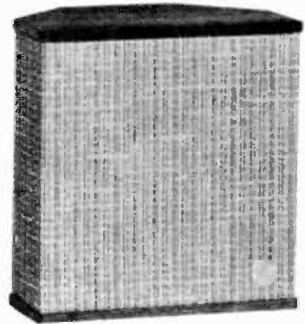
Uniform efficiency and performance over a wide range of frequencies (that is, 15 to 15,000 cps) is not a characteristic of the cone speaker. The response to different frequencies is somewhat related to the maximum diameter of the cone. A general rule is that the larger the cone, the lower the frequency it can handle. Common sizes range from 4 to 15 inches, with the latter considered necessary by purists for really good bass response, but because the 15-inchers cost somewhat more, usually require tweeters and take up extra space, the 12-inch size is more popular. Size alone, of course, does not guarantee a good speaker. And, paradoxically, a large speaker is not apt to be good at high frequencies. This, again, is the nature of the beast. A small cone responds most readily to the rapid and minute fluctuations of high frequencies, while the large cone is most suitable to the wave lengths and large cone movements associated with bass frequencies.



A British import, the Goodmans Delta speaker system covers full range in comparatively small, flexible enclosure. It can be used as bookshelf speaker or mounted on legs



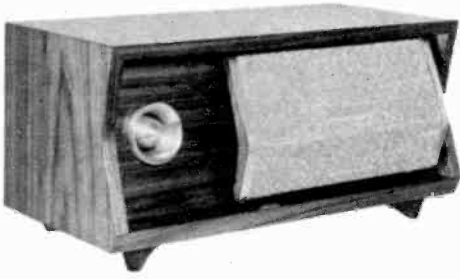
University Stereoflex is add-on speaker, for use with the existing system



The Stereodot system manufactured by Stephens Trusonic is a unique pair of trim, compact add-ons designed to flank an existing full-range speaker to provide additional channels for stereo. Add-ons and controls cost \$169.50

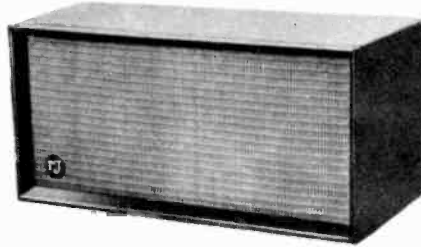
It is because of this seeming paradox that two speakers are often used; a large cone functions as a "woofer" for the bass range and a small "tweeter" does the job for the treble range. Sometimes this total range is broken into three, four or more sections, each handled by a specialized speaker. Such systems make it possible to engineer each segment of the system for maximum efficiency and fidelity within a relatively narrow range, rather than for a compromise result over the entire range. Substitutes for two- or three-speaker systems are the "coaxial" or "triaxial" speakers which are actually such a combination of speakers connected to the same frame on a common axis. In either case, separate or axially mounted, multi-speaker systems are designed with "crossover" points—points at which the speakers take over from each other in doing their separate jobs on portions of the frequency spectrum. A two-speaker system might, for instance, have a

## LOUDSPEAKERS

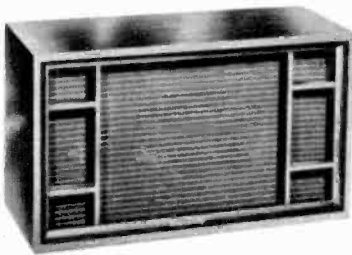


In mahogany or walnut, J.B. Lansing's Bel-Aire bookshelf model contains a ring tweeter and an eight-inch speaker

Containing an eight-inch speaker, the R/J Wharfedale, a British import, is a popular bookshelf model



At left is the University Ultra-Linear 12-inch speaker system, for shelf or floor placement



crossover at 1,500 cps. The woofer then would cover 30-1,500 cycles, the tweeter 1,500-15,000. A three-speaker system might have an additional crossover to a mid-range speaker at 800 cycles. This speaker would reproduce the frequencies from 800 cps to 1,500 cps.

As the frequencies get higher, they tend to propagate more like beams of light, which is to say that they attenuate, or fall off, as you get away from the axis of the speaker. To widen the horizontal angle of dispersion, horns of one kind or another are often used with tweeters. Such horns also tend to improve the efficiency of the speakers by improving their coupling to the air, an effect similar to the one you get when you talk through a megaphone, and still another reason why it is more practical to have tweeters and woofers rather than a single wide-range speaker is that the tweeter can be designed for maximum dispersion as well as efficiency.

The descriptive terminology for loudspeakers and speaker systems can be confusing. There will usually be a statement such as "frequency response 30-12,000 cps." Strictly speaking, that is not a description of "response" but of range. It tells us nothing about the speaker's relative response at different parts of its range; nor whether it has a smooth or an erratic response over

its range. It is well to bear in mind that wide range is not in itself a guarantee of a good speaker. Another stopper is magnet weight. Heavy magnets are generally associated with power-handling capacity, but the correlation is not a direct one; when judging a speaker, it is wise to note the stated capacity rather than the magnet weight in pounds.

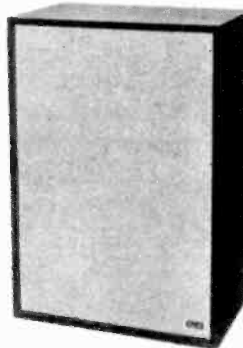
## ELECTROSTATIC SPEAKERS

About four years ago, the electrostatic speaker made its appearance. Structurally, this speaker bears no resemblance to the dynamic cone speaker we have been discussing. The electrostatic has no cone, voice coil or magnet. Its name derives from the fact that it works on an electrostatic rather than an electromagnetic principle. Basically, the unit is a large capacitor (condenser) with three plates, using air as a dielectric (or medium permitting the passage of the lines of force in the electrostatic field). You might think of it as a cheese sandwich with the two outside plates (the bread) stationary and the center (the cheese) movable between them (varying the capacitance). The important characteristic of capacitors for hi-fi is that they offer less opposition to the flow of current as the frequency gets higher. For this reason, we would expect electrostatic speakers to be suited for service as tweeters, and they are. As such, they present a larger radiating surface than the average tweeter and are felt to have a much better and smoother high-frequency response than the average tweeter.

We have heard some excellent results from electrostatic speakers and believe they have exciting possibilities for the future. At the present writing, however, there are few makes and models on the market (compared with the great profusion of magnetic speakers) and, with the exception of one



The Eico HFS-2 employs floating tweeters for highs, folded horn for bass



KLH's Model One is acoustic-suspension design, fine for stereo listening

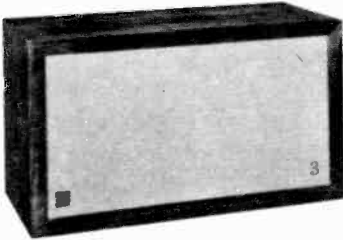
## LOUDSPEAKERS



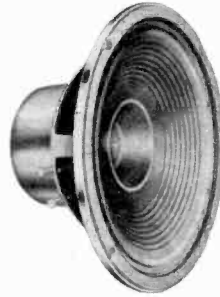
Pickering Isophase, above, is an electrostatic tweeter. It offers fine treble response, should be used with a woofer



JansZen's Model 130 is a tweeter electrostatic design. This unit comes in various wood finishes to match decor



The Acoustic Research AR-3 speaker system utilizes cabinets filled with fiber glass, offers excellent bass response for its size



Model SP 12B, by Electro-Voice is a 12-inch speaker with one-pound ceramic magnet; price is \$34.30

or two Japanese imports, they are rather expensive. The two American firms that have pioneered in electrostatics are JansZen and Pickering, and their products range from \$80 to \$220. Other factors to be considered are appearance and physical flexibility. Unlike cone speakers, electrostatics are not available for mounting or "building in" in any way that suits you. Because of their special design and construction they come already enclosed, which may add up to convenience and economy if you happen to like the looks of them and can fit them into your available space.

## CONE SPEAKERS

The basic cone speaker, like the "works" of a watch, has to be covered in some way. Otherwise it would be unsightly, would work poorly and would be in danger of damage. To reproduce low frequencies efficiently, the front of the cone speaker has to be acoustically separated from the rear. If you take a large board, cut a hole in it and mount the speaker in the hole, you have performed the acoustical separation with what is called a "baffle." Mount it in a wall, with the rear open, and you have an "infinite baffle." Or mount it inconspicuously, cover it with a piece of porous cloth, and you have also given it rigidity, safety and protection from dust.

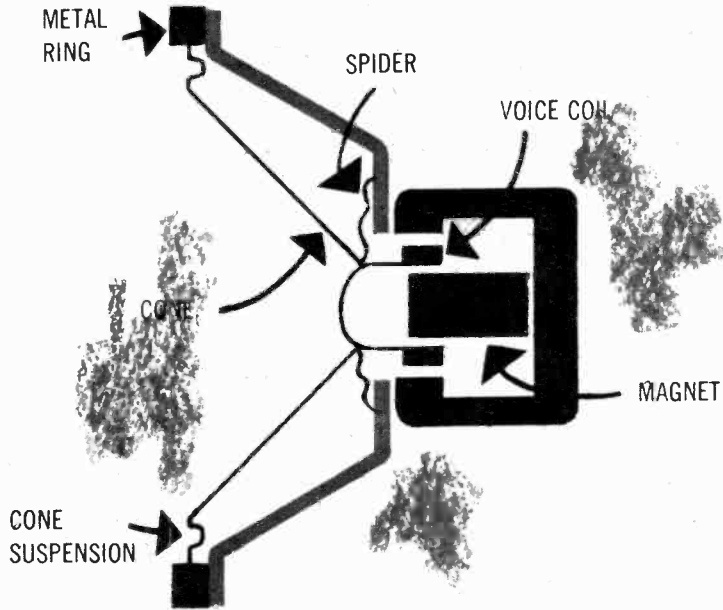
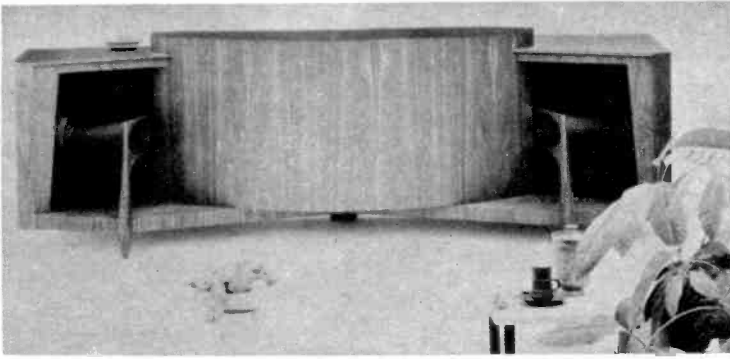


Diagram of good cone loudspeaker shows how basic elements work: signals from amplifier enter voice coil, causing it to vibrate within the field of the magnet. These make cone vibrate, setting up shock waves in air that are heard as sound

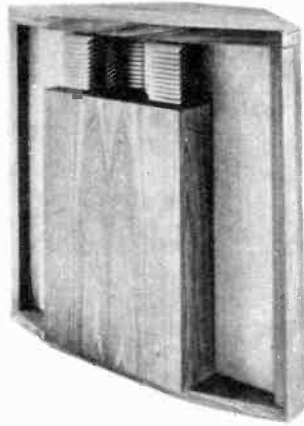
When a baffle is attached to the front of a box, we have the basic enclosure cabinet. Included are open-backs, closed-backs, vented (or ported) enclosures, enclosures that provide "horn loading" and many others. Some enclosure cabinets merely enclose, without engineering complications, but even the simplest open-back cabinet provides a pretty good baffle. More elaborate enclosures attempt by their construction to extend the low-frequency response, raise the speaker's efficiency at the low-frequency end, smooth out the low-frequency response and provide better coupling to the air. Other enclosures of special design are intended to produce good low-frequency response with relatively small speakers in a relatively small space. Remember the rule of thumb is that for bass response you should have a big speaker. Therefore these small space units are meant to provide good bass response *considering* their size. They are not substitutes for larger jobs where space and/or money are no object. The type we are describing might be lumped together as the bookshelf type and include brands such as R-J, KLH and AR. All three produce surprisingly good results, though some aficionados advise supplementing them by a tweeter for the middle and high ranges.

When the front of the speaker cone moves out to produce a compression of air, its rear is producing a rarification. We describe these two conditions as being "out of phase." The ported or "bass reflex" cabinet attempts to



J.B. Lansing Ranger Paragon is biggest stereo speaker. Fully eight feet long, it houses two systems

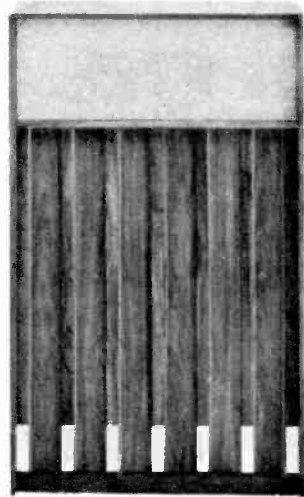
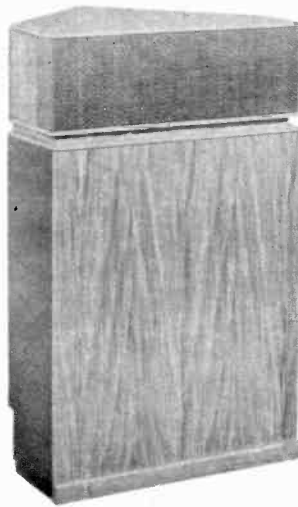
Here is J.B. Lansing's Hartsfield, a monophonic corner horn. Unit should be matched for best stereo



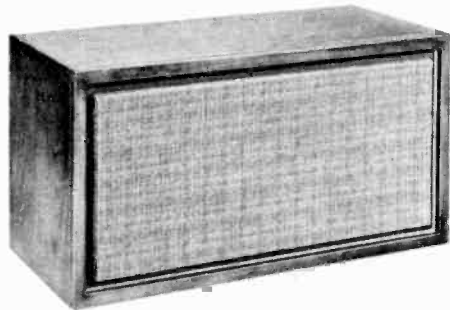
get these waves in phase at the front of the speaker (in a particular narrow-frequency band) in order to reinforce and smooth out the bass response. The bass reflex, pioneered by Jensen, is one of the earliest types of enclosures for hi-fi and is still popular. It is a closed-back cabinet for which a carefully contrived formula provides the over-all dimensions, the size, shape and location of the port and, of course, the size and position of the loudspeaker itself, to produce the desired results. Bass-reflex cabinets tend to produce a sort of "boomy" bass that is not regarded with much favor by audio enthusiasts these days.

We asked you to visualize a megaphone when we mentioned horns for tweeters, and pointed out that a horn improves speaker efficiency. The size of the horn bears a direct relation to the frequency (or frequency range) involved. This is obvious if you compare a cornet and a tuba. Outside of a movie theater (where size is no problem) horns for bass speakers were considered impractical until Paul Klipsch started exploiting the Klipschorn. His trick was to produce a "folded horn." While not exactly tiny, the folded horn takes up no more than a quarter of the space needed by a full-length horn for bass frequencies. This type of enclosure is designed to raise speaker efficiency at low frequencies and—when driven by a capable speaker—it almost invariably will do an excellent job.





Above are two examples of cost-is-no-object mono speaker design. Klipsch corner horn is at left, Electro-Voice Patrician at right. Both produce sound that is of highest excellence. An Electro-Voice Linden bookshelf speaker shows the recent approach to design of stereo speakers



Getting back to stereo, we find that we need two speakers or speaker systems. The word "system" can refer to a two-speaker, high-low system or a three-speaker, high-middle-low system, with appropriate networks. For best results, these two systems should be identical, equivalent or equally matched. Balance controls and separate tone controls for each channel can help restore equality to unmatched systems. It follows that if you had something like the biggest Klipschorn combined with, say a JansZen 130 electrostatic tweeter, you would want two of each for stereo—if that is, you had enough room and money. In other words, the necessity of duality in stereo may preclude some choices that might have been made with mono.

Speaker systems for stereo are generally one of three types: two completely separate units; a one-piece unit containing two speakers or two sets of speakers; and units with detachable speakers (usually portable) that can be moved apart. A fourth variation might be a hi-fi unit or ensemble with another speaker added to it. It has been generally conceded up to now that, for optimum reproduction, stereo speakers should be six to ten feet apart. This introduces a problem whose solution should be up to the manufacturers, not the consumers. The problem is that having two speaker systems that far apart—whether separate or in one cabinet—is relatively costly and pre-empt a good deal of space in the home. Manufacturers feel impelled to offer



Turn-of-century decor was excellent for a love nest or other such purpose, but would have left something to be desired as a listening room for hi-fi stereo. The draperies, rugs and other impedimenta make this an acoustically dead room

something that will fit the small home and the small pocketbook, regardless of whether it can provide optimum stereo. If very many of these small-separation stereo units are sold, those who are responsible for stereo discs, prerecorded stereo tapes and stereo broadcasts may have to take this into consideration—that is, make program material available which sounds different and interesting despite the limited separation of speakers.

### CHOOSING A SYSTEM

What type of system is best? We would say without reservation that those systems are best which permit relatively easy movement of the speakers (or at least one of them) both as to distance (separation) and direction. Variations in the program material plus variations in room acoustics make it virtually impossible to provide a permanently anchored set of speakers that will produce optimum results on *all* material and in *any* home. For this reason, two compact speaker systems that are—or can be—mounted in two separate cabinets, one for each stereo channel, is to be recommended. Very elaborate arrangements have been suggested which take advantage of the fact that bass frequencies are relatively non-directional while high frequencies are directional. But such arrangements suggest a lot of experimentation, plus complete freedom as to ultimate placement. Most married



Clean lines of modern room contrast in more ways than one with rococo establishment on opposite page. The uncluttered decor of this room allows ample unbroken areas to reflect sound, helps make it acoustically "live"

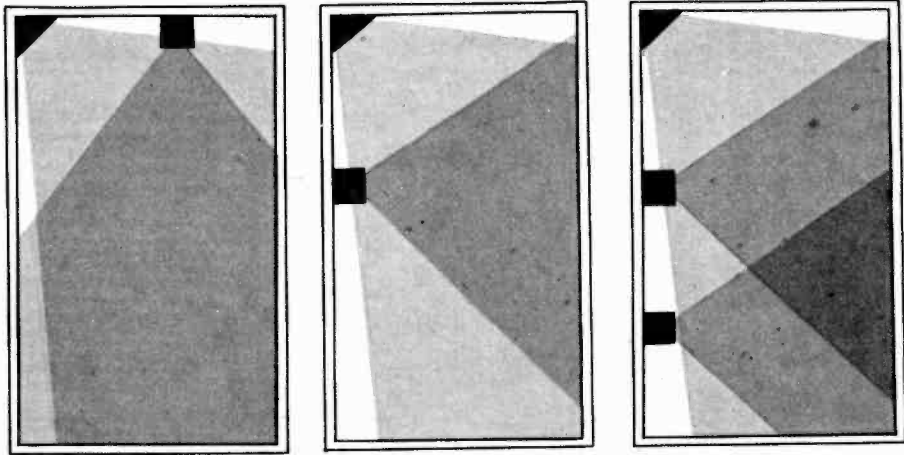
audiophiles, lacking such freedom, must find a compromise between perfection, practicality and appearance.

We've been talking about two channels, but a third, phantom, channel is making its appearance. The phantom channel is designed to fill up the "hole in the middle" in much the same way that recording engineers plug it up by using a phantom microphone channel that is divided between the two basic channels when a disc is cut. The three-channel speaker puts a low-frequency speaker between the two main units which derives its signal by stealing a little from each of the two channels. Special circuits within the amplifiers are necessary to provide the "third channel. Very little equipment of this type is available at present, and we have not been able to evaluate it in comparison with conventional two-channel stereo.

"Balancing," as the term applies to stereo controls, means equalizing the sound output of the speaker-systems or adjusting the balance until the result is most pleasing. Properly, a balance control should cut one speaker down while raising the other, so that the net combined volume is still the same. Equalization of the tonal balance in the two speakers systems is also a very desirable feature. It should also be possible to adjust the over-all volume of the system without upsetting the balance by using a "master" volume control.

When two or more loudspeakers are near each other and facing so that they "cover" the same area, they must be properly phased. When "in phase,"

## LOUDSPEAKERS



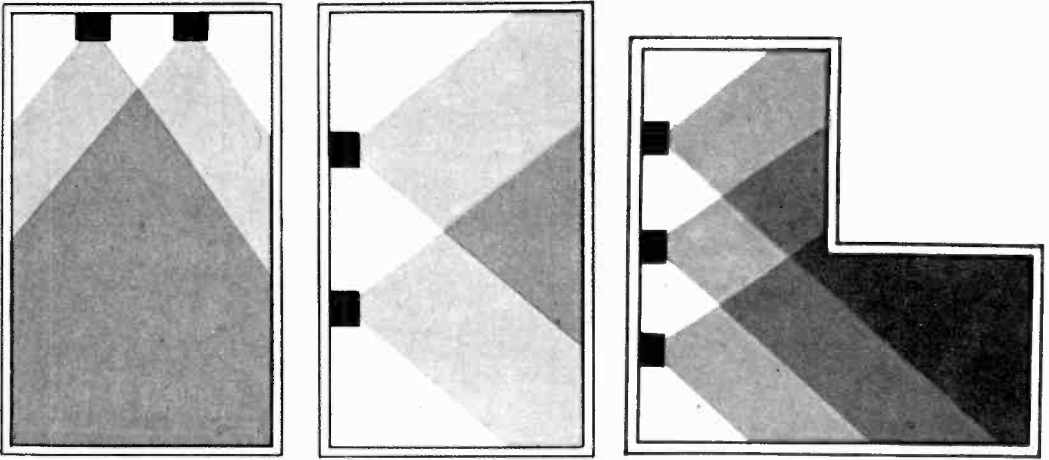
Darkly shaded areas show parts of rectangular room that will have maximum stereo effect when speakers are placed as shown. If the original speaker is corner type, choose an along-the-wall type for the second unit. Third speaker improves sound even more

they produce maximum loudness; when “out of phase,” their sounds tend to cancel each other out, especially at bass frequencies. In speakers, being out of phase usually means that one speaker cone is moving out while the other is moving in. Flipping the phase control would reveal that one position sounds better than the other. Phase differences can arise elsewhere than in the loudspeaker, so the phasing control cannot be set permanently.

## ROOM ACOUSTICS

Besides the various controls we have mentioned, it is possible (and usually necessary) to fiddle with the speaker placement. This is due partly to the nature of the stereo material and partly to room acoustics. “Room acoustics” is a broad term that primarily describes the reverberation characteristics of a room, and, in our present application, the effect of these characteristics on the sound of music. Room acoustics can make or break a sound system; identical hi-fi rigs will sound different in different rooms. In commercial installations, acoustics are within the control of engineers and architects, but in our homes we have little or no control over most of the factors on which room acoustics depend. These are the dimensions of the room—length, width and height—and their relation to each other; the nature of permanent surfaces—walls, floors and ceiling—with respect to their ability to reflect or absorb sound; and the nature and placement of furniture and furnishings.

In a room lined with sound-absorbent materials, there will be little if any reverberation of sound, and we say it is a “dead room.” A room with smooth plaster walls, hard-surface floor covering and no drapes or upholstery would



If original speaker was along-wall type, second one for stereo should be as similar in design as possible. Three speakers are often the best solution to stereo coverage in an oddly shaped room, but always experiment with placement before making decision

be a “live” room in which there would be much reverberation, or ricochet, of sound. Reflected sound waves can reach you in phase, for reinforcement; out of phase, for cancellation; or in a wide variety of phases, producing din or cacophony. How they reach you depends on room geometry, sound-source placement, listener position and the wave length of the frequency reproduced. While we cannot control many factors involved in room acoustics, we do have some say about the nature and placement of furniture and furnishings, placement of the sound source and the listening position. The ideal room is a compromise between the extremes of live and dead. The ideal placement of equipment (sound source) is in a corner, facing along a diagonal of the room. Second best is on the short wall, facing the long way of the room. Either of these placements provides for maximum coverage of the room with direct (rather than reflected) sound waves, using reverberation—under ideal conditions—only to reinforce and add brilliance. This arrangement also affords optimum distribution of high frequencies.

These same precepts would hold true for stereo, too, except that placing the speaker systems six to ten feet apart precludes single-corner placement and suggests that the best position is along one of the short walls of a rectangular room. The placement of chairs and sofas must be considered, because people have to be able to listen. It is unfortunately rare to have a seating arrangement that faces the short side of a room. More common is the rectangular room that has a fireplace on one long wall with the seating arrangement facing it. The writer resolved this problem by putting the main equipment center and speaker system on one side of the fireplace and the second speaker on the other side. The results are pleasant, though not ideal.



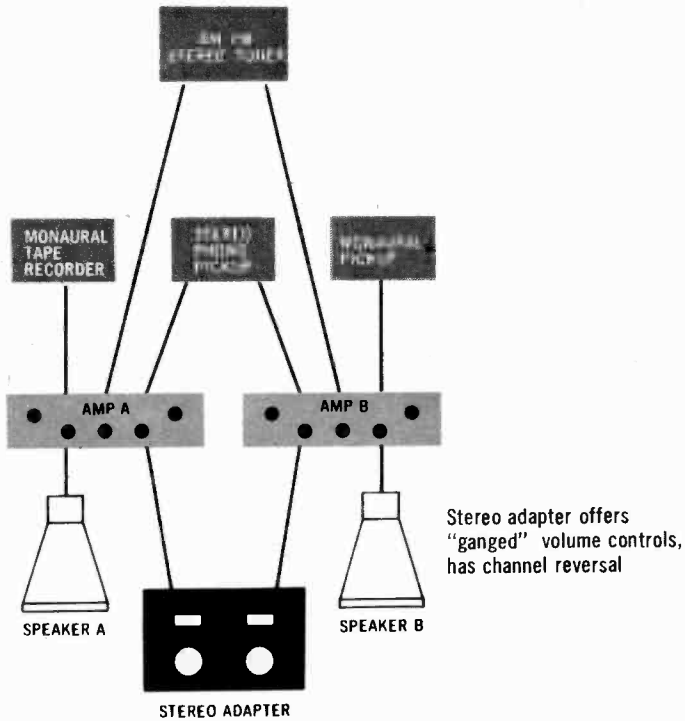
THERE ARE A GREAT MANY PRODUCTS ON THE MARKET THAT MAKE LIFE EASIER FOR OWNERS OF STEREO RIGS — FROM SPLICERS AND HEAD DEMAGNETIZERS FOR TAPE RECORDERS TO DISC COVERS, STYLUS PRESSURE GAUGES ■ PERHAPS MOST IMPORTANT ARE ADD-ON **CONTROLS**

## CHAPTER 8

**E**xcept in the complete, "all-in-one" stereo set-up, a number of different pieces of electronic equipment must be joined together properly and controlled or "blended" satisfactorily. Often the equipment used will be made by different manufacturers and have different capabilities. Certain items in this category should be considered necessary, others "not mandatory but desirable" for optimum convenience and satisfaction.

A new stereo preamp-amplifier such as is described in Chapter 3, or a stereo receiver as described in Chapter 6, will as a rule have all the necessary arrangements: input jacks for different program sources, function selector, provision for channel balancing and over-all volume control, plus parallel amplifier connections for monophonic program sources. But if units are added to existing equipment, or if a mixture of mono and stereo components are in use, some

## CONTROLS

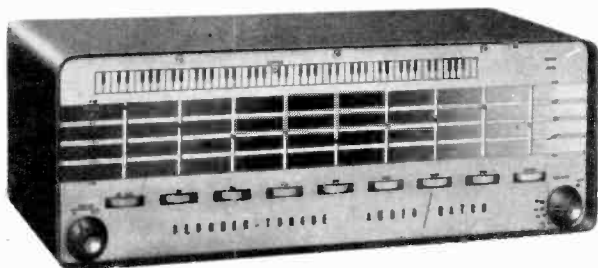


sort of adapter will be needed to provide the necessary additional services. If, for an example of the stereo unit addition, you had a separate tuner, separate preamp-control unit and separate amplifier for mono, you might substitute a stereo preamp-control unit for the existing preamp and then add another monophonic power amplifier.

It must be borne in mind that stereo provides two separate channels that are in essence separate audio systems. A mono amplifier, preamp, tuner (or combination of these items) just cannot feed the second channel. Another point to remember is that the average stereo rig is not a stereo rig only: it's a combination of stereo and monophonic. If you use discs, for instance, you will probably find that for some time to come you will be playing some mono discs. If you use tape, you may very well decide to limit stereo to playback, in which case you might have mono recording and playback plus stereo playback. If you have a tuner, you must use it monophonically most of the time, since stereo broadcasting is still fairly infrequent. So, counting both mono and stereo, you must be able to handle up to six different playback sources (stereo and mono, multiplied by disc, tape and tuner). An important requirement is for your rig to accept and select all these types of material.

Adjustment of the two channels is necessary for several reasons. Among them are differences in the nature of the various program sources, differences





Blonder-Tongue Audio Baton permits owners to emphasize certain parts of audio spectrum

Lafayette Stereo Control has virtually all the controls of stereo preamp on its front panel

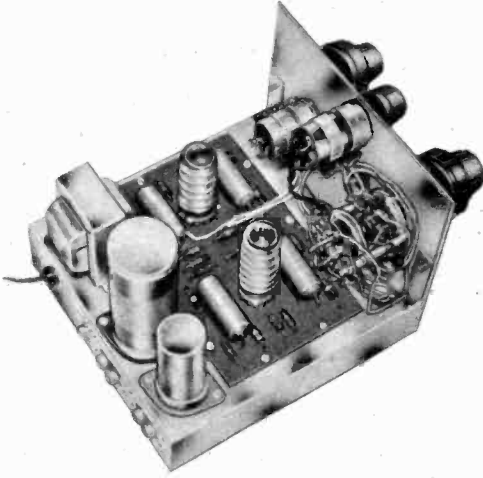


between individual samples of each source, differences in the capabilities of the specific pieces of equipment in the two channels (even if units are identical in design, hand work makes it possible for them to vary from unit to unit) and, finally, differences between the two loudspeaker channels because of room geometry and because the user's set-up differs from that which the recording engineer had in mind. That's not really the "final" reason, because the tastes of the listener have to be taken into consideration, too.

## ADJUSTING THE CONTROLS

Some facilities for "balancing" the two channels are therefore desirable. The accepted use of the word "balance" is that it means to balance amplitude, or loudness. We believe it is also desirable to balance tone, or frequency response, to compensate for possible differences between speaker systems. In either case (loudness or tonal balance), there are some shortcomings to be aware of. It's hard to tell exactly how the stereo result is supposed to sound—what was intended. An imbalance in loudness or tonal quality may have been contrived to achieve an effect that the user may destroy without knowing it. The user may also, in attempting to fill "the hole in the middle," destroy some of the movement and spatial relationships that were intended

## CONTROLS



Stereo adapter contains volume control (left) for both stereo channels; program selector is on right

Another answer to the control problem is to replace mono preamp with stereophonic model



to be there. This is just something we have to live with to get to understand fully. The writer has found the same difficulty with color TV: trying to figure out, while adjusting the controls, exactly how the picture really should look. At least in TV, you have a standard to go by—skin tones, although there is considerable latitude for interpretation even in that area. That is, perhaps, the clue with stereo: use the manufacturers' instructions for preamps and amps as a starting point, then adjust for some known quality in the sound; when you have it, leave it, and let the chips fall where they may from then on.

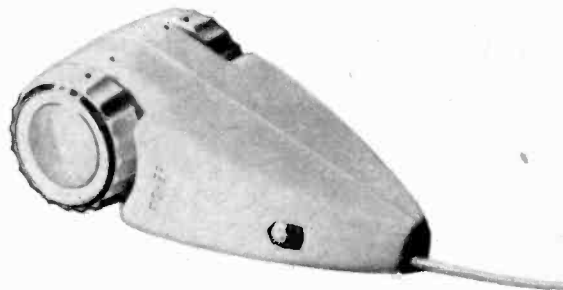
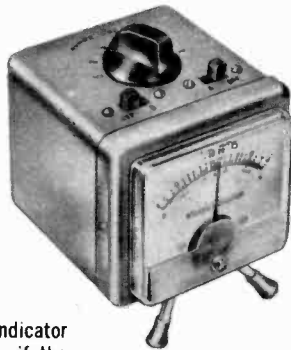
Before proceeding to itemize some of the equipment available, we'd like to pass along one recommendation concerning controls in general. That is, try to avoid having too many knobs in too many different places, especially if they overlap in function. One set of controls in one location is ideal. Perhaps the acme in this respect would be to have a combined stereo tuner and dual preamp. Then all the knobs could be in one place. One exception to this rule, and the only one we need consider here, is that it is desirable to have sound-channel control at the listening position. If the speakers are in the same place as the audio equipment, we would recommend a remote location for channel control (phasing, balance, master volume).

There are many adapter units, either ready-made or kits, which provide control for the two sound channels of a stereo system (loudness balance,

phasing, channel reversal, monophonic or stereo operation and master volume controls). Among them are the Bogen STA-1 (\$13.50); the Marantz Model 6 (\$45.00); the Scott 135 (\$24.95); and in kits, the Dynakit DSC-1 (\$12.95); the Knight Y-778 (\$9.95); and the Lafayette 315 (\$27.50). Some have additional features, as noted below. In addition to these units, two items are available for the bare essentials of remote control. These are the General Electric RG-1000 (\$14.75), providing balance, phasing and master volume; and the Fisher RK-1 (\$17.95), providing balance and master volume.

### SPECIAL ADAPTER FEATURES

In addition to the ones previously mentioned, here are some of the special features of particular adapter units. Loudness compensation for each channel is provided in the Scott and Dynakit adapter units. This means that by switching in the compensation circuit, tonal (bass-treble) balance will be adjusted automatically as the volume level is changed, to compensate for the deficiencies of our hearing apparatus at the extreme low and high ends of the audio spectrum. The Marantz Model 6 provides input jacks for the various program sources and a function selector switch to choose the desired source. This could be an important feature since your monophonic equipment would have neither input jacks nor selectors for the "A" and "B" (left and right) stereo channels. Both the Scott and Marantz units have power on/off control of associated equipment plugged into them (amplifiers). The Lafayette and Dynakit units provide means of "cross-blending" of the two stereo channels, to fill the hole in the middle or to feed a third, "phantom," channel. The Scott,



Stereo indicator shows visually if the balance is right. Fisher's RK-1 remote control (right) and General Electric's RG-1000 allow you to make adjustments in the listening area



## CONTROLS

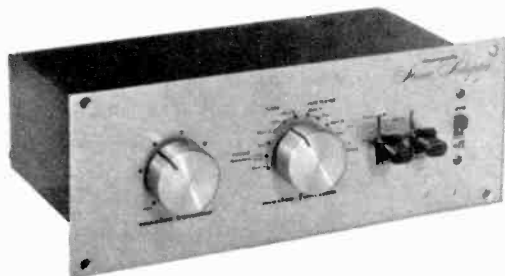
Dynakit and Marantz units provide jacks for tape monitoring. Several of the units provide both phase reversal and channel inversion. The difference between these features is this: for phasing, the connections to one channel are reversed, which changes that channel's phase with respect to the other channel, while channel inversion switches left to right and vice versa.

The multiplication of features on these adapters could go on and on, until the units were virtual substitutes for the preamp. It should be borne in mind that a remote unit *needs* only those adjustments which are most handily made when the user is not at the main equipment location. You will find in examining your needs and evaluating equipment for purchase that some units provide more than is needed for remote control but not enough for complete "adaptation." The information in this chapter is not designed to serve as a specific buying guide, but just to acquaint you with what to look for.

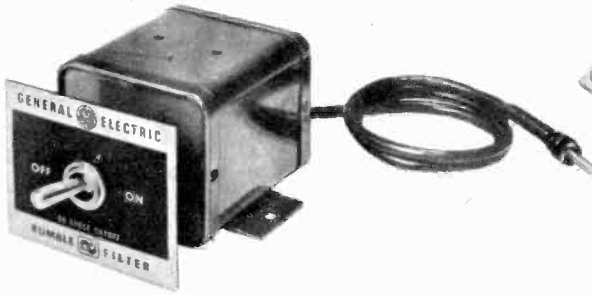
## ACCESSORIES

You will find a great number of accessories at your hi-fi shop or in mail-order catalogues, items that will add convenience and versatility to your rig. For the record player, there are various kinds of disc cleaners and protective sleeves for records, slides for pull-out record-changer mountings, stylus pressure gauges and turntable levels. These last two are essential to any well-ordered system. Just about any small dime-store pocket-level will serve for the leveling job. Stylus pressure gauges are distributed by Weathers, for \$2, and, among others, by Gray and Garrard, for \$2.50.

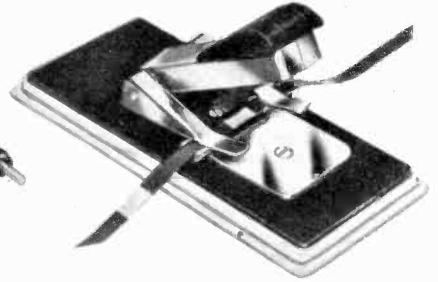
For the tape recorder, you'll need empty reels and boxes, a tape splicer and splicing tape. Leader tape is a good thing to have. It comes in several colors and can be used to identify tapes as well as to protect them. Connecting cables of varying lengths and with various terminals at the end are always handy when working with a tape recorder, and they can be used to make the rest of your system more flexible, too. One gadget that is well worth having is a device called a "Time-All"—an electric alarm clock that will turn your



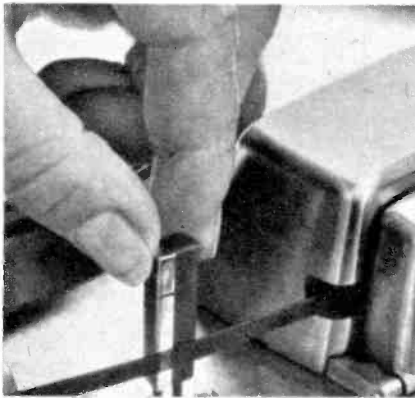
Marantz stereo adapter (at left) and Dyna stereo control (right) provide several functions in addition to ganged volume controls. Each is designed to be used exclusively with manufacturer's preamps. The Dyna unit comes in kit form only



General Electric's A1-903 Rumble Filter is electronic accessory that makes listening more fun by eliminating bass rumble



Tape splicer from Robins Industries is only one of several similar units on the market. It repairs tape breaks



Audio Devices' Echoraser removes tape print-through as tape passes it in course of playing. Eraser sells for \$12.50

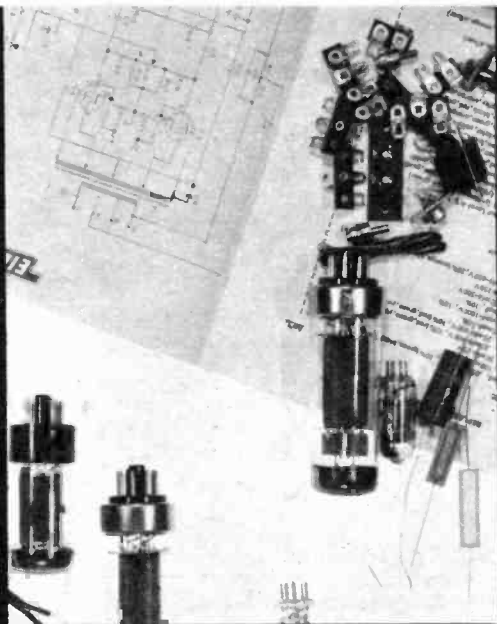


Another accessory is Irish tape strobe disc. With it you can check speed of your tape recorder for complete accuracy

system on and off at a specified time. You can use it to tape radio programs—even stereocasts—while you're away from home.

For the FM tuner, you'll want either a proper FM antenna or a set coupler, which makes it possible for you to use your television antenna for the tuner. A number of other electronic gadgets are useful not only for the tuner but for the entire system. They include remote controls and wall-mounted volume controls and speaker selectors; a device that shuts off your entire rig when the changer finishes playing the last record; and connections for an outdoor extension speaker with its separate volume control.

To improve the looks of the rig, there are attractive handles for pull-out drawers, kits to retouch scratches in the woodwork, a variety of patterns in grille cloth which can be used to make your speakers visually, as well as aurally, appealing. While most of these items are not necessities, they can make life with your stereo home music system much more pleasant.



IF YOU'RE HANDY WITH A SCREWDRIVER AND  
SOLDERING IRON, IF YOU'RE WILLING TO DO IT  
YOURSELF, YOU CAN SAVE MONEY AS WELL AS  
HAVE FINE STEREO WITH SOME OF THE BEST  
EQUIPMENT ON THE MARKET ■ NOW'S A GOOD  
TIME TO INVESTIGATE

# STEREO KITS

## CHAPTER 9

**B**uild-it-yourself kits have carved out for themselves a very important and significant spot in the electronics field and should definitely be considered by anyone who would like to save some money in the assembly of a stereo system or the conversion of an existing mono hi-fi system to stereo. They have proved reliable and satisfactory over a period of time, and while over-all quality may vary somewhat from manufacturer to manufacturer and—this should not be overlooked—from builder to builder, the products themselves have no more unusual ups and downs than regular factory-finished equipment.

Today's kits are designed for the layman—the man who may never have taken the case off an amplifier before. Simple, clearly written, step-by-step directions lead him by the hand through the construction process. Like any other do-it-yourself project, the assembly of hi-fi and stereo kits requires a

## KITS



Standard equipment for kit builders is shown at the left. To build a Rek-O-Kut turntable (above), you will need screwdriver, pliers and patience. This kit retails for only \$40 complete

certain handiness and adaptability. There are some people, we must admit, who are "all thumbs," and who have never been able to hang a picture, tighten a window shade or replace a fuse. This relatively small segment of the population will be no more proficient with a soldering iron than it is with a hammer. But if you are at all handy around the house, though not a craftsman of any sort, you can easily make it with kits. Kits are available for test equipment, amateur radio rigs and all varieties of home-entertainment equipment. We shall confine ourselves in this chapter, as far as possible, to stereo.

### ONLY TUNERS ARE RISKY

With the possible exception of tuners, electronic kit equipment can be evaluated against regular finished merchandise feature for feature, watt for watt. That is, you can reasonably expect to come out in the end with a piece of equipment that conforms to the printed specifications, and you can decide what you want on the relative merits of the finished product. We say "with the possible exception of tuners," because this is still a questionable area in the kit field. The critical wiring and careful alignment usually needed in the tuning stage-of FM tuners seem to us a bit out of the range of a man who is no more than fairly handy and has no special knowledge or previous experience. Kit manufacturers are trying to overcome this problem with the use of prefabricated, or printed, circuits in critical areas as they have already done in the amplifier field, and pre-aligned and sealed front-end assemblies where the tuning occurs. Even so, the novice should be wary of tuner kits.

Perhaps one shortcoming of kits and the people who build them is that the



kits *are* so simple to put together. It is possible in many cases to construct a piece of equipment successfully and acquire nothing beyond the knack of following directions and using a soldering iron. The average kit is provided with diagrams that are really representational drawings of the actual physical appearance of the equipment. While this makes construction easier, it could be profitably supplemented by an attempt on the builder's part to relate the real circuit diagram to the literal picture. The understanding of circuitry gained in this way would be very useful if repairs ever became necessary.

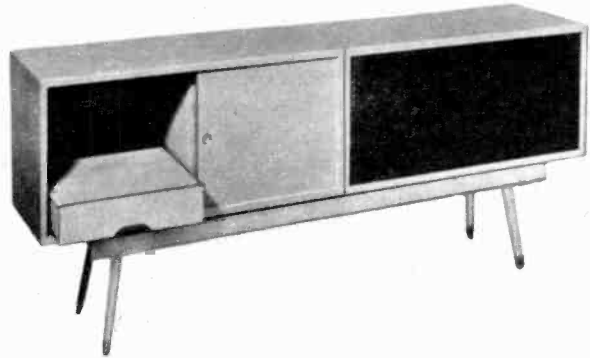
## THE TOOLS FOR THE JOB

For the construction of most kits you need no more in the way of tools than some screwdrivers, pliers, wire cutters and a soldering device. We recommend without qualification the purchase of a soldering gun, as opposed to the soldering iron. The average kit builder will find a gun not only easier to use but, since it must be triggered to heat, far safer than an iron. Solder is intended, not to provide a strong mechanical connection but a good and permanent electrical connection. In other words, don't expect it to hold wires in place. Crimp your connections *before* you solder them so that they'll be secure. Then add the solder to make the electrical connection permanent. Bear in mind that the soldering iron is not used to melt the solder but to heat the



You can assemble a virtually complete hi-fi stereo rig from kits alone. Heathkit record changer, shown at upper left, costs \$75. Or, if you prefer, you can build an Audax tone arm (above) for \$18.50. It's designed for use with the turntable kit offered by Rek-O-Kut. The Dyna preamp (left), at \$35, is one of the best buys available. Two, plus adapter, make a stereo unit

## KITS



Two different outlets for the kit builder's skill are Heath tape-deck recorder (left) and River Edge cabinets for records, speakers, equipment. Kits offer economy over assembled units, basic lessons in electronics and frequently very good equipment indeed at budget prices



Among the more popular items available in kit form are amplifiers, preamplifiers and tuners. Lafayette LA-90 stereo amp (left) has two 14-watt stereo channels, complete controls, for \$72.50. Eico HFT 94 AM-only tuner costs \$39.95, is companion to HFT 90 FM-only tuner

parts involved so that the solder will flow into them when applied. This is an important point. It is very simple to melt solder by touching it to the end of the iron, but it won't stick to anything unless that part has been pre-heated by the iron. If the directions for the kit indicate that care should be observed in the heating of certain critical parts, follow the instructions. Some parts, made of plastic or impregnated with wax, can be melted by the indiscriminate application of heat. Other components, like transistors and crystal diodes, can be permanently impaired by being heated.

All instructions, of course, should be carefully followed. This includes things that novices tend to ignore, such as which way to route a wire around the chassis. Very troublesome problems can result from the improper placement of wire (known as "lead dress"), even though the connections are sound and the parts are all in good shape. It is a good idea to check off—physically, with a pencil—each operation or connection as you make it. A wire that was never connected or never soldered can be very difficult to find later on, when it has been covered up by other components.

## A BRIEF LIST OF STEREO KIT MANUFACTURERS

### COMPLETE AMPLIFIERS

Approved Electronic Instrument Corp., 51 Vesey St., New York 7, N. Y.  
Arkay Radio Kits, 120 Cedar St., New York, N. Y.  
Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City, N. Y.  
Grommes Div., Precision Electronics, Inc., 9101 King Ave., Franklin Park, Ill.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
Knight Kits (Allied Radio), 100 North Western Ave., Chicago 80, Ill.  
Lafayette Radio, 165-08 Liberty Ave., Jamaica, N. Y.  
Precise Development Corp., 2 Neil Court, Oceanside, N. Y.  
Tech-Master Corp., 75 Front St., Brooklyn 1, N. Y.

### PREAMPLIFIERS

Acro Products Co., 369 Shurs Lane, Philadelphia 28, Pa.  
Approved Electronic Instrument Corp., 51 Vesey St., New York 7, N. Y.  
Dyna Co., 5142 Master St., Philadelphia 31, Pa.  
Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City, N. Y.  
Grommes Div., Precision Electronics, Inc., 9101 King Ave., Franklin Park, Ill.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
Knight Kits (Allied Radio), 100 North Western Ave., Chicago 80, Ill.  
Lafayette Radio, 165-08 Liberty Ave., Jamaica, N. Y.  
Precise Development Corp., 2 Neil Court, Oceanside, N. Y.  
Printed Electronic Research, Inc., 4212 Lankershim Blvd., North Hollywood, Calif.  
Regency Div. of I.D.E.A., Inc., Indianapolis 26, Ind.  
Tech-Master Corp., 75 Front St., Brooklyn 1, N. Y.

### POWER AMPLIFIERS

Acro Products Co., 369 Shurs Lane, Philadelphia 28, Pa.  
Approved Electronic Instrument Corp., 51 Vesey St., New York 7, N. Y.  
Dyna Co., 5142 Master St., Philadelphia 31, Pa.  
Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City, N. Y.  
Grommes Div., Precision Electronics, Inc., 9101 King Ave., Franklin Park, Ill.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
Knight Kits (Allied Radio), 100 North Western Ave., Chicago 80, Ill.  
Lafayette Radio, 165-08 Liberty Ave., Jamaica, N. Y.  
Printed Electronic Research, Inc., 4212 Lankershim Blvd., North Hollywood, Calif.  
Regency Div. of I.D.E.A., Inc., Indianapolis 26, Ind.  
Tech-Master Corp., 75 Front St., Brooklyn 1, N. Y.

### AM-FM TUNERS

Approved Electronic Instrument Corp., 51 Vesey St., New York 7, N. Y.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
Knight Kits (Allied Radio), 100 North Western Ave., Chicago 80, Ill.  
Lafayette Radio, 165-08 Liberty Ave., Jamaica, N. Y.  
Precise Development Corp., 2 Neil Court, Oceanside, N. Y.

### FM-ONLY TUNERS

Approved Electronic Instrument Corp., 51 Vesey St., New York 7, N. Y.  
Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City, N. Y.  
Grommes Div., Precision Electronics, Inc., 9101 King Ave., Franklin Park, Ill.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
Knight Kits (Allied Radio), 100 North Western Ave., Chicago 80, Ill.  
Lafayette Radio, 165-08 Liberty Ave., Jamaica, N. Y.

### SPEAKER ENCLOSURES

Artizans of New England, Route 39 North, Sherman, Conn.  
R. T. Bozak Sales Co., Box 1166, Darien, Conn.  
Electro-Voice, Inc., Cecil & Carroll Sts., Buchanan, Mich.  
Karlson Associates, Inc., 1610 Neck Rd., Brooklyn 29, N. Y.  
River Edge Sales Corp., 80 Shore Rd., Port Washington, N. Y.  
University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.

### SPEAKER SYSTEMS

Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City, N. Y.  
Electro-Voice, Inc., Cecil & Carroll Sts., Buchanan, Mich.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
Jensen Manufacturing Co., 6601 S. Laramie Ave., Chicago 38, Ill.

### EQUIPMENT CABINETS

Artizans of New England, Route 39 North, Sherman, Conn.  
Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.  
River Edge Sales Corp., 80 Shore Rd., Port Washington, N. Y.

### RECORD CHANGERS

Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.

### TURNTABLES, TONE ARMS

Gray Manufacturing Co., Inc., 16 Arbor St., Hartford, Conn.  
Pickering & Co., Inc., Plainview, N. Y.  
Rek-O-Kut Co., 38-19 108th St., Corona 68, N. Y.  
Weathers Industries, Barrington, N. J.

### TAPE RECORDERS AND DECKS

Heath Co., 305 Territorial Rd., Benton Harbor 15, Mich.

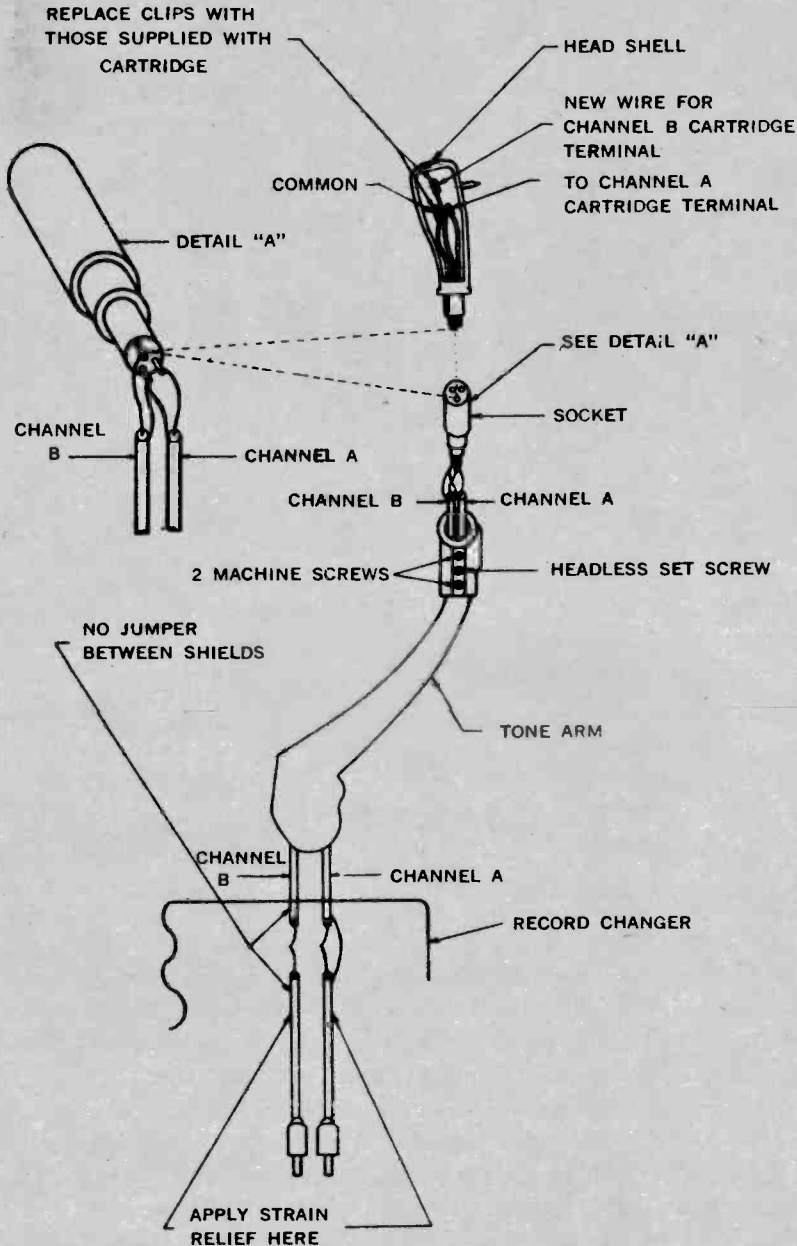


PREPARING FOR STEREO MAY INVOLVE BUYING AN ENTIRE NEW HIGH-FIDELITY STEREO RIG OR IT MAY SIMPLY MEAN ADDING A STEREO CARTRIDGE, SECOND AMPLIFIER AND SPEAKER TO THE RIG YOU HAVE ■ YOUR PRESENT HI-FI EQUIPMENT DETERMINES

## WHERE YOU START

# WHERE YOU START

## STEREO WIRING FOR A RECORD CHANGER



Converting your changer or tone arm to stereo involves running second pair of wires through arm to stereo cartridge, which replaces your present cartridge. Shielded cables are attached at terminal plate under changer and connected to amplifiers

## CHAPTER 10

**T**he reader may plan to start from scratch in assembling a stereo system, or he may wish to convert or adapt the elements of an existing monophonic rig to two-channel. The desire to do the latter raises such questions as, "Should I convert?," "Can I convert?," "How do I convert?" and so on.

In general we may say that conversion certainly can be effected; that it is usually less expensive than starting from scratch; that sometimes the converted rig may be less convenient to operate or to house because of the necessity for doubling up in some areas where new equipment would provide two channels on one chassis; and that, quality-wise, the converted rig will provide as good results on stereo as the original equipment did on mono.

For a complete answer to questions about conversion, we must consider what your present rig consists of, what you want to get out of it—now and

less obtrusive than on units not so equipped. Most recent Viking, Bell, Concertone and Ampex (to name just a few) units fit into this category, and these manufacturers offer a catalogue of accessory equipment.

Stereo playback is the most commonly desired feature and is relatively easy to add to an existing mono machine. Where two-channel preamplification, power amplification and loudspeaker systems are already provided in the rig, the only requirement at the deck is the stereo (dual-channel) playback head plus an electrical and/or mechanical means of switching from mono to stereo.

Strictly speaking, you can't "convert" a tuner, but you can convert to stereo broadcast reception by the addition of certain components. The commonest type of stereo broadcast is that in which one channel is on AM, the other on FM. Growing in importance is FM or multiplexed stereo. On the distant horizon but as yet in the experimental stage is AM stereo.

On a monophonic AM-FM tuner, it is not possible to receive AM and FM simultaneously, so it would be necessary to add a second tuner to accommodate the rig to this type of stereo broadcast. An FM tuner is the likely choice, because better-quality equipment is available, as a general rule, for this service. The outputs of the two tuners feed into the stereo sound system in the same manner as the two channels of any other program source. A more

up less space, be more convenient to operate and most likely incorporate "provision for" reception of FM stereo. As explained in an earlier chapter, a multiplex adapter is needed to complete the service for this kind of stereo.

If the owner wants to make provision for FM multiplex on a mono tuner (either FM or FM-AM), he can add an outlet into which a multiplex adapter is plugged, at a relatively modest price. Conversion of the mono AM-FM tuner to stereo, therefore, may include the addition of a second tuner for AM-FM stereo *and/or* the addition of facilities for receiving FM stereo.

If your tuner is a combination tuner plus preamp and audio control, its audio features (preamp and control) must be supplemented for stereo by the addition of a second preamp. A more expensive alternative is to abandon the mono preamp—move it, sell it, trade it in—and get a stereo preamp on which all switching and mixing facilities are in one place. If you are planning to add a second tuner for the purposes outlined above, this might well be a duplicate of the original (with preamp), thereby providing the second preamp and control channel on a single chassis.

It's easy to add a second amplifier. Good results at greatest economy are usually achieved by matching the original amplifier and adding an inexpensive converter or adapter which essentially ties the two together. Most manufacturers offer second mono preamps that can be "stacked," or put in tandem,



with an existing mono unit. If cost is not a big factor, you can gain convenience by replacing your single preamp with a dual unit. This is a matter of the handiness and versatility of controls, plus space conservation, rather than of quality. Here again, almost all manufacturers stand ready to fill your needs.

A loudspeaker is one item you don't have to convert, because what you need is two separate loudspeaker channels. The best recommendation is to match your present (mono) speaker system if you're happy with it. By using identical units, you ensure that the sound of the two channels will be as closely matched as possible, and therefore simple to balance. Unfortunately, when the mono rig contains speakers of very high quality, these are apt to be large in size as well as high in cost. This means that in "matching with identical units," even if cost is not a problem, space may be.

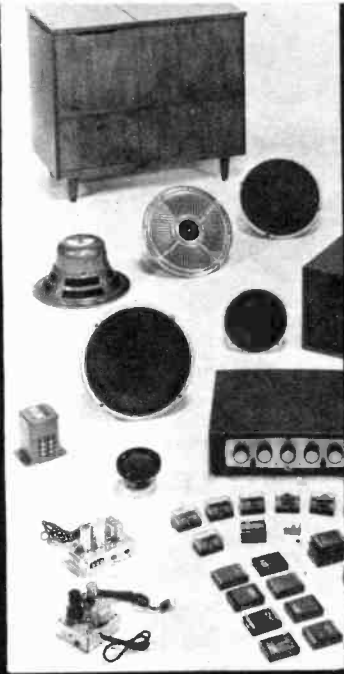
The two factors—space and cost—are probably the reason for the trend toward smaller speakers for stereo. Full- and limited-range speakers can be added to existing speakers with rather good results. Where possible, it would make sense to buy an "add-on" from the maker of your original speaker.

## THE SYSTEM AS A WHOLE

To sum up, you can convert any or all of your present equipment to stereo. But you do not have to convert all, if you wish to get your feet wet without tapping the mint too heavily. Consider the system as divided into two parts: program sources, such as disc, tape and tuner; sound system and controls, including preamps, amplifiers and loudspeakers. If you are going to have stereo reproduction from any program source, you must have a complete two-channel sound system. But you do not have to convert all program sources to stereo. The logical place to start is with disc playing, and some people may decide to convert only that service.

Your choice in the end—both as to which program sources to convert and which of the alternative methods of conversion to use—should be determined by your listening habits. Other matters that will enter into your decision are the amount of money you have invested in the components of your present rig, how recently you acquired them, how permanent the installation is and how much money and space you feel you can invest in stereo. If you own a fairly elaborate, good-quality hi-fi system, you will not for a moment question the advisability of converting it to stereo, as opposed to starting all over again. If the home-entertainment system, however, consists of something like a portable phonograph, a TV-console unit or a radio-phonograph combination of some years back, you may well think in terms of starting from scratch and creating—either by degrees or all at once—a hi-fi as well as a stereo system.

The burden of this chapter has been the subject of conversion. The matter of buying all new equipment will be discussed in Chapter 11 and will concern the problem of providing a two-channel sound system fed by whatever program sources are desired. As in conversion, the end result is a rig that will reproduce both stereo and mono program material.



THE BIG PROBLEM IS TO MAKE HI-FI STEREO COMPONENTS PRESENTABLE ENOUGH TO FIT IN WITH MILADY'S LIVING-ROOM DECOR ■ FOR THE OWNER, THE SKY'S THE LIMIT OR THE EXPENSE CAN PROVE TO BE SURPRISINGLY LOW FOR GOOD STEREOPHONIC

# INSTALLATIONS

**A**s we pointed out in the first chapter of this book, stereo is not necessarily hi-fi. Two-channel sound can be provided in a diminutive piece of portable equipment that makes no pretense at high fidelity. But stereo *can* be hi-fi, and we like to think that this is what most of our readers have in mind.

From this point of view, then, the stereo hi-fi installation is not apt to be diminutive. It *is* likely to be a matter of considerable personal pride on the part of its owner, however, so it may take the shape of a sizable one-piece equipment cabinet arrangement, a combination of one or two cabinets (an equipment cabinet, for instance, plus two speaker enclosures) or a built-in rig, possibly in the form of a storage wall. The choice, of course, depends on the user's tastes and preferences, what equipment he already has, whether he owns or rents and, finally, how much he can spend. Whatever his approach,

he wants his stereo set-up to sound good, look good, be convenient to operate and easy to maintain—the four major considerations.

## HOW TO GET THE BEST RESULTS

“Sound good” depends on the components in the system and how they are put together. “Look good” is a matter of taste and design. “Convenient to operate” means that all the components and their controls are comfortably accessible. “Easy to maintain” means that the equipment itself (rather than just the front panels) and the interconnections between units can be easily got at if trouble shooting or equipment changes are necessary, and also that the rig has adequate ventilation and protection from accident.

The most convenient and practical disposition of components is to line them up along a shelf. This provides good visibility and easy access for operating, easy access for servicing and modification, plenty of room for heat dissipation

and for the separation of elements that might induce hum. (The loudspeakers, for reasons we shall come to in a moment, would not be on the same shelf.) This ideal is not always attained, however, because the shelf space may not be available or, if it is, may not be as attractive as cabinet work. Trying to "hide the body" in a decorative setting often results in features that are neither convenient nor even sensible from the standpoint of heat dissipation, electrical interference and good audio quality. A typical inconvenience is that of locating a record changer near the floor, making it necessary to sit on the floor to play it. While this practice may result in pretty "salon" photos of alleged hi-fi rigs, it is considerably less convenient than having the disc equipment up where you can see it, reach it and operate it with ease while standing.

The pull-out drawer for the disc equipment is a handy invention because it circumvents the other alternative for a built-in arrangement—having a lift-up lid in the top. The writer prefers the fixed installation as opposed to the movable one, however, because records and styli are less subject to damage

If the components are to be grouped in a cabinet or built-in-the-wall type of installation, quality of operation as well as physical convenience must be considered, which often leads to a compromise. Three problems that cannot be compromised are heat, hum and acoustic feedback.

The primary sources of heat are the power-output tubes and, consequently, the power amplifiers. A preamp generates virtually no heat; the tuner may develop a moderate amount. Sufficient room must be allowed for circulation of air and dissipation of heat. Another point that the owner of a hi-fi system should bear in mind is that heat rises; he should therefore try to avoid placing the power amplifier directly under the other equipment.

The location of components with a power transformer near a low-level sound source (phono cartridge or tape head, for example) can cause hum to be induced into the low-level stage. The hum will then be amplified along with the music. Ideally, a power transformer should be located as far away as possible from such equipment. This will usually obviate the problem, but if it does not, or if space does not permit optimum arrangement, try, by turning the amp a little bit at a time (in the horizontal plane), to change the angular

relationship between the transformer and the turntable or deck. Leave the amplifier in the position where it causes minimum interference.

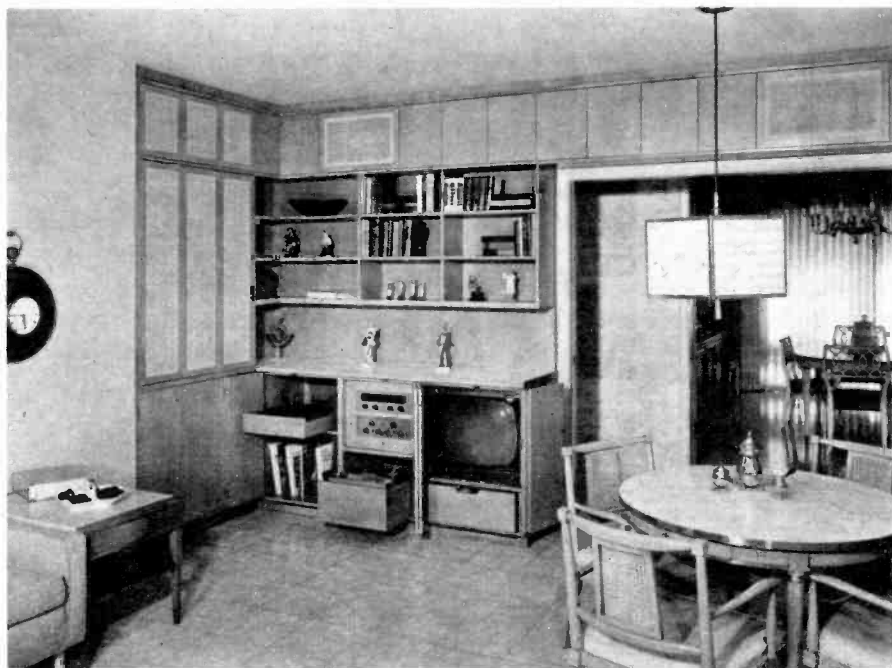
We have described cartridges and tape heads as low-level sound sources, which is to say that their output is of low amplitude. Wire lines or leads are also classified as low-level or high-level, depending on the amplitude of the signal they are carrying. The leads between cartridge and preamp, for instance, are low-level lines with which length and placement are more critical matters than with high-level lines. Particular care should be exercised to dress low-level lines away from sources of power-line hum, such as line cords and power transformers. Get them as far away as space and practicality permit. As for length, it is a good rule of thumb to consider the lead length or cable length which the manufacturer provided as the maximum to be used. This is usually not more than three feet. One reason is that some signal degradation (that is, frequency response) will result from running low-level, low-impedance, shielded lines a long distance. When manufacturers provide equipment for long runs, the line is equalized to compensate for this degradation. It's easy enough to recognize low-level lines. They're shielded with a woven metallic covering and grounded at each end.

The *output* of a preamp, for all practical purposes, can be considered a high-level line. The lines from the power amplifiers to the loudspeakers are definitely high-level. For the purposes of home installation, these lines can be of indefinite length and, incidentally, of any kind of wire. Lamp cord and television



Dream rig in a dream living room offers, besides swivel-mounted TV set, a stereo changer at left, vertically mounted AM-FM stereo tuner and stereo amp, two speakers placed unobtrusively on shelf above, with ample storage space for records, tapes, accessories

## INSTALLATIONS



Stereo system incorporating TV receiver utilizes Garrard stereo changer, Fisher X101 amplifier and companion 101R AM-FM tuner, Bell tape deck. Speakers, concealed in paneling above bookshelf and archway, are James B. Lansings and Wharfedales

twin-lead wire are frequently used for speaker lines. The latter has the advantage of being flat so that it can be slipped conveniently under a carpet for runs across a room. It is not advisable to locate a low-level phono cartridge or tape head a long distance from its preamp. There are no particular limitations, however, on the separation between preamp and amplifier other than what may be recommended by the manufacturer; and there is (in the home) vitually no limitation on the distance between the amplifier and the speaker.

Acoustic feedback, to get to the last of the three factors that can't be compromised, is the return of sound waves or vibrations to the generating source, either through air or a solid medium such as a wooden cabinet. Most people have, at one time or another, heard the howl that is set up in a sound system when the sound from the loudspeaker gets back to the microphone. That's one example of feedback. Feedback is either positive (additive, or in phase) or negative (canceling, or out of phase). Electronically, negative feedback is often used in amplifiers to cancel out harmonic distortion. Acoustically, a problem can result from feedback from the loudspeaker to the phono cartridge. This can cause distortion, hum and added record wear. It can be avoided by not putting the speaker near or in the same cabinet with the player. Another problem that can result from having a high-power loudspeaker directly adja-



cent to the disc equipment is actual vibration from low-frequency components of the sound. You can feel this vibration if you hold your hand against the speaker baffle. In extreme cases, it can cause the needle to bounce or skip.

## INSTALLING YOUR OWN SYSTEM

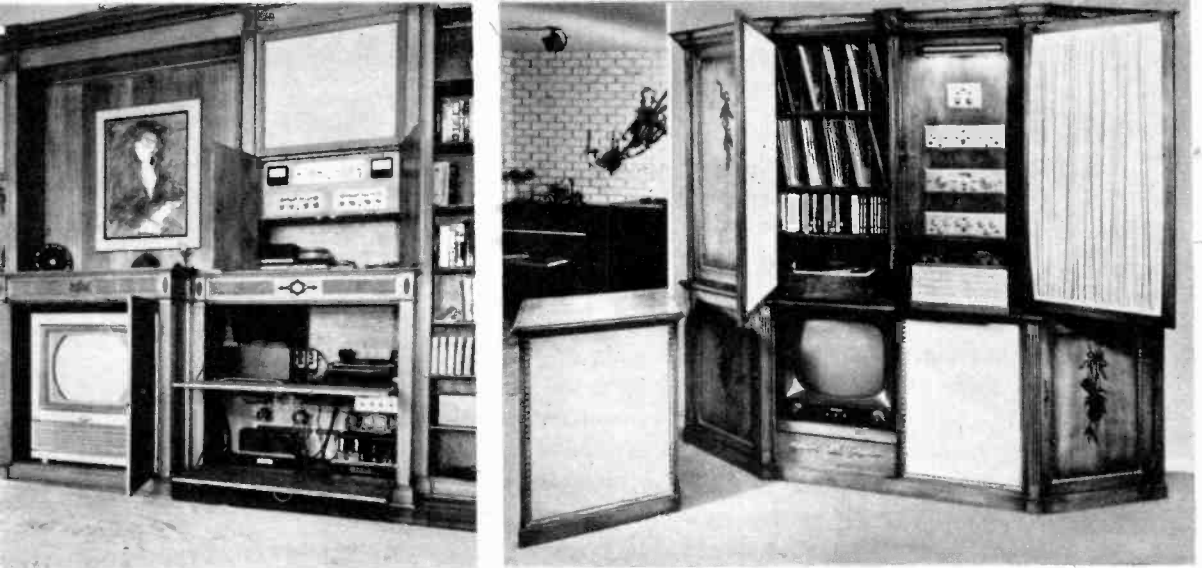
If you plan to install your own speaker system, a few construction and installation hints might be helpful, in addition to the above-mentioned considerations concerning placement. The speaker enclosure should be as strong and solid as possible, so that parts of it will not vibrate sympathetically at whatever audio frequencies they happen to be resonant. The inside of the enclosure is lined with acoustic deadening material to absorb sound waves inside the cabinet (emanating from the rear of the cone) which might cause vibration, set up unwanted resonances or result in undesired phase cancellations. If you are copying the design of a "tuned" enclosure such as a bass-reflex cabinet, follow it to the letter, since the design is based on careful calculations concerning the production and reinforcement of sound in various frequency bands, as well as the smoothing of the over-all response curve and the damping of transients. Baffles should be painted black so that loudspeaker cones don't show through the grille cloth as black holes.

A large number of different grille-cloth designs is available but you may still find that your taste (or that of your wife or your decorator) cannot be



Do-it-yourself stereo gets a boost from Knabe piano in center of stereo system that includes every conceivable sound source—stereo records (turntable and record changer), stereo broadcasts and stereo tapes. Unit also provides storage space

## INSTALLATIONS



Handsomely paneled built-in unit at left has VU meters at preamps to allow visual stereo balancing. Power amps are located in cabinet, center. Another answer, at right, involves use of stereo adapter (upper right) with two mono amps, stereo tuner, changer and tape

satisfied by any of them. If this is the case, you need not feel limited to the use of fabrics that are labeled "grille cloth." Ideally, the grille cloth is woven loosely, to permit efficient transmission of the sound, and is constructed of yarns (usually synthetic) that will not absorb sound. In choosing other fabrics or materials you can be guided by these principles or—when in doubt—by an actual A-B test. In order either to repeat or coordinate with fabrics serving as drapes or slip covers, the writer has used without noticeable signal degradation materials like silk, linen, hopsacking and chair-seat caning.

### BUILT-IN PROTECTION

Recalling for a moment the problem of small children, the writer has made it a practice to give the speaker cone built-in protection by stapling a piece of metallic window screening over the baffle before putting on the grille cloth. This has not resulted in any noticeable degradation of sound and, when attached securely, does not vibrate or resonate. The result is that when little fingers poke at the source of sound, they hit a protective screen. This avoids the tragic situation of a two- or three-hundred-dollar speaker with a hole in the cone. Aluminum screening has proved more successful than copper, because it is more rigid and thus has greater resistance.

It seems obvious that good visibility is necessary at the record player and at the controls of tuner and/or preamp, yet often such components are deep

in the shadows. We have found it practical to install a small night light of the type designed to plug into a wall outlet in the record-player compartment. This is provided with its own light shield, and the light can be directed for maximum usefulness. By means of an extension, the light can be plugged into the amplifier (or whichever unit is being used for master power control) so that it lights whenever the equipment is turned on. Thus it serves not only as illumination but also as a quite visible pilot light and as a notification that the rig is still running. In extending the cord from this light to the amplifier, care should be exercised to dress it away from low-level lines, to avoid hum.

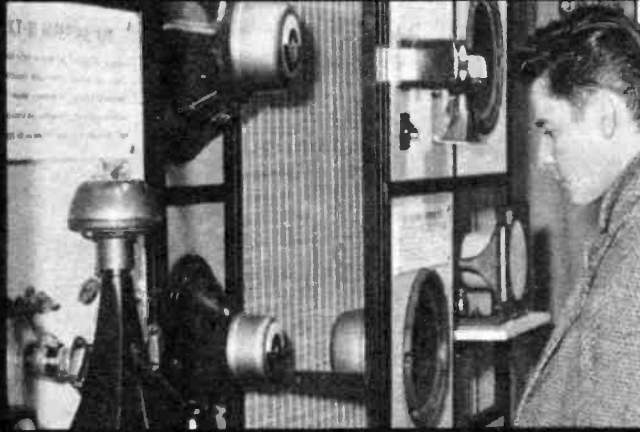
Virtually all electronic equipment used in home-entertainment systems (tuners, amplifiers, preamps, etc.) can be mounted vertically as well as horizontally. This gives considerable latitude in the design of the built-in installation. For example, in the author's two installations the tuner in one case is mounted vertically so that the dial and the knobs are flush with the counter top—you look down at the controls, making them easy to see and to operate. In the other instance, where the tuner is mounted below a counter arrangement, it is inclined at a 45° angle to improve visibility for a person standing above it and eliminating the necessity to stoop down to look at it. The record-playing equipment, of course, must be mounted horizontally and be perfectly level. Tape decks are available for both types of mounting.

## ELECTRIC-SHOCK PROBLEMS

Connecting the several different chassis of a hi-fi rig may produce hum and/or mild electric-shock problems. It is sometimes difficult to solve one of these problems without making the other worse. From the point of view of electricity, associated components should be bonded together by a heavy ground wire (#14 would do) and grounded at one point to the "system ground," which can be a cold-water pipe, the external surface of a conduit or an electrical-outlet box. This puts all the equipment at the same potential and all the external metal surfaces at ground potential. As it happens, the various components are grounded together by the metallic shields on the low-level cables, which often increases hum, because with two sets of grounding wires (the system ground plus the audio shielding) you have potential parallel paths for the creation or reinforcement of hum "loops."

To summarize: If shocks are troublesome, the first thing to do is to reverse the power cords, one at a time; sometimes this phase reversal is all that is needed. If that doesn't help, try grounding the components together and to a common system ground, as suggested above. If this results in hum and you can't lick both the hum and the shocks at the same time, your best bet is to call a reliable repair man.

Space limitations do not permit our making any valid generalizations about taste and design in the appearance of the stereo hi-fi installation. The illustrations in this chapter are designed to provide some helpful ideas as well as suggestions about the arrangement and location of equipment.



YOU CAN BUY STEREO IN A STORE OR THROUGH  
THE MAIL ■ EITHER WAY, YOU CAN PICK UP A  
BARGAIN YET NOT GET YOUR MONEY'S WORTH ■  
OR YOU CAN SPEND A LOT AND GET THE BEST  
BUY EVER ■ THERE'S A GREAT DEAL THAT YOU  
MUST LEARN ABOUT

## **BUYING STEREO**

## CHAPTER 12

**W**hether you're converting existing equipment or starting from scratch, your possible sources of supply are the same, and might include radio-TV-music stores, hi-fi specialty shops, radio-TV parts jobbers and mail-order catalogue houses. Generally speaking, the parts jobbers and catalogue houses get the major share of the business because they have the most extensive selection of equipment and because, as a rule, they offer competitive prices.

The price situation in hi-fi is a strange one. Unlike most finished consumer goods, which carry a "suggested retail price" and are merchandised in a three-step system (from manufacturer to distributor to retailer to consumer), hi-fi components have a somewhat confused history in which the price was "sort of wholesale" and a two-step distribution system was common from manufacturer to jobber to consumer or from manufacturer to mail-order

## BUYING STEREO

house to consumer, and sometimes even from manufacturer direct to consumer). In recent years there has been an attempt to regularize the distribution of this type of merchandise and to establish something more conventional in the way of a pricing set-up. But because buyers were used to buying at wholesale—or at what they were led to believe was wholesale—the term “Audiophile Net” began to take the place of “Suggested Retail” or “Suggested List.” While the word *net* has an implication of rock bottom, this is not necessarily the case. In fact, by watching advertised sales, the hi-fi buyer can often do better than the advertised net price.

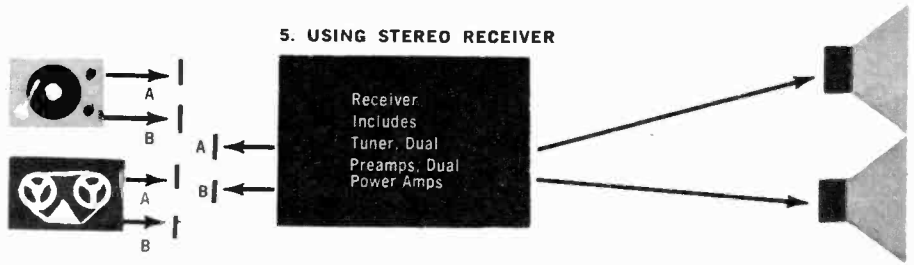
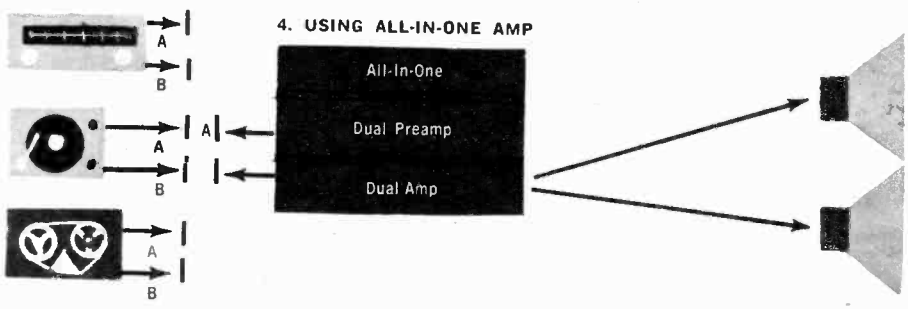
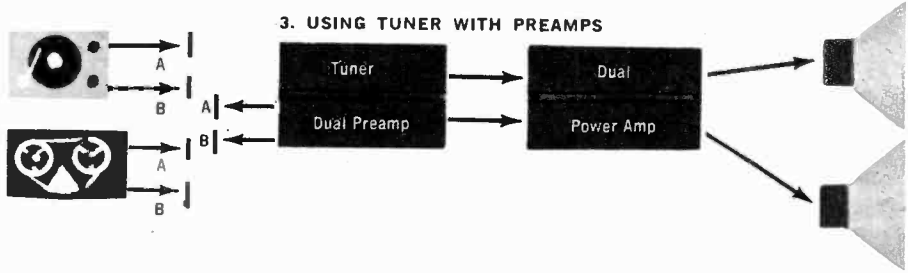
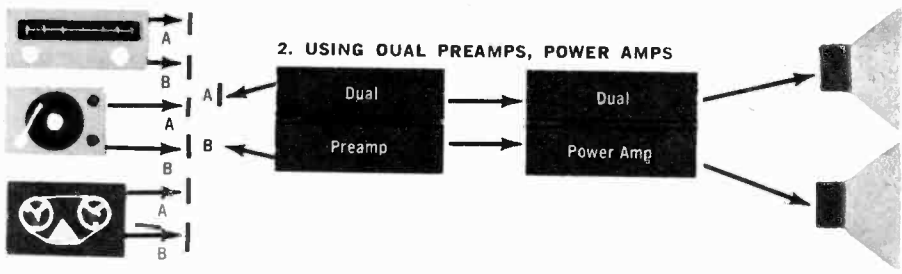
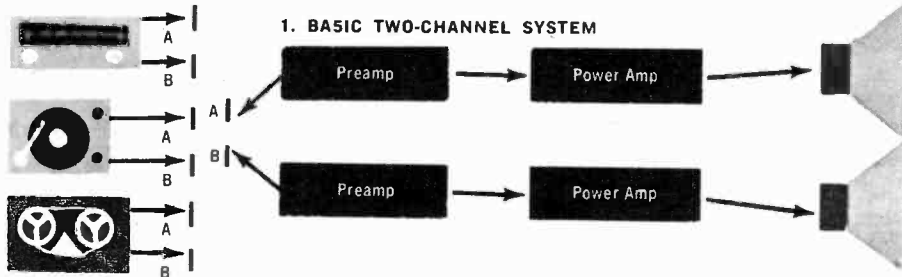
### WHERE AND HOW TO BUY

We can't in the space available here list specific hi-fi outlets in every locality, but if you do not already know them, we suggest you ask friends, consult the “Yellow Pages” and attentively read the magazines that cater to this field. You will also usually find in the magazines the names of prominent mail-order houses, the best known of which are Allied Radio (Chicago), Lafayette Radio (New York), the Radio Shack (Boston), Leonard Radio (New York) and Newark Electric (Chicago). These and other firms offer free catalogues on receipt of coupons that appear in the magazines. The catalogues are useful, whether you plan to buy by mail or locally, since they comprise an extensive directory of equipment together with descriptions and prices.

Shopping in person, of course, has many advantages. For one thing, you can see what the equipment really looks like. Although one expects photographs in advertisements to flatter the equipment, the reverse often turns out to be true. Many components that look dull and commonplace in the ads turn out to be quite handsome. Shopping in person in the bigger hi-fi centers also gives you an opportunity to listen to various components singly and in combination. In addition, you may run into a “buy” or a close-out that you had no reason to expect. It is wise to go shopping with a list of desired components in hand, with model numbers and prices, since you may not find a salesman who has time to help you plan a system unless you go in off-hours.

In buying for stereo, it is well to be wary of close-outs of monophonic equipment which—while a bargain—can't be conveniently incorporated into a stereo system. The only item in the chain that doesn't have to be specifically designed for stereo is the loudspeaker. Second least specialized is the record changer (or player or turntable) which is essentially the same for mono and stereo except for the cartridge and the connections to it. Ideally, however, the pickup arm should come wired for stereo, or you'll have a small conversion job on your hands, adding leads (wires) for the second channel. Amplifiers, preamps, tuners and tape recorders are essentially less adaptable, and should be designed for a stereo system from the ground up.

Some of the catalogue houses and hi-fi shops feature special “package deals” that offer a considerable saving in the aggregate if the user can be satisfied with the particular assemblage of components included. Such deals, where



## BUYING STEREO



A typical assortment of stereo components is displayed in the showroom of Lafayette Radio, in New York City. The salesman is at a panel of the sort commonly used to switch equipment, so that customers may compare the sound of different items

available, should be carefully examined and checked out—especially in terms of price. The reader may find that he can buy an entirely new system for a sum he had been willing to lay out just to add a new tape recorder, say, or a stereo tuner to the system he already has.

Most electronic equipment carries a 90-day warranty on parts and tubes, and our confidence in this warranty is usually based on the assumption that the manufacturer has been in business for several years, is likely to be in business for many more, and has a good reputation. Such factors are, we believe, worth a few extra dollars and we recommend that the reader keep this in mind when shopping for bargains.

In order to avoid repetition of the material on conversion which was outlined in Chapter 10, we will assume in the following discussion that the reader is starting from scratch. He will obtain a stereo (two channel) sound system plus however many program sources he desires or can afford. He has a choice of getting every item in the chain as a separate unit or of buying items that combine one or more functions, like tuners and dual preamps combined; complete receivers; all-in-one amplifiers (dual preamps plus dual power amps); and so forth. Separate components provide maximum freedom of choice, flexibility of placement and flexibility for modification. Combination units provide maximum convenience from the standpoint of grouping of



controls and—sometimes—a saving of money. The limited lists that follow illustrate the relative costs involved.

## WHAT TO PAY FOR STEREO

The simplest basic system incorporating stereo would include a record changer with stereo cartridge, an all-in-one dual preamp-amp and two loudspeakers. In most of the examples shown, enclosures are provided for the speakers. If you plan to build yours in, or construct your own enclosures, appropriate savings can be deducted from the sums indicated.

Besides equipment that only masquerades as hi-fi, there's a wide selection of components that are very good indeed. Here are some of them, from which you can reasonably select a high-fidelity stereo system. The specific ones you choose should depend on your pocketbook, your listening room and the feature or features most important to you. They are listed to show price only; other details have already been covered elsewhere in this book.

### RECORD CHANGERS

There are nine major record changers: the Collaro TSC 740 (\$42) and TSC 840 (\$48.50); the Garrard RC 88 (\$54), RC 98 (\$68) and RC 121 (\$42); the Miracord (\$66); the Glaser-Steers and Stromberg-Carlson units at approximately \$60 and, for that dream rig, the Thorens (\$78.35). Manual



Visitors to a hi-fi show inspect a loudspeaker display. Shows are held once or twice a year in the larger cities, give hi-fi shoppers a chance to spot trends in new components, learn prices and specifications directly from the manufacturers

## BUYING STEREO



A well-stocked hi-fi dealer's showroom gives a graphic idea of the vast number of components available today for stereo. Large dealers inventory thousands of items, made by hundreds of suppliers—all for the hi-fi stereo buyer

players are available from the manufacturers of these changers at from \$30 to \$50. Quality turntables are available from Rek-O-Kut (\$60 up), H. H. Scott (\$140), Pickering (\$60), Bogen-Presto (\$75 up), Weathers (\$50), Gray (supplied with arm for \$80), Fairchild (\$100 up) and others. Turntables require a separate tone arm. Most turntable manufacturers also sell tone arms in the \$15-\$30 price range. In addition, such arms as the Grado (\$29.95), Garrard (\$19.50), General Electric (\$29.35), Shure (\$89.50) and Electro-Sonic (\$35) are in wide use by audiophiles. The London-Scott arm comes with a cartridge, for \$90. Popular magnetic cartridges include the General Electric (\$23), B & O Stereodyne (\$30), Stereotwin (\$45), Shur M3D (\$45), Pickering 371 (\$30), Grado (\$30) and Fairchild (\$49.50). Non-magnetic cartridges include the Electro-Voice 26MDST at \$22, the Ronette BF-40 for \$18.50, the Sonotone for \$14.50 and the Weathers Ceramic for \$17.50.

### SPEAKERS

Speakers that are ideal for stereo use include the Eico HFS-2 (\$140), the Acoustic Research units and KLH speakers (from \$99 to \$199), University's S-10 (\$140) and S-11 (\$240) units, the General Electric LH-12 (\$140), the Electro-Voice Regal (\$103), Jensen's TR-10 (\$114.50), the Bel Aire (\$170) from James B. Lansing, plus units from Wharfedale, Lafayette and Allied

Radio. Smaller systems, like the Telematic Minstrel and Hartsdale (\$30 each) and the Weathers Harmony (\$130), are excellent buys in their price category. Complete stereo speaker systems are also available from such manufacturers as Bozak, James B. Lansing and University; prices run up to \$2,000.

### TUNERS

In the tuner category, the H. H. Scott (Model 330 AM-FM tuner sells for \$225; the 320 FM multiplex tuner for \$140). Harman-Kardon's T-224 sells for \$115; the TP-200 for \$190. A complete receiver, Model TA-230, sells for \$260. Pilot's FA 680 sells for \$200; a combined stereo tuner-preamp sells for \$270. The Model 600 complete receiver from Fisher costs \$350; the 101R AM-FM unit is \$230. Bogen's TG200 is \$129.50; the ST 662 sells for \$190. Other models are available from Stromberg-Carlson, Sherwood, Karg, General Electric and Sargent-Rayment. The kit manufacturers—Lafayette, Knight and Eico—have stereo tuners already assembled for as low as \$70.

### AMPLIFIERS

Many of the tuner manufacturers are also in the amplifier business. Scott has a \$139 model to match its \$139 tuner, as well as the Model 130 (\$170) and 299 (\$199). Harman-Kardon's units are the A-224 (\$100) and the A-250 (\$180). Bogen's stereo amps start with the AG210 for \$100, run through the DB 212 at \$115 to the DB230, for \$170. In addition, there are the Bell 2221 (\$130), 3030 (\$170) and 6060 (\$220); the Fisher X 101 (\$189.50), the Pilot SM-245 (\$189.50), the General Electric MS-2000 and MS-4000 (\$140 and \$180 respectively) and the products of the kit manufacturers, which run as low as \$75 and are extremely effective.

So far, we've been talking about complete amplifiers. In separate power amps and preamps, the kit makers are also prominent. Pilot's stereo preamps include the SP-216, \$189.50, and the SP-210, \$89.50. The matching power amps include the SA-232, \$89.50, and the SA-260, \$129.50. Fisher's 400-C stereo preamp sells for \$170, can be used with two Fisher basic amps. McIntosh follows the same plan, with a stereo preamp for \$99, to be used with two basic amps (\$143.50 each for the 30-watters, \$198.50 for 60-watt amps). Similarly, the Marantz Stereo Console (\$249) can be used with two Marantz power amps (\$147 or \$198 each). The Leak stereo preamp goes for \$110, its companion power amp is priced at \$189.

### TAPE RECORDERS

In tape recorders, there are units such as the Viking (\$113 and up) and Bell tape decks (\$120-150), the Norelco (\$299) and Tandberg (\$299 up) portables, the Roberts and Superscope (two Japanese imports in the \$350-400 price range), the Magnecord, Ampex and American Concertone units, which start from \$450 and run well over \$1,000, and such strictly professional units as the Crown Presto and Ferrograph (\$600 up). Cost here is related directly to the features you feel are necessary and the quality you're willing to pay for.

## BUYING STEREO

### FOUR STEREO BUDGETS

A modest budget system, in which every item was kept to rock-bottom cost, might look something like this:

Record changer	45
Stereo cartridge	15
Stereo amplifier	100
2 speaker system	60
	<hr/>
	220

The outlay for the various components in a medium-priced system might be on this order:

Turntable	60
Stereo arm	20
Stereo cartridge	45
Stereo amplifier	140
2 speaker systems	200
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	465

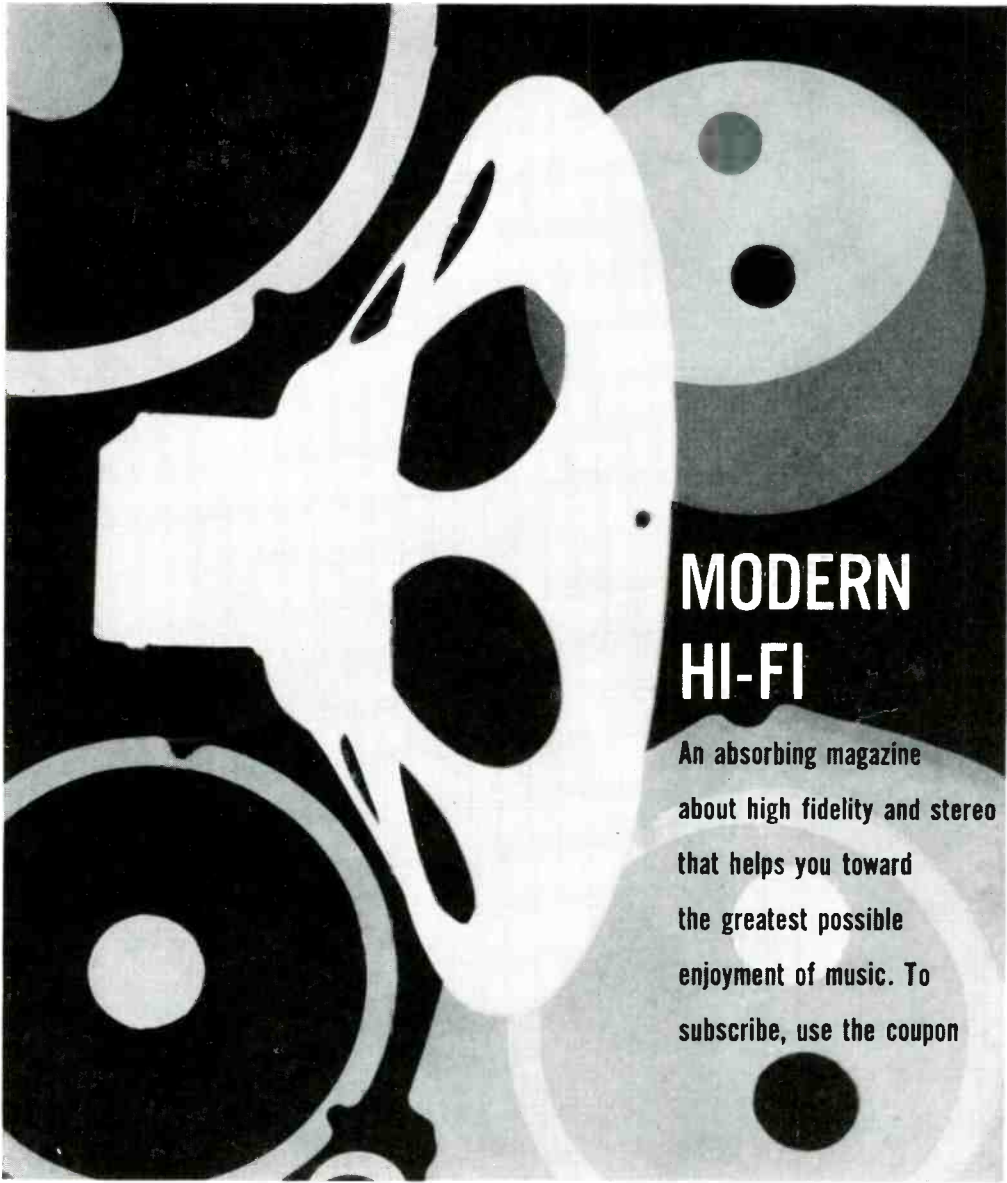
A still more ambitious system would probably include at least the following mono and stereo components:

Record changer	60
Mono cartridge	20
Stereo cartridge	45
Turntable	70
Stereo arm	35
Stereo tuner	115
Stereo amplifier	200
2 speakers	280
	<hr/>
	825

If you're in a dreaming mood, here's a system in which all program sounds are included. Price is no object in this system:

Record changer	60
Turntable	250
Mono cartridge	20
Stereo cartridge	45
Stereo arm	35
Stereo tuner	250
Stereo preamp	170
Stereo power amp	270
Stereo speaker system	1,900
Tape unit	600
	<hr/>
	3,600

These rigs don't begin to exhaust the possible combinations, nor do they encompass mono equipment that might be purchased as add-ons for conversion. For complete details on the components, consult the manufacturers' literature and their advertisements in such publications as MODERN HI-FI and, finally, your local hi-fi dealer. A word of caution: Don't underestimate the value of your own ears in the process of selecting equipment; in the end you are the one who must be convinced that what you buy sounds good.



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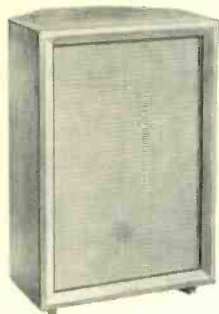
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