AUDIO

JANUARY, 1958
50¢

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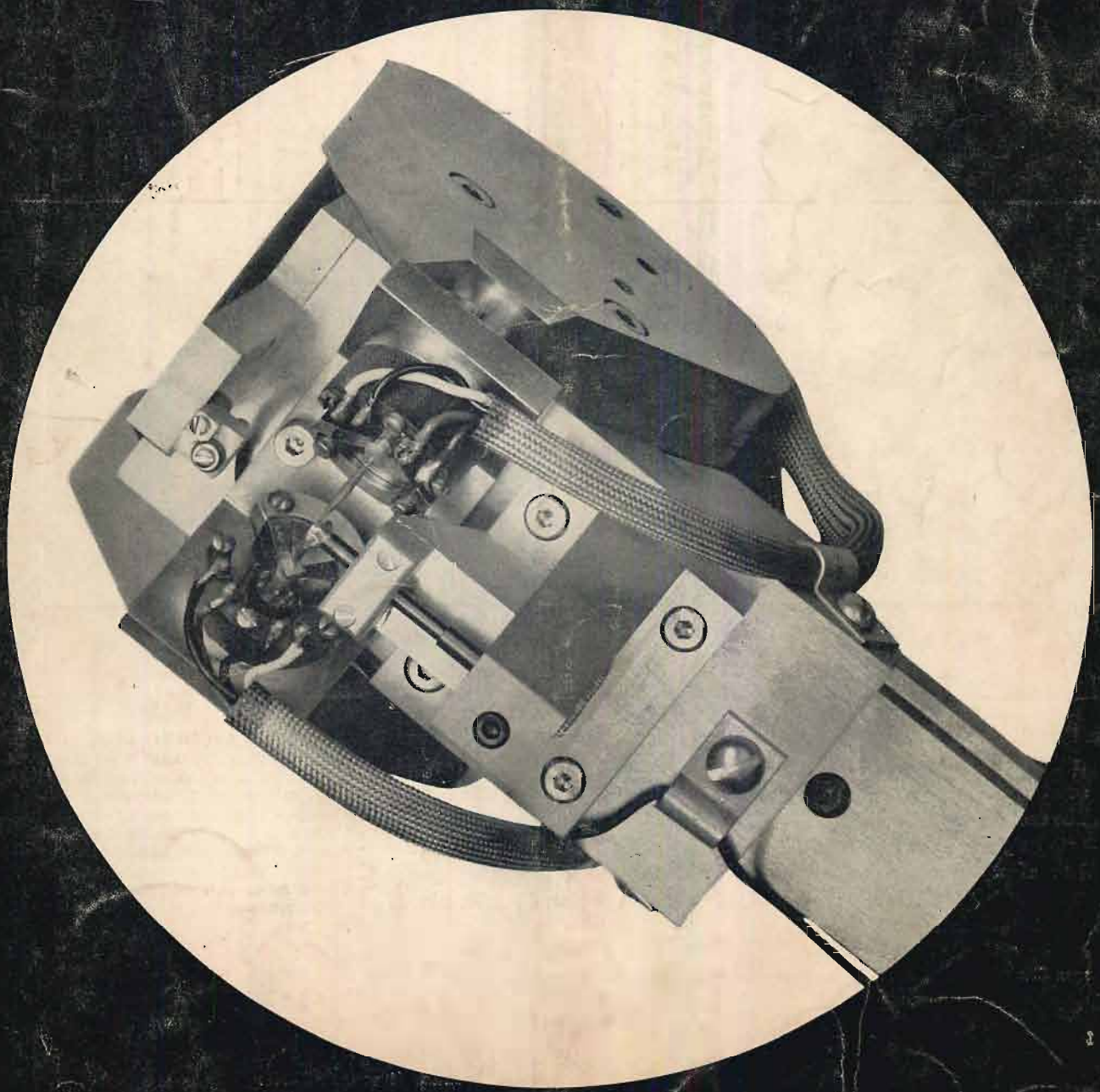

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JANUARY, 1958 VOL. 42 No. 1
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

COVER PHOTO—The device responsible for much of the current talk about stereo phonograph records—the Westrex 3A Stereophonic Disc Recorder. Advance ball assembly and vacuum horn have been removed to show details of construction. *Courtesy Westrex Corporation.*

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S. Possessions, Canada and Mexico, $4.00 for one year, $7.00 for two years, all other countries, $5.00 per year. Single copies 50¢. Printed in U. S. A. at Lancaster, Pa. Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the Act of March 3, 1879.

RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.

AUDIOCLINIC??

JOSEPH GIOVANELLI*

Matching Transformer Impedances

Q. The impedance of my phonograph cartridge is very low, resulting in output voltage insufficient to drive my preamplifier. I therefore resorted to the use of a matching transformer. However, I noticed that when the secondary is terminated in a resistance of the proper value, less output is obtained than is had when the transformer is terminated in a resistance several times larger than that of its nominal secondary impedance. What is the significance of these findings? S. Kalmer, New York City

A. We match transformer impedances mainly with the idea of transferring as much power from one circuit to another as possible. This can be done only when the transformer is terminated in a resistance equal to the nominal impedance of the transformer. However, a vacuum tube is not a power sensitive device but is, rather, voltage actuated. A transformer will, when terminated in a resistance higher than its proper terminating resistor deliver a higher voltage into that resistance than it would into its correct value. Although this happens, maximum power is no longer transferred. While maximum voltage will occur when the transformer is terminated in a resistance at least five times its nominal rating, the low-frequency response is optimum only when the transformer is properly terminated, since the low frequency response is determined in part by the current flowing in the windings of the transformer. Exactly what will happen to the response varies from unit to unit and so, no figure can be given. If the additional gain is not required, terminate the transformer in its proper load. If it is needed, adjustment of the bass controls should be carried out by means of trial and error.

Field Coil Speakers

Q. Field coil speakers never seem to be used for high fidelity sound reproduction. Why? C. E. Garry, Caruthersville, Missouri.

A. Field coil speakers require bulky external circuitry to apply the necessary ripple-free power to actuate the magnet. It is, of course, possible to substitute the field coil for the choke in an existing amplifier, but this would mean that long leads would be needed to carry the high-voltage d.c. to the speaker field, which arrangement might prove dangerous. Although these speakers are very efficient, alloys have been developed which allow p.m. speakers to approach the high efficiency of their predecessors.

Amplifier Power

Q. I've heard a great deal lately about amplifier power, to the effect that more is always better, provided that the power is clean at higher levels. Would this be true for a speaker system of high efficiency, such as a Klipschorn? I'm using a 30-watt amplifier to feed such a system but, if 50 watts of comparable quality would give me better performance, I would like to make the change. J. H. Moore, Tulsa, Oklahoma

A. So long as the power amplifier is of good quality and is operated well below its maximum capabilities and is fed into a speaker of reasonably good efficiency, there is no need to substitute one of higher power output capabilities for that which you are now using. However, if your listening environment is such that this amplifier must be run too close to its capacity, then I should certainly suggest that a more powerful unit be substituted. Be sure that the speaker system is capable of continuous operation at the highest program level to be used, and in fact, some tolerance should be left to account for transient peaks. If your speaker system cannot cope with the demands to be placed upon it, additional speakers should be used which can take up the power and which can provide better sound dispersion, too.

Matching Impedances

Q. How can I go about matching impedance of a tuner and the output or input impedance of an amplifier or preamplifier? H. T. Sutcliffer, Redwood City, Cal.

A. In audio work, it is rarely necessary to know the exact input or output impedance of a piece of equipment, though that of the output stage of a power amplifier and of some low-impedance input stages is somewhat more critical. With straight RC circuitry, all that is necessary is for the impedance of a stage being supplied with signal to be at least twice that of the driver. I usually establish this ratio at between five and ten to one. Cathode followers are of low impedance usually, and can be easily fed into amplifiers of many times their impedance without the use of matching equipment. The actual impedance of a cathode follower depends upon the tube employed and upon the cathode resistor. The input impedance to a particular amplifier or amplifier stage is roughly that of the load into which the coupling capacitor works. For example, the output impedance of a discriminator of an FM tuner is approximately that of the resistance between cathode and ground of the diode from which audio is derived (about 100,000 ohms, usually). The coupling capacitor should be 0.02 μf. or larger. The output of the capacitor should be terminated in a stage whose input impedance is approximately 0.5 megohm.

The output of a conventional grounded cathode a.c. amplifier is roughly that of the plate load resistor, and again, the value of the capacitor used to couple the signal to the next stage can be neglected.

Capacitive Reactance

Q. I have a motor and a medium-quality pickup arm. Recently I exchanged my crystal for a magnetic pickup. This will give me a wider frequency range, but at a lower voltage. On this basis, the chances are greater for distortion to occur in the form of hum fields produced by the motor. In more powerful amplifiers, some leads are shielded, the shield being grounded. However, if the shield does not have a fairly large diameter compared to that of the center conductor, some capacitive reactance will be present. This tends to attenuate the higher frequencies. It seemed to me that I should use shielded coaxial wire as lead-in for the magnetic cartridge to protect it from the magnetic field of the motor. Will the capacitive reactance tend to cancel the advantages of the shield?

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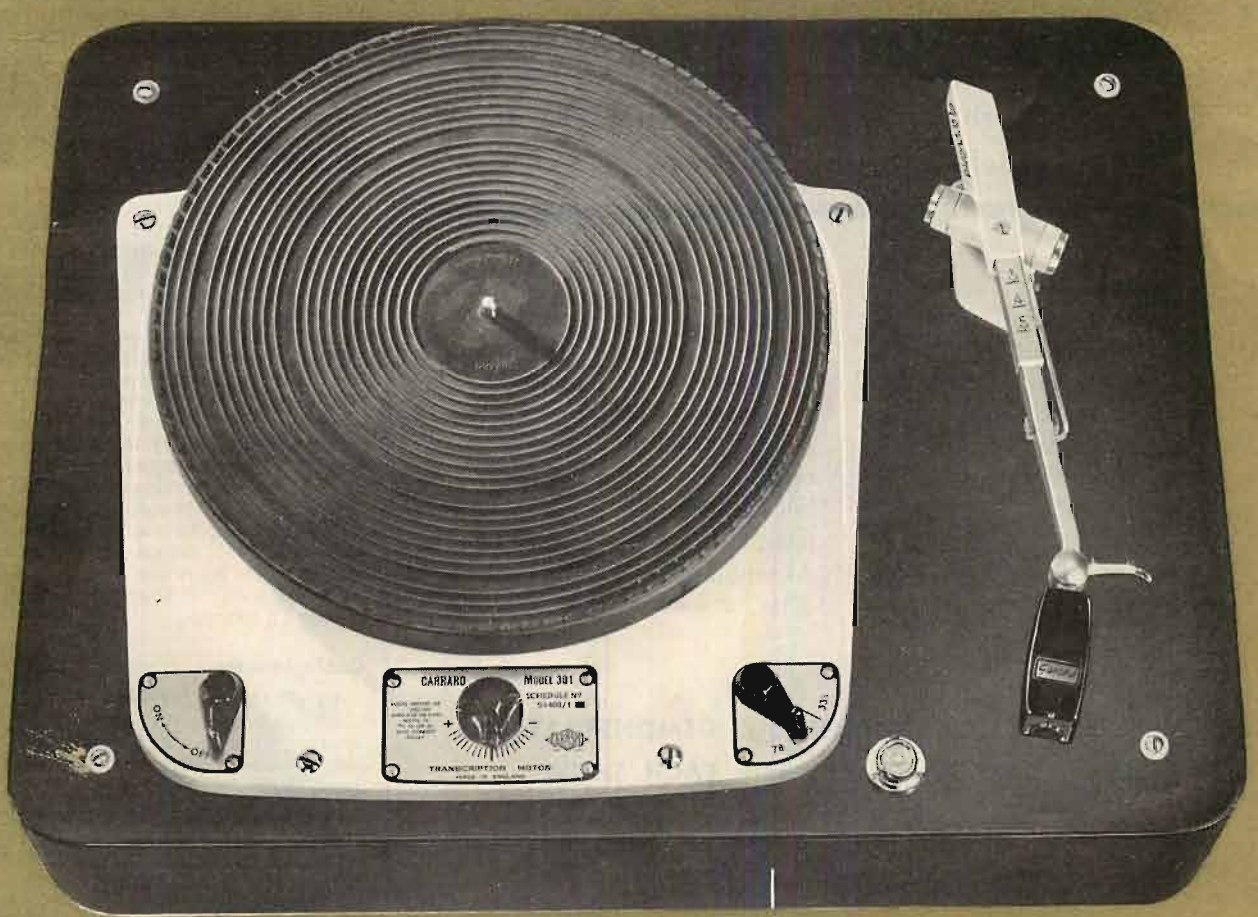

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A. Your statements about capacitive reactance of shielded cables are, of coure, true. However, if the length of such cables is kept as short as possible, the reactance at audio frequencies as compared to the impedance of the cartridge used is high. Therefore, the wide frequency range of such cartridges is not shunted, and can be passed on to your preamplifier. I cannot specify the exact length of cable which can be used without losses because so much depends upon the type of cable and upon the impedance of the cartridge used. Magnetic cartridges used in modern home music systems range in impedance from an ohm or two to around fifty thousand ohms. The higher the impedance, the shorter the length of cable which can be tolerated.

RMS

Q. What is RMS? Name withheld.

A. Measurements on the a.c. supply voltage used for home illumination shows it to be 115 volts, approximately. But this voltage is constantly varying from zero to a maximum value, back to zero, to an equal maximum of opposite sign, then back to zero, to begin the cycle over again. Since the maximum values of a.c. voltage are instantaneous, the *effective* voltage is less than this maximum. While the maximum voltage appearing across your house wiring system may be 150 volts, it is no more effective in doing work than an equivalent d.c. voltage of 115 volts. Most a.c. voltmeters are calibrated to indicate this effective value. It can be shown that this effective value is 0.707 of the maximum value (with a sine wave), while the maximum value is 1.414 times the effective value. This is arrived at in the following manner: As many instantaneous voltages along a cycle as practical are first squared, then added up, divided by the number of points involved, and the square root is extracted. It is from this process that we get the term RMS, *root mean square.* All we are doing is taking an average but, because of the sinusoidal nature of the alternating voltages, we must use squares and square roots as well as the standard means of taking an average.

Cable Lengths

Q. What are the maximum lengths of cable which may be attached to a loudspeaker of a given impedance without a loss of more than 0.1 db? J. Kass, Asbury Park, New Jersey

A. There are two variables which must be taken into account in order to answer this question. One is the impedance of the speaker and the other is the resistance of the connectiug cable. For a given length of cable, it must be kept in mind that a cable is composed of two separate conductors, each of which contains a specific resistance per unit length. The resistance is inversely proportional to wire diameter. The following table shows the length of a cable used for connecting speakers to amplifiers with impedances ranging from 4 ohms to 500 ohms. The table represents the actual physical length of line, rather than the lengths of the two conductors laid end to end. Æ

TABLE I

Wire Guage	Line Impedance in Ohms				
	4	8	16	150	600
22	20′	40′	80′	800′	3200′
20	30′	60′	120′	1000′	4000′
18	50′	100′	200′	1600′	—
16	80′	160′	320′	2400′	—

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. . . the first application of servo principles to high fidelity. Without it, your system cannot correct for distortions inherent in every loudspeaker. With it, distortion coming from magnetic nonlinearities, room acoustics, cabinet resonances and speaker suspension design is completely eliminated . . . automatically.

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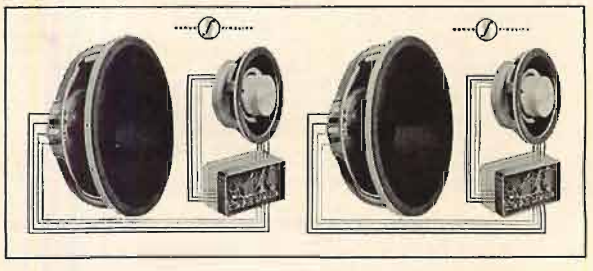

INTEGRAND T.M.

SERVO SPEAKER AMPLIFIER SYSTEM

LETTERS

Comments about Etaoin Shrdlu

Last month we headed the letter telling us of some errors in the previous issue with the words above, and queried readers to find out if anyone was interested in knowing the source of this particular grouping of letters. Actually, those who have little to do with the graphic arts couldn't be expected to know where these words come from. One reader suggested that it might be the order of frequency of appearance of the letters of the alphabet in normal English words, and he is partly right, since the frequency undoubtedly governs their placement on the linotype keyboard.

This keyboard is greatly different from that of a typewriter. It consists of fifteen columns of six letters each. The left third consists of lower case letters, the middle third with small capitals, and the right with large capitals—numbers, punctuation marks, combination letters, and special characters taking up the number above 26 in each third.

Starting at the top, the first column contains the letters *e, t, a, o, i,* and *n,* while the second colnmn contains the *s, h, r, d, l,* and *u.* When a linotype operator makes a mistake in a line, for example, he must fill it out with some letters in order to clear the machine so he can reset the line correctly. Rather than run in many of the same characters, as one would do on a typewriter, he drops in one or two matrices (the matrix is the brass "pattern" in which the letter is cast in lead) of a number of different letters to avoid running the magazine out of matrices (commonly called "mats") for any one letter. The easiest way to do this is to run a finger down one of the columns and then another until the line is filled out, and the two left columns seem to be easier to reach —aside from having a somewhat larger number of mats than some of the other columns. On a typewriter, for instance, one would run a finger along a row, if the same procedure were necessary, and would therefore get *qwertyuiop, asdfghjkl;,* and *zxcvbnm,.*

While this may seem a lengthly explanation, enough readers commented on the words to warrant a thorough coverage. We cannot recall ever having seen any description of the why and wherefore of these words anywhere in print, and we hope readers will find this one illuminating.

Better someone should have finished out a line on either typewriter or linotype and started over, (or the proofreader should have caught them), for we have the following comment from one reader:

SIR:

As a whole, Mr. George F. Cooper's article "Which Tube Shall I Use?" in the November issue is excellent and well written.

However, the printing of the mathematics leaves a bit of room for improvement. On page 30, the lower case Greek letter *alpha* is used both as a coefficient of e_g in formulas (1) and (2) and also in formula (2) and in the integral for l_a to indicate the derivatives or differentials. While this is not confusing if *very carefully read,* it could have been avoided easily.

Again at the top of page 66 the gain formula should have read:

$$\mu R_L/[R_L + r_p + (\mu + 1)R_k].$$

Omission of the one plus sign would lead to a very erroneous result.

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NEW This beautiful equipment enclosure will make your hi-fi system as attractive as any factory-built professionally-finished unit. Smartly designed for maximum flexibility and compactness consistent with attractive appearance, this enclosure is intended to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the majority of record changers, which will fit in the space provided. Adequate space is also provided for any of the Heathkit amplifiers designed to operate with the WA-P2. During construction the tilt-out shelf and lift-top lid can be installed on either right or left side as desired. Cabinet is constructed of sturdy, veneer-surfaced furniture-grade plywood ½" and ¾" thick. All parts are precut and predrilled for easy assembly. Contemporary available in birch or mahogany, traditional in mahogany only. Beautiful hardware supplied to match each style. Dimensions are 18" W x 24" H x 35½" D. Shpg. Wt. 46 lbs.

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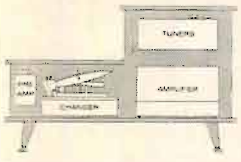

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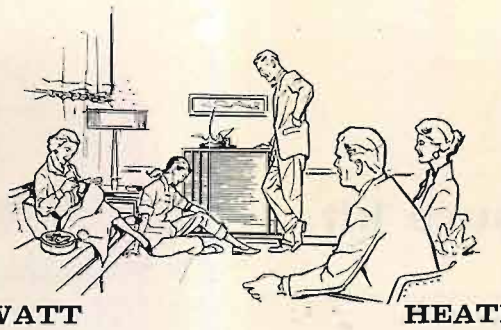

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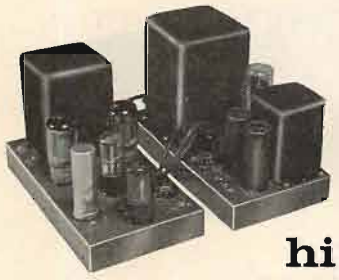

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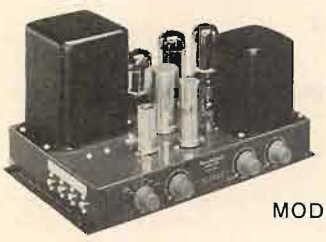

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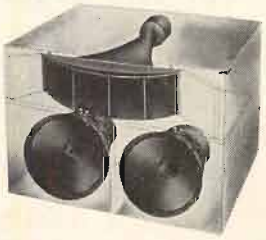

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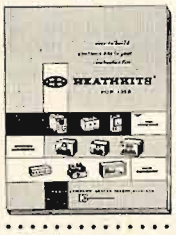

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AUDIO ETC.

Edward Tatnall Canby

For The Record

1. JUNIOR

It was a long while back that I first heard of the excellent Components professional turntable, the one with the linen belt drive. When a Junior home model turned up last year, I was immediately interested and asked for one; at about $40 it seemed like a very good bet. It is.

Several reasons can be hauled out for the delay in this report, the main one being that in this too, too complex world I just didn't get around to it. Ah, what a familiar excuse. But I might mention a minor detail that did add, unintentionally, to my trying-out time. The table, very simply, came unmounted and unwired. *That*, in the face of a million other things to do, was enough to keep me from getting around to it for awhile.

There are, you see, a good many home tables that now come ready-wired, with power and audio cables attached. For home hi-fi, this helps no end. It seems to me wise (before I get to Junior) to remind that people who aren't professionals or aren't engineers often object to hooking up wires (I'm repeating myself; I first said that in print around 1946 when *nobody* wired up anything, ahead of time.) Yes—I know it costs more; but in the end both dealers and purchasers are happy for it. After all, a wire is a wire and there isn't much choice in the installation unless, maybe, Aunt Mamie wants a baby-pink cord instead of regulation brown. . . .

But back to the Components Junior. This table is basically a one-speeder, a new and very useful category for those who deal primarily in one kind of record (usually LP). Saves in every way but mostly in simplicity of design and absence of speed-change complications. (There is a newer model, for another $10 or so, that offers two speeds, another good point of compromise that allows maximum quality under the circumstances.) The table itself is a compound unit, the outside a pressed aluminum pie-plate shell, the inside a thick ceramic disc, for weight and non-magnetic stability. The belt drive, from motor to table, is hidden underneath and, my experts tell me, is a bit hard to install when you are setting up. Like a fan belt on an automobile, perhaps.

But, once the belt is on and the table is running, you will find this Junior about the most silent turntable you have ever not heard. It is so quiet that I keep leaving it on by mistake. Generally speaking, you will hear no sound at all from it in a quiet room until you come within a foot or two, and then only a very faint rustling. Nice.

Performance, so far, has been excellent —without qualification as to price category. (I.e., *not* "excellent, considering its low price.") I detect no waver, no flutter, in the most demanding music, and I am not aware of rumble. My oldest table, which cost four times as much when new, produces a definitely audible rumble component with new records and new speaker equipment of the better sort. Standards have changed over five or six years.

By "so far," above, I merely mean that I intend to keep the Component Junior running until something goes wrong, which might not be for years. It's a useful little table, small enough to fit into many close-hauled changer spaces where the usual manual table won't possibly fit. (I'm installing it in a changer box, deliberately, to see how well it will do as a changer replacement.)

The only thing I've noticed so far is a slight crinkling noise from the belt and, naturally, I am curious to know just how long that belt will last. But rather than turn on the machine and cruelly let it run for a couple of weeks without stopping, I prefer simply to use it, in the normal intermittent way. A much fairer test, if time-consuming. I gather that a good deal of research went into the belt, as the crucial element in the system, and I remember vaguely that a change was made back in the very earliest production—which pretty much guarantees that present belts will be satisfactory.

I have only two possible cautions in respect to this pleasing little table. One is minor—the torque is not tremendous and you won't be able to use the table for broadcast record "slipping"—holding the disc back while the table turns underneath. It slows down. But one in a million people is bothered by this. Torque is plenty for all intended uses. Second is that the aluminum top plate is pressed, not cast (which would cost far too much) and is therefore rather easily bent or dented. If you plan to drop your table from a height of more than one foot, better take this into account! More important—check yours (by turning it at speed) to be sure it is in round. Even though the sound is unaffected, a wobble-edged table is not aesthetically pleasing This one could be dented in shipping or assembling.

2. PLUG-IN POINTS

I'll have to separate the Pickering Fluxvalve cartridge from the special Pickering Unipoise arm which makes use of a built-in Fluxvalve taking the standard stylus inserts.

You'll remember that the traditional Pickering design for many years stuck doggedly and honestly to the permanent, non-removable stylus as the way to produce the best sound from the factors involved in that famous older series of cartridges. At one time there was, to be sure, a shady sort of second-best model for changers, that had a removeable stylus; but it wasn't considered proper for real hi-fi bugs to use, as I recall. Definitely, it was intended as a compromise for practical reasons. The regular Pickerings brooked no compromise and you sent your cartridge to the factory when the stylus wore out.

The Fluxvalve, then, is a major step in a new direction for this company and I must compliment the designer on the ingenuity and convenience of the new Fluxvalve series of removable styli, each one built into a T-shaped plastic unit that is big enough so that it can be handled easily by people with ten or more thumbs, which is more than can be said for any other removable stylus assembly I can think of, even including the GE slip-in. (Well, you can get hold of the GE even if you have four thumbs, I guess. . . .) Quite seriously, the Fluxvalve stylus change is the simplest and easiest to manage I have ever tried, simple enough so that, for once, you may really buy one cartridge and several styli and interchange them as you change from one type of record to another.

Incidentally, the answer to a lot of problems in miniature parts, like the stylus, is to break up the larger working units into big sections. Instead of a big pickup and a tiny little "needle," you build the stylus into a hunk of the cartridge itself that is big enough to get hold of; slide the larger parts together and you have your cartridge.

The Fluxvalve stylus assemblies come in five types now, the 1 mil diamond (red), and sapphire (gray), 2.7 mil for 78 rpm (yellow, white) and the special ½ mil stylus (green). Single and double cartridges, too.

It would be nice if, somehow, these color codes agreed from one maker to another—these aren't the same as the GE code, for instance; but put that aside—Pickering's colors are big and bright all over and you don't need a magnifying glass to tell which is which. You keep your styli in a plastic box which it is wise to glue down to something near to the pickup itself. Just reach in for the color you need and slide it horizontally into the cartridge body, and you're in biz.

I am doubtful, at this juncture, as to the practical value of the ½-mil point. Under ideal conditions and extremely light weight it can help a lot. But the simple fact that when you halve the radius you increase the point pressure *four* times, for the same stylus force (weight), means that there is a very great practical risk in using a ½-mil stylus for most situations. Slip your green (½-mil) point into an arm weighted at 4 grams and you get the equivalent pressure on the groove of 16 grams with the standard red 1-mil stylus. Put a nickel on top of the cartridge (as people *will* do) and the stylus tunnels downwards toward China.

I'd like to see a 0.7-mil stylus in this handy Pickering form. That size is an excellent compromise, it seems to me, between the 1-mil point and the ideally better but dangerous ½-mil, since the 0.7 figure merely doubles the pressure at the point. Double is risky enough, for the present.

If your arm is playing at six grams and you plug in a 0.7-mil for your LPs in place of the 1-mil, your effective stylus force (in conventional terms) is increased to the equivalent of 12 grams, too much but not enough to do major damage. Replace the 1-mil with the ½-mil, however, and the force, all in an instant, is equal to 24 grams with the standard point. Ouch!

Too many people are going to think that the force can be just the same, or can be merely halved for the half-size tip. And, more, too many miscalculations in weight,

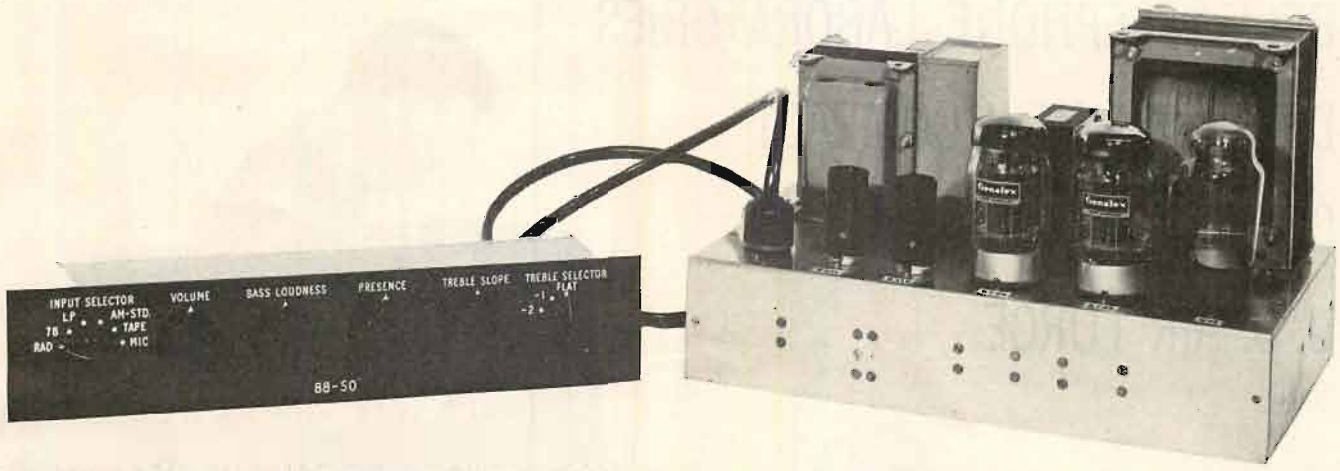

Fig. 1. External view of amplifier and preamplifier described by the author. This installment covers only the 50-watt power amplifier.

The 88-50—a Low-Distortion 50-Watt Amplifier

With harmonic distortion of less than 0.5 per cent throughout most of the audio spectrum, this 50-watt amplifier is comparatively simple in construction and requires only ordinary care in wiring.

W. I. HEATH* and G. R. WOODVILLE*

FOR AUDIO AMPLIFIERS of medium power, the KT66 output tube became well known with the Williamson amplifier, and its reputation for reliability has made it much sought after in "off-the-shelf" high-fidelity amplifiers, as well as in home-built kits.

From the same stable there now follows a new tube, the KT88, a pentode with a higher plate-plus-screen dissipation of 40 watts, and a higher mutual lows a new tube, the KT88, a pentode with a higher plate-plus-screen dissipation of 40 watts, and a higher mutual conductance of 11 mA per volt (11,000 microhms.

The KT88 makes it possible to use familiar circuit techniques to build audio amplifiers giving the higher power output needed to handle the "peaks" in high-fidelity reproduction at home, or for public address equipment. This higher output is obtainable without using a plate voltage higher than that available from standard components. The KT88 achieves this by virtue of its lower plate impedance. For example with cathode bias, 30 watts of output power is obtainable with a plate supply of only 375 volts, compared with 425 volts required by the KT66. The maximum power obtainable with cathode-bias from a pair of KT88's is slightly over 50 watts with a supply voltage of 500 volts. This article describes the design and construction of such an amplifier; a second article will give similar details of a matching preamplifier. They are shown together in *Fig.* 1.

The complete amplifier, the "88-50," has been designed to give a high performance and a complete range of input and control facilities without complihas been designed to give a high performance and a complete range of input and control facilities without complicated networks or unusual components. It is therefore reasonably economical to construct. With its preamplifier it will reproduce from any programme source such as radio tuner, magnetic or crystal phonograph pick-up, microphone, or direct from a magnetic tape replay-head. A rotary switch selects the required input circuit and at the same time adjusts sensitivity and frequency correction to the required playback characteristic. The preamplifier is separate from the power amplifier and is connected to it by a flexible cable. Its controls include a loudness control, a presence control, and a treble-slope control, all these being continuously variable with a flat position around half-way. A wafer switch preselects the frequency at which the treble-slope control operates. To avoid one of the biggest gremlins of high-fi apparatus a rumble filter using an attractively simple circuit is incorporated in the preamplifier.

* *The General Electric Company Ltd., Wembley, Middx, England.*

The Power Amplifier

The circuit of the power amplifier is shown in *Fig.* 2. A pair of KT88's is connected in an ultralinear output stage. They are driven by a push-pull double connected in an ultralinear output stage. They are driven by a push-pull double triode (B329/12AU7) having a low plate impedance. A high-gain donble triode (B339/12AX7) acts as the first stage and phase splitter. Over-all feedback of 22 db gives low distortion and good damping factor. The input sensitivity of the power amplifier is about 0.5 volt rms for 50 watts output. A U52/5U4G rectifier provides the 500-volt plate supply, and a thermistor[1] protects the electrolytic smoothing capacitors against excessive voltage during the warming-up period. The fact that all the plate cir-

[1] A "thermistor" is a resistor having a large negative temperature coefficient of resistance. The type used here is about 3000 ohms when cold at switch-on, and gradually reduces to about 30 ohms in a minute or two when it has reached its running temperature under the influence of the combined plate and ripple currents.

BELL TELEPHONE LABORATORIES DEVELOPS NEW COMPACT COMPUTER FOR U. S. AIR FORCE

J. A. Githens, B.S. in E.E., Drexel Institute of Technology, and J. A. Baird, Ph.D. in E.E., Texas A. & M., check the control panel of Leprechaun, a new high-speed computer which solves extremely complex problems in one-tenth of a second. Small size and low power are made possible by new design principles and Bell Laboratories' invention of the transistor.

The United States Air Force assigned Bell Labs an interesting assignment: develop a new kind of electronic computer. The major requirement was greater simplicity. Of course, no computer is simple, but this one (known as "Leprechaun" to its designers) is much smaller and simpler than most of the computers currently in use.

It has only some 9000 electrical components; 5000 of them are transistors. As a result, Leprechaun has less than one-third the components of conventional computers. This facilitates testing, experimentation, assembly and service.

Even in its experimental state, Leprechaun is a stimulating example of great strides in the simplification and miniaturization of circuitry . . . a problem of profound interest to all Bell Laboratories researchers as they develop radically new equipment for your future telephone service.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

cuits are in push-pull pairs enables the plate supply smoothing to be reduced to a minimum, with consequent economy of components.

The ultra-linear connection for output tetrodes and pentodes has become well known in recent years for its ability to provide the output power of pentodes at a distortion level as low as, or even less than triodes. As will be seen from *Fig.* 2, the screen grids are tapped down the primary winding of the output transformer so that the audio signal voltage on each screen is a fraction of the signal voltage at the corresponding plate. The screen-to-plate turns ratio may be anything from 20 per cent to slightly over 40 per cent for satisfactory results to be obtained. However, to avoid instability at very high frequencies when feedback is applied, the output transformer must have tight coupling between the various sections, and this is easier to achieve with a screen-to-plate turns ratio around 40 per cent, that is, each half primary is tapped 40 per cent (turns ratio) from the Bt. end. The ultra-linear circuit provides a low output impedance, roughly equal to the load, and a good damping factor is, therefore, easily obtainable with feedback.

The push-pull double-triode driver stage gives symmetrical drive to the output stage and prevents unbalanced operation even when grid current flows during overload. The B329/12AU7 was selected for the driver stage because of its low plate impedance, about 10,000 ohms. This makes sure that phase shift due to the input capacitance of the output stage is moved to frequencies above 50,000 cps. Combined with the symmetry of the circuit, this greatly assists in ensuring freedom from high-frequency instability when feedback is applied overall.

A high-gain double triode in the first stage (B339/12AX7) provides self-balancing in the phase-inverter circuit and adequate over-all sensitivity after feedback is applied.

Balancing Circuits

The push-pull signal at the plates of the phase inverter stage is balanced to about 2 per cent provided that the 1-megohm resistors R_8 and R_9 are equal. More perfect balance may be obtained if R_9 is about 2 per cent higher in value than R_8, the actual value being unimportant. If a comparison meter is available, a good compromise is to use 5 per cent tolerance resistors, making R_9 the one having the higher value. Stabilizing capacitors C_5 and C_6 should also be of similar tolerance.

The balance is improved somewhat by the use of an unbypassed cathode resistor, R_{18}, in the driver stage. The power stage uses close-tolerance individual cathode bias resistors, R_{27} and R_{28}, and this tends to equalize any slight inequalities in the output tube characteristics.

The over-all push-pull balance achieved by the above precautions in circuit design will give a performance which is absolutely satisfactory for most purposes. However, where an audio generator and 'scope are available, adjustment can be made which will give a minimum distortion figure. For this a preset wire-wound potentiometer, R_{39}, must be incorporated in the plate circuit of the driver stage as shown inset in *Fig.* 2. The audio generator should be set to a frequency between 200 and 2000 cps and should be reasonably free from second harmonic distortion. It should be adjusted to give a signal which drives the KT88's up to full power output into a dummy load resistance; this will be indicated by a slight flattening of one or both peaks of the output waveform, due to the onset of grid current. The balance control, R_{39}, should then be adjusted so that both KT88's reach the onset of grid current simultaneously as the signal voltage is increased. It has been found

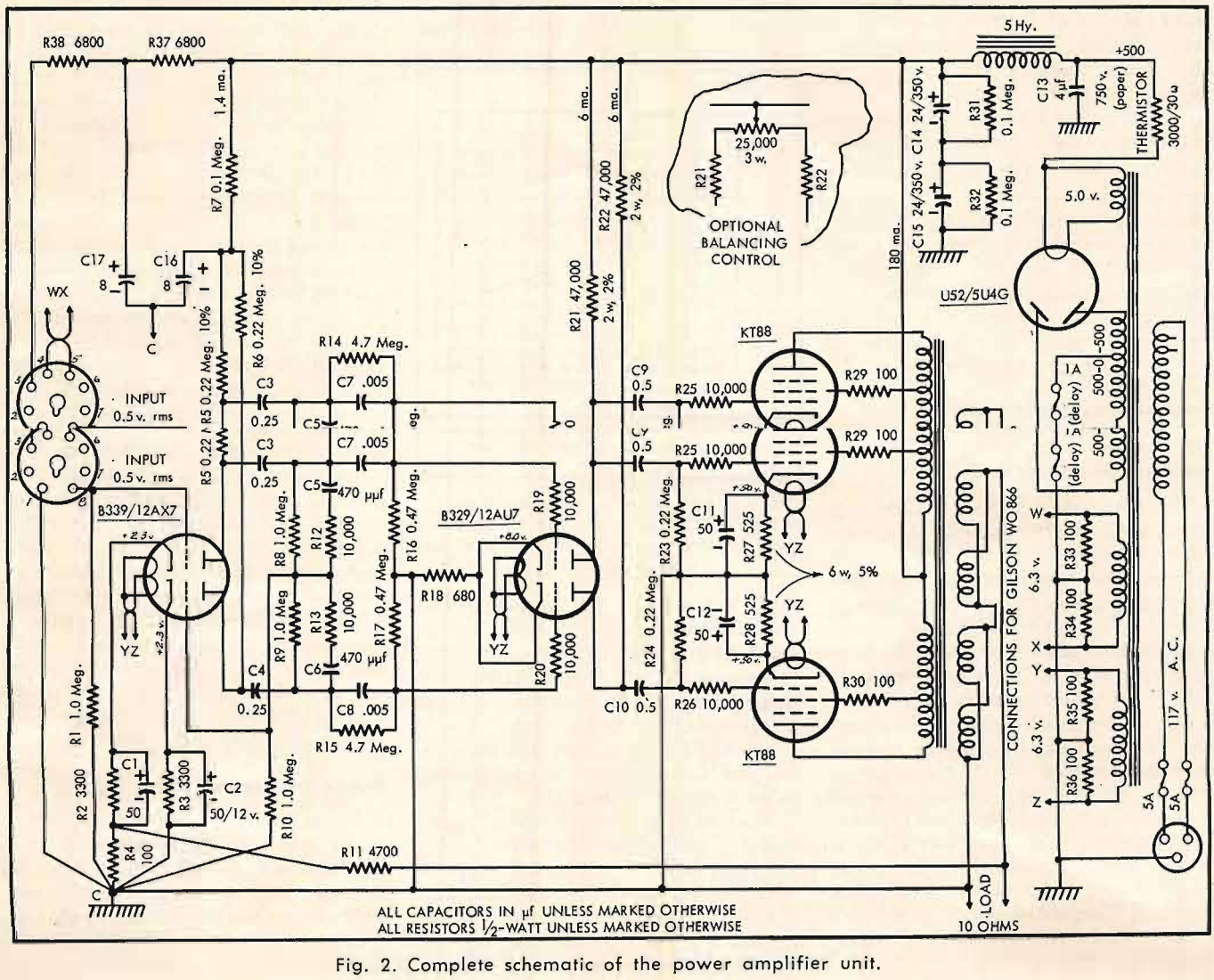

Fig. 2. Complete schematic of the power amplifier unit.

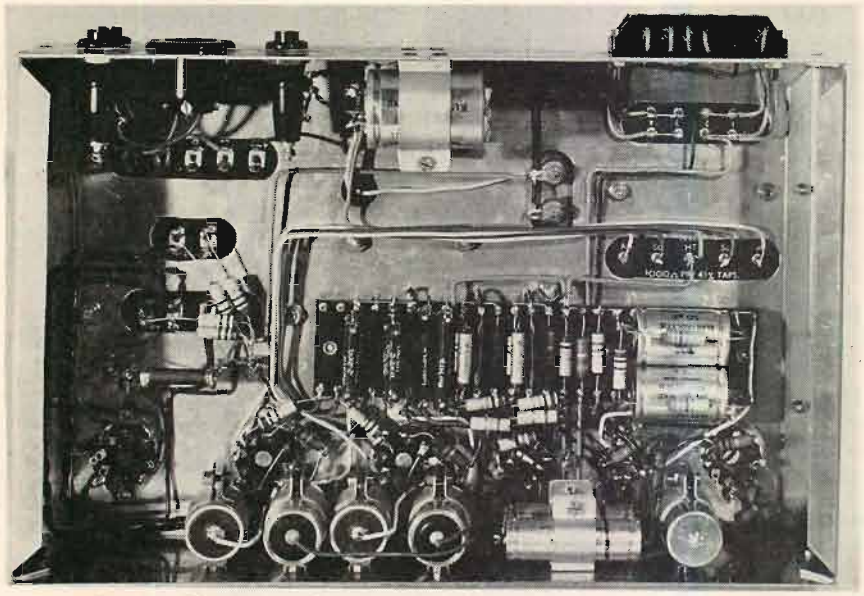

Fig. 3. Underside of chassis, showing placement of parts and wiring arrangement.

that this adjustment gives minimum distortion with a pair of output tubes that have not been specially matched.

Stabilizing

The feedback applied to an amplifier must be negative over the whole frequency range fed to the amplifier. Outside this range, the feedback must be either negative or inoperative. If this is not so, the final frequency response will show peaks, and a slight variation in feedback or load conditions may cause oscillation at these "peak" frequencies. This tendency for feedback amplifiers to oscillate is due to phase shifts in the coupling circuits, and in the output transformer itself. These peak frequencies are usually just above and below the audio band, and the technique for dealing with them is to remove them to as high or as low a frequency as possible, and then reduce the over-all feedback at very high and very low frequencies.

Low-Frequency Stabilizing

Low-Frequency Stabilizing

The low-frequency peak occurs only when feedback is applied. It results from the combined phase shifts of (1) the coupling capacitors and associated grid leaks and (2) the primary inductance of the output transformer combined with the load and tube impedances. The peak occurs below 20 cps and often results in motorboating when a preamplifier is connected to the same plate supply. The peak is minimized by making the time constants of all the coupling circuits different, by suitable choice of capacitors, and the shortest time constant is consequently that of the output transformer itself. For complete elimination of the peak, the amplifier gain before feedback is connected should be reduced at the peak frequency without introducing additional phase shift. For a flat frequency response, the reduction in gain required is approximately equal to the feedback that is to be applied.

In practice, this is achieved by inserting a "step-circuit" in an early coupling circuit. This consists of a small series capacitor shunted by a high resistor, before the grid leak. Thus, the gain is reduced as the signal frequency is lowered and at the very low frequencies is reduced by a substantially resistive potential divider with very little phase shift. For a 20-db (10:1) gain reduction, the shunt resistor should be ten times the grid leak. The capacitor should be sufficiently small to have, at very low frequencies, an impedance equal to or higher than that of the shunt.

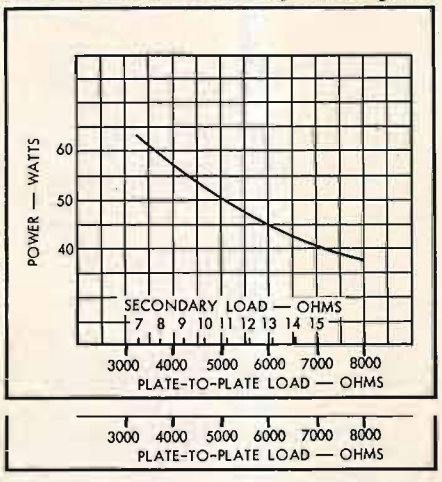

Fig. 4. Curve showing maximum power output of KT88 output stage delivered to load on secondary of transformer at frequency of 500 cps.

As the "88-50" is push-pull throughout, such a circuit has to be incorporated on each side. In *Fig.* 2, this consists of C_7 shunted by R_{14} and followed by grid leak R_{16} on the one side, with C_8, R_{15} and R_{17} on the other. The values chosen will give low-frequency stability with any output transformer capable of delivering the full power output down to 40 cps. An advantage of this type of stabilization is that the response of the power amplifier is devoid of peaks, and falls sharply at very low frequencies with the result that there is no tendency for motorboating to occur when the preamplifier is connected on the same plate supply. This enables economy to be exercised in the smoothing for the preamplifier supply, to the extent that it is merely required to give adequate reduction of ripple.

High-Frequency Stabilizing

Before feedback is applied, peaks may be detected in the response of most amplifiers at frequencies up to 100 or 200 kc owing to resonances in the output transformer. With the output transformers used in designing the prototype 88-50, leakage inductances between the various windings were low and the first high-frequency peak was detected about 100,000 cps. Such a peak is always exaggerated when feedback is applied, and may cause instability under certain conditions. Accordingly, a stabilizing step circuit, comparable to that used at the low frequencies, is incorporated. This circuit (*Fig.* 2) consists of C_5 with R_{12} in series, and to maintain symmetry C_6 and R_{13} on the other side.

Location of Stabilizing Circuits

The early stages of the amplifier have been chosen so that the high-frequency phase shifts due to Miller effect are slight, and with the component values given the stabilization is substantially independent of output transformer and load. The stabilizing circuit has been inserted in an early stage in the amplifier to remove the risk of overloading the preceding tube. With such a circuit it is undesirable to use additional capacitors across the output transformer, or across the feedback resistor, and in any case the use of such capacitors is critically independent on the particular type of transformer and load used.

The component values were chosen to [illegible] type of transformer and load used.

The component values were chosen to give the best results with transformers of the characteristics described below, but it was found that a simple transformer with slightly higher leakage inductances was quite stable in operation. With a transformer of the preferred specification, the overshoot on a 10,000-cps square wave was about 10 per cent with a resistive load, and there was reduction of 6 db in the effective feedback at 40 and 10,000 cps.

Output Transformer

Desirable requirements for an ultralinear transformer for use with negative feedback are adequate primary inductance and low leakage inductances. Primary inductance should be adequate for full power performance down to at least 40 cps. Leakages between primary

and secondary, between each half primary, and between each plate tapping of the half primaries and its associated screen tapping should not exceed 6 millienries each.

The output transformer used for the prototype amplifier was the WO866 made by R. F. Gilson Ltd., St. Georges Road, London, S.W.19 using grain oriented silicon iron. Although designed for operation at lower power outputs than those obtainable from the KT88, it gave very good results, as the curves show, over the frequency range from 40 to 20,000 cps. Excellent results have also been obtained with a Partridge Type 5353, and a Savage 4N1, the latter giving full power output down to about 20 cps. All these transformers had the necessary low leakages, and a resonant frequency around or above 100,000 cps.

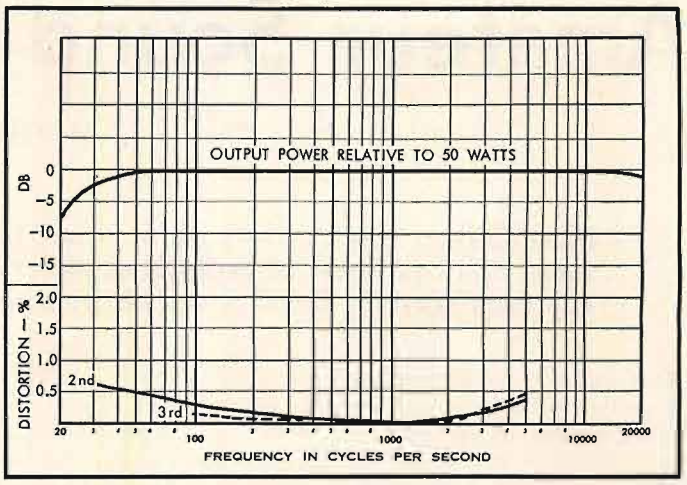

Fig. 6. Maximum output power, relative to 50 watts, over entire frequency spectrum, together with distortion curves at rated output.

Construction

Figure 3 shows the underside of the power amplifier chassis. The prototype was constructed on a chassis measuring 14 in. × 9 in. × 3 in. The assembly plan follows an "in-line" strip layout with *one* ground terminal near the *input* socket and first tube, (B339/12AX7). If larger transformers are used the chassis may need to be increased in size but the layout is important and must be followed. It was thought advisable to mount the transformers with terminals down for safety.

The power transformer is as far as possible from the input to prevent hum and its orientation should be noted. (*Fig.* 1).

A mounting board is used for all smaller components. The larger coupling capacitors and the later cathode bypass capacitors are clipped direct to the side of the chassis, and this provides screening, with the exception of C_{14}, which must be insulated. For ease of servicing almost no wiring is beneath the tagboard.

The heater wires should be laid in first, with twisted twin wires along the bend of the chassis and the tube sockets oriented to avoid heater wiring crossing grid wiring. The heater supply for the preamplifier should also be laid in to the octal socket connection. Both supplies must have a center-tap grounded to chassis, or an artificial center-tap using two equal resistances, as shown. The ground point mentioned above should be placed near the first tube and a 'star' lug bolted down with a lock washer for good contact. All grid, plate, and intertube coupling circuits must be returned by insulated wiring to this one chassis point.

The signal input (pin 8 on the octal socket) should be wired as directly as possible to the grid of the 12AX7. The ground connection (pin 1 on the octal) and the grid leak should be connected to the 'star' lug. The cathode bypass capacitor C_1 with the series feedback resistor R_4 should be wired between the cathode pin and the 'star' lug, as close to the grid input lead as possible. The cathode bypass capacitor of the second half of the 12AX7 should be wired in an equally compact manner. The grid, fed from the phase-splitting network, should also be wired as compactly as good mechanical location of the components will permit.

Throughout, grid and plate leads should be short and separate as far as possible. 'Dead' wiring, such as plate-supply leads returning to a smoothing capacitor or cathode bias resistors which are bypassed, may be longer, if necessary. Grid stoppers R_{19}, R_{20}, R_{25}, R_{26}, R_{29} and R_{30} must be wired direct to the tube socket with very short leads.

The ground point of each tube should be insulated, connected back to the corresponding point on its predecessor and so on to the star lug. Similarly, the grounded end of the output transformer secondary should be returned to this point, as this circuit is part of the feedback. The grounded side of the plate supply and heater center tap may, however, be wired to the chassis. The output transformer is, of necessity, near the input circuits, and the live plate and screen wiring should be bound to-

the input circuits, and the live plate and screen wiring should be bound together and positioned well away from the mounting strip.

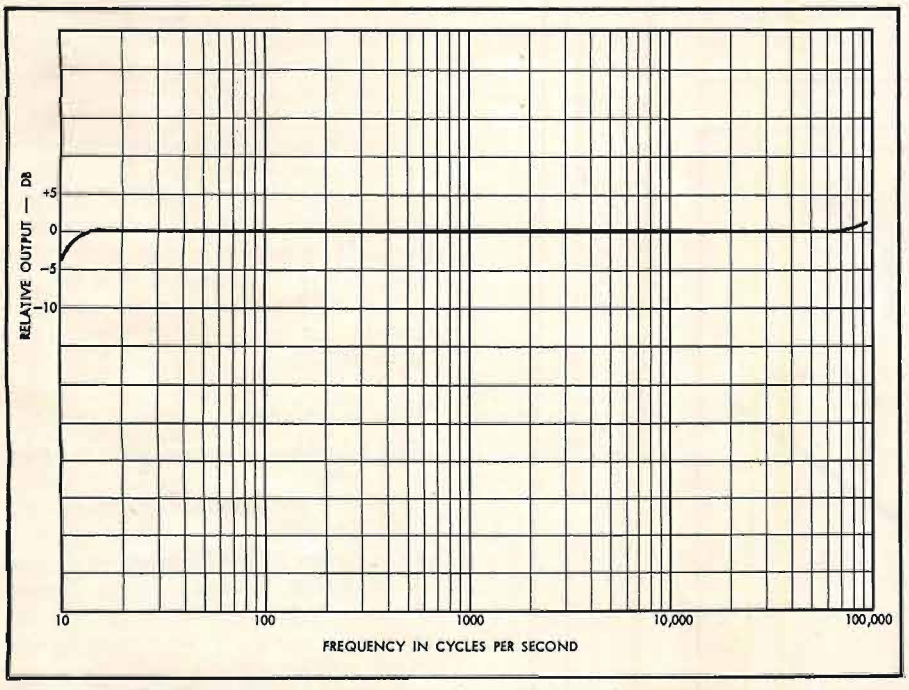

Fig. 5. Frequency response of amplifier at 1-watt output.

Connecting the Feedback

When completed and checked, a dummy resistance load should be connected, and the amplifier first switched on with the feedback disconnected by an open circuit at R_{11}. If the voltages measured across the cathode bias resistors approximate to those shown in *Fig.* 1 (some voltmeters will give a lower reading) a test signal may then be connected to the input of about 100 mv, and a loudspeaker tapped across the dummy load. If an audio oscillator is not available, a phonograph pickup having a high output, such as a crystal type, can be connected to the input via a temporary volume control. An extra

(*Continued on page 73*)

Amateur Sound Film Equipment

H. THIELE*

Most amateur movie makers will welcome the availability of a thoroughly workable 8-mm sound film equipment of exceptional picture and sound quality. This new Zeiss-Ikon system from Western Germany can be compared favorably with most 16-mm equipments.

JUST AS OLD as the film technique itself are the endeavors to give more life to the pictures on the screen by adding sound. With the earliest films, a person had to explain the action while a piano player took care of the background music. Later, several decades of developments had passed, the implements of the sound film technique became established. This made possible, on the one hand, the reproduction of the sound which belonged to the picture and was recorded together with it. Furthermore, a "silent" film could be produced much more effectively by means of explanatory texts, music, and corresponding noises.

The advantages of the sound film in comparison with the silent film are so outstanding that, after overcoming the initial difficulties, all motion picture theaters acquired the equipment required for the reproduction of sound films. Film amateurs, too, endeavored right from the beginning to enhance their films by means of sound. Most amateurs are, due to financial considerations, limited to film sizes which are smaller, and therefore less expensive, than the standard 35-mm films. In consideration of this, the introduction of sound films to amateurs was hampered chiefly by technical difficulties. Today, however, we have a number of processes permitting the amateur to augment his small films of a width of 16 or 8 mm with music and explanatory talks. It is true, of course, that only in the rarest occasions there will be a desire or a possibility to record sound on a film in the same manner as it is done in a studio producing professional films. There, with some exceptions, the associated sound is recorded at the time the picture is taken. The film delivered to a moving picture theater always contains the picture and the sound on the performance copy. As a sound recording process, the optical method technique proved itself to be adequate right from the beginning. The advantage of this process lies in the simple production of the release prints, with the picture and the sound both being recorded at the same time in the printing machine.

The introduction of multichannel sound reproduction in the moving picture theaters required the placing of several sound tracks on the 35-mm film, without taking up any room in the space which, until now, had been reserved for the picture. The reduced dimensions of the resulting sound track area prohibited the use of the optical technique for reasons of quality. However, endeavors to place the four channels (which were considered to be necessary to obtain sufficiently the stereophonic effect) on four magnetic sound tracks were crowned with success. We shall, however, not discuss here any details concerning the technique of optical and magnetic sound.

* *Zeiss Ikon AG., Mecklenberger Strasse 32–36, Kiel-wik, Western Germany.*

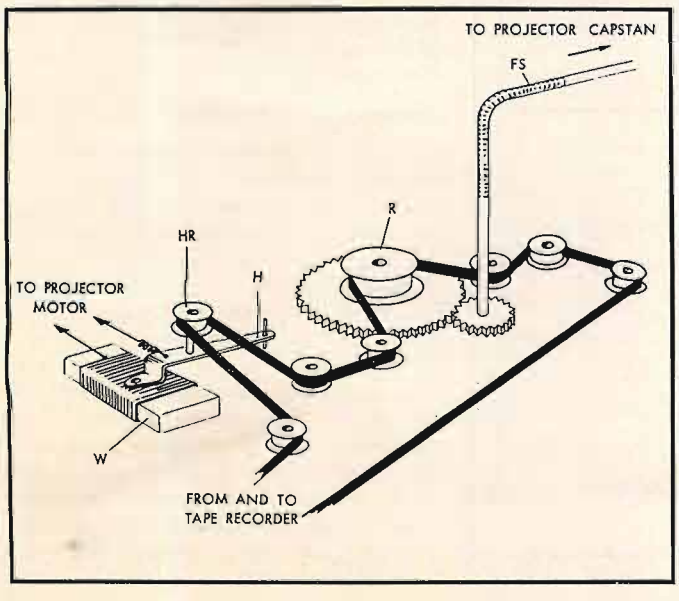

Fig. 1. Diagram of a synchronizing Device.

Synchronizing Problems

The machinery required for the production of films with synchronized sound is extensive. In addition, there are difficulties of production in producing a good job of shooting the picture and recording the sound. Thus only very few amateurs will have the opportunity of using this technique. However, this should not be considered as an absolute disadvantage. If we take into consideration that culture films, weekly news reviews, and even feature films often have sound added subsequent to shooting, an amateur, too, can enliven his performances greatly in comparison with purely silent films by the same method. For this purpose, there are now a number of recording processes, differing from each other in price as well as in their operational characteristics.

It is desirable to reproduce the sound immediately after the recording without any further treatment so that faulty sound effects can be easily corrected. Neither the optical technique nor acetate disc recording fulfill both of these requirements and should, therefore, not be considered. But these requirements are perfectly fulfilled by the magnetic sound process. Among others, the raw films used by the amateur make a difference.

. A prerequisite for the reproduction of used by the amateur make a difference.

A prerequisite for the reproduction of recorded amateur films is that the film projector is suitable for sound film performances with regard to its operational noises. It is usually placed in the same room in which the recording is done as well as in the same room in which the reproduction takes place when projecting the films.

Projector Problems

In this connection, we wish to stress a few points. An amateur film projector is expected to reproduce bright pictures which are well-focused. The brightness of the screen picture depends on a number of factors, among other on the reflection capacity of the screen, on the efficient opening of the projection objective, and on the capacity of the source of light. Disregarding the characteristics

of the screen, it depends on the beam of light delivered by the projector to obtain a certain brightness on the screen. A frequently chosen arrangement for obtaining the desired beam has the following appearance: Use is made of a projection lamp of high electric capacity, for instance of 500 or 750 watts, which can be connected directly without any interposition of transformers or resistors to a 117-volt line. Filaments in such lamps are rather thin and thus the resulting temperature is low, with the result that per watt of lamp capacity only a proportionally small light flux or beam is produced. In order to make the light flux, which is radiated to all sides by the large-surfaced helix of the lamp, useful for projection, the helix is reflected by means of a concave mirror and the diminished helical picture is concentrated in the image aperture by means of condenser lenses. However, a high lamp capacity requires, in consideration of the life span of the lamp and of the temperatures created in the projector, a large quantity of air to cool the lamp and the projector. Thus a ventilator with a high air-conveying capacity must be present. Unfortunately, it is a fact that although this device produces quite an current, at the same time, it also produces a great deal of noise. This explains the fact that a great number of commercial projectors give forth noises while operating which do not differ much from the noises made by a vacuum cleaner.

However, especially for 8-mm projectors, there exists a possibility to obtain, with a greatly reduced electric capacity, a comparatively good light flux. A prerequisite for this is a so-called "low-voltage lamp" which, for all practical purposes, can only be connected to the line by interposing a transformer. Especially advantageous conditions are created when the lamp, with a power consumption of approximately 50 watts, is designed for an 8-volt supply. The thick filament, heated by a current of some six amperes, provides good efficiency and an advantageous light color —much as does an automobile headlamp —and it also has the long life of this more common light source. The narrow coiling permits the optical reproduction of the filament, forming a luminescent triangle, simply by using a concave mirror, that is, without a condenser, directly in the image aperture. In order to simplify matters, this mirror has been affixed directly to the lamp. As a result, the greatly reduced power input heats the projector and the lamp much less than high voltage lamps; thus the quantity of cooling air can be reduced and the operating noise of the projector is greatly lessened. An 8-mm projector, equipped with such an optical system, will be described further.

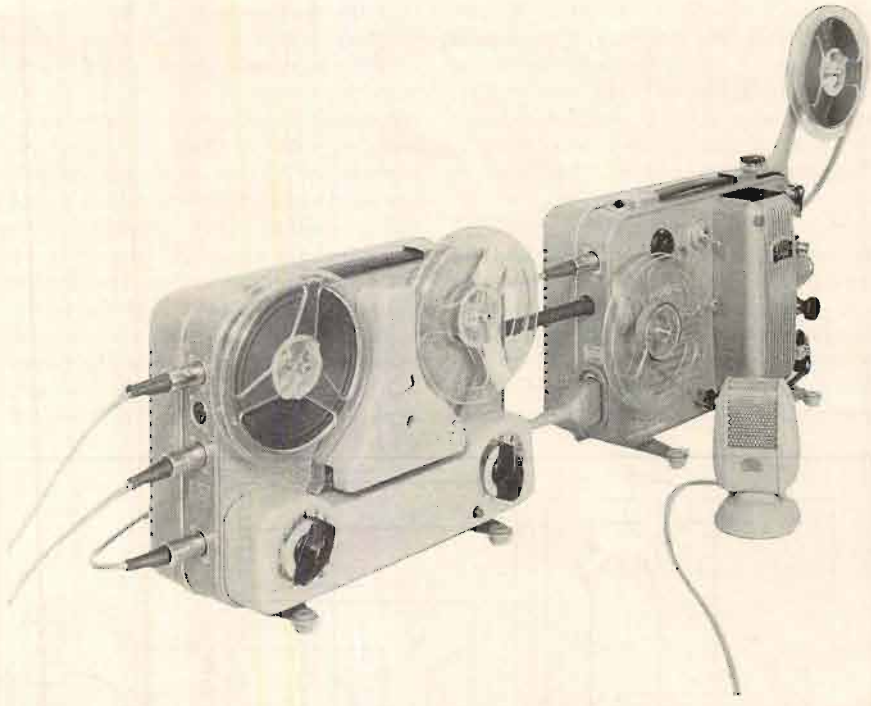

Fig. 2. Zeiss Ikon Movilux 8B and Moviphon B sound film equipment in operating position.

Recording Applications

Let us consider now the various possibilities of sound tracking, in order to learn how they differ from each other. The most primitive application of adding sound to an existing silent film is, without doubt, the adding of commentary to the action in the film. If it is a question of repeated performances of the film, this can be done by speaking the text into a sound recorder, using a tape which can be run off accompanying any repeated performance of the film. In addition to recording speech on the sound tape, some music adapted to the mood of the picture can be used as a background; thus in the performance a mixture of music and text will be available. Actually many amateur films are recorded in just this way, and it improves operation if the projectors are equipped with devices which automatically regulate the syncronized starting of film and sound. Thus the film and the sound tape will always start together, and it will depend on the characteristics of both devices whether, during the run, the synchronization of the film and the sound will be maintained as in starting. Especially suitable for such synchronization are projectors and tape recorders equipped with "Ansynchron"[1] motors. The latter depend relatively little on fluctuations of the line voltage. While it would be a perfect solution to equip both devices with synchronous motors, the expense is so great that such equipments could not be introduced into the commercial market for amateur use. But in many cases it becomes necessary to assure much better synchronization between the action of the picture and the sound reproduction than it is possible in using the process just described. For this purpose, synchronizing devices are being developed in Europe, which use an especially prepared small film projector and a standard sound tape device. As it is a known fact that the speed of a sound carrier—tape or disc—cannot be changed without impeding the quality of reproduction, care has to be taken that the sound tape, running at a constant speed, is used in controlling the speed of film. In order to do this, the device holding synchronization is connected, according to Fig. 1, by means of a flexible shaft *W* with the projector, so that the roller *R*, contained in the synchronizing device, turns at a speed corresponding to the

[1] *Not* synchronous.

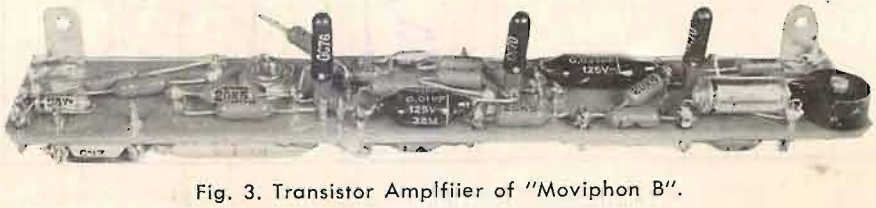

Fig. 3. Transistor Amplfiier of "Moviphon B".

operational speed of the film. Wound around this roller is a loop of the sound tape which is taken from the recorder. The tape is also guided over a roller *HR,* arranged on a lever *H,* so that, in case the speed of film deviates, said lever is effecting a rotary motion. This lever is connected to a slider on resistor *W* which is included in the motor circuit of the projector, and thus regulates the speed of the film so that it always maintains a constant relationship to that of the tape, and thus the picture and sound always remain synchronized. There are also projectors permitting a direct assembly of the synchronizing device, so that the flexible shaft can be eliminated.

Other types of construction provide in the projector a commutator rotating with the speed of the film. In the synchronizing device there is also a commutator rotating with the speed of a tape-driver roller. The two commutators are electrically connected. If the speeds differ, current flows through a relay, which in turn varies the current through the projector motor, thus synchronizing the speed of film to that of the tape.

With these processes, a device additional to the projector and the recorder must therefore be available. The sound tape must be guided in the form of a loop from the recorder to the synchronizer, and the synchronizer and the projector must be coupled mechanically or electrically.

Improved Method

These disadvantages are eliminated in another construction of the machine. If the projector is equipped with an efficient "Asynchron" motor, the latter can drive a special tape recorder, which has no motor of its own, directly. Thereby, not taking into consideration the negligibly small slip of the tape, there are no relative speed differences between the film and the tape. Thus good synchronization between the picture and sound can be obtained, in this manner, without any additional attachments. The Zeiss Ikon 8-mm film equipment Movilux 8B and Moviphon B have been constructed on this principle. *Figure* 2 shows the details of this equipment.

The projector had been placed in a handy case, containing all individual parts required for the projection of pictures. A driving motor, whose speed cannot be regulated, drives the projector mechanism over a belt transmission with the securely adjustable picture frequencies of 16, 18 and 24 pictures per second. A precision gripping device and a secure guiding of the film in the aperture guarantee a good position. The projector accommodates 400-ft. reels. As a lighting system, a 50-watt, 8-volt special lamp with a concave mirror has been provided. Condensers or auxiliary mirrors are not required. The light flux or beam, when the three-blade aperture is in operation, is approximately 60 lumens.

The "Cetar" projection objective has an aperture of f/1.5 and renders very bright pictures with sharp edges. In order to make it possible to connect the machine to all standard a.c. line voltages, it is equipped with tapped power transformer. The total power input is approximately 100 watts so that the Movilux 8B can also be connected to direct-current sources by means of a vibrator. Moreover, the power transformer supplies also an a.c. output of 30 volts, which is required for the operation of the Moviphon B. This sound mechanism is driven by the projector motor over a flexible coupling. It can be seen in *Fig.* 2 that the Moviphon B has the same case form as the Movilux 8B. During operation, it is placed behind the projector. It contains all parts required for transporting of a standard sound tape at a speed of 3¾ ips. (with 16 frames per second of the projector), and a large flywheel mass regulates the necessary synchronization. The tape can be played in one direction on two tracks, one after the others. Either track 1 or track 2 can be reproduced selectively, or both tracks can be reproduced together. This ar-

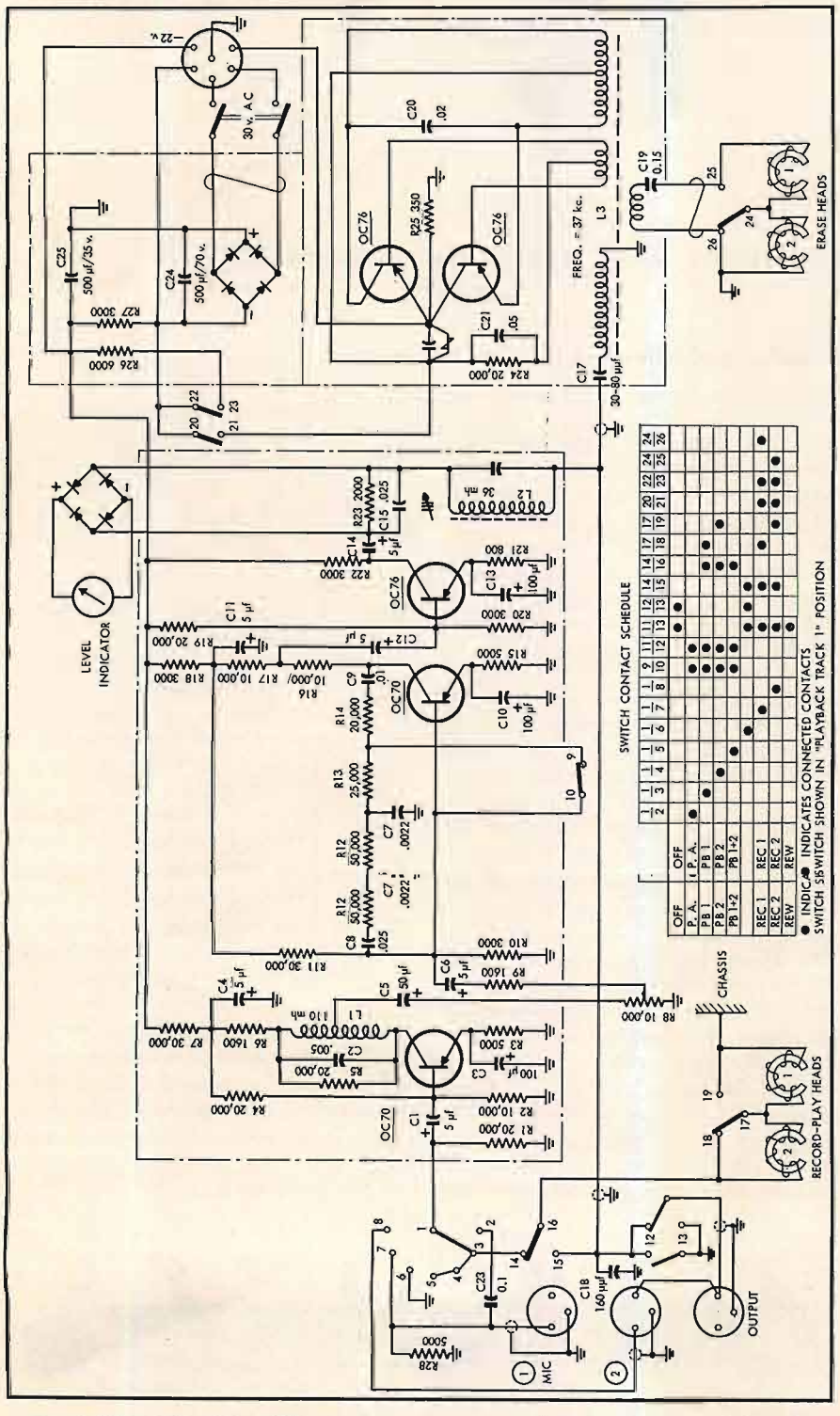

Fig. 4. Schematic of amplifier and associated electrical circuits of Moviphon B.

Multichannel Audio Mixer-Preamplifier

HAROLD REED*

Circuitry for mixing a number of low-impedance inputs can become complicated when attention is paid to correct impedance matching, and losses are likely to become excessive. The use of a transformer between the network and the succeeding amplifier will eliminate the effect of the losses.

AUDIO FREQUENCY MIXERS comprising three or four inputs or channels are quite common and present no serious problems in design and construction. With an increasing number of inputs, greater difficulties are encountered. Loss of signal voltage between the input and output of the mixer increases as the number of channels is increased. This alone may not be considered too serious. But when we give our attention to hum and noise figures we realize the importance of large losses in mixer circuits which may result in a signal-to-noise ratio figure so low as to make the overall operation of the mixer unacceptable, even for ordinary non-critical use.

Using individual, low-impedance-to-grid input transformers and a single-stage preamplifier for each input channel can overcome all problems except one. That is, the cost of the unit. With this arrangement, however, several advantages are immediately observed. The low output voltage from each source, say a microphone, is at once given a step up by the input transformers. If we use a 50-ohm-primary to 50,000-ohm-secondary transformer, a type frequently used for this purpose, the voltage step-up is equal to the turns ratio or the square root of the impedance ratio of the transformer. In the example under discussion this amounts to $\sqrt{50{,}000/50}$, or approximately 33.

Now if we connect a low-impedance microphone with a rating of -55 db, (reference, 0 db = 1 mw/10 dynes/cm^2), which gives 0.4 millivolts across the 50-ohm input, then 0.4 mv multiplied by 33 results in about 13 mv across the transformer secondary and available at the grid of the preamplifier input. So, we get off to a good start. However, the use of cheap, poorly constructed transformers can offset, and in some instances to a considerable extent, the advantage of the voltage gain just cited due to greater a.c. hum voltage on the grid which may be picked up by the transformer from nearby a.c. fields. Good-quality, well shielded transformers should be employed. Evidently, then, this is a large item, from the cost standpoint, when we are considering say, a ten-channel mixer which would require ten transformers and ten preamplifiers.

* *3917 Madison St., Hyattsville, Md.*

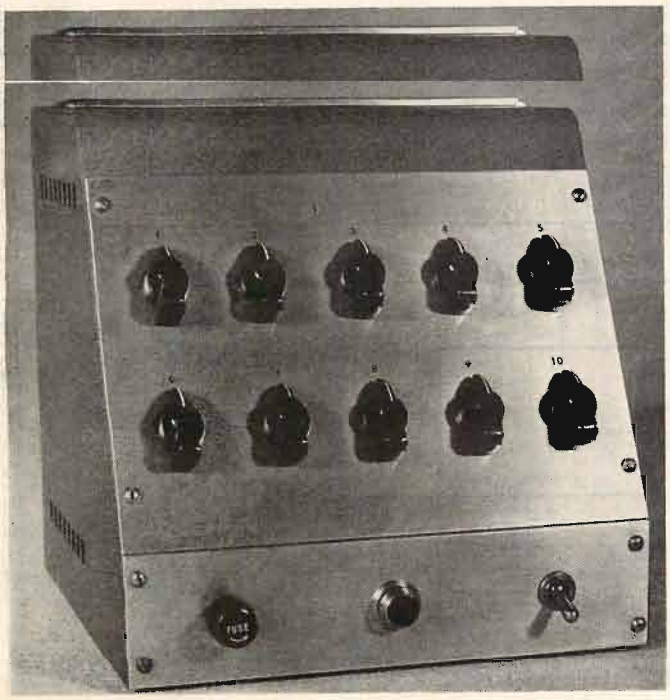

Fig. 1. The author's complete ten-channel mixer and its associated preamplifier can be built in a small sloping-front metal cabinet.

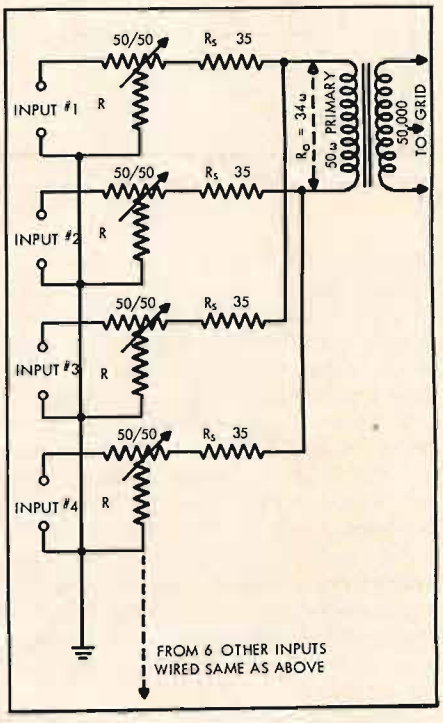

Fig. 2. One type of mixing network—series-parallel—which is often used for several inputs.

series-parallel—which is often used for several inputs.

Of the many circuit configurations for input mixers one that offers least loss is the series-parallel arrangement. A circuit for a ten-channel mixer using this type of circuitry is shown in *Fig.* 2. This is for ten, 50-ohm sources. For a total number of inputs other than ten and for different values of input impedance R, the value of R_s, the series resistor and R_o, the output impedance, may be found by two simple equations. $R_s = R(N-3)/N$ and $R_o = 4R(2N-3)/N^2$. It will be seen in *Fig.* 2 that the mixer output

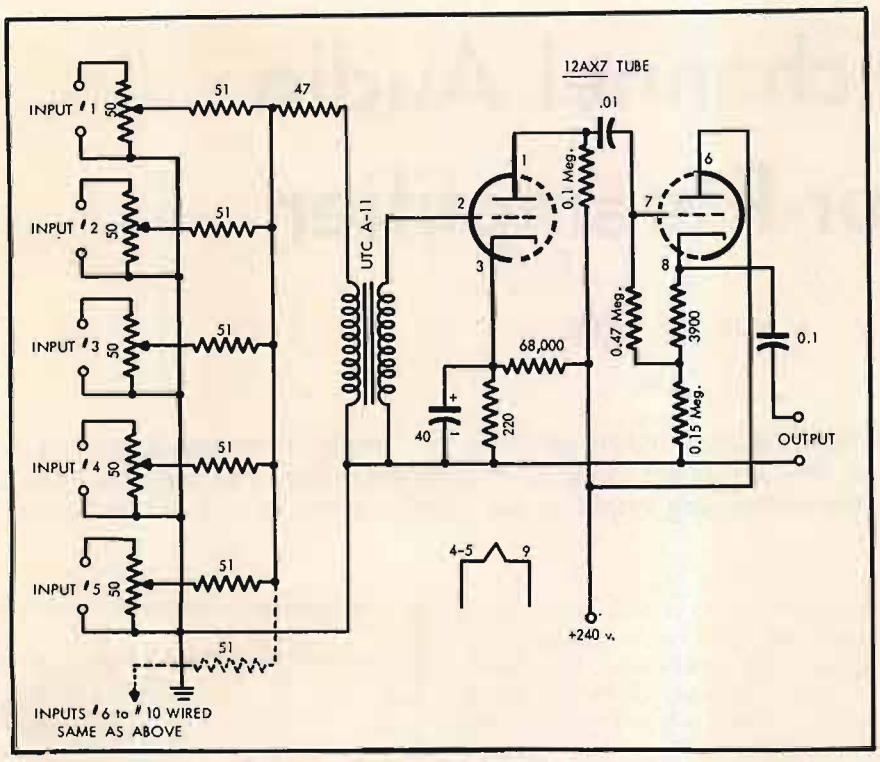

Fig. 3. Inexpensive ten-channel mixing network, using simple potentiometers instead of T-pads.

works into a 50-ohm-to-50,000-ohm transformer. The 50-ohm primary is a close match for the mixer output. The transformer provides a voltage step-up of 33 as mentioned previously. The loss in the mixer circuit is a little over 13 db.

Suppose we round the mixer loss figure off to 14 db and use a microphone with a rating as given previously. A 0.4-millivolt signal to the mixer input will then be down 14 db or reduced to 80 microvolts, since db = 20 times the log of the voltage ratio.) This voltage is applied to the transformer primary. The signal at the secondary will be 2.6 millivolts which may be fed directly to the input grid of an amplifier.

The attenuators, *R*, of the foregoing circuit must be of the constant-impedance, zero-insertion-loss variety. Good attenuators of this type do not come cheap. Ordinary potentiometers are not suitable. Wirewound T-pad attenuators can be used but will be noisy when varied. However, if the controls are preset for certain levels and not used for extensive "gain riding" they may prove satisfactory and they are relatively inexpensive. One type is the Mallory T series available in fourteen different impedances.

Practical Circuit

A very inexpensive method of constructing a ten-channel mixer will now be considered. The circuit arrangement is given in *Fig.* 3. In this circuit potentiometers are used. They should be of good quality such as the Ohmite "AB" type. The circuit shows 50-ohm controls but, of course, other ohmic values may be substituted. For 10 inputs the mixer loss is about 20 db. Using the same type of microphone as discussed in the foregoing circuit, 0.4 millivolts is applied to the mixer input. With a mixer loss of 20 db the signal is reduced to .04 millivolts at the 50-ohm transformer primary. The transformer voltage gain of 33 provides a 1.3-mv signal to the grid of the preamplifier which is one half of a 12AX7 tube.

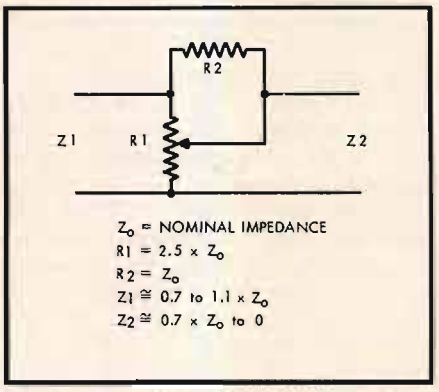

Fig. 4. Alternate arrangement used to maintain input impedances at a more constant value.

Fig. 4. Alternate arrangement used to maintain input impedances at a more constant value.

The 12AX7 input stage has a voltage gain of 47 which boosts the signal to 61 millivolts at the 12AX7 plate. The other half of the 12AX7 serves as a cathode follower stage which, theoretically provides no voltage gain. However, the signal measured at the cathode follower output was 66 millivolts, which, of course, is a negligible difference over the input signal.

The cathode follower has the advantage of low-impedance output and therefore, the mixer and preamplifier can be operated at a reasonable distance from the main amplifier or recorder. The 66-mv signal is more than sufficient to work into the high-impedance microphone input of an amplifier or tape recorder.

Interaction between the channels amounted to a maximum of just 3 db variation in output for any setting of the controls. This is for the worst condition, that is when feeding a signal to one input and varying the other nine potentiometers from minimum to maximum positions.

For applications where it is preferable to maintain a more constant load impedance on the microphone or other sound source, the circuit of Fig. 4 may be used instead of a simple potentiometer. With this arrangement, the input impedance ranges from about 0.7 to 1.1 times the nominal value. When the arm of the potentiometer is at the top, the input impedance is equal to the nominal value shunted by 2.5 times the nominal value. When the arm is at the bottom, R_2 replaces the load and consequently the input impedance is the same as at the top. In the center, the impedance is equal to twice the load impedance shunted by 2.5 times the load, which is about 1.1 times. This will improve the loading on certain types of microphones.

Any power supply with an output from 200 to 250 volts can be used for

(*Continued on page 76*)

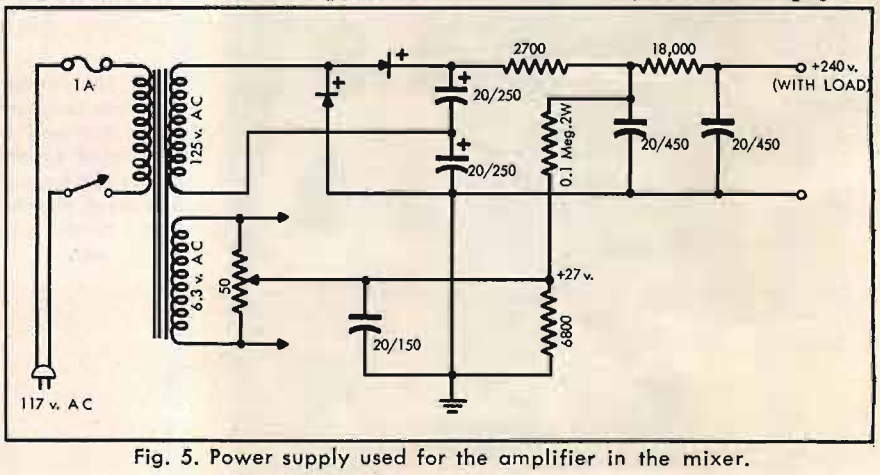

Fig. 5. Power supply used for the amplifier in the mixer.

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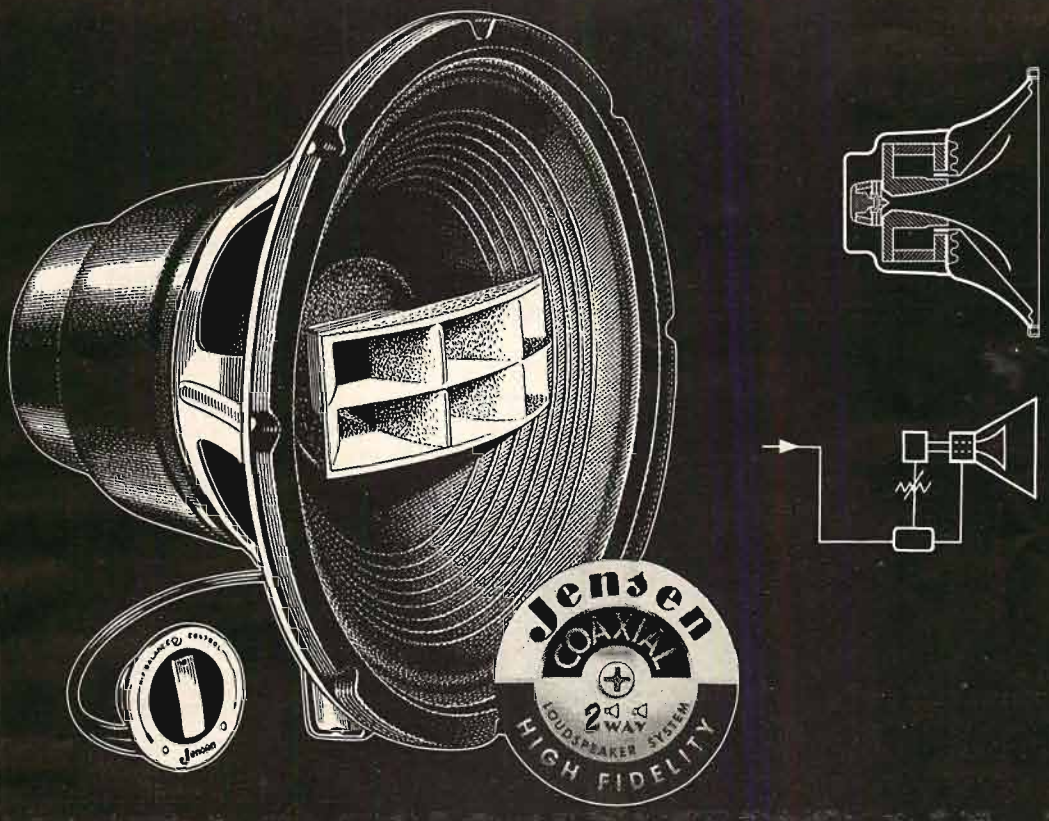

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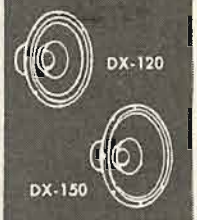

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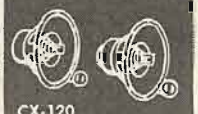

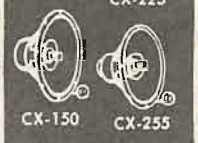

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An Improved Loudness Control

J. P. WENTWORTH

While many music lovers and hi-fi enthusiasts would not be caught dead with a loudness control, there are at least as many more who wouldn't do without one. For them as likes 'em, here is a new arrangement with several advantages.

THERE HAS BEEN MUCH discussion of the relative merits of the loudness control, in which the signal level is varied in accordance with the Fletcher-Munson subjective loudness curves, as compared with the simple gain control, which raises or lowers the signal level an equal amount at all frequencies. It is not the author's intention to reopen the controversy at this time. The purpose of this paper is to present, for those who favor the use of a loudness control, an improved circuit that gives a good approximation to the Fletcher-Munson curves, while using less expensive or complicated components than any other such circuit the author has seen.

Continuously-variable loudness control circuits published to date usually depend on the use of either a tapped potentiometer or a special control made up of several potentiometer elements on a single shaft.[1,2,3] As a result, such controls tend to be expensive and of limited flexibility, and to present other serious disadvantages, such as an appreciable insertion loss, a variation in the impedance presented to the previous stage, a lack of mechanical strength, or the like. Furthermore, because they include several moving parts, or, in the case of the multitapped control, a rather complicated mechanical arrangement, maintenance troubles are multiplied.

The circuit shown in *Fig.* 1 includes only one moving part—an ordinary single-section potentiometer, with no taps. All of the other components are standard low-cost resistors and capacitors. The frequency-response curves of this circuit are shown in *Fig.* 2 (solid curves). As may be seen by comparison with the dashed Fletcher-Munson curves, the output is very well matched to the response of the average human ear over a 40-db variation in sound level.

Other features of this type of circuit which compare favorably with conventional circuits are: (1) it introduces no insertion loss, and (2) the impedance it presents to the previous stage does not vary with the setting of the control.

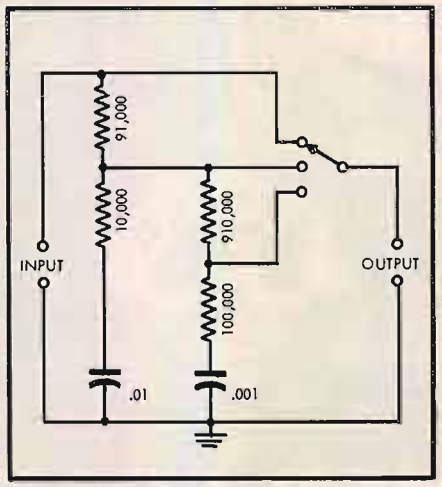

Fig. 1. Schematic diagram of the author's improved loudness control.

Because the variable element in the control is a simple potentiometer, this configuration lends itself to a flexibility of operation that is not possible to other circuits. For example, the potentiometer can be replaced by the combination of a fixed resistor and a vacuum-tube resistance element. Then, since the setting of the control can be varied by adjusting a direct voltage, the loudness-control effect can be obtained with remote control, automatic volume control, or compressor/expander operation. Various other applications might be devised by using fixed resistors in conjunction with other types of variable resistance elements, such as varistors or thermistors. Care should be taken in such applications, however, not to introduce large amounts of phase shift or distortion in the control circuit, as the shape of the over-all response curves depends greatly on the phase relationships within the circuit.

Principle of Operation

The principles of operation of the control can be more easily understood if the circuit is considered in three parts. The frequency response of the two-stage integrating (low-pass) network made up of R_1, R_2, R_3, R_4, and the two capacitors is shown in *Fig.* 3. The output of this circuit is added to the output of the potentiometer via the summing network consisting of R_5 and R_6. However, since the two summed outputs are not in phase with each other, the voltages do not add directly, but in such manner as to produce the response curves given in *Fig.* 2.

Another feature of the circuit is that it can easily be converted to a conventional gain control, merely by breaking the circuit at point "A" (*Fig.* 1). It might well be argued that such a feature is of doubtful utility, since this circuit, like all loudness controls should be operated with an auxiliary level control, which is used to set the over-all signal

like all loudness controls should be operated with an auxiliary level control, which is used to set the over-all signal

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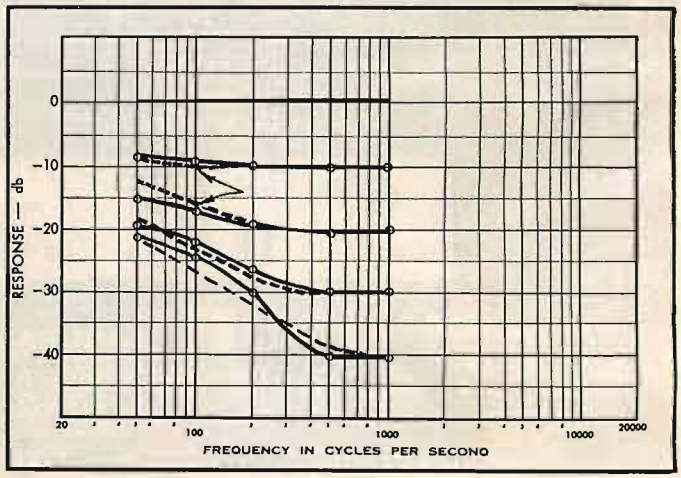

Fig. 2. Frequency response curve for the circuit shown in Fig. 1.

* *American Consulate, Medellin, Colombia*

1 E. E. Johnson, "A continuously variable loudness control." AUDIO ENGINEERING, December, 1950.

2 Ray C. Williams, "A feedback loudness control." *Radio & Television News*, March, 1954.

3 J. W. Turner, "Construction details of a continuously variable loudness control." AUDIO ENGINEERING, October, 1949.

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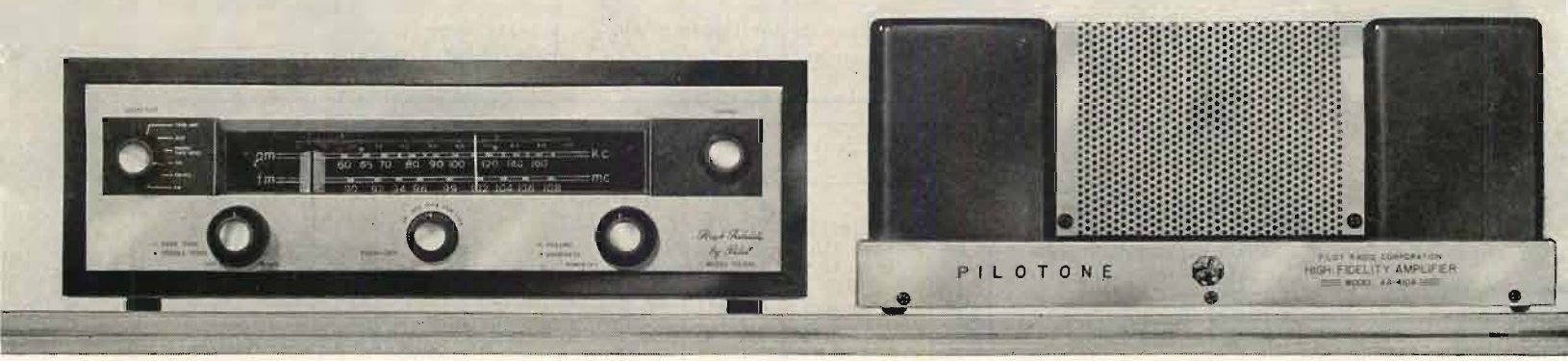

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Loudness, Its Definition, Measurement and Calculation

HARVEY FLETCHER and W. A. MUNSON

Part III

FROM THE ARCHIVES OF BELL TELEPHONE LABORATORIES

The values of b_k can be computed from this equation from the observed values of L and L_k by using the values of G given in Table III. Because of the difficulty in obtaining accurate values of L and L_k such computed values of b_k will be rather inaccurate. Consequently, considerable freedom is left in choosing a simple formula which will represent the results. When the values of b_k derived in this way were plotted with b_k as ordinates and Δf as abscissae and L_k as a variable parameter then the resulting graphs were a series of straight lines going through the common point (– 250, 0) but having slopes depending upon L_k. Consequently the following formula

$$b_k = [(250 + \Delta f)/1000]\, Q(L_k) \qquad (17)$$

will represent the results. The quantity Δf is the common difference in frequency between the components, L_k the loudness level of each component, and Q a function depending upon L_k. The results indicated that Q could be represented by the curve in *Fig.* 11.

Also the condition must be imposed upon this equation that b is always taken as unity whenever the calculation gives values greater than unity. The solid curves shown in *Fig.* 10 are actually calculated curves using these equations, so the comparison of these curves with the observed points gives an indication of how well this equation fits the data. For this series of tones Q could be made to depend upon β_k rather than L_k and approximately the same results would be obtained since β_k and L_k are nearly equal in this range of frequencies. However, for tones having low intensities and low frequencies, β_k will be much larger than L_k and consequently Q will be smaller and hence the calculated loudness smaller. The results in *Figs.* 8 and 9 are just contrary to this. To make the calculated and observed results agree with these two sets of data, Q was made to depend upon

$$x = \beta + 30 \log f - 95$$

instead of L_k.

It was found when using this function of β and f as an abscissa and the same ordinates as in *Fig.* 10, a value of Q was obtained which gives just as good a fit for the data of *Fig.* 10 and also gives a better fit for the data of *Figs.* 8 and 9. Other much more complicated factors were tried to make the observed and calculated results shown in these two figures come into better agreement but none were more satisfactory than the simple procedure outlined above. For purpose of calculation the values of Q are tabulated in Table VI.

There are reasons based upon the mechanics of hearing for treating components which are very close together by a separate method. When they are close together the combination must act as though the energy were all in a single component, since the components act upon approximately the same set of nerve terminals. For this reason it seems logical to combine them by the energy law and treat the combination as a single frequency. That some such procedure is necessary is shown from the absurdities into which one is led when one tries to make Eq. (17) applicable to all cases. For example, if 100 components were crowded into a 1000-cps space about a 1000-cps tone, then it is

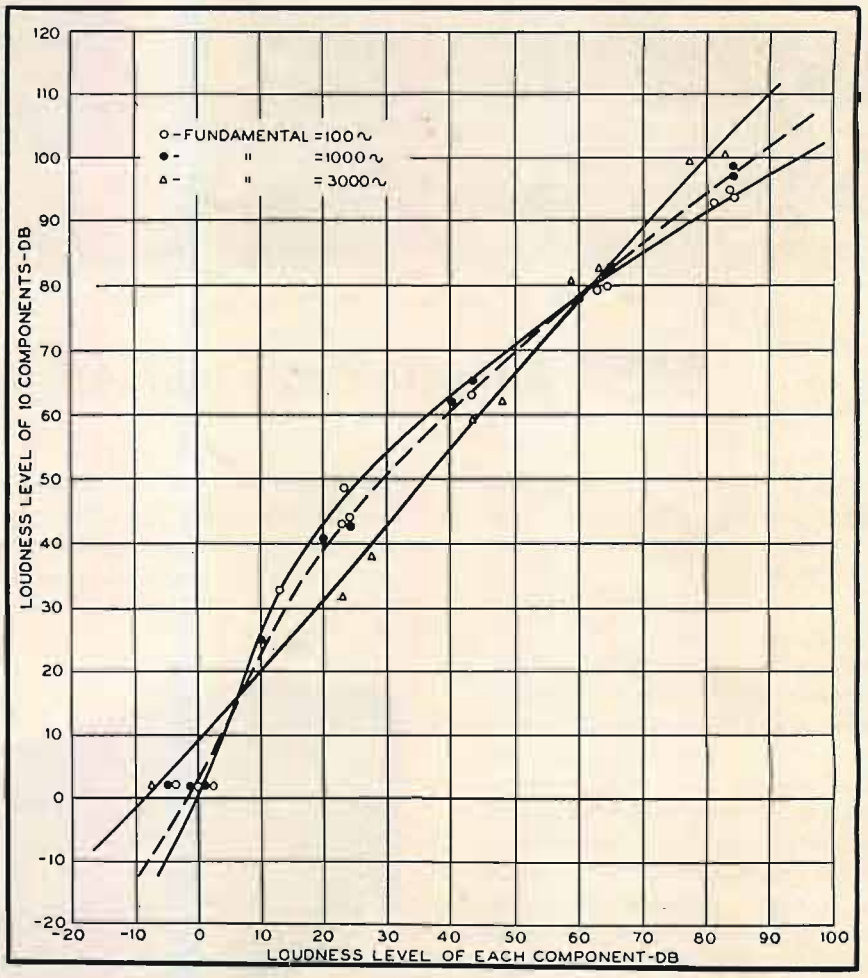

Fig. 8. Loudness levels of complex tones having ten equally loud components 50 cps apart.

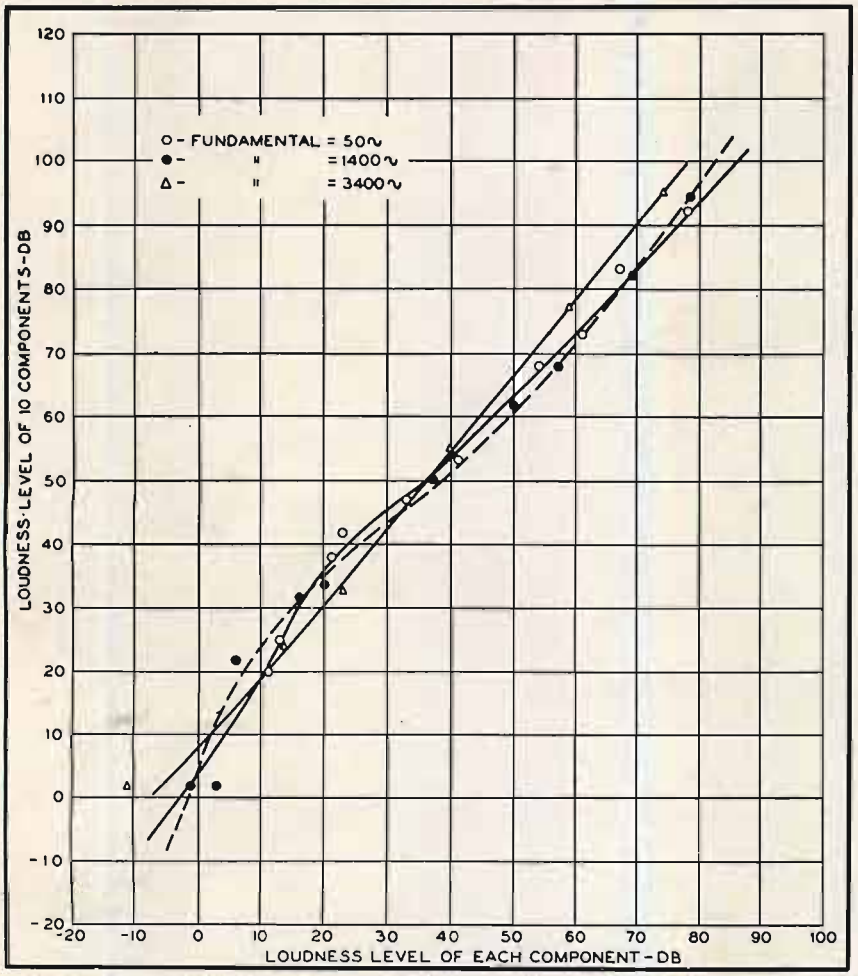

Fig. 9. Loudness levels of complex tones having ten equally loud components 100 cps apart.

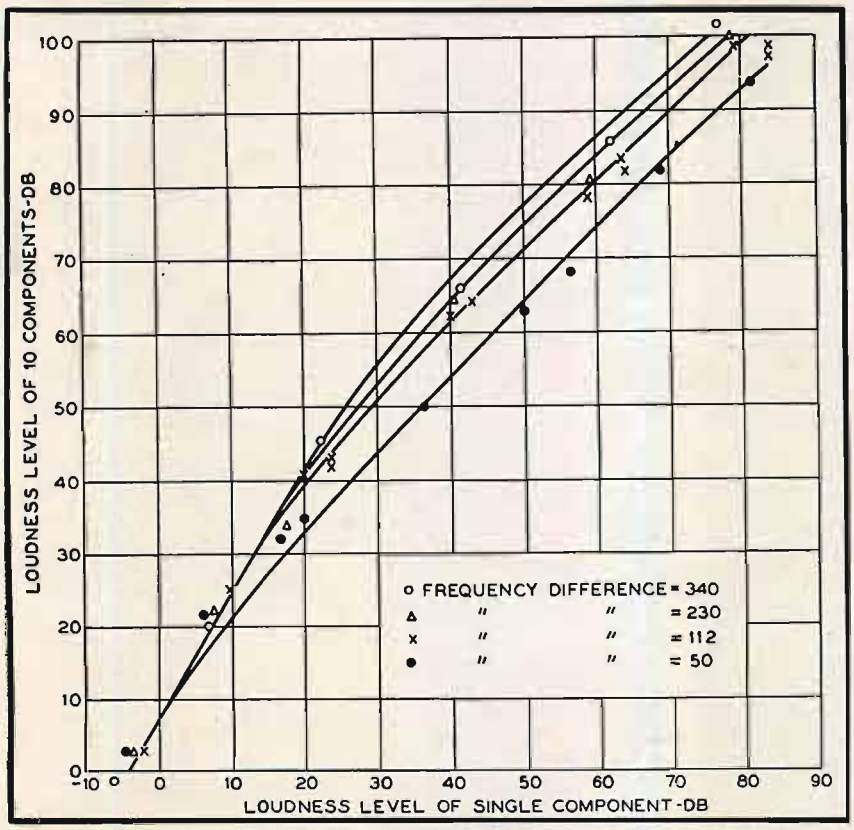

Fig. 10. Loudness levels of complex tones having ten equally loud components with a fundamental frequency of 1000 cps.

obvious that the combination should sound about 20 db louder. But according to Eq. (*10*) to make this true for values of L_k greater than 45, b_k must be chosen as 0.036. Similarly, for 10 tones thus crowded together $L - L_k$ must be about 10 db and therefore $b_k = 0.13$ and then for two such tones $L - L_k$ must be 3 db and the corresponding value of $b_k = 0.26$. These three values must belong to the same condition $\Delta f = 10$. It is evident then that the formulae for b given by Eq. (*17*) will lead to very erroneous results for such components.

In order to cover such cases it was necessary to group together all components within a certain frequency band and treat them as a single component. Since there was no definite criterion for determining accurately what these limiting bands should be, several were tried and ones selected which gave the best agreement between computed and observed results. The following band widths were finally chosen:

For frequencies below 2000 cps, the band width is 100 cps; for frequencies between 2000 and 4000 cps, the band width is 200 cps; for frequencies between 4000 and 8000 cps, the band width is 400 cps; and for frequencies between 8000 and 16,000 cps, the band width is 800 cps. If there are k components within one of these limiting bands, the intensity I taken for the equivalent single frequency component is given by

$$I = \Sigma I_k = \Sigma 10^{\beta_k/10} \qquad (18)$$

A frequency must be assigned to the combination. It seems reasonable to assign a weighted value of f given by the equation

$$f = \Sigma f_k I_k / I = \Sigma f_k 10^{\beta_k/10} / \Sigma 10^{\beta/10} \qquad (19)$$

Only a small error will be introduced if the midfrequency of such bands be taken as the frequency of an equivalent component except for the band of lowest frequency. Below 125 cps it is important that the frequency and intensity of each component be known, since in this region the loudness level L_k changes very rapidly with both changes in intensity and frequency. However, if the intensity for this band is lower than that for other bands, it will contribute little to the total loudness so that only a small error will be introduced by a wrong choice of frequency for the band.

This then gives a method of calculating b_k when the adjacent components are equal in loudness. When they are not equal let us define the difference ΔL by

$$\Delta L = L_k - L_m. \qquad (20)$$

Also let this difference be T when L_m is adjusted so that the masking component just masks the component k. Then the function for calculating b must satisfy the following conditions:

$b_k = [(250 + \Delta f)/1000]Q$ when $\Delta L = 0$,
$b_k = 0$ when $\Delta L = -T$.

to many accidental jabs, are going to be quadrupled in effect—and so in danger. Even in a special arm such as Pickering's own Unipoise the ½-mil tip is pretty risky. The 0.7 tip is OK, with caution, and will do a good job.

3. UNIPOISE

The special Pickering Unipoise arm is designed, as the name implies, around a single point of support—and is it a point! A sharp upward-thrusting needle holds the entire arm-and-cartridge, like a circus athlete holding his lady friend in mid air by one upraised arm. It just balances, as does she.

I've tried this arm, on and off, for a number of months. Given the basic premise, one-point support from a needle bearing, the design is a logically flowing development. But, if this is the way it must be, I personally am not too happy about the principle, however fine it may be in the theoretical aspects. I am frankly afraid of that needle point, which is dreadfully sharp and easily exposed to flesh if the arm is moved off it. (The arm just sits on it, is not fastened down, comes off easily.) Moreover, my point soon bent double just at the extreme sharp tip—too fine a point—though in view of the leverage exerted I don't think this did any drastic harm. I was just as glad to have it slightly blunted, to tell the truth.

Like all high-quality light-weight arms, the Unipoise is delicate to use and must be handled carefully and in this respect I found its overhead finger lift easier to use accurately than the pushbutton on the Shure Dynetic arm, as already mentioned some time back. Delicacy in the using is an unavoidable part of fine performance now, and will be until we get an automatic arm or a satisfactory mechanical-lift system to put the arm in the groove without using clumsy fingers.

I also found, however, that the Unipoise is sensitive to the Canby Track Test, which is not be be confused in any way with the McProud tracking test. The McProud system subjects the arm to a 45-rpm record held against a standard spindle at the edge of its center-hole, so it weaves eccentrically and makes you cross eyed as you look at it. It also throws many a stylus—but not all—straight out of the grooves.

The Canby test is more down to earth; it is better known, informally, as the Loose Floorboard Test. You just walk around. I have lovely creaking floorboards in both my listening places and, necessarily, all my equipment gets exposed to them at one time or another. Under the clomp-clomp test, an outrageous one to perpetrate on fine equipment I admit, the Unipoise jumped happily and skipped reams of music, doing no harm at all to the grooves thanks to its small mass. It obviously doesn't approve of loose floorboards and perhaps it is right; or its designers are. Such equipment is not intended for crass, gross, roughneck use. Even so. . . . Some people are going to have floorboard trouble until they build a new house or install a concrete pickup platform; it is a factor that has to be considered, and so must be reported on.

The semi-permauent head of the Unipoise is a built-in Fluxvalve though its shape is somewhat different from the regular unattached cartridge. It takes the standard Fluxvalve stylus inserts, easily and quickly. Again—an excellent idea.

4. PLUGS AND GRIPES

The LP record is such a quality product now, compared to its state six or seven years ago, that by sheer contrast a number of minor items stand out rather annoyingly, as somewhat less than perfect compared to the record itself. I've got a couple of minor LP gripes on this score that I've been saving up, but before them I must first put in a plug for one feature that used to gripe me, until I was persuaded of its value—the inner bag or envelope that protects the record in its cardboard sleeve.

It seems to me clear now that the introduction of inner containers has done more for the quality of our records in actual use than any improvement in the record itself. Even unsealed containers, paper containers, wax paper. Better *any* container than no container, just the bare cardboard sleeve.

In order of choice, I find the thin paper protectors worst. They tear upon opening and are almost impossible to use again, so the record goes back into its container naked. The heavier paper slip-in envelopes are easy to use and offer moderate protection, though not enough. At least they are sturdy enough to go back into the cardboard sleeve without ripping—if you are careful.

Best, without a doubt is the polyethylene plastic bag, I have reluctantly decided. Reluctantly because for a long while I was so annoyed by the clumsiness of these stretchy things with the curved bottoms that I took to tearing them furiously off my new records. I also disliked the ragged frieze of plastic that sticks out of the record sleeve, and still do.

But gradually I have come to realize that records which stay in the plastic remain fresh and clean while those in plain cardboard usually come out scratched and gritty next time I use them. Cardboard containers are deadly grit-collectors. The plastic somehow manages to cushion whatever small amount of grit and dust manages to get by—it isn't much because of the peculiar "sticky," rubbery feel of the stuff, and its ability to cling to itself for a tight seal.

I finally got so I could put records into these plastic bags without losing my temper at the silly things. In inexperienced hands they tend to bind and grab, refusing to go over the record, until you rip them apart in sheer fury.

The Canby method of getting records into plastic bags:

1. Take the bag by one extreme upper corner with a thumb and forefinger, the finger just inside the opening.

2. Stretch the opening out with the other hand, then dangle the bag diagonally with the opening towards you.

3. Take the record up in the other hand and slide it a couple of inches, then *pull down* on it, against the lower end of the opening to draw it tight.

4. "Roll" the record in, along the lower side of the bag, slipping it past the thumb and forefinger, until it hits the curved bottom.

5. Pull the bag up tight by shaking it from the two top corners, one in each thumb-and-forefinger.

—All of which takes only a couple of seconds to do in spite of the long description.

Ideally, the bag should go into the cardboa sleeve with the opening down, to seal out dirt, but I defy you to get most of them in that way without pushing the plastic back in a tangle—like pyjamas in insomnia—leaving a hump a half-inch thick inside. Better to put them in the other way and get them flat.

So—now I not only keep all my plastic bags but I have finally opened up a couple of packages of extra ones sent to be a

(*Continued on page 54*)

warped records!

time or another. Under the clomp-clomp

3. Take the record up in the other hand

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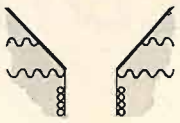

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Exclusive, massive flux-contoured 6 pound Gold Dot Alnico 5 magnet provides efficient power drive for deepest low frequencies, free of transient distortion.

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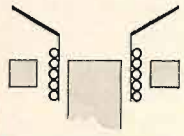

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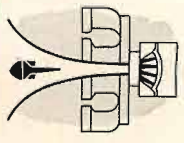
True through-axial construction permits balanced tweeter, mid-range and woofer acoustic integration without design compromise.

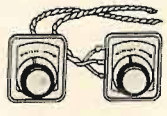


Exclusive hypersonic tweeter incorporating radial phasing equalizer automatically balances all high frequencies for smooth, realistic reproduction.

Exclusive "reciprocating-flare" horn now has wave front equalizer for more uniform wide-angle treble coverage.

Exclusive multi-sectional Diffusicone provides controlled diffraction for linear mid-range response and dispersion.

Continuously variable dual control network integrates and blends mid-range and tweeter for concert realism regardless of room acoustics.



Response: 25 cps to inaudibility; **Power capacity:** 50 watts, integrated program; **Total magnet wt.:** 6½ lbs. Alnico 5; **Impedance:** 8-16 ohms; **Depth:** 12"; **User net:** $156.00.

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HIGH FIDELITY

EDITOR'S REVIEW

STEREO BOXSCORE

DECEMBER, 1957, will probably be remembered as the month of stereo announcements, since both Fairchild and Pickering held demonstrations of pickups and one record manufacturer announced the first commercially available stereo record.

Viewed with mixed reaction throughout the record and hi-fi industries, the Audio Fidelity announcement of this record came as a complete surprise. Within a week practically everyone in the industry who has any stake in phonograph equipment had his copy of this disc—though relatively few could play it, at least publicly. Unofficially, most pickup manufacturers are and have been working on new pickups, and undoubtedly most have arrived at a design which may need only some final polishing to be ready to put into production. However, with no decision from the record industry as to what system will be adopted, no one would be inclined to go into full-scale production.

At the studios of WQXR in New York, a demonstration of the potentialities of stereo—as a whole, not only disc records—was staged on December 13 by Anton Schmitt and Jimmy Carroll of Harvey Radio Company and Chester Santon of WQXR's staff. After discussion of equipment necessary and the playing of several new tape releases, the Fairchild Stereo Cartridge was shown and demonstrated. Fairchild had announced the $250 cartridge a week previous. It is a moving-coil unit designed for the Westrex system, and performance would be judged as commercially satisfactory.

On December 16, Pickering and Company released an announcement which stated that the company had completed tests of the new "Stanton 45 × 45" stereo cartridge and was ready to put the new pickup into production as soon as the industry announced its intention to produce stereo discs. On December 19, Pickering and Company held a press conference and demonstrated the new cartridge. Walter Stanton, Pickering president and inventor of the Fluxvalve pickup, stated that the recent activity in stereo discs could be construed by the public as an indication that stereo discs are here and can be purchased in the near future, but that "in this age of rapid communication such activity is always widely publicized and is not a definite indication that stereo discs are soon to be on the shelves in record shops." Basically, therefore, although Pickering & Company has a stereo-pickup design completed, it does not intend to make the units commercially available until the records are ready for the purchaser.

For the greatest benefit to all in the industry—both record and hi-fi—it would have been far better if this entire development had been kept under wraps until it was a *fait accompli*. But, to mix metaphors, the cat has got out of the bag and is now among the pigeons, so we have to make the best of it. Automobile manufacturers learned—biggest lesson was in 1928 when the Model A Ford was introduced—that you do not show a new model until your distributors have warehouses full of them so they can take advantage of the immediacy of customer reaction. Better we should have kept quiet until we were ready to go.

However, we can't help but thank Boy Genius Sidney Frey, president of Audio Fidelity, for making it possible for the experimenter to have a record to play with, even though this same experimenter may not be able to play it. Maybe he'll figure out a method. We did.

WELCOME TO THE ARENA

To the best of our knowledge AUDIO was the first magazine in the high-fidelity industry to take open issue with the findings of some of the so-called consumer service organizations. And so, it is with understandable gratification that we acknowledge the efforts of another publication to erase the halo of infallibility which some of these groups claim for themselves.

At a recent press conference in New York attended by the editors of leading electronic periodicals and by representatives of trade organizations, Albert J. Forman, editor of *Electronic Technician,* announced the conclusion of a project which should capture the interest of every audio engineer and hobbyist.

Mr. Forman and his co-editors set out to double-check the findings of one of the aforementioned groups. In selecting equipment for test they chose items which ran the gamut from unacceptability to highest approval, according to you guess who.

Conducted in one of the country's best-equipped laboratories by a group of engineers with no commercial interest in the gear being analyzed, the tests reflected substantial disagreement with certain data published recently.

The entire report on the tests is far too lengthy for inclusion here. Suffice to say they were conducted with meticulous attention to sound engineering practice. The resultant conclusions indicate either a lack of technical competence, practical judgment, or both, on the part of the self-styled consumer service group.

In his report on the *Electronic Technician* tests, Mr. Forman states: "It is of interest to note that we asked (this organization) to show us their original lab report and testing facilities, since we wanted to duplicate their procedures and equipment. Our request was refused."

At the risk of being repetitious we are going to fall back on our original statement on this matter which appeared in the April issue of AUDIO: "We feel that the lack of responsibility shown by some of the so-called consumer service organizations should merit nothing but contempt for their findings."

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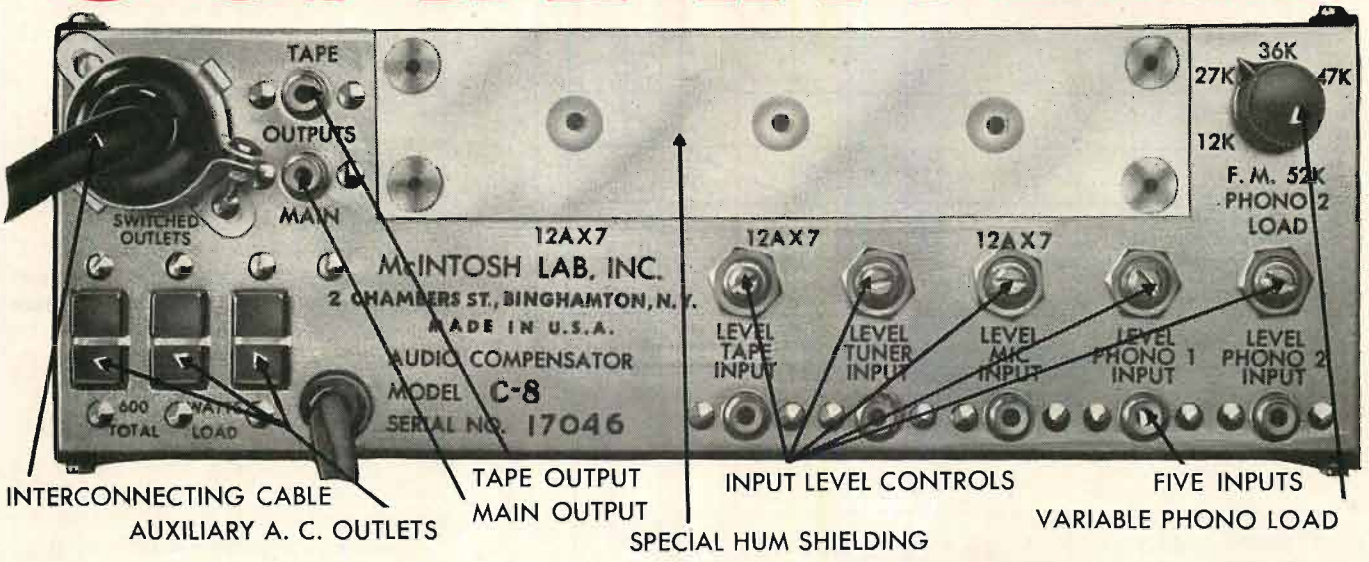

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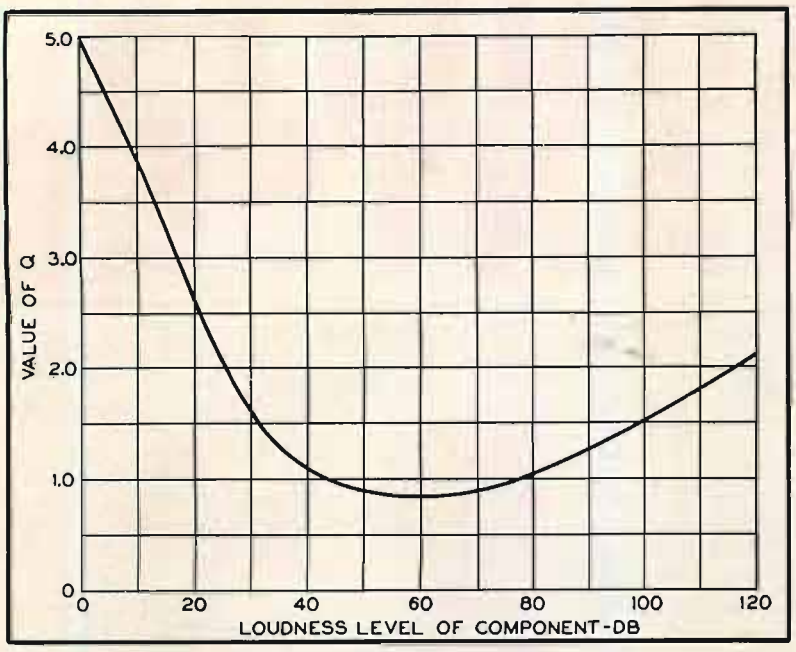

Fig. 11. Loudness factor "Q."

TABLE VI

VALUES OF $Q(X)$

X	0	1	2	3	4	5	6	7	8	9
0	5.00	4.88	4.76	4.64	4.53	4.41	4.29	4.17	4.05	3.94
10	3.82	3.70	3.58	3.46	3.35	3.33	3.11	2.99	2.87	2.76
20	2.64	2.52	2.40	2.28	2.16	2.05	1.95	1.85	1.76	1.68
30	1.60	1.53	1.47	1.40	1.35	1.30	1.25	1.20	1.16	1.13
40	1.09	1.06	1.03	1.01	0.99	0.97	0.95	0.94	0.92	0.91
50	0.90	0.90	0.89	0.89	0.88	0.88	0.88	0.88	0.88	0.88
60	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.89	0.89	0.90
70	0.90	0.91	0.92	0.93	0.94	0.96	0.97	0.99	1.00	1.02
80	1.04	1.06	1.08	1.10	1.13	1.15	1.17	1.19	1.22	1.24
90	1.27	1.29	1.31	1.34	1.36	1.39	1.41	1.44	1.46	1.48
100	1.51	1.53	1.55	1.58	1.60	1.62	1.64	1.67	1.69	1.71

Note: $X = \beta_k + 30 \log f_k - 95$.

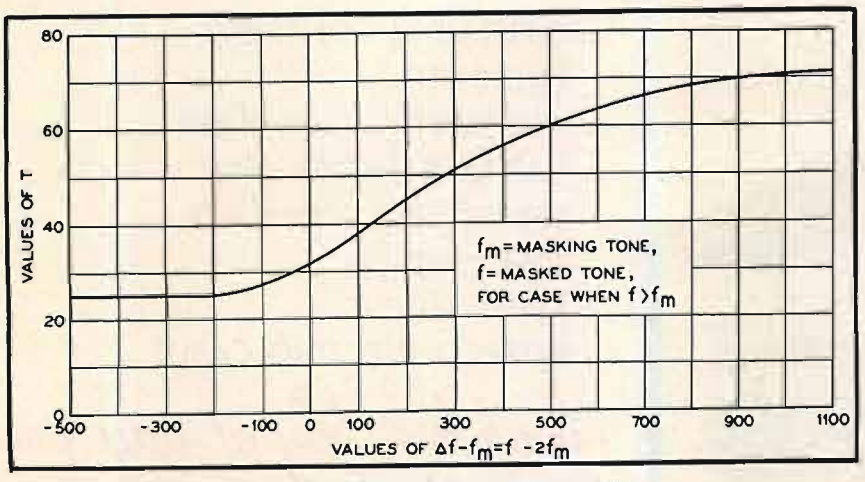

Fig. 12. Values of the masking "T."

COMPUTATIONS

k	f_k	β_k	L_k	G_k	b_k	
1	60	50	3	3	1.0	
2	180	45	25	197	1.0	$\Sigma b_k G_k = 1009$
3	300	40	30	360	1.0	
4	540	30	27	252	1.0	$L = 40$
5	1200	25	25	197	1.0	

Also the following condition when L_k is larger than L_m must be satisfied, namely, $b_k = 1$ when ΔL = some value somewhat smaller than $+T$. The value of T can be obtained from masking curves. An examination of these data indicates that to a good approximation the value of T is dependent upon the single variable $f_k - 2f_m$. A curve showing the relation between T and this variable is shown in *Fig.* 12. It will be seen that for most practical cases the value of T is 25. It cannot be claimed that the curve of *Fig.* 12 is an accurate representation of the masking data, but it is sufficiently accurate for the purpose of loudness calculation since rather large changes in T will produce a very slight change in the final calculated loudness level.

Data were taken in an effort to determine how this function depended upon ΔL but it was not possible to obtain sufficient accuracy in the experimental results. The difference between the resultant loudness level when half the tones are down so as not to contribute to loudness and when these are equal is not more than 4 or 5 db, which is not much more than the observational errors in such results.

A series of tests were made with tones similar to those used to obtain the results shown in *Figs.* 8 and 9 except that every other component was down in loudness level 5 db. Also a second series was made in which every other component was down 10 db. Although these data were not used in determining the function described above, it was useful as a check on the final equations derived for calculating the loudness of tones of this sort.

The factor finally chosen for representing the dependence of b_k upon ΔL is $10^{\Delta L/T}$. This factor is unity for $\Delta L = 0$, fulfilling the first condition mentioned above. It is 0.10 instead of zero for $\Delta L = -25$, the most probable value of T. For $\Delta f = 100$ and $Q = 0.88$ we will obtain the smallest value of b_k without applying the ΔL factor, namely, *0.31*. Then when using this factor as given above, all values of b_k will be unity for values of ΔL greater than 12 db.

Several more complicated functions of ΔL were tried but none of them gave results showing a better agreement with the experimental values than the function chosen above.

The formula for calculation of b_k then becomes

$$b_k = [(250 + f_k - f_m)/1000]\, 10^{(L_k - L_m)/T} Q\,(\beta_k + 30 \log f_k - 95) \quad (21)$$

where

f_k is the frequency of the component expressed in cycles per second,

f_m is the frequency of the masking component expressed in cycles per second,

L_k is the loudness level of the kth com-

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COMPUTATIONS

k	f_k	β_k	L_k	G_k	f_m	L_m	(30 log f_k − 95)	Q	b	$b \times G$
1	60	80	69	7440	—	—	—	—	1.00	7440
2	180	75	72	9130	60	69	−28	0.91	0.41	3740
3	300	70	69	7440	180	72	−21	0.91	0.27	2010
4	540	60	60	4350	300	69	−13	0.94	0.23	1000
5	1200	55	55	3080	540	60	− 3	0.89	0.61	1880

loudness G = 16070
loudness level L = 79 db

TABLE VII

TWO COMPONENT TONES ($\Delta L = 0$)

Frequency Range	Δf	Loudness Levels (db)					
1000–1100	100	L_k	83	63	43	23	2
		$L_{obs.}$	87	68	47	28	2
		$L_{calc.}$	87	68	47	28	4
1000–2000	1000	L_k	83	63	43	23	−1
		$L_{obs.}$	89	71	49	28	2
		$L_{calc.}$	91	74	52	28	1
125–1000	875	L_k	84				
		$L_{obs.}$	92				
		$L_{calc.}$	92				

TABLE VIII

TEN COMPONENT TONES ($\Delta L = 0$)

Frequency Range	Δf	Loudness Levels (db)									
50–500	50	L_k	67	54	33	21	11	−1			
		$L_{obs.}$	83	68	47	38	20	2			
		$L_{calc.}$	81	72	53	39	24	8			
50–500	50	L_k	78	61	41	23	13	−1			
		$L_{obs.}$	92	73	53	42	25	2			
		$L_{calc.}$	91	77	60	42	27	8			
1400–1895	55	L_k	78	69	50	16	6	−1			
		$L_{obs.}$	94	82	62	32	22	2			
		$L_{calc.}$	93	83	65	31	17	0			
1400–1895	55	L_k	57	37	20	3					
		$L_{obs.}$	68	50	34	2					
		$L_{calc.}$	73	52	36	5					
100–1000	100	L_k	84	64	43	24	2	84	64	43	24	2
		$L_{obs.}$	95	83	59	41	2	94	80	63	44	2
		$L_{calc.}$	100	83	68	47	12	100	83	68	47	12
100–1000	100	L_k	81	64	43	23	13	−4				
		$L_{obs.}$	93	82	65	49	33	2				
		$L_{calc.}$	98	83	68	45	27	3				
100–1000	100	L_k	83	63	43	23	0					
		$L_{obs.}$	95	79	59	43	2					
		$L_{calc.}$	99	82	68	45	9					
3100–3900	100	L_k	83	63	43	23	78	59	48	27	−7	
		$L_{obs.}$	100	82	59	32	99	81	62	38	2	
		$L_{calc.}$	100	80	60	38	95	77	65	42	0	
1100–3170	230	L_k	79	60	41	17	7	−4				
		$L_{obs.}$	100	81	65	33	22	2				
		$L_{calc.}$	100	83	64	34	18	3				
260–2600	260	L_k	79	62	42	23	13	−2				
		$L_{obs.}$	97	82	65	44	28	2				
		$L_{calc.}$	100	85	68	45	27	5				
530–5300	530	L_k	75	53	43	25	82	61	43	17	−2	
		$L_{obs.}$	100	83	73	52	105	90	73	40	2	
		$L_{calc.}$	101	82	72	48	108	89	72	34	5	
530–5300	530	L_k	61	41	21	−3						
		$L_{obs.}$	89	69	45	2						
		$L_{calc.}$	89	70	42	4						
100–1000	100	$L_{obs.}$	93	82	65	49	33	2				

ponent when sounding alone,

L_m is the loudness level of the masking tone,

Q is a function depending upon the intensity level β_k and the frequency f_k of each component and is given in Table VI as a function of $x = \beta_k + 30 \log f_k - 95$,

T is the masking and is given by the curve of *Fig.* 12.

It is important to remember *that b_k can never be greater than unity so that all calculated values greater than this must be replaced with values equal to unity.* Also all components *within the limiting frequency bands must be grouped together as indicated above.* It is very helpful to remember that any component for which the loudness level is 12 db below the kth component, that is, the one for which b is being calculated, need not be considered as possibly being the masking component. If all the components preceding the kth are in this class then b_k is unity.

RECAPITULATION

With these limitations the formula for calculating the loudness level L of a steady complex tone having n components is

$$G(L) = \sum_{k=1}^{k=n} b_k G(L_k), \qquad (10)$$

where b_k is given by Eq. (*21*). If the values of f_k and β_k are measured directly then corresponding values of L_k can be found from *Fig.* 5. Having these values, the masking component can be found either by inspection or better by trial in Eq. (*21*). That component whose values of L_m, f_m and T introduced into this equation gives the smallest value of b_k is the masking component.

The values of G and Q can be found from Tables III and VI from the corresponding values of L_k, β_k, and f_k. If all these values are now introduced into Eq. (*10*), the resulting value of the summation is the *loudness* of the complex tone. The loudness level L corresponding to it is found from Table III.

If it is desired to know the loudness obtained if the typical listener used only one ear, the result will be obtained if the summation indicated in Eq. (*10*) is divided by 2. Practically the same result will be obtained in most instances if the loudness level L_k for each component when listened to with one ear instead of both ears is inserted in Eq. (*10*). [$G(L_k)$ for one ear listening is equal to one half $G(L_k)$ for listening with both ears for the same value of the intensity level of the component.] If two complex tones are listened to, one in one ear and one in the other, it would be expected that the combined loudness would be the sum of the two loudness values calculated for each ear as though no sound

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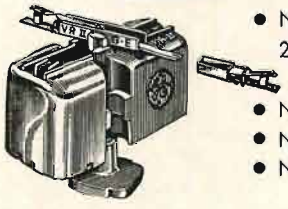

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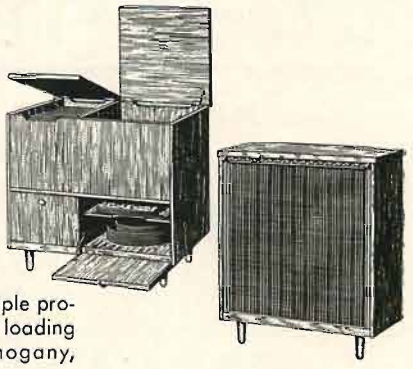

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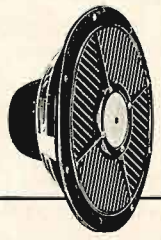

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TABLE IX

ELEVEN COMPONENT TONES ($\Delta L = 0$)

Frequency Range	Δf	Loudness Levels (db)						
1000–2000	100	L_k	84	64	43	24	−1	
		$L_{obs.}$	97	83	65	43	2	
		$L_{calc.}$	103	84	64	45	7	
1000–2000	100	L_k	84	64	43	24	1	
		$L_{obs.}$	99	82	65	42	2	
		$L_{calc.}$	103	84	64	45	11	
1150–2270	112	L_k	79	60	40	20	10	−5
		$L_{obs.}$	99	78	62	41	25	2
		$L_{calc.}$	98	81	61	40	23	1
1120–4520	340	L_k	77	62	42	22	7	−7
		$L_{obs.}$	102	86	66	46	20	2
		$L_{calc.}$	101	88	69	44	19	−1

TABLE X

TEN COMPONENT TONES ($\Delta L = 5$ db)

Frequency Range	Δf	Loudness Levels (db)						
1725–2220	55	L_k	82	62	43	27	17	−6
		$L_{obs.}$	101	73	54	38	30	2
		$L_{calc.}$	95	76	56	40	30	−1
1725–2220	55	L_k	80	62	42	22	12	−2
		$L_{obs.}$	94	66	50	33	22	2
		$L_{calc.}$	93	76	54	35	22	4

TABLE XI

ELEVEN COMPONENT TONES ($\Delta L = 5$ db).

Frequency Range	Δf	Loudness Levels (db)						
57–627	57	L_k	79	61	41	26	16	1
		$L_{obs.}$	91	73	56	41	28	2
		$L_{calc.}$	90	76	59	43	28	8
3420–4020	60	L_k	76	61	42	25	15	−9
		$L_{obs.}$	95	77	55	33	25	2
		$L_{calc.}$	89	75	54	36	26	−4

TABLE XII

TEN COMPONENT TONES ($\Delta L = 10$ db)

Frequency Range	Δf	Loudness Levels (db)						
1725–2220	55	L_k	79	59	40	19	9	−5
		$L_{obs.}$	95	71	54	33	22	2
		$L_{calc.}$	91	73	51	31	17	−1
1725–2220	55	L_k	79	61	41	27	17	−1
		$L_{obs.}$	89	67	48	37	27	2
		$L_{calc.}$	92	75	53	39	28	4

TABLE XIII

ELEVEN COMPONENT TONES ($\Delta L = 10$ db)

Frequency Range	Δf	Loudness Levels (db)						
57–627	57	L_k	80	62	42	27	17	2
		$L_{obs.}$	88	70	53	40	27	2
		$L_{calc.}$	90	76	59	45	30	8
3420–4020	60	L_k	81	62	42	27	17	−4
		$L_{obs.}$	100	70	50	33	26	2
		$L_{calc.}$	94	75	53	37	27	0

were in the opposite ear, although this has not been confirmed by experimental trial. In fact, the loudness reduction factor b_k has been derived from data taken with both ears only, so strictly speaking, its use is limited to this type of listening.

To illustrate the method of using the formula the loudness of two complex tones will be calculated. The first may represent the hum from a dynamo. Its components are given in the table of computations.

The first step is to find from *Fig.* 5 the values of L_k from f_k and β_k. Then the loudness values G_k are found from Table III. Since the values of L are low and the frequency separation fairly large, one familiar with these functions would readily see that the values of b would be unity and a computation would verify it so that the sum of the G values gives the total loudness 1009. This corresponds to a loudness level of 40.

The second tone calculated is this same hum amplified 30 db. It better illustrates the use of the formula.

The loudness level of the combined tones is only 7 db above the loudness level of the second component. If only one ear is used in listening, the loudness of this tone is one half, corresponding to a loudness level of 70 db.

COMPARISON OF OBSERVED AND CALCULATED RESULTS ON THE LOUDNESS LEVELS OF COMPLEX TONES

In order to show the agreement between observed loudness levels and levels calculated by means of the formula developed in the preceding sections, the results of a large number of tests are given here, including those from which the formula was derived. In Tables VII to XIII, the first column shows the frequency range over which the components of the tones were distributed, the figures being the frequencies of the first and last components. Several tones having two components were tested, but as the tables indicate, the majority of the tones had ten components. Because of a misunderstanding in the design of the apparatus for generating the latter tones, a number of them contained eleven components, so for purposes of identification, these are placed in a separate group. In the second column of the tables, next to the frequency range of the tones, the frequency difference (Δf) between adjacent components is given. The remainder of the data pertains to the loudness levels of the tones. Opposite L_k are given the common loudness levels to which *all the* components of the tone were adjusted for a particular test, and in the next line the results of the test, that is, the observed loudness levels ($L_{obs.}$), are given. Directly beneath each observed

(*Continued on page 68*)

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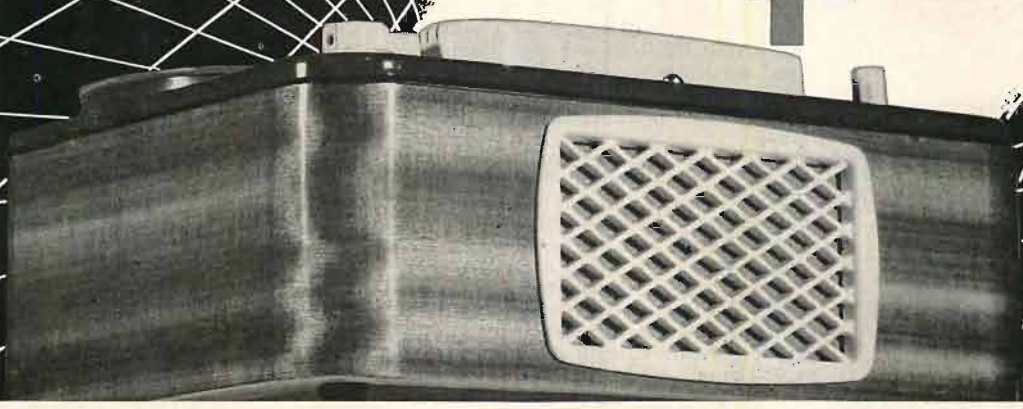

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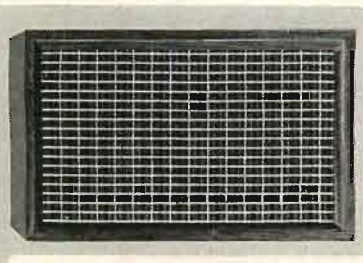

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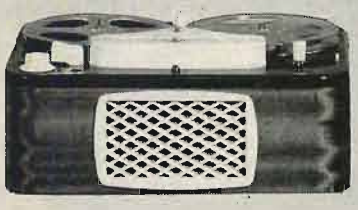

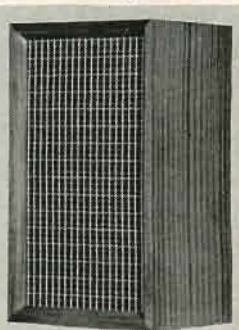

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Equipment Review

Pickering "Isophase" electrostatic loudspeaker—Heathkit Model W-6M 70-watt amplifier—Shure Model 330 "Unitron" and Model 430 "Commando" microphones.

PICKERING ISOPHASE LOUDSPEAKER

The first time we heard this model—at the 1955 audio show—we were considerably impressed with the quality of reproduction, which we described in the succeeding editorial as being like "a window on the studio." Like any new item, this speaker had both proponents and opponents, and during the past two years it has undergone several improvements, as would be expected, so that today it is a superb device. We have had the pleasure of living with the newest model for over a month, and we still believe that the quality of reproduction is about all that could be desired. In short, we are most enthusiastic about it.

Basically, of course, the electrostatic speaker is not a new device—one was on the market commercially in a console radio as far back as 1932 under the name "Peerless 'Kylectrou'" and was, for its time, a fairly good loudspeaker. We had a friend who owned one, and upon its periodic puncturing of the diaphragm he would go to the corner drug store and buy a small device manufactured by Klienerts and some chocolate bars manufactured by Hershey—those that were wrapped with very thin tinfoil. He would then cement the foil onto the rubber, replace the assembly into the speaker unit, and everything was fine again until another puncture.

As we recall it, this speaker was single-ended—that is, it did not employ an electrode on each side of the diaphragm. Modern electrostatics are push-pull, and the diaphragm is spaced between the two outside electrodes, as seen in *Fig.* 2. Advances in plastics make it possible to utilize a very thin diaphragm on which a metallic coating has been evaporated, resulting in greatly reduced mass, so that the spacing between the outer electrodes and the diaphragm is maintained by myriads of tiny "stand-off insulators," the electrodes being not unlike a flocked screen. The over-all area of the speaker diaphragm is 730 square inches, and the complete assembly is 36 iuches wide, 28 inches high, and 8½ inches deep.

Because of the large area—even at a practical spacing—the speaker has a capacitance of approximately .0025 μf, which is reflected at the input terminals of the divider as approximately 12.25 μf. This type of load can be troublesome with poorly designed amplifiers, but we have tried it with the 70-watt Heathkit described on the following page, with both Dynakit II and Dynakit III, with the Marantz power amplifier, and with a 65-watt Fairchild amplifier and performance has been satisfactory with all of these.

Earlier models of the Pickering Isophase were thought to be inefficient, and they were often coupled with inefficient woofers because of this. Present production has overcome this difficulty, and we are currently using the unit with the woofer of a United Speaker Systems' "Premiere"—which is an Altec 803, and of recognized high efficiency. The Pickering 401E divider, which also furnishes the polarizing voltage for the electrostatic unit, is equipped with an attenuator in the woofer circuit, but it is properly balanced with the attenuator at its maximum position, so the Isophase is essentially of the same efficiency as the Altec woofer.

The Isophase has a frequency range from 200 to 35,000 cps, and will accept the full power output of a 50-watt amplifier at 8 ohms without damaging the diaphragm, but we have never found it necessary to turn the volume up to that extent—and we like fairly high listening levels.

One feature we consider excellent is the provision of a phasing switch on the divider which permits reversing the relative phase of woofer and tweeter. This is much simpler than having to reverse the woofer leads physically at the termiual strip, and permits making rapid checks to determine the correct phasing position. Once set, of course, there is no need for change. The Isophase speaker and its associated 401E divider are designed to work from an 8-ohm amplifier tap. The crossover frequency is 500 cps, which is fixed in the divider. The divider utilizes a 1V2 rectifier tube to furnish the 1500-volt d.c. for polarizing, and the power requirement for the divider is only 10 watts so we find it simpler to leave the unit plugged into the a.c. line all the time, since the speaker is some distance from the amplifier and running an additional a.c. line is not convenient.

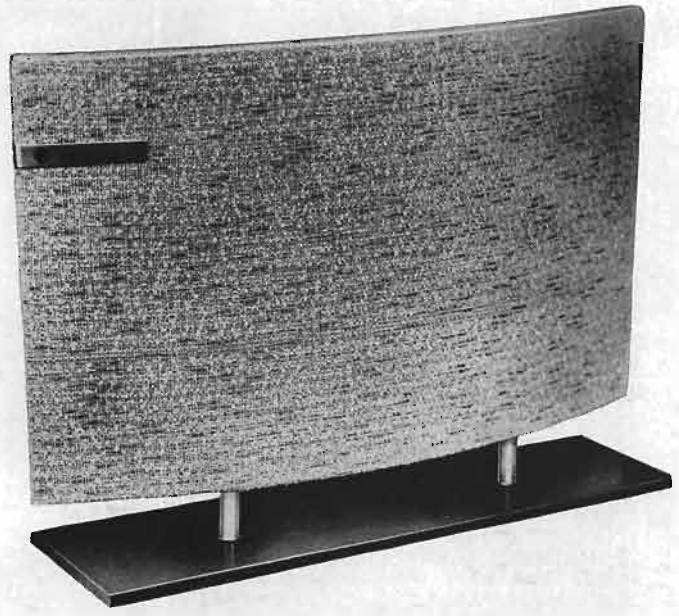


Fig. 1. The Pickering "Isophase" electrostatic loudspeaker.

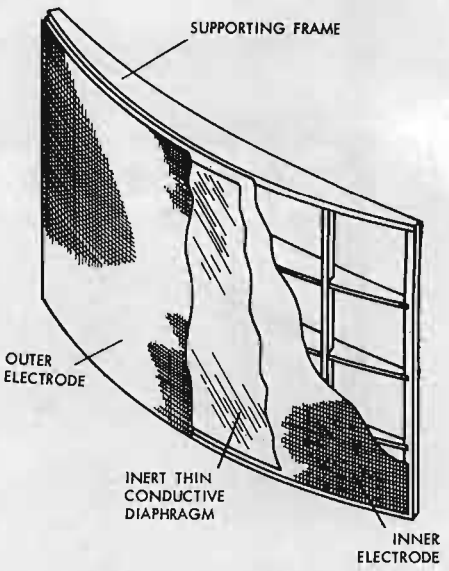


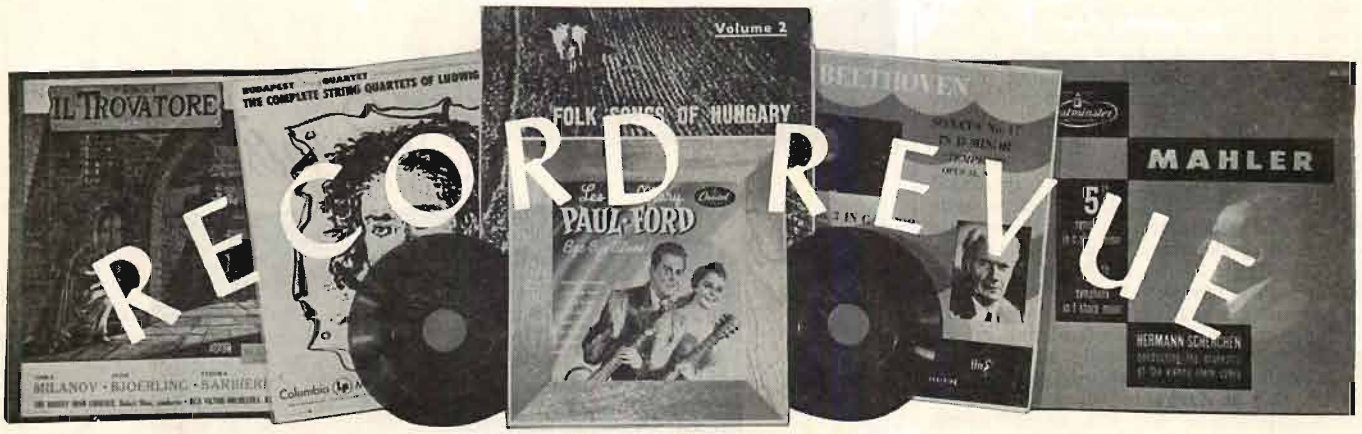
Fig. 2. Diagram of internal construction of the Isophase.

Performance

From the subjective standpoint, we have noted things on records which we had never heard before. With no claim for any stereophonic effect from the Isophase, it does appear to have a spacial quality which is hard to describe. As one moves around within the 55-degree pattern of the speaker, the sound seems to originate at varying parts of the diaphragm. Moving up close to the unit, with the ear practically against the grill cloth, one notes that the actual level does not appear to be very great. This is logical since the ear hears only a small portion of the diaphragm, and the small excursion of the diaphragm moves only a small amount of air at any given *point*. Because of the large surface, however, the over-all sound output is comparable with any other type of loudspeaker. We would not say that good performance is not attainable from conventional types of tweeters—we have been quite content with them for years. But if enough space is available for an Isophase, it is quite probable that the quality of reproduction may bring a new pleasure to listening. A-21

HEATHKIT W-6M AMPLIFIER

There was a time when the "home-built" amplifier was the only type available to the hi-fi enthusiast, because there were no factory-built models for this market. These amplifiers were also, in most instances, home-designed, and they did not *always* perform as their designers hoped. Now, of course, there are all sizes, types, and colors of amplifiers available as finished products, and all may be presumed to work satisfactorily from the first moment they are



EDWARD TATNALL CANBY*

1. ODDITIES

Around the Horn. Joseph Eger, French Horn, with others. **RCA Victor LM 2146**

This is a one-man exposition of the French horn's abilities that is also, quite unsuspectingly, a fine portrait of a typical "classical" orchestra man, complete with super dexterity upon the chosen instrument, a batch of very horny pieces and a hornish bias that has the entire musical world spinning about that instrument as though the rest of music were so much window dressing! A pardonable attitude, if one is to be a specialist and professional in these times; we have the same in other fields, if I may suggest it.

There's one complete and authentic orchestral work for horn here (though not for the modern valved instrument), a Concerto by Mozart, in which the horn playing, naturally, is highly competent, though the orchestra is perfunctory—it was probably sight-reading. There are a couple of short chamber works with horn and then the inevitable series of "arrangements," showing off the horn at the expense of other people's music, so to speak. Let the other people, the composers, turn in their graves or be amused; this is the horn's own heyday, from Schubert songs to Bartok piano pieces and a Gershwin Prelude! Also something called the Harmonica Player, if you can believe it.

Mr. Eger fills one band with his own commentary on music from the horn's-eye view, and does it well, with nice illustrations (using double recording, too) though with a typical professional slant in the argument. There is much, thus, about the insufficiencies of the old, non-valve horn and the versatility (illustrated) of the modern instrument but little about the qualities that led so many big composers to write for the "insufficient" horn, with its technically limited resources.

Is versatility always desirable, I kept thinking? That is the convention and it is the force behind the Electronic Music Synthesizer; but old Herr Brahms, who knew his music very well, persisted in writing for the valveless horn, in spite of the improved model, because he liked its limitations . . . Well, such paradoxes aren't the sort of thing you'd expert to find explored in this type of record and so I can't complain.

It's interesting that, though many classical instruments have found a new voice in jazz or pops—even the tuba—Mr. Eger's horn music doesn't offer anything more radical than the Gershwin Prelude, which isn't exactly modern jazz. Jazz, I guess, is for a different sort of horn.

Four First Recordings—Sonatas for Two Violins and Piano. (Telemann, Handel, Honegger, Milhaud.) Gerald and Wilfred Beal; Harriet Wingreen, pf., **Monitor MC 2008**

This pair of identical twins is perhaps the first in musical history to play twin fiddles and since they are both highly musical the results are unusual, in unexpected ways.

Identical twinism is always a bit strange; there is inevitably that odd feeling that in a sense we have only one person before us, not two. It is no coincidence that they look alike, dress alike, act alike, and even play fiddle alike. These two make a team so perfectly coordinated that we seem to be hearing one poly-violin, a single instrument played by a single person.

Now this is interesting—for in general the music that has been composed for two violins has been intended for two *different* fiddlers, to a considerable extent pitted against each other though working together; the assumption of two different personalities is taken for granted and is built into the music itself. Music of this sort, as in the Telemann and Handel works here, is rather surprisingly weakened by the lack of personality contrast. The more perfectly do the Beal twins play, the more deadening is the wet blanket effect! There just isn't that opposition, that challenge of difference, within the one style and the same piece, that brings life and vividness to the expression.

It suddenly struck me that we have experienced this same effect before—in the electronic duplication of parts by re-recording that is now so often accomplished, one player playing two or more parts. Heifetz did it 'way back with the Bach Two-Violin Concerto and the result was remarkably like that experienced here, a perfect but somebow colorless rendition, devoid of the required contrast. The Beal twins, with the best will in the world and plenty of musicianship, are the living embodiment of re-recorded duplication.

An extra fillip is given to this idea, however, by the two modern pieces on the Beal record. They were both composed for two violins operating in effect as one; four hands and eight strings applied to a single piece of musical fabric. In these the twins are no less than superb. For the life of you, you will not be able to tell them apart, nor feel that there are two people playing. There is only the one compound twin-violin, perfectly played. A very interesting record.

A Lincoln Album—Readings by Carl Sandburg. **Caedmon TC 2015 (2).**

One of the significant things that LP is doing today is to bring home to our very ears the ways in which styles change with the times—for though we ourselves march on as a people, the LP record pins us down, here and there, for posterity. Oddly enough, we are already to some extent that posterity.

Sandburg, for instance. He is a very old man now but as young in heart—and in voice—as he was tweuty or thirty years ago. He's been telling these same stories, singing the same songs, to audiences far and wide, for dozens of years and they're as good now as they ever were. He has a fine mike personality, a resonant delivery, and a sheer folksiness that makes his discourse fascinating to hear. Especially when he settles down for a long pull—and does Sandburg love to go on and on, whether in an endless after-dinner speech or on a pair of LP records!

You'll be delighted by this rambling collection of sentimental tales about Lincoln; but you'll see what I mean about posterity. This is a style of the past, about the past, out of a past America. I don't mean Lincoln's own time; I mean that great period, now in effect ended, when Lincoln was the overwhelming figure of a recent American history, when his war was THE great war and no other American war was imaginable, unless the earlier War of Independence. Sandburg speaks out of a time when Lincoln had no later rivals of importance except a Teddy Roosevelt, a time when America was really unconcerned with the rest of the world and Lincoln was the great, modern, towering American figure of hope, faith and ambition, as Walt Whitman was a tower of American poetry in the same vein . . .

I could go on and on, like Sandburg; but better to put on these two rambling records and listen in on the glorious, sentimental past for yourself!

Listen and Learn German. Dr. A. von Gronicka, Dr. Paul Holtzman, et al. **Dover Publications (2 10")** (920 Broadway N. Y. 10)

Language records have come a long way since those $50 monster 78-rpm sets put out before the war, and the teaching of elementary "practical" material has moved utterly out of the where-is-the-table-of-my-cousin era. This set, for a mere five bucks, gives you four ten-inch hi-fi LP sides of English phrases and German equivalents, with pauses for you to say the stuff yourself, plus a thick booklet with everything in it, including a quick and useful index, a list of public notices (the first thing you see in any foreign langnage)—the whole set of them with a reasonable intelligible phonetic system for pronunciation reminders. A lot for a little.

The course boasts that you'll learn essential German in fifteen hours—I'm sorry I didn't have that much time at hand, but as one who has travelled in German-speaking lands with a very few words on the end of my tongue and no courage at all, I frankly quail at the thought of rolling out some of the mouthfillers here presented—with my little book helpfully in one hand. This record does give you ultra-practical stuff, I'll admit, all the way from *where is the men's room* to *I like you very much may I call again?* or *is Flight 23 on time* and *bartender, I would like a drink.*

But these professors have fallen into the old trap of perfectionism—they give you the correct, perfect, jumbo-size German phrase for everything, down to that last trailing verb. How many of us will ever get to the verb at all, in the sort of dire emergency that occurs 100 times a day when you travel?

My own small store of German includes few verbs, because I have no nse for them. Somehow, I always lose my audience before I get to the verb-end of a German sentence—especially when I stop in mid-stream to look it up in my little book. So I resort to the single-word system and I find it very effective.

When I drive up to a German gas station (as I did couple of summers back) I don't nutter *Wieviel costet ein Liter Benzin.* They

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

which employs an acoustic phase-shift network to cancel out sounds originating from its rear. When used for P.A. pick-up, the cardioid pattern permits its being placed somewhat further from the sound source than is possible with a non-directional model—our experience being that it will function satisfactorily at almost twice the distance. Thus the gain may be increased by 10 to 15 db without danger of acoustic feedback. Furthermore, the smooth response —claimed by the manufacturer to be within ±2.5 db from 30 to 15,000 cps—reduces still more the tendency to "howl" anywhere in the audio spectrum.

The Unitron is a professional microphone, and is available only as a low-impedance unit, with a screwdriver-operated switch on the front to select one of its three impedances—50, 150, or 250 ohms. This is an advantage when the microphone is to be used with different equipments, as is occasionally the case in broadcast or recording studios. Its sensitivity is rated at

Fig. 6. The Shure "Commando", designed for efficient non-directional pick-up.

– 152 db under the RETMA system, or—for comparison with more commonly understood ratings—at – 59 db below 1 milliwatt for a 10-microbar signal. It is designed to work into a balanced line matching any of its three impedances, which makes it possible to use the microphone at a considerable distance from the amplifier without loss of either level or frequency response, and with a minimum of hum pick-up or crosstalk.

One of the advantages we found with this microphone was that with the reduction of pick-up from the back, good recordings could be made in a small room without objectionable reverberation or reflection. For most applications we prefer low-impedance microphones, even though most home equipment is designed to accept high-impedance models. The addition of a small transformer, either in the line using one designed for this purpose, or permanently in the amplifier will usually eliminate hum problems, and in most instances will improve over-all frequency response.

The unit, shown in *Fig.* 5, measures 7 9/32 inches in height from the bottom of the

(*Continued on page 57*)

for comparison with more commonly under-

to the production of the Model Four, thus assuring the uniformly high quality of every Model Four that leaves the KLH factory.

damping-factor control is turned, but as the quality of the speaker and enclosure is lowered, the effect becomes more and more noticeable. The higher values of damping factor minimize cabinet resonance and thus reduce any boominess that might result from poor enclosure balance. When used to drive a number of speakers at the same time, the damping factor should best be operated at its maximum position.

Construction

As with other Heathkits that we have had personal experience with, the W-6M "builds" nicely. The instructions are well written, and give the impression that once being completed, they were possibly given to a completely inexperienced constructor to find out if they were sufficiently clear and complete. After completing and testing the amplifier, we "unbuilt" it far enough to add a 25-volt transformer, a full-wave selenium rectifier, and filter capacitors so as to have a 24-volt d.c. supply for a new preamplifier. The space between the power and output transformers is wide enough to accommodate the rectifier and the capacitors, and the extra transformer will just go into the space under the output transformer.

And then—after the manner of silent picture subtitles—came stereo. The problem now is to find space enough (and strength enough) in a cabinet to hold two of these units—118 pounds—completely aside from the need for physical strength enough to lift them. We shall remain quite content with a smaller amplifier for the second speaker, using this model for the principal speaker and the five others that are distributed around our home at strategic locations. By which we mean to imply that we consider this one of the better amplifiers available and will continue to use it.

That is, we suppose until somebody introduces a practical 100-watt amplifier for home use. **A-22**

SHURE MODEL 330 "UNITRON" AND MODEL 430 "COMMANDO" MICROPHONES

With practically no exceptions, the original source of electrical signal for ultimate reproduction over our home systems is the microphone, and we may rewrite the old adage to read that "a sound system can be no better than its poorest component." A high degree of perfection has already been attained in amplifiers, for they deal in only one field and can be made to do what the designer wishes. But both loudspeakers and microphones are transducers, and both have to work in two fields —one acoustic, and the other electrical. Both are dependent on acoustic design more than on electrical design, for the latter is relatively simple. But making a good microphone and a good loudspeaker are difficult problems. Almost anything can be used to change an acoustic signal into an electrical signal, but to get a high degree of faithfulness the microphone has to be much better than just "good."

Fig. 5. Shure "Unitron" microphone—a ribbon type with a cardioid characteristic.

Of the many types of microphones available, the proper choice must be made for a given pick-up problem. The inexpensive unit that comes with the usual home-type tape recorder will pick up all types of sound, to be sure, but its quality leaves much to be desired. The first step in obtaining better quality may well be to replace the microphone.

The pattern of the pick-up for any microphone depends on the construction. Units may be had which are essentially non-directional; others have a Figure 8 pattern, being equally sensitive on both faces—or practically so—while others have a heart-shaped pattern, with somewhat less sensitivity at the back than at the front. Each type has its optimum applications. However, for pick-up from a small (or even large) group of musicians or singers, the cardioid is especially useful in that it is relatively insensitive at the back, and thus reduces reverberation as well as direct sounds originating at its rear. Such a unit is the Shure "Unitron," Model 330, which we have given a workout under various conditions.

The Unitron is a ribbon microphone

Did Someone Say "Switch?"

When the art of recording was just taking shape

And it seemed to the experts that tape was just tape,

It made sense to try switching from this brand to that—

Until **irish** pulled **FERRO-SHEEN** out of the hat!

Now the **FERRO-SHEEN** process, the experts agree,

Has made **irish** tape different in *kind,* not degree,

So there's no earthly reason for switching your brand,

Save from Long Play to Double, or Brown to Green Band!

...if you are using
irish BROWN BAND
(an inexpensive general-purpose tape of excellent characteristics)
. . . and want all the advantages of FERRO-SHEEN . . .

...switch to
irish
FERRO-SHEEN GREEN BAND
(it costs no more than old-fashioned coated tape)
. . . if you then want the ultimate in professional tape . . .

...switch to
irish
FERRO-SHEEN SHAMROCK
(specially made with premium oxides and film)
. . . if you then want 50% more playing time on the same size reel . . .

...switch to
irish
FERRO-SHEEN LONG PLAY
(on 1-mil Mylar or acetate base)
. . . if you then want twice the normal playing time on the same size reel . . .

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(made on ½-mil Mylar base and available on 5″ and 7″ reels)
There's an **irish** tape for every recording purpose!

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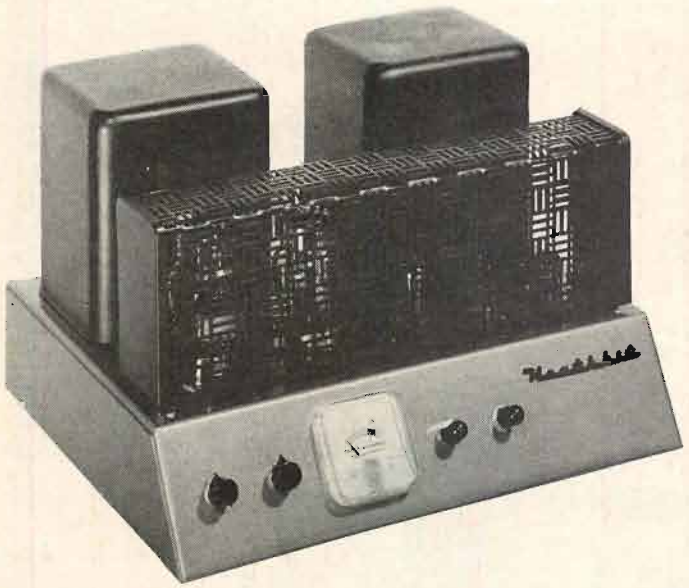

Fig. 3. External appearance of Heathkit W-6M-70-watt amplifier.

plugged in. There are still plenty of people —this observer is one—who enjoy building something, particularly when in doing so we can save quite a bit of money—basically that representing factory labor and its associated overhead and profit. Heath equipment has long been noted for its reliability, and in the new W-6M 70-watt amplifier the results are all that could be desired, and at a price that betokens a considerable saving.

This amplifier, shown in *Fig.* 3, measures 14¼ inches wide, 12½ inches deep, and 9½ inches in height, and has a shipping weight of 59 pounds. Most of this weight is, as would be expected, in the two transformers, so it is obvious that there is no skimping on quality. The circuit, which is shown in *Fig.* 4, offers some innovations which result in a high degree of performance. The first two stages consist of the two halves of a 12AU7, direct coupled. The second half is the usual split-load (cathodyne) phase splitter, and it feeds a 12AX7 voltage amplifier, which in turn feeds a 12BH7 which is a cathode-follower driver for the two 6550 output tubes in an ultra-linear circuit.

The power supply uses a voltage doubler circuit with four silicon rectifiers and more than adequate filtering. An extra winding on the power transformer provides 130 volts to a selenium rectifier for bias supply. Plate currents in the output stage tubes are metered, and provision is made for balancing the two tubes by varying the bias on the driver tubes. Conventional output impedances of 4, 8, and 16 ohms are available for loudspeaker loads, and an additional 70-volt output tap is provided for feeding large speaker distribution systems. When driving loudspeaker loads, the damping is adjustable over a range from 0.5 to 10 by means of a continuously variable control.

Performance

Frequency response is within ±0.5 db from 6 to 70,000 cps, with smooth rolloff beyond these limits to ensure transient stability. Power output is down 3 db at about 13 cps, while harmonic distortion remains below 0.25 per cent over the important ranges, and only reaches 1 per cent at 70 watts at frequencies of 20 and 10,000 cps. Intermodulation distortion reaches 1 per cent at about 73 watts, and at our rating point—2 per cent IM—the output was measured at 81 watts. Full output is reached with an input of 1.1 volts, and hum and noise measures lower than 70 db below 1 watt.

One of the problems encountered with the Williamson-type circuit—comprising the direct-coupled input pair of stages—was its poor performance as regards overload recovery. This was shown by oscillograph traces of signal output when the level was changed quickly from a high value to a very low value—a condition that is common in musical program material. No such instability was observed with the W-6M, however, and only the slightest amount of ringing was noticed on 10,000-cps square waves when driving a loudspeaker load, and none at all on frequencies below 2000 cps.

Variable Damping

The schematic of *Fig.* 4 shows an unusual arrangement of the output wiring. Note that the variable-damping-factor control is a dual potentiometer, with the 10-ohm section in the return side of the output winding. In order to maintain constant gain as the damping factor control is rotated, three different resistors are used for the three low-impedance output taps. Thus the control—which changes the ratio of voltage feedback to current feedback—can be calibrated directly in damping factor, and gain and distortion remain constant for any setting of the control.

With a high-quality speaker system there is little difference in performance as the

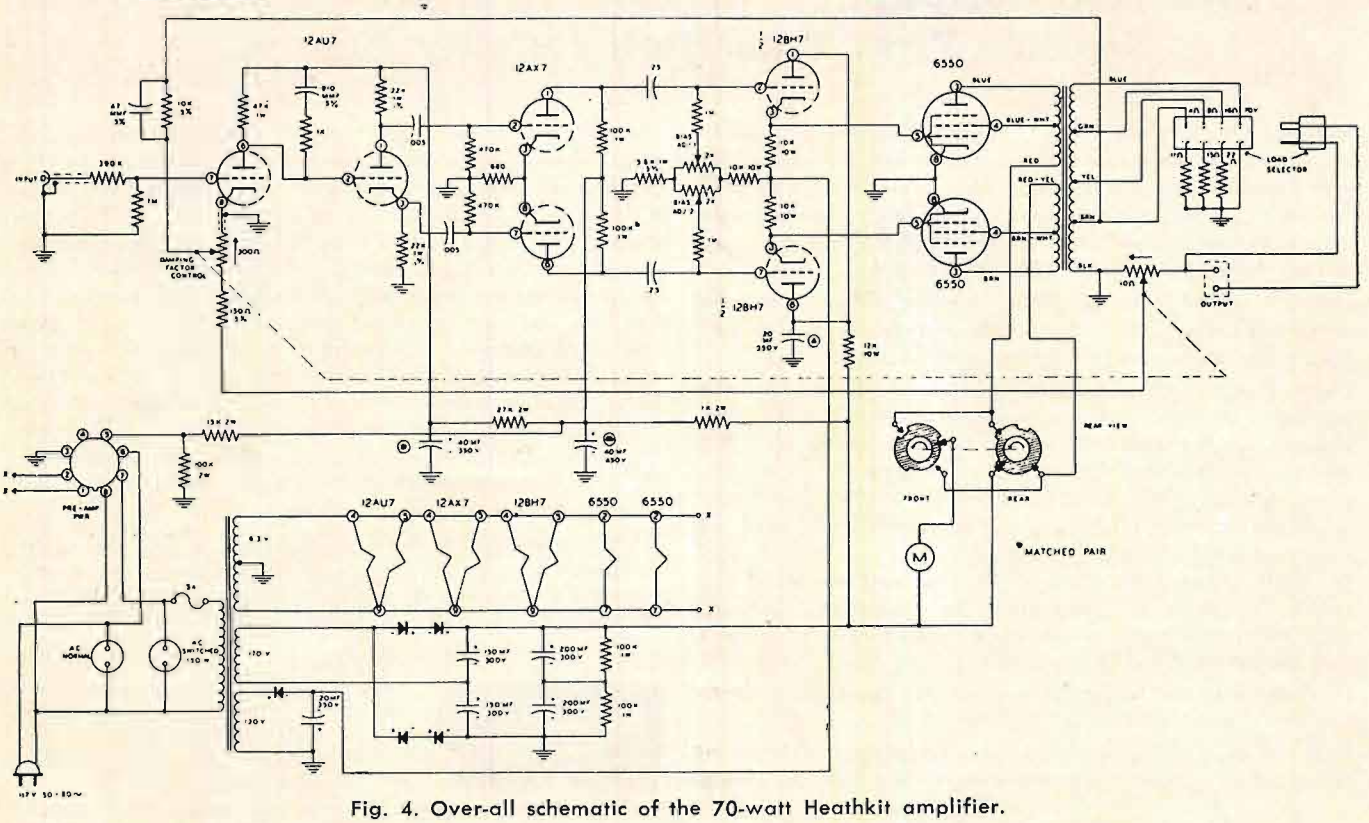

Fig. 4. Over-all schematic of the 70-watt Heathkit amplifier.

*New Transcription-Type Tone Arm Makes Collaro World's First True High Fidelity Changer

Selecting your own high fidelity record playing system can be an exciting and rewarding experience. You look for an amplifier with low distortion and low noise level. You want a speaker capable of reproducing the entire audible range. And you want to make certain you pick the right record player to go with your system—because that's where **the music begins.**

The *right* record player for today's fine high fidelity systems is the all new Collaro—*the turntable that changes records*—featuring the revolutionary transcription-type tone arm.

The new arm is one-piece, counter-balanced and will take any standard cartridge. Resonances are below the audible level. Between the top and bottom of a stack of records there's a difference of less than 1 gram in the tracking weight as compared with 4 to 8 grams on conventional changers. This insures better performance for your precious records and longer life for your expensive styli.

It's worth noting that Collaro quality is so well recognized that leading American manufacturers of fine console units incorporate Collaro into their instruments in order to achieve the best possible performance in a record player.

In addition to the transcription-type arm, the Collaro Continental features:

Four speeds, manual switch that permits playing single record or portion of a record; jam proof mechanism, hold the arm in mid-cycle and it won't jam; automatic intermix, plays 7", 10" or 12" records in any order; automatic shut-off after last record has been played; wow and flutter specifications, ¼ (0.25%) RMS at 33⅓ RPM, superior to any changer in the world; muting switch and pop filter to eliminate extraneous noises; extra heavy duty 4-pole induction motor; heavy rim-weighted, balanced turntable for fly wheel action; removable heavy rubber turntable mat; pre-wiring for easy installation; attractive two tone color scheme to fit any decor; factory custom-testing for wow, flutter, stylus pressure and correct set-down position. Reflecting their custom English craftsmanship Collaro changers are tropicalized to operate under adverse weather and humidity conditions. The base, in blond or mahogany, is optional at slightly extra cost and the Collaro mounts easily and quickly on a pre-cut mounting board or base.

When you buy your Collaro, you're buying professional quality equipment at a record changer price. Collaro prices start at $37.50. The Continental, featured above, is $46.50. (Prices are slightly higher west of the Mississippi.)

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FREE: Colorful new catalog, containing guide on building record library plus complete Collaro line.

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MAMARONECK, N. Y.

Rockbar is the American sales representative for Collaro Ltd. and other fine companies.

to make certain you pick the right record player to go with your muting switch and pop filter to eliminate extraneous noises;

parent concern is French but, via some sort of criss-cross arrangement, a large number of English-made recordings have appeared on the label, as in these cases.

Dart is an excellent harpsichord and organ scholar and both his own playing and the ensembles he directs are well informed, serious and highly musical, as well as very British. In the first record we have two great English harpsichordists, Farnaby a miniaturist with a gentle, folksy touch and much humor, Gibbons one of the great keyboard composers of all time and remarkably close to his successor, Henry Purcell. The second record, with strings, small organ (a lovely one!), and harpsichord, explores some interesting music from a time not nearly well enough known in English musical history, the early 1600's, after Queen Elizabeth I. Giovanni Coperario, before he went to Italy to study music, was born plain John Cooper—but his English music does have a rather Italianate flavor, which no doubt helped it in that particular time.

Better ask your dealer for news on L'Oiseau-Lyres from London; they might be going out of circulation, which would be a shame.

Debussy: La Mer.
Ravel: Daphnis et Chloë, Suite #2. Los Angeles Philharmonic, Leinsdorf.
Capitol P 8395

This is the debut offering, if I am right, in a new "combo," featuring these varied collaborators and it is a good one, well matured, though on the surface it might seem an improbable mixture—French music, a Viennese conductor and a West Coast recording company.

The L.A. symphony buckles down to an intense and disciplined sort of playing under Leinsdorf, and this well known and earnest conductor betrays his Viennese origin not at all in the playing, which is, as they say, highly idiomatic. That is, the French music says what it must say in its own terms, with understanding and expressiveness and not a bit of alien stylizing.

In fact, the main quality of this performance is one that ties in well with Capitol's Steinberg recordings of the Pittsburgh orchestra—a keen, no-nonsense modernism, taut, economical, disciplined, expressive more through the musical notes than through displays of orchestral temperament. Good, and we can look forward to other Leinsdorf offerings.

Of the two I prefer "La Mer." The early Ravel music is of such a fiercely passionate nature that Leinsdorf's relatively cool approach does not quite give it the full incandescence —though no Ravel playing should ever be less than wholly disciplined.

Franck: Chorales #1, #2, #3. Albert Schweitzer, organ. **Columbia ML 5128**

Albert Schweitzer was once well known musically as a Bach player, and his early organ records were largely Bach. Now, with time's passing, Schweitzer's Bach has turned "old-fashioned"—it pre-dates the whole new revival of "classic" or Baroque organ style and lacks the crispness and color we expect these days.

But Schweitzer himself is as close to France as to Germany; his early study was in Paris, he was brought up in the French school—he arrived in Paris only a few years after Franck's death.

These are in the right style, then; they are Schweitzer's own music, as much as Bach ever was. They do not scintillate as performances—he isn't that sort of organist (and many professionals, valuing finger dexterity, despise his playing). There is the usual grave, methodical yet mystical approach on the edge of being clumsy but saved by the power of the mind behind the fingers. And the organ sound and color are suited to Franck's music, as Schweitzer's Bach sound is no longer. A good record.

Chopin and Liszt. Louis Kentner, piano.
Capitol P 8400

Louis Kentner's new record can be described simply enough. (1) He is, indeed, an "imaginative" pianist, as critic Howard Taubman called him, and his Chopin is of the poetic, sweet kind rather than the powerhouse, piano-breaking sort; even his Liszt is a lot less than ear-cracking. (2) The sound of his recorded piano is soft and well bred and very British, quite unlike most American piano recording, including Capitol's own.

All of which is explainable by (a) the fact that though Kentner was born in Hungary, he is now a naturalized British musician and (b) the recording just must have been made in England, by E.M.I. It has that "His Master's Voice sound!" And the piano probably isn't a Steinway.

(The Liszt includes three of the Années de Pélerinage pieces, plus the waltz from "Faust," transcribed; the Chopin is the Nocturne in D Flat, the C Sharp Minor Fantaisie-Impromptu and the Impromptu No. 1 in A Flat.)

Spohr: Octet in E Major.
Poot: Octet. The Vienna Octet.
London LL 1610

The octet of mixed strings and winds is a marvelous combination for recording and the hi-fi cognoscenti are likely to hop whenever the word appears on a record label—classical or popular. Here we have two odd names; one is out of Beethoven's time and famous in that day, the other is out of now, and well known in Belgium if not hereabouts. Spohr was one of the best of Beethoven's contemporaries; Poot (born 1901) is head of the Brussels Conservatory.

If you like earlyish Beethoven, if you have enjoyed Beethoven's early Septet and the more profound Schubert Octet, both with double bass, if you like the "Trout" Quintet, also with double bass, then this Spohr work will please you no end, and you'll be surprised at how good the fellow was. Not quite up to Beethoven, but well ahead of plenty of others. Very melodious and "thematic" and one movement is a set of variations on the familiar "Harmonious Blacksmith" tune by Handel. As to Poot, he exploits a similar array of instruments, in a conservative modern style that is light, airy and beautifully written. You'll hardly notice the dissonance . . .

Beethoven: Symphony #7. Pittsburgh Symphony, Steinberg. **Capitol P 8398**
Beethoven: Symphony #3 ("Eroica"). Cleveland Orch., Szell. **Epic LC-3385**

These are my nominations for tops in the new, modern, streamlined approach to old Beethoven, and they are quite remarkably alike in many ways. Outwardly, both are from "lesser" American orchestras, performing with top efficiency, both are from medium-sized companies in the classical field out to develop home competition for the big orchestras like the New York Philharmonic and the Philadelphia, both companies are in dead earnest and trying very hard to do a good job and win a higher rating.

Inwardly, Steinberg's Seventh and Szell's Eroica share a characteristic new lightness of texture, an over-all shape that is almost easy-going in their large, architectural viewpoint, like suspension bridges (rather than massive, Napoleonic monuments); the tempi in both are on the fast side, there are few exaggerations and heroics, even in the Eroica. All in all, these big symphonies never sounded so sinewy, so casual, so clean-limbed, so effortlessly athletic. And in both the recording is excellent, in conservative hi-fi minus exaggerated close-up effects.

3. OPERA AND BALLET

Offenbach: La Perichole (In English). Patrice Munsel, Cyril Richard, etc., Metropolitan Opera Orch. and Chorus, Morel.
RCA Victor LOC 1029

Perhaps this will make good entertainment for those who come to it "cold," not knowing the nature of the French original but I have my doubts, what with a printed libretto that throws any listener off the track every few lines, English or no English. If you know Offenbach—any Offenbach—as the French know him, you can expect to gasp at the extent to which a fine style is lost in the

Gilbert and Sullivan. (No offense intended; the Italians are just more emotional and their language sings itself!) Marenzio writes "classic" madrigals of the perfected form, Gesualdo's are eccentric, of the revolutionary early 17th Century, full of strange, Wagner-like harmonies and preoccupied with death. (Not surprising; he was a murderer on the side.) The German madrigal group is beautifully disciplined and sings with the sense of the music very much in mind (texts and translations provided), though their pitch could be better.

The High Renaissance—Palestrina: Mass "Papae Marcelli"; Stabat Mater; Improperia. Aachener Domsingknaben, Domchor, Rehmann. **Archive ARC 3074.**

Throw in one more in this particular series, ("Research Period IV"), the famous Palestrina. What a glorious surprise here in the singing of the Aix Cathedral Singing Boys—literal translation—who provide the first side, the well known Mass of Pope Marcellus. Such heights of childish pitch, without strain, with perfect musical sense and amazing breath control! Though I don't much like the "ha-ha-ha" sort of technique the choirmaster has evolved to punch through the echo of his cathedral (it shows up unpleasantly at the mike's range), I can't help admiring the beauty of the singing he invokes from his kids.

The grown-up choir (the Domchor or Cathedral Choir) sings a double-chorus work and the miking for this effect is the best I've ever heard—a real sense of the two, separate choirs, yet each is alive and not overly "off-mike." Very hard to achieve, this effect; usually the two simply merge on records and sound like one.

* * * * *

If any of this appeals to your interest, be sure to check on the many dozens of other Archive releases. Almost all are of unusual interest.

Haydn: Symphony #45 ("Farewell"); Symphony #82 ("The Bear"). Southwest German Radio Orch., Reinhardt. **Vox PL 10340**

Haydn: Symphony #55 ("Schoolmaster"); Symphony #45 ("Farewell). Aldeburgh Festival Orch., Britten. **London LL 1640**

A sense of style and interpretation is what a conductor must have—but a composer, in the last analysis, need know his own style only. Most composers are by their very trade narrow-minded as to the rest of the musical world!

So it is with Benjamin Britten. I can ouly say that these two Haydn Symphonies, played at the Aldeburgh Festival in England and recorded at the concert, are unbelievably bad. Part of it is in the orchestra, which is no great shakes—but far from all of it, I just don't think Mr. Britten has much idea of what Haydn was about, and I don't really see any reason why he should (except, of course, when he undertakes to conduct Haydn).

The young Rolf Reinhardt's Haydn shows the other side of the picture, in case you want to compare. He is just thirty, but he has absorbed the Haydn tradition and the inner sense of these symphonies to such a degree that these might well be the matured work of a conductor in his later years. Especially in the "Farewell," which is a symphony that depends on the very drama of understatement for its profound effectiveness. In the wrong hands, it is just silly sounding.

Masters of Early English Keyboard Music IV. Gibbons and Farnaby. Thurston Dart, harpsichord. **L'Oiseau-Lyre OL 50131**

Jacobean Consort Music (Coperario, Ward, Lupo, Hume, Gibbons). Jacobean Ensemble, Dart. **L'Oiseau-Lyre OL 50133**

London seems to have lapsed on its L'Oiseau-Lyre imports the last few months—these are from a batch I got back in June and are typical of a lot of excellent and. indeed, unique items on this label, not very handsomely promoted by London which probably in consequence didn't sell very many. The

tell you how much a liter is, right on the pump, same like at home. So I just point to the tank and say *Vierzig*, and in goes the gas, gurgle-gurgle. (In Denmark I couldn't even count, so I just wrote the number on a piece of paper.) It's the one-word system for me. I should hate to have to orate pompously *Füllen Sie bitte die Batterie mit Wasser auf!* to get my battery filled—I'd never make it. Instead, I open the hood, point to the darned thing and say *WASSER!* It works.

Most people lose their nerve at the end of two or three words of an unfamiliar language, even if there are a few chrome-plated souls who speak carefully, slowly and loudly enough to rouse all the natives within a half mile. When I hear them I want to go and hide. My idea of a strange language is to use as little of it as I can, as quickly and as unobtrusively as possible! No fancy phrases for me.

If these professors could just bring themselves to underline in bright red the one, vital key word in each sentence, the one that will do the trick in a pinch—any pinch—they'd make us timid souls feel a lot happier. Why, we'd be able to master the course, one-word style, in the time it's taken me to write this.

The series covers ten languages already, in case you want one word in a few other languages. At $5, these are bargains, timid soul or no.

Music by Alan Hovhannes. (Assorted artists) **M-G-M E3517**

The exotic, super-hi-fi music of Hovhannes must be selling well and a good thing too; this is the fourth M-G-M all-Hovhaunes disc and it is evidently made up of numerous leftovers—not less interesting than other pieces but perhaps the wrong length for the inconvenient strictures of the LP record. It happens at all recording sessions and, mostly, the extra stuff never has a chance to appear.

This record includes music for brass, for solo piano and piano quartet, for violin and piano, for string orchestra and for mixed orchestra—a bit of everything (since percussion comes naturally into almost all Hovhannes that allows it). No room for details, but this is "more of the same," in variety—the same strange, dynamic, motionless music that is at its most effective on M-G-M's earlier disc of the Saint Vartan Symphony (E3453), a symphony like no other ever composed. The usual and excellent M-G-M artists are here—the Ajemians for violin and piano, Marga Richter on piano solo, various M-G-M instrumental ensembles, and the Manhattan Piano Quartet. Fine music, fine hi-fi.

Russkaya! Hollywood Bowl Symphony Orchestra, Dragon. **Capitol P 8384**

Once upon a time there was an Emperor (oddly enough, his name was Younmee) who was frequently served up a dish of goods by his high placed advisers. Gullible old soul, he fell for it all, including the magic of the Tartars, the spell of "Russkaya" (though he wasn't quite sure what the word meant), and he also loved music—which, he was told, "in the splendor of an outdoor setting, gains a special beauty that inspires musicians and audiences alike," not to mention emperors. Even canned outdoor music.

Yep, this Emperor liked to show off his newly acquired goods, too, just like you and I. The high placed ones, one day, really got themselves worked up. Was it a new piece of music they were selling him, or a suit of Russian clothes?—I can't remember. Anyhow, they told him that this stuff (from *étoffe*, French for cloth) had "an underlying melancholy and barbaric splendor that can be traced back to the Mongol conquests of the Thirteenth and Fourteenth Centuries, when the Golden Horde swarmed into all Russia" and, fairly jumping for joy, he put on his new Russian clothes, melancholy and all, and rushed forth to be admired by All the Populace.

Now All the Populace (which in thos country was known as the Public) had been duly assembled in long rows, expressly to admire their Emperor, who was at One with his people. And the Public said yes, this stuff truly has an underlying-melancholy-and-barbaric-splendor-that-can-be-traced-back-to-something-or-other (for the Public's memory wasn't very good)—WE CAN SEE IT FOR OURSELVES.

But off in a corner was a little knot of skeptics among whom there existed a soul named Can-bee. And he said, in a not-inaudible whisper, BUT our dear, gullible Emperor, none other than Younmee himself, is NAKED. *He doesn't have any clothes on at all.*

That's just stuff, said his nearest neighbor, and so it was, and everyone was happy.

(N.B. The record contains the Russian and Ludmilla Overture, Volga Boatman, Meadowland, Melodie (Tchaikowsky), etc. and it's very nicely played if you like cool music, real chilly. As for the "tidal wave" of the Mongol invasion that "left its undeniable mark" on Russian music, I don't hear a trace. Sounds to me like the Hollywood Bowl, and playing indoors, too. Ah, publicity!

Clarabelle Clowns with Jazz. (With the Norman Paris Trio).
Golden Crest CR 3030

It seems that Clarabelle, the clown in Howdy Doody, is a jazz fiend on the side and plays jazz clarinet. On TV his only voice is a small *oink oink* from a species of squeeze horn, but it says almost anything needed, depending on the inflection.

In these rather suave jazz bits, the *oink oink* appears regularly, sometimes as an opener, at other times neatly blended into the music itself. A trade mark, of course, and intended to complete the sales tie-in between the music and the TV show; but the thing is done so casually and so expertly that I couldn't help admiring it. Very musical, jazz or no. And hi-fi, of course—chamber jazz is a wonderful medium for quiet hi-fi, of a sophisticated sort.

(In case I have intimidated you by that dreadful word, "chamber," I'll hastily add that the proper term in jazz seems to be "intimate." The Norman Paris group plays in "intimate" night clubs. Maybe we should talk about "intimate" music by Beethoven and Mozart! The same idea.)

2. CLASSICALIA

The High Renaissance—9 Chansons; 16 Danserye. Pro Musica Antiqua, Cape.
Archive ARC 3071

The High Renaissance—Marenzio; 6 Madrigals; Gesualdo: 6 Madrigals. Singemeinschaft Rudolf Lamy.
Archive ARC 3073

The Archive series, promoted through Decca, continues to pour out an astonishingly wide range of earlier music in wide-open, liesurely, non-excerpt fashion, and I get to writing about the records only too seldom. This is the first series in phonograph history that is both comprehensive *and* unlimited in its coverage—all the other histories and surveys resort to the inevitable boiling-down, excerpting, sampling. The reason, evidently, is that this series has no end. It just goes on and on, and there is thus always theoretical and practical room for as much of anything as the producers can produce! (Imagine, similarly, a "hi-fi demonstration" disc, or an "audio test record" that could just go on indefinitely, delving into every aspect of the subject as exhaustively as you pleased. Say, five or six records devoted to harmonic distortion, perhaps a dozen LP's on every form of IM . . . that's the size of this Archive series.)

Anyhow . . . the Safford Cape Musica Antiqua discs in this series are always a pleasure, the old music done up in a vital, alive, wonderfully sensuous form, full of rhythm and of real vocal appeal, as well as with an exquisite feeling for dynamic pitch. This one, with the "danserye" on it, has some lovely songs, as collected by a highly musical noble lady, Margaret of Austria, in the early 1500's, plus a batch of popular dances, among the first to be published in notation after the development of suitable printing facilities. Very sprightly.

The madrigals, out of Italy and a later time, neatly contrast the earlier and latest madrigal period. Neither composer will remind you of the English madrigalists—no cuteness and frills in the Italian madrigal, which was to the English madrigal as Italian opera is to

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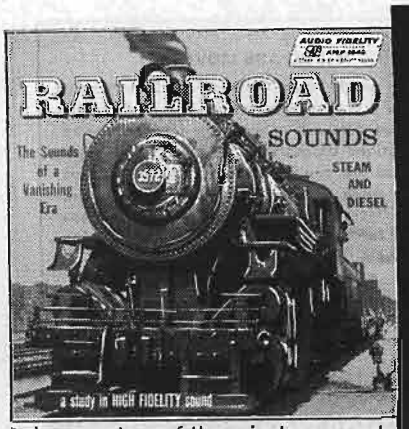

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AUDIO FIDELITY, Inc., 770 Eleventh Ave., New York

shuffle in this shapeless composite production, that will not settle down in any style.

Patrice Munsel is the heroine of the farce and sings at one moment like Carmen and the next like Broadway—what is it that we do to fine American voices to give them so quickly the edge and strain of an instrument half worn out? Munsel sounds about forty five at times, though she rallies to a pleasing youthfulness here and there.

The big cheese—an elderly Spanish viceroy—is Cyril Richard, who acts—and sings—as of an amateur Gilbert and Sullivan show. Funny, yes, but French—no. In the end, the Gilbert and Sullivan atmosphere takes a shaky lead over both Carmen and Broadway, which is unfortunate because the plot is *very* French, even in translation. With G & S peeping over your shoulder, you will be shocked at some of the goings-on in this affair!

Some day, let's hope, the august Metropolitan Opera will learn that opera is two thirds style to begin with, whatever the language; everybody else found it out centuries ago. With all the superb opera on records coming over here from Europe, the Met makes a sorry showing in the big-league field with this sort of thing—however amusing the actual stage production may have been.

The recording is of excerpts, the continuity arranged via spoken narration, plus extra printed comments in the libretto. (You get lost while you try to read them as the opera plays.)

Tchaikowsky: The Swan Lake Ballet (complete). Philadelphia Orch., Ormandy. **Columbia ML 5201**

This is the stuff! I am enthusiastic about the spate of new complete recordings now coming out of works which for many long years have been known only in brief suites, intended for concert use. How much music we have missed—and how much of the real sense and flavor of the whole score.

The complete "Nutcracker" was a case in point a few seasons back; now here is an early Tchaikowsky in the same tradition, another hour-long score with the familiar bits and pieces filled out by quantities of new music that few of us have heard before. It makes wonderful listening for a long, liesurely dinner.

What? I mean exactly that. The significance of such scores as this is that they were never intended, in their wholeness, for direct, concert attention, of the sort where one sits motionless and all ears, where the minutes quickly add up to hours and the seats get stiffer and stiffer, the eyes weary, the mind over-crammed. This type of music is the essence of enlightened background music—for an occasion where you, the listener, are wrapped up in some other, complementary delight to such an extent that you don't even bother to count the minutes and supress that inevitable concert yawn!

I am quite serious, though I don't mean to run down the concert; a Beethoven symphony is concert music and best treated with concert respect, for its inner concentration and intensity. This other kind of music, though, has an enormously varied and honorable history, longer and wider than concert music itself. And so positive are the virtues of enlightened background music that we can very readily substitute one foreground for another, with the same musical results.

Put on ""Swan Lake" with your soup and give it half a chance to be heard; you will he as happy with it, when the grand climax comes just in time for dessert and coffee, as though you had absorbed the music at the ballet theatre. Too long? You won't even notice how the time flies. That's the big point and it is a genuine one, that accounts for the very shape and texture of the music itself. Too long, much too long for concert use; too padded, too repetitive, too loosely organized. But perfect for ballet, and for casual home listening, too.

Ormandy and the Philadelpbia are always in their best form in such ventures as this; it could not be better turned out for the casual purpose. Big, rather distant recording with a fine clumpy bass and lots of cymbal, that sounds like cymbal, not breaking glass.

I am quite serious, though I don't mean to

AUDIO ETC

(*from page 14*)

long time ago by the Walco Company for trial—the trade name is *DisCovers* and they sell at $1.50 a dozen, or did when I got these. My apologies to Walco for not disCovering their usefulness before.

Plastic bags are best, but Angel's neat plastic-lined paper envelopes are almost as good and far more convenient to use. The trick is plastic bonded to paper and Angel, if I am right, will give the know-how to any manufacturer who is interested (if he hasn't found it somewhere else). I don't remember seeing anybody else's discs with plastic-paper containers. I think they should be investigated by all. Home-type plastic-paper bags would be highly useful and convenient, especially if there were some sort of simple fold-over seal arrangement.

A sidelight on this. Decca's imported German Deutche Grammophon Archive LP's are monumentally sealed with German thoroughness; the slick-paper envelope is surrounded with plastic and inside it is a second plastic container around the record itself. In the earlier releases some chemical miscalculation unsealed the glue on the paper envelopes and they fell apart in a most undignified way, like some of the very earliest American LP's.

But the newest batch of Archive records has been fixed up. There is some sort of strong plastic glue now and the paper envelopes are bound for good with cloth edges.

And the Factory Seal, which used to be glued on, is now an American-type seal, rubberized so it peels off neatly. But unlike our "sealed" records, these are really tamper-proof; the Factory Seal is *inside* the outer plastic cover, which is sealed tight.

The Germans mean what they say by *Original Verpackung*—original packing.

A persistent minor trouble I've been noticing lately with the new lightweight arms is that when their points are placed on the lead-in grooves of the new raised-edge LP's they tend to skip suddenly towards the record's center with a squawk—because of the sharp inward slant at the raised hump around the rim. It happens with manual arms and it also happens with some new changer arms of the feather-weight sort. Quite annoying. But there's not a thing we can do about it except, perhaps, to cut deeper lead grooves—or give up the raised hump altogether.

This may be one good reason why some brands, notably London, still use the old flat surface right out to the record edge.

A less excusable fault that has been making me frown of late is the noisy lead-in and even noiser lead-out grooves now often heard on otherwise impeccable hi-fi records. Why?

Do we have to listen to those very audible groans and swishes and swoops, before the music starts? And are the much more unpleasant sounds at the lead-out grooves necessary, the ones that get repeated over and over, if a changer isn't used?

Some of the noise, I guess, is unavoidable but I am sure that most of it is just lack of interest on the part of the cutting engineers. Many a really fine record ends up with a series of whines and cat's maoiows and staccato yelps. Some of these effects sound suspiciously like unedited after-noise at the end of the tape. If sounds like that are unforgivable in the body of a record, why should we have to hear them at the end? Some records—a Golden Crest disc I just played, for instance—are perfectly tailored at beginning and end, with scarcely a whisper of extraneous noise. But many discs from the very large companies are particularly offensive.

What we need, now, is a hi-fi lead-in and lead-out.

5. DOUBLE-DAMPED

Fairchild has been issuing a series of "X" model experimental cartridges, sold to the public on a limited-production basis and at a considerably higher price than the regular model. This seems to me an excellent idea. The "X" model, of this sort, represents faithfully and quite honestly that stage in a new development where it is approaching regular production, but is not yet settled down and fixed into that final and rigid category. Such experiments are fascinating for many layman and professionals and there are many people who will snap them up as there are volunteers for the first moon trip—by which I mean, a lot of people. And also, we all like to have a "special" model, exclusive and advanced.

Ordinarily, two things happen in the constant foreward surge of progress towards new models. (1) The new developments are held off the market and off the final production stage as long as the maker can conscientiously burn up capital—then they are frozen and put out for profit. (Or he *thinks* they are frozen. Usually, as we all know, unexpected things happen in droves and all sorts of costly unfreezings are required before the model settles down to steady, reliable production. By that time, it's high time for a new model.)

(2) And/or samples of the new, almost-frozen production are passed around, far and wide, for pre-production opinions while it's still not too late. In the soap industry this sort of thing is highly organized, with "research institutes" and what-not, spreading samples all over the land and collecting housewifely opinion. The products, there, are usually anonymous—which dishwashing powder do you like better, sample A or sample B?

But Fairchild's idea, you see, cuts across these methods and puts a legitimate profit factor into the limited production, both selling and sampling. Good experience for the maker, all around, and interesting for the buyer—who doesn't have to buy if he's not interested, after all. The idea, perhaps, came from auto makers—you may have seen the Chrysler 300 zooming around the roads, but you don't often see it in the ads, though you can have one, I gather, if you will ante up. Produce a special model, put it through a sort of test-run production set-up—and actually sell it, on that very basis. I think we could have more of this sort of thing, with profit and knowledge gained.

Maybe it's an anti-climax to say I haven't tried the current Fairchild XP-3 model, the one that looks outwardly like the standard 225 but has inner advances. The idea is—*you* try it. If you're scared of the price, around $60, then you can always get the 225 which, I might say, is my present high-quality work-horse and has proved a

sweet-sounding and extremely reliable cartridge during the last months.

Double damping? The title refers to what follows though, it occurs to me, it fits in a vague sort of way into the idea of damping out those spurious bugs, those unfortunately unforeseen "oscillations," that plague early-model production. The "X" cartridges are thus double-damped, internally for the usual literal reasons and, in a figurative sense, they are acting as advance damping factors to smooth the way for future production.

What I had in mind originally was this, and let it be a warning. I now own the only existing model of the Fairchild 225½ Double Damped Magnetic. It was originally my 225, and I had it mounted in my neat little Japanese viscous-damped arm, which suited it to a T.

But recently (as you'll learn in a forthcoming issue, I hope) I have been Industrial Designed. All my pickups are now mounted in beauteous white masonite inserts, which slip into pre-fabricated motor boards, which in turn slip into mahogany-finished boxes, which in turn fit over (optional) platforms on fancy tapered legs. And the pickups not in use are hung up on a long black-finished wooden rack fastened to the wall, adorned with big, golden hooks. They dangle there like graceful Calder mobiles and, incidentally, are accessible and out of the way as well as out of danger. The arms are kept from swinging loose by a neat tensile member of bright red vinyl plastic that loops around them and fastens them down to their white boards . . . but this is ahead of my story.

By the sheerest and most natural sort of absent-mindedness, the Japanese arm was industrialized right into this fine system along with all my other arms—quite a batch by now. And thus, with never a thought, I hung it up on the wall, one day, so I could try out something else.

A couple of hours would have been OK. But it stayed for a week or so. And by then I had my Fairchild 225½ automatically. The thick silicone damping fluid had poured down the arm at a snail's pace and, given the time, had methodically proceeded to coat itself onto every surface available, with the persistence of a *very* viscous fluid. It even squeezed into the tight crack between the cartridge back and the mounting slider.

Did the cartridge play? Of course—I didn't even notice the goo at first, until I got my fingers into it. Then I hastily removed the 225½ and tried to wipe the half off. Got most of it. But I decided *not* to tamper with the stylus. It was gooed up too, of course, but I was afraid that to do more than slurp up the extra goop from around it might be dangerous. The original damping might come along too.

After all, how did I know what damping material Fairchild already had around the stylus base? Looked vaguely rubbery, but then it might be any old thing and, horrid thought, it could be soluble in carbon tet or alcohol (says I to myself)—in which case a cleaning bath would throw out the baby with it. (The bath.) So, I figured, maybe I'd just better let nature's laws of viscosity take their course. I just dabbed a bit, no more.

Whatever the damping stuff that was there in the first place, then, it is now gently reinforced by a delicate infusion of silicone, especially designed for damping purposes.

And, I'll have you know, my 225½ sounds as sweet as cream. Cream-and-silicone, that is.

(P.S. If I can get the green light from Fairchild maybe I'll be able to re-convert it to a 225, yet.) Æ

to tamper with the stylus. It was gooed up too, of course, but I was afraid that to do

naturalness incorporating the latest advances in the art of music

ABOUT MUSIC

RECORDING IN MILAN (CONCLUDED)

HAROLD LAWRENCE*

ON THE NIGHT of August 16, 1943, the heart of Milan was razed by a massive Allied air attack. Among the many old historic buildings bombed, the Teatro Alla Scala received a direct hit. Its onormous chandelier was sent crashing to the floor of a devastated auditorium. At the war's end the Milanese reconstructed their famous theatre within a year's time.

Since then, wrecks and conflagrations of another kind take place regularly beneath the giant proscenium of La Scala. Funeral pyres are ignited by Brünnhilde in Wagner's *Die Götterdämmerung*, and by the Roman conquerors of ancient Britain in Bellini's *Norma;* Enzo sets fire to his ship in Ponchielli's *La Gioconda;* and Samson brings down the Temple of Dagon in Saint-Saëns' *Samson and Delilah.* One of the most exciting events in La Scala's postwar history was the revival of Cherubini's *Medea*, an opera with a generous share of havoc, all of it concentrated in the last moments of the final scene. Spurned by her deserter-husband, the legendary Greek sorceress satisfies her lust for vengeance by murdering the children she bore him, poisoning her rival and putting a torch to the temple.

Last September the complete opera was recorded on the stage of La Scala with Maria Callas in the leading role and Tullio Serafin directing the chorus and orchestra. The artists were dressed in everyday attire, and Medea did not show up in her flame-colored wig. Yet the performance caught fire just as surely as if real smoke were pouring from the burning Grecian temple.

The absence of sets and costumes, however, did not lighten the tasks of the recording staff sent to Italy from Mercury Records in collaboration with G. Ricordi. Elaborate preparations had to be made for the sessions. First, the entire parquet was stripped of its velvet-upholstered seats which were transported to the main lobby. In order to take full advantage of the La Scala's acoustical properties, the orchestra was moved onto a platform extending into the hall to a point further than usual. The high-domed theatre may not suffer from the excessive reverberation of such a hall as the Baptistry of Pisa where an arpeggio sung beneath the Gothic vaulting is transformed into a sustained chord, but a ring of keys dropped in the empty theatre will be heard many times over. To cope with this resonance problem, a crew of stagehands was dispatched to the uppermost tier of boxes (now converted into galleries); half were posted on one side of the auditorium, half on the other. A huge curtain was stretched out under the dome. The effect of this damping was carefully noted by C. R. Fine (the engineer and technical supervisor) in the mobile recording truck located near the backstage entrance, and in the monitor room manned by Wilma Cozart (Mercury's vice-president in charge of classical discs), and Carlo Ricordi, of the publishing firm, and the writer. The curtain was raised, lowered and moved back and forth several times before we finally arrived at the desired reverberation period.

Balance is, of course, an all-important factor in every musical recording, and nowhere is more painstaking care required than at the taping of an operatic work. Cherubini's *Medea* is no exception. At one point, the score calls for an offstage chorus, a band of wind players, and soloists. Our objective was to achieve an effect of distance while at the same time maintaining correct aural relationships with the onstage musical forces. The musicians were sent to the rear of the stage and a test was made. Everyone agreed that the sound was not remote enough. The performers were then told to turn left and sing in the direction of La Piccola Scala (the new 'little Scala' Theatre located off the wing of the larger theatre). Still too close. The proper results were obtained only after the musicians had explored virtually every foot of backstage territory, including standing with backs turned on the conductor.

A 60-cps generator powered the recording truck, which contained Fairchild tape machines for monaural pickup and Ampex half-inch machines for the 3-channel stereophonic pickup. Bob Fine shuttled between truck, auditorium and monitor room supervising the curtain brigade, directing the stagehands in improvised Italian, and dashing upstairs to listen to playbacks. A single Telefunken microphone was used for the monaural recording, three for stereo.

To say that Maria Callas has a reputation for being even-tempered, cooperative, and friendly would not be quite accurate. Controversy surrounds her name like the veil around the head of Medea stealing into Creon's palace. Yet the famous singer exhibited all of these admirable qualities at the present recording session, reserving her emotional outbursts for the exciting role. Off the stage, she was charming and unaffected. Musically speaking, she was as solid as the Rock of Gibraltar. Whether singing a simple recitative or negotiating a difficult

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passage, she infused every note and word with the precise inflection and intensity it required.

In one particular scene, Medea pleads with Creon to allow her to spend a day with her children before being banished from the city. In the first take, Callas sang meltingly. Everyone was thrilled—except Callas herself. The interpretation, she maintained, was not in keeping with the character of Medea; a proud and fiery woman, her plea should be cooler and somehow menacing in quality. On the second take, the voice was still ravishing, but the effect was spine-chilling.

In the last moments of the final session, Serafin summed up the feelings of all who were associated with the recording project. He had just finished conducting the Overture to Act III with its pathetic, subdued conclusion, when he said, partly to himself, "Ah, what beautiful music!"

EQUIPMENT REVIEW

(*from page 47*)

mounting, which houses a vibration isolator, to the top. The mounting is arranged to accept a 3-conductor Cannon connector, with the microphone case being grounded through the cable shield. The mounting is fitted with a swivel so the head may tilt forward 45 deg. or backward 70 deg. The external surfaces of the microphone are finished in a brushed chrome, which is attractive and serviceable.

The "Commando"

Model 430 is one form of the Commando series, which includes the high-impedance Model 415, and the lavalier type designated as Model 420. Both the 430 and the 420 are multi-impedance units, working either into a high impedance or into a load of 150 to 250 ohms. The change of impedances is made by removing two or three screws in the case and changing the position of a pin from one pin jack to another. This is slightly more trouble, perhaps, than having a switch, but for those who have only one type of amplifier it avoids making an erroneous connection.

Models 415 and 430 are similar in appearance, as in *Fig.* 6, but the lavalier type is shorter because of the elimination of the switch. The 415 and 430 may be slipped into a desk stand which is available as an accessory, while the 420 is normally worked on a lanyard around the user's neck.

These models are described as being of the balanced armature controlled magnetic type, which is sensitive and rugged. The frequency range extends from 60 to 10,000 ohms, which we found to be adequate when used with a typical home recorder, although not as extended nor as smooth as the more expensive 330. When used in a vertical position it is essentially non-directional, so that it is useful for conference recording, for example, by simply placing it in its stand on a table. In the high-impedance connection, the sensitivity is rated at 55 db below 1 volt for a 1-microbar signal; in the low-impedance position, it is rated at −54 db with respect to 1 milliwatt for a 10 microbar signal, which is fairly sensitive. The unit would undoubtedly improve quality with a typical tape recorder in any home application. **A-23**

CHARLES A. ROBERTSON*

Doc Evans: Classics Of The '20s.
Audiophile AP50

TO HEAR IN A LIVE PERFORMANCE the finest traditional cornetist now playing, it would be necessary to journey to Minnesota at a time when Paul Wesley Evans was leading his band at the Hotel Duluth, or presenting a combined concert and lecture on jazz at the Walker Art Center in Minneapolis. Better known as Doc, he is as much a phenomenon of the Midwest as Bix Beiderbecke or Muggsy Spanier and has never strayed for long from his home base. Due to another phenomenon of this region, the unsurpassed recording techniques of Ewing Nunn, he is making an exceptional series of albums while at the height of his powers. In his latest, the young cornetist Bob Gruenenfelder joins him to recapture the spirit and instrnmentation of the King Oliver band.

It is the culmination of twenty-five years of growth as a professional musician and shows his increasing bent toward early New Orleans style. As Evans noted, when asked about some of his theories on his music, "I suppose I was influenced by a lot of musicians. At first it was Red Nichols, because that was all we knew. Then I discovered Armstrong and Bix. It wasn't until many years later that I had an opportunity to hear real New Orleans jazz—or Morton—or Oliver. I think my progress has been a tendency away from Dixieland and Chicago styles in the direction of New Orleans. This I have tried to do without the common error of the revivalists—the error of sounding archaic, if not actually "ricky-ticky". Put me down as a traditionalist, if you will. But not a revivalist—I never stopped playing jazz since I first heard it in the twenties."

A new generation of players, who turned to the older men for inspiration, injected fresh life into this music as an aftermath of the last war. It flourished with growing vigor, especially in Britain, and gained an impetus which will never let it die out, though its popularity may shift with the public fancy. In reference to this renaissance, Evans commented, "I'm rather wary of labels, because they seem to mean different things to different people. How true this is of even the word jazz. Let's call the younger groups who are attempting to recreate the music of the "classic" jazz period revivalists. I don't always go along with the result, but for the effort, I'm with them.

"I guess we all went through a period of emulation of some idol. It's natural for a youngster, or the novice jazzman, to try to play just like Dodds, or Ory, or Bunk, or Louis. The result may be mediocre, it probably will be, because the original man was expressing himself, where the imitator is using all his hero's cliches and not creating much. The same goes for bands that try to play "just like" some one else. A jazz band is made up of so many individuals, each creating his own part, and is at its best when they play from their own inspiration, not memory and another's ideas. However, this emulation serves a useful purpose in the development of a jazzman, though not when mistakes are religiously copied from a record. One should listen and learn—not phrases or tricks—but the approach."

As to critics and their concern with influences, Evans was not kind, "The whole jazz picture has been confused no end by jazz writers who are riding a theory. The anthropologists with their "Afro-American" theories; the French critics with their theories about jazz being a return to the primitive. Most of their effusions strike me as sheer balderdash. They have all sorts of knowledge of trivia, but lack two all-important things: an open mind and an ear for music. These are the fellows that encourage Turk Murphy to sound like a Cro-Magnon, who cheer all the wrong things and never hear the subtleties.

"Maybe I sound a little burned up—maybe I am. But we need a return to perspective. Morton didn't try to sound crude and uncouth, neither did Keppard, or Oliver, or James P. Johnson. I played with Bunk Johnson and knew him pretty well. He made it pretty clear that jazz to him was musical and pretty, not raucous and as rough as possible. Why can't the people who affect to admire the masters listen to them, not just talk?"

Before Evans learned about jazz, mainly from phonograph records, he had taught himself to play the violin, clarinet, saxophone, drums, and cornet. It was this last instrument that he played while earning a B.A. degree in English at Carleton College, and at the University of Minnesota while taking post graduate work in the subject. After teaching in high school for two years, he decided in 1932 that he preferred the freer, if less certain, life of a professional musician. This centered mainly around St. Paul and Minneapolis, where for six years he owned and operated Lane's End Kennels which bred or owned some eleven champion cocker spaniels.

In 1947, following a couple of appearances at jazz concerts for the Chicago Hot Club, the Rhinehardt's invited him to head the band at their new club, JAZZ, LTD., in Chicago. It stretched into an engagement of six years, with time out for short tours to other cities, and gained Evans his first wide recognition. He returned to Minneapolis in 1952, where he completed his fifth season of outdoor concerts and lectures at the Walker Art Center last summer.

His most recent tour was a stint with the Turk Murphy band, one of the more prominent revivalist groups. Of this experience, Evans related, "Personally, I like Turk a lot and admire his integrity. I think some of the originals he wrote with Lu Watters were very good—as good as many of the 'good old ones'." We could all use more original material, but I guess there isn't the economic incentive to write real jazz tunes any more. I did find that I have been a leader too long, and have too many definite ideas of how a band should sound, to be happy in a secondary role in such surroundings."

The Evans' household includes a son Jeffrey, nearing his second birthday, and an extensive record collection of both rare jazz items and the more substantial classical composers. His dream is to expand the concert-lecture idea to a yearly six-month tour of large colleges and universities. On present bands, he commented, "I like Kid Ory, though he needs a better trumpet. The De Paris band has a great beat, but is sometimes too precious. In many ways I have enjoyed the bands of Paul Barabrin and George Lewis. I think Yank Lawson is a great unsung hero of the cornet. I love Louis in spite of his awful band and the bad things he has done to jazz.

"The bands playing today that are, in my opinion, the best, do not copy. But you do, perhaps, use older numbers, even the general approach of someone else in some cases. A Morton number is almost inseparable from the arrangement—he composed with a band treatment in mind. So when we do a Morton number, we use Morton's skeletal idea, but don't play note for note. A clarinet part, as I write it on one of these numbers will be only chord symbols at least half of the way. Everyone is given much freedom, and some of the men may never have heard the original record at all. Some tunes I arrange using the old piano sheet music as a guide. Such was our arrangement of *London Blues*.

The circumstances which permitted the adoption of the Oliver instrumentation were revealed by Evans, as he told how the date was planned, "I conceived the idea of the second cornet when Bob and I were running over some of the Oliver numbers I had written for my concert series. We had never played together before except at informal parties at my home. But I felt that Bob had the tone to make a good addition, and he fell into the phrasing naturally. Luckily, Ewing Nunn could see the value of the idea at once. He has helped me no end— in criticism, in my search for material, in suggestions. Most important, you can be relaxed when you work with him. In order to get ten tunes ready, I was writing up to the last minute. The men had neither played nor heard some of the numbers until rehearsals."

For those who become misty-eyed about the Armstrong-Oliver teamwork in the Creole Jazz Band of 1923, this is a record to treasure. For other perceptive ears, it is a rewarding and enlightening experience. Some of the numbers have not been recorded since the twenties, and the others have seldom been done so well. The second cornet is used in superb ensembles on *Frog-I-More, Snake Rag, Sweet Lovin' Man* and *New Orleans Stomp*. Not since 1950, when Bob Scobey and Lu Watters parted company after working ten years as a team in the Yerba Buena band, has such creative

* *732 The Parkway, Mamaroneck, N. Y.*

of the revivalists—the error of sounding ar- He made it pretty clear that jazz to him played together before except at informal

unity been attempted, but Evans comes closer to the Oliver ideal in the compressed power of his silvery tone and his ability to contribute more than is expected.

It is remarked frequently that Evans outshines the men around him and the wish has been expressed to hear him in a group better matched to his talents. Though he stands head and shoulders above the others on this record, it would be difficult for him to form a traditional unit today where this would not be the case. There is certainly no fault in trombonist Hal Runyan's chorus on *Wild Man Blues*, or clarinetist Dick Pendleton's solo in low register on *New Orleans Stomp*, or the way Tubby Main on tuba backs the lilting piano of Mel Grant on *Frog-I-More*. But it is Evans who has the fervor to lift the performances to greatness, and the skill to walk the tightrope of a stoptime chorus or plunge into a brilliant break. Gruenenfelder is an excellent partner; may their relationship continue. Warren Thewis on drums and Eddie Lynch on banjo have a firm beat. Other numbers are *Perdido Street Blues, Sidewalk Blues, Buffalo Blues* and *Chicago Breakdown*. A single microphone was used and the result is a model of the clarity and balance possible by this method.

Vic's Boston Story **Storyville STLP 920**

That serene singer on the trombone, Vic Dickenson, finally has a chance to put his solo standards to the test as he wends his way through a dozen numbers, and his every note is shot with gold. Long valued for the firm strength he brings to any group, he has shown his worth as a sideman and leader on many occasions, but mainly in relation to other horns. In a solo role, he enjoys a release from such considerations and plays for himself, fitting chorus to chorus with lyric imagination in a variety of registers and intonations. He creates a private world of profound expression into which he invites his listeners and a trio of George Wein on piano, Buzzy Drootin on drums, and Jimmy Woode, or Arvell Shaw on bass.

What he plays is hardly important as the tunes all become pure Dickenson. Once his lingering treatment of *Yesterdays* is heard, it will be recalled whenever the song is played. He sings all too briefly on *Willie Mae* in a manner to recall Jerry Mengo with the Quintet of the Hot Club of France. He is remarkable in two blues, including the title tune, and Ellington's *In a Sentimental Mood* and *All Too Soon*. As an accompanist, Wein is in accord with Dickenson's every whim and gives exact dynamic shading to help build a climax. As the most complete representation of one of the great trombonists, it must be recommended highly.

Bob Brookmeyer: Traditionalism Revisited **World Pacific PJ1233**

This quintet is essentially The Jimmy Giuffre Three, with the addition of drummer Dave Bailey and Bob Brookmeyer on trombone and piano, on a fertile expedition with some pre-1940 tunes. Ralph Pena of the Giuffre trio and Joe Benjamin divide the bass chores. But the idea for the album comes from Brookmeyer and much of the credit for its success belongs to him, for he brings to it a fund of emotion and an intuitive sense of what is right. He is able to return to fundamentals and a fresh approach on either instrument. That Giuffre is still feeling his way in this idiom serves to stimulate him, adding greatly to the interest of his playing. All of the numbers are not in a strict sense traditional, but the blues-based guitar of Jim Hall gives even the oldest more of a folk-flavor than it enjoyed in earlier versions. Though the usual cliches are avoided, they come up with a few of their own, including a winning "Good evening, friends" ending which deserves some permanence, to *Some Sweet Day*.

Giuffre's clarinet introduction to *Santa Claus Blues* is proof that he is an original voice. Brookmeyer works like a Trojan, contributing sorely needed dynamics and switch-

Bob Brookmeyer: Traditionalism Revisited

orchestra volume surges at *any* part of the audible spectrum. The

ing from trombone to piano. The dual track recording of *Honeysuckle Rose* is well managed. Other numbers are *Louisiana, Truckin', Jada,* and *Don't Be That Way.* Now all this unit requires is a cornetist like Doc Evans. Both traditionalists and modernists may find it controversial to the point of displeasure but, as it is likely to be the most discussed jazz record of the year, they can scarcely afford to ignore it.

Bob Scobey: Direct From San Francisco
Good Time Jazz L12023

One of the tangible aftermaths of a lecture-concert tour of the Midwest by Bob Scobey Frisco Band and the noted semanticist Professor S. I. Hayakawa, who tells the story of the trip on the liner, is this program of a dozen musical illustrations used to demonstrate the Dixieland tradition. The intangibles lie in the impact of the spirited octet on a number of young and receptive college audiences, for this is not the expanded unit now backing the Scobey trumpet. The strong front line includes trombonist Jack Buck and Bill Napier on clarinet, backed by Clancy Hayes, banjo; Jesse Crump, piano; Boh Short, tuba; Hal McCormack, bass; and Fred Higuera, drums. Any weakness in the album arises from the necessity of choosing tunes which may well be already represented several times in some collections, though possibly in not as good a recording as Roy DuNann affords *San, Sensation, Sobbin' Blues,* and *Ostrich Walk.* One rarity is *Michigan Water Blues,* with a sensitive solo by Crump and an appealing vocal by Hayes, which is alone worth the price of admission. When he limits himself to a chorus at a time, Hayes is the most pleasant singer around.

John Coltrane: Coltrane **Prestige LP7105**

Recognition as a new star on the tenor sax was gained by John Coltrane during his period with Miles Davis, and he is adding lustre to that designation as a member of Thelonious Monk's quartet. His first LP as a leader finds him in the company of John Splawn, an earthy young trumpeter from Harrisburg, Pa., influenced by Clifford Brown, and Sahib Shihab on baritone sax. Mal Waldron and Red Garland alternate at the piano in a rhythm section of bassist Paul Chambers and drummer Al Heath. Coltrane has a tart, muscular sound which he tempers only slightly for the ballads *Violets For Your Furs, Time Was* and *While My Lady Sleeps.* On these he is accompanied only by the rhythm section, and a good opportunity is offered to compare his style to that of less pungent modernists. He plays like a man on his way, and his restless drive colors the work of the rest of the group. Carl Massey's *Bakai* is an expedition to the Far East, and Coltrane contributes *Straight Street* and *Chronic Blues.* It is the first time he has been able to express himself at length on his own, and a good recording presents him as he now sounds in person.

Paul Chambers: Bass On Top
Blue Note 1569

Since arriving in New York two years ago, Paul Chambers has won much space on discs, mainly as bassist in the Miles Davis rhythm section, and now meets the searching exposure of an entire LP. That he sustains interest through more extended solo space than anyone on his instrument has attempted before is due in no small measure to the presence of Kenny Burrell on guitar, Hank Jones on piano and drummer Art Taylor. Also the balance places him on top on a full-blown, bowed *Yesterdays,* and in his melodic solos on *Confessin'* and *The Theme,* a number used by Davis to close a set. By way of variety on *Dear Old Stockholm, Chasin' the Bird,* and *You'd Be So Nice,* he moves back to his usual position in the section to provide a solid bottom for the rest of the quartet. It is a useful example of how an engineer can aid in the creative side of a date. Chambers is as remarkable in his timing as in his solo capacity, and never hesitates to pluck the deepest tones from his instrument. With soulful work by Burrell and the fine conception of Jones, the group satisfies more than some highly-toned quartets. It should be encouraged to achieve some permanence.

Sonny Rollins, Vol. 2 **Blue Note 1558**

Having left the sheltering wing of Max Roach, Sonny Rollins is appearing in the studios with a number of increasingly varied musicians. Not only is their caliber high in this instance, but they could well have been selected with an eye to challenging his ingenuity. There is Thelonious Monk to alternate with Horace Silver at the piano on his slow blues *Misterioso,* and to solo on his ballad *Reflections.* There is J. J. Johnson, the leading modern trombonist, to help set the pace as drummer Art Blakey flexes his snares on *Why Don't I* and *Wail March,* the two Rollins originals. And Paul Chambers on bass for a bowed solo on *You Stepped Out of a Dream.* After meeting the demands of two such exacting taskmasters as Monk and Silver, Rollins relaxes and nurses his tenor sax through some unexpected twists in a pensive solo on *Poor Butterfly.* It is as complete a picture of Rollins, both from his most difficult and his more easily accessible angles, as is likely to be encompassed on one record.

Sonny Rollins: The Sound Of Sonny
Riverside RLP12-241

At his previous recording dates, Sonny Rollins has been asked to exhibit as many facets of his personality as possible, usually alternating the complexities of a long ad-lib number with the lighter treatment of a popular tune. This last side comes to the fore, as he fronts a quartet of pianist Sonny Clarke and drummer Roy Haynes, with Percy Heath and Paul Chambers sharing duties on bass, on eight standards and *Cutie,* an original ballad. In this capacity, he is unexcelled among today's crop of tenor saxophonists. With a sense of time as accurate as a bass player, he has the control to give direction to his instrument in imaginative and singular lines. His sound has matured to a fullness of warmth and lyricism that can only be compared to a Coleman Hawkins or a Ben Webster, had they been born twenty years later. Rollins plays *It Could Happen to You* unaccompanied, and gives new form to *The Last Time I Saw Paris, Mangoes,* and the Al Jolson favorite, *Toot, Toot, Tootsie,* in a program of songs not too often heard.

Thelonious Monk: Monk's Music
Riverside RLP12-242

Maintaining his reputation for the unexpected by a brief preface of an arrangement of *Abide with Me* for four horns, Thelonious Monk devotes most of the rest of this disc to revised versions of four of his own classics of the '40s. In this revitalization they are expanded and enriched by the addition of the horns of Roy Copeland, trumpet; Gigi Gryce, alto sax; and the tenor saxes of John Coltrane and Coleman Hawkins, who makes *Ruby, My Dear,* with the encouragement of Monk from the piano, a vivid exercise for his ballad style. In clothing the bare bones of his ideas in *Off Minor, Epistrophy,* and *Well, You Needn't* with a loose-knit seven-piece score, Monk makes them not only more understandable but more palatable. They become less a formula and more of a part of the mainstream of jazz. In his piano solo on *Crepescule with Nellie,* he examines the hour of surrealism—twilight. Drummer Art Blakey controls his explosive style to fit a mood and Wilbur Ware is on bass. With the minor complaint that the opening 19th Century hymn, by William H. Monk, lasted less than a minute, this record is a valuable expression of the growth of a man and his music.

Ronnell Bright: Bright Flight
Vanguard VRS8512

Brought to New York from Chicago to help back Rolf Kuhn in his quartet, Ronnell Bright later settled down with his trio for a long engagement at Cafe Bohemia and has an assured future in the smaller jazz rooms. Not only does he acquit himself well on the ballads, show tunes and older favorites expected of such pianists, but he is amassing a goodly array of original material. *Sallye, For Pete's Sake,* and *Bohemia, U.S.A.* are resplendent examples of his writing, and have the properties needed to show his technical facility without

If *your* loudspeaker system is suffering from

sounds in person.

In clothing the bare bones of his ideas in *Off*

undue emphasis on his classical training. Bassist Joe Benjamin's *Toasted 'Ammond* is a clever piece for the group and is not dedicated to John Hammond, the producer of the date, but to the electronic organ of the same name. It is startling in its realistic limning, with the aid of Bill Clark on drums, of some characteristic sounds of the instrument. Among the eleven tunes on the finely-made recording are *People Will Say, Liza*, and *It Could Happen To You*.

Barney Kessel: The Poll Winners
Contemporary C3535

This album title is not in itself any recommendation of its contents for there have been many gatherings of poll winners where everyone became hopelessly bogged down in the studio, one reason being a determination by the producer to cram as many men onto the date as possible, regardless of their compatability with each other or the material. In this case the invitations were limited to Barney Kessel on guitar, Ray Brown on bass and Shelly Manne on drums, all of whom have enjoyed recognition as being at the top on their instrument for so long that they take a clean sweep of most polls in their stride. The result is an intelligent conversation among equals at repartee and challenging satement as they mull over such tunes as *It Could Happen To You, Don't Worry About Me, Green Dolphin Street, You Go To My Head*, and *Nagasaki*. Or stimulate each other to imaginative flights on a blues by Kessel, *Jordu*, and extended treatments of *Mean To Me* and *Satin Doll*. What they have to say is as interesting on the tenth hearing as on the first, and will be fresh ten years from now.

Mundell Lowe: A Grand Night For Swinging.
Riverside RLP12-238

Like many musicians employed in studio work, the guitarist Mundell Lowe is a switch-hitter equally at home with a score, or in the fluent company of pianist Billy Taylor, engaging in a free exchange of jazz ideas. With the title tune by Taylor to set the album's theme, they explore *Easy to Love* and *Crazy Rhythm*. Altoist Gene Quill adds his buoyant voice on *Love Me or Leave Me, You Turned the Tables on Me*, and an unclinical *Blues Before Freud*. Lowe selects *It Could Happen to You* to demonstrate his distinctive solo style. Bassist Les Grinage and drummer Ed Thigpen do nothing to impair the atmosphere of relaxed and listenable chamber music.

Russ Freeman and Chet Baker: Quartet
Pacific Jazz PJ1232

By virtue of five originals, pianist Russ Freeman splits honors with his former boss Chet Baker on the billing of this album, and he seems to have designed them with the moody and reflective side of the trumpeter in mind. Not that the lighter, swinging facets of his personality are neglected, but it is the quiet beauties of *Summer Sketch*, the smoky quality of *Fan Tan*, and the musings on *Amblin'* that are most persuasive as Baker coaxes rounded, Bixian tones from his horn. *Say When* allows drummer Shelly Manne an *I Got Rhythm* solo, and he indulges in some by-play with bassist Leroy Vinnegar on the uptempo *Hugo Hurwhey*. On *Love Nest*, Baker bites off his choruses in Roy Eldridge fashion and again changes pace on *Lush Life*, the other standard. As a composer and pianist Freeman deals in essentials, an attribute which will stand him in good stead when he chooses to write for a larger group.

Toshhiko Akiyoshi: Her Trio Her Quartet
Storyville STLP918

When this young Japanese girl arrived in the United States nearly two years ago to study at the Berklee School of Music, she garnered the sort of publicity the public press reserves for an oddity. Rather than capitalize on it, she maintained a quiet devotion to her studies and now numbers a *Jazz Suite for Orchestra* among her compositions. The respect she has gained by her complete involvement in a music learned in her native land from the phonograph, is likely to be enhanced by her sparkling piano and two originals on her second LP. She is joined by Oscar Pettiford, bass, and Roy Haynes, drums, on five tunes, including her crisp *Salute to Shorty*. On *No Moon At All, Thou Swell*, and her *Pea, Bee and Lee*, Boots Mussulli adds his alto sax to the support of Wyatt Reuther, bass, and Ed Thigpen on drums. Though her style is based on Bud Powell, she is using her closer view of the jazz scene to find her own voice. Her new perspective may enable her to regard her own heritage in more favorable light. For a great deal of the charm found here comes from a piquant Oriental touch Toshiko Akiyoshi gives to a phrase or her sounding of a chord. She may want to disclaim it, but it could be employed to her advantage.

The Jazzpickers **EmArcy MG36111**

Credited as being the founding father of the cello in jazz, Harry Babasin has worked mainly on bass in large groups where his part demanded that he supplement the drummer. By returning to the cello in his quintet after a decade of preparation, he is able to relate his role more closely to the guitar of Don Overbeg for distinctive voicing and rapid interplay between the two instruments. He never uses a bow and the two plucked lines, especially when combined with the smooth-flowing vibes of Bob Harrington, do much to account for the unique sound of the newly formed unit. It is gentler and more subtle than most intimate combinations and the light, airy tone of Buddy Collette on flute carries out the theme. A baker's dozen of tunes range from ballads to the complex *Yardbird Suite* and the swingy *Clap Hands, Here Comes Charlie*. Four originals are by Babasin and two by Harrington, who alternates with Bill Douglas on drums. It is jazz chamber music of rare virtuosity.

The Mastersounds: Jazz Showcase
World Pacific PJM403

Formed into a cooperative unit with the same instrumentation as that of the Modern Jazz Quartet, the Mastersounds try for a different sound and make their approach from a less rarefied atmosphere. The Fender electronic

bass played by Monk Montgomery is the most noticeable source of their distinctive sound. Just as in the case of the electric guitar before the artistry of Charlie Christian broke down the barriers, it is an instrument struggling to gain acceptance. In some passages its tone bears a striking resemblence, though with a little more resonance, to the Cook Chromatic Scale Test Record. After five years of study, Monk claims he is a long way from mastering it, but he extracts a strong, pulsing line and shows its inherent advantages at fast tempos. Whether he will be its Charlie Christian is still to be determined, but he gives it a flying start which offsets any eventual exploitation in rock and roll.

Their ten numbers are arranged for maximum swing and Buddy Montgomery, a young brother, is on vibes and contributes *Drum Tune*, while Wes, a third brother, wrote *Wes' Tune*. They all hail from Indianapolis as does Benny Barth on drums. Pianist Richard Crabtree is the composer of *The Queen and I*, and his *Water's Edge* recalls *If I Had You*. Part of the cover design is a photograph of what is said to be the world's largest loudspeaker, a 16-footer from Sausalito, California.

Ted Heath: Spotlight On Sideman
London LL1721

For sheer technical brilliance on every chair the Ted Heath personnel can match most big bands of the past and present, but the commercial success which makes this array of talent possible also limits the purely jazz role of the players for much of the time. Here eleven of the sidemen are permitted to put their personal imprint on a tune of their choice, and the remaining five are featured on Johnny Keating's *Witch Doctor*, a showpiece for the drums of Ronnie Verrell and the engineering of Arthur Lilly. It would be hard to pick out a favorite soloist, but they all have the leader's polish and he is amply repaid for putting them on their mettle by the best work the band has turned out yet. It will aid immensely in wider appreciation of the band and Heath should make a similar date an annual event.

In a Tribute To The Fabulous Dorseys, LL1743, respects are paid to the two brothers who served as models for Heath since he played with them in London in the '30s. He consolidates their two personalities, better than they were able to themselves at times, on a dozen of their favorites, just as he absorbed much of their style into his organization. Leslie Gilbert plays Jimmy's alto-sax solo on *Oodles Of Noodles* with considerable aplomb and the band is faultless in *Green Eyes, Song Of India, Marie*, and so on. Billboard's compilation of the standards most played on American radio stations is represented on the All Time Top Twelve, LL1716.

Art Blakey: Orgy In Rhythm, Vol. 2
Blue Note 1555

Sabu: Palo Congo **Blue Note 1561**

The Original Trinidad Steel Band
Elektra 139

Along with virtuoso drumming and an amazing number of concepts in a seemingly limited form, a lesson in folkways is contained in the percussion studies on these three discs. On the second part of his essay in communication between jazz and Latin drummers, Art Blakey leads the same ten rhythm section men, with Herbie Mann on flute, who were responsible for the dramatic first volume. *Amuck* and *Elephant Walk* are stories told in primitive jungle sounds. *Come Out And Meet Me Tonight* is a calypso underlined by tympani, and *Abdullah's Delight* is a blues stated in several unusual ways. Though led far afield, the jazzmen never falter, but the contrasting rhythms are as much a challenge to the listener as to the drummers.

Leading the Latin forces opposite Blakey is *Sabu* who, when heading his own unit, selects five Afro-Cuban percussionists and two vocalists. He conducts them in tunes rich in folk elements and strange religious rituals, rather than the Afro-Cuban beat adapted by dance bands. Along with the customary conga and bongo timbres, there are quinto, golpe, tumbadore, and llamador drums. Arsenio Rodriguez alternates on guitar for several solos. Like the rest of the program, they present a music not found elsewhere on records. Seemingly primitive, as Hsio Wen Shih points out in the notes, it is "neither artless nor lacking in its own brand of musical sophistication."

The original Trinidad Steel Band has performed together as a concert unit in the United States for several years. Its fifteen numbers are a fusion of such disparate influences as rhythms from Africa by way of the West Indies and melodies from Spain, or the latest popular tune. As a final sociological note, all three groups make their headquarters in New York City.

Pedro Garcia: Cha Cha Cha, Vol. 3
Tango
Audio Fidelity AFLP 1837-38

The Hotel del Prado orchestra of Mexico City, under the leadership of Pedro Garcia, continues its exploration of the cha cha cha in the third volume of a successful series and begins a display of its tango repertoire on another dozen tunes. Though it specializes in the suave and danceable rhythms of a society band, it has the advantage of an authentic styling and a natural talent for the material which makes it always listenable. Besides meeting the essential requirement of good percussion men, it has excellent strings and a well-schooled brass section. Dancers who have mastered the cha cha cha may well want to attempt the more difficult tango as represented by such familiar numbers as *Inspiration, A Media Luz, La Cumparsita*, and others not as well known. Both albums have fine sound and include dance instructions and charts of the steps.

Glenn Yarbrough: Here We Go, Baby
Elektra 135

Chicago Mob Scene Riverside RLP12-641

Herb Straus: Folk Music For Peaple Who Hate Folk Music **Judson L3003**

Since its introduction to discs by a few hardy troubadours, folk music has expanded in all directions, not always in the same healthy tradition, at a pace accelerated by the demands of LP. Three varied examples of this evolution must be headed by the songs of Glenn Yarbrough, who is the most welcome addition to the ranks of balladeers to come along in some time, as he is backed by a chorus and orchestra under the direction of Fred Hellerman of The Weavers. His acompaniment on the fifteen songs may range from the guitar of Josh White, to a skiffle group, to the full complement with French horn and flute, then to his own guitar. The arrangements never descend to Mitch Miller banalities and Yarbrough is my nomination to displace Belafonte, or Elvis for that matter. The sound is excellent.

Subtitled a folk-song jam session, the album by The South Six, a group centered at the University of Chicago where some of its members study, is just that. A soloist may complete one of the sixteen numbers or everyone may join in for alternate choruses. An original verse may turn up at any time and even the producer, Dean Gitter, becomes enwrapped in *Mob Blues*. It is an impromptu song fest that might be heard at a gathering in New York's Washington Square, a studio in San Francisco or any number of colleges.

A more sophisticated approach is taken by Herb Straus, whose arranger, Mundell Lowe, may draft an English horn, flute or bassist Eddie Safranski to aid his guitar in the accompaniment. On their dozen numbers, they may renew a familiar song with original lyrics, introduce a translation of a Hebrew song, or show that they can be authentic on *Aura Lee*.

Genaro Nunez: Bullring!
Audio Fidelity AFLP1835

In the fourth volume of La Fiesta Brava, Genaro Nunez conducts the Banda Taurina of Plaza Mexico on a dozen numbers which in the main are used to entertain the crowd between the various episodes of the bullfight. Though they could be just as well programmed at a band concert in any Mexican town, in this context they take on the drama and color of the arena and are given the same open, out-of-doors recording characteristic of the rest of

The Original Trinidad Steel Band
Elektra 139

plete one of the sixteen numbers or everyone

the series. The resplendent trumpet of Filipe Leon comes through with a brightly charging sound or with distant mournfulness, depending upon the emotion it is called upon to convey. A sketch of one of his country's heros is contained in Nunez's composition *This Is Cantinflas*, a warm tribute to the comedian. There is a strong folk-flavor to the other numbers and it seems likely they are making their first appearance on LP.

Mammoth Fair Organ **London LL1644**
Bill Thompson: Plays the Baldwin "45" **Pacifica P2004**
Harry Farmer: Capers On The Console **London LL1726**

The mechanical organ of the Carrousel Becquart, built in Belgium about fifty years ago by Louis Hooghuys and said to be the last of its kind, is still being transported about the Continent to spread its mammoth store of good cheer among adults and children gathered at fairs. Its brazen charms are about equally due to its numerous effects and the delightfully archaic arrangements on the perforated rolls of A. Schollaert. Set to the tempos of a gayly-painted wooden horse, they let the bells ring and the percussion sound in a dozen marches, waltzes and the overture to *The Beautiful Galathea*, and follows a slow *Fontaine Lumineuse* with the courageous *A L'Attacque*. Skillful microphone placement picks up its voice in full cry, but not the rustling of its inner works.

Bill Thompson introduces the new Baldwin Model 45-H electronic organ, with its nineteen independent voices and four couplers, on a dozen ballads and swing favorites, including *Kitten On the Keys, Song of India, Mad About the Boy* and his own *Brown-Eyed Girl*. Also heard is the new percussion ensemble of vibra harp, organ harp and string percussion. The liner notes contain full technical details.

Harry Farmer is credited as being the first to introduce the Hammond organ to Britain in 1937, and he still plays it with characteristic spit and polish on a dozen light classics. An excellent comparison of the organs is offered by the two albums.

COMING EVENTS

HI-FI SHOWS

January 10–12—Minneapolis: Hotel Dyckman (*Rigo*).

January 17–19—Indianapolis: Hotel Antlers (*Rigo*).

January 24–26—Buffalo: Hotel Statler (*Rigo*).

February 7–9—Denver: Hotel Cosmopolitan (*Rigo*).

February 14–16—San Francisco: Whitcomb Hotel (*IHFM–NCAS*).

Feb. 26–Mar. 2—Los Angeles: Biltmore Hotel (*IHFM*).

March 7–9—Pittsburgh: Hotel Penn-Sheraton (*Rigo*).

March 14–16—Washington, D.C.: Shoreham Hotel (*Independent*).

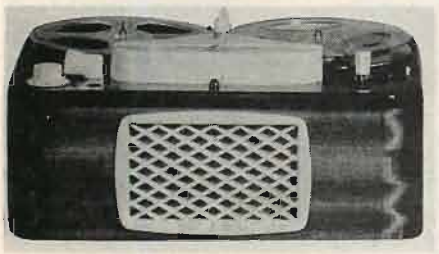
March 21–23—Newark: Hotel Robert Treat (*Rigo*).

March 28–30—Baltimore: Lord Baltimore Hotel (*Rigo*).

Sept. 30–Oct. 4—NEW YORK High Fidelity Show, New York Trade Show Building (*IHFM*).

NEW PRODUCTS

• Tandberg 3-Speed Stereo Recorder. Compact and portable, this new Tandberg unit can be used for both recording and reproduction of live performances and stereo AM-FM broadcasts. Despite its small size, the Model 3-Stereo is equipped with two power playback amplifiers. Frequency response at 7½ ips is 30 to 17,000 cps. Upper frequency limit at 3¾ and 1⅞ ips is 10,000 and 5000 cps, respectively. The stacked-head assembly permits use of the instrument for twin-track monaural recording and reproduc-

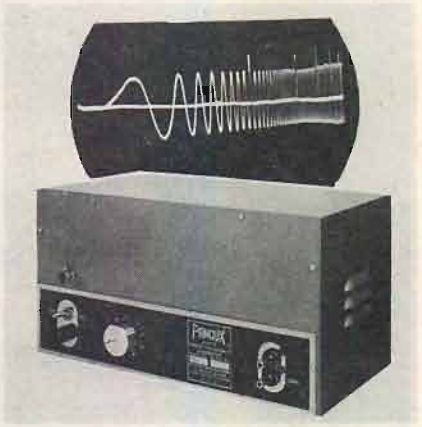


tion when desired, in which case all characteristics are similar to those of the standard Tandberg Model 3 recorder. A built-in Goodmans speaker provides monitoring facilities while recording. To meet the needs of those who want a complete stereo tape system, Tandberg has available a speaker system, Model 266, which is matched to the stereo playback amplifiers. Two of these systems, used in conjunction with the recorder, afford complete stereo playback facilities. Weight of the Model 3-Stereo is only 32 lbs. in its handsome luggage-type carrying case. Tandberg, 10 E. 52nd St., New York 22, N. Y. **A-1**

G-E 20-Watt Amplifier. Although priced modestly, the new General Electric Model PA-20 leaves little to be desired as an amplifier for custom hi-fi systems. Frequency response is 20 to 20,000 cps and harmonic distortion is below 1.0 per cent. Phono-input hum level is – 60 db at full output. Incorporated in the PA-20 is a

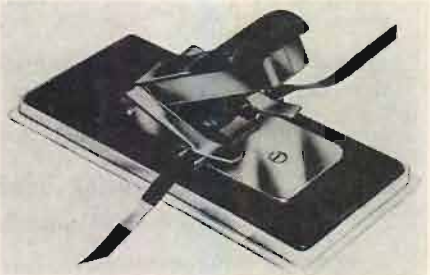
newly-designed rumble filter which has a sharp low-frequency cutoff of 12 db/octave below 40 cps, thus effectively filtering out sub-audio frequencies without appreciable effect on bass response. Interstage feedback phono compensation allows the use of practically all low- and high-input cartridges on the market. Phono input sensitivity is 5 to 7 mv for full output. The amplifier has five separate inputs and three separate outputs for a wide choice of applications. The loudness control, one of seven controls, is compensated for the physiological hearing curve to assure musical balance at all intensity levels. Further information may be obtained from: Specialty Electronic Components Dept., General Electric Co., Auburn, N. Y. **A-2**

Sweep Generator. The Pandux Audio Sweep Frequency Generator is an instrument for determining quickly the behavior of audio equipment with respect to frequency and associated phenomena. It is designed for use with any standard oscilloscope. The complex signal is produced by scanning photo-electrically a synchronously rotating disc. The modulation on the disc is the photographic reproduction of a precision pattern, the accuracy of which assures a positive signal which eliminates anomalous distortion, frequency and other discriminations which could be introduced by non-stable reactive components of more complex circuits. The signal, as it comes from the generator, scans from 80 cps to



20 kc. The sweep frequency is covered by 20 signal pulses per second. The signal is flat over the specified range with 1.0 db. Frequency markers occur at 2, 5, 10, 14, 18, and 20 kc. A base line is provided for determining relative amplitudes. Output is 4 volts, open circuit, with internal impedance of 200 ohms. For production testing, the sweep signal can be piped to production line test points where an instantaneous check can be made by using "go" and "no go" markers on the 'scope screen. The generator can also be used in the design and testing of microphones and loudspeakers, as well as for making periodic checks of the over-all performance of the audio circuits and transmission lines of radio and television stations. Designated Model 125-C, the Pandux audio sweep frequency generator is manufactured by Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 64, Calif. **A-3**

"Irish" Tape Splicer. Fast, precise tape editing and repairing is afforded by the new "Irish" Tape Splicer, recently announced as an addition to the Irish brand



line of tape products manufactured by ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala. The unit is designed to cut two rounded indentations in the tape, giving the splice a narrow waist, and leaving the edges of the tape which contact parts of the recorder entirely free of adhesive. As little as one-quarter inch of tape need be removed for making the splice. **A-4**

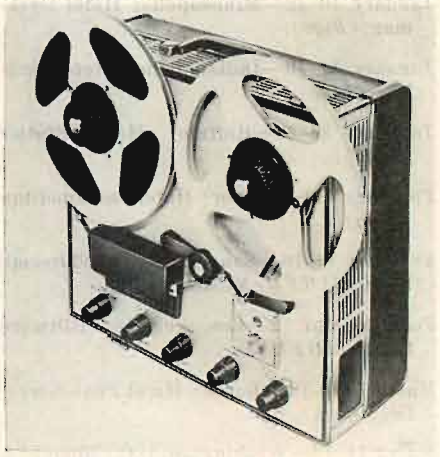
Fisher Ultra-Sensitive FM-AM Tuners. Recently added to the Fisher line of high-fidelity components are two new Anniversary series tuners—the Model 90-R Tuner, and the Model 90-T Tuner and Audio Control Center. Remarkable sensitivity is afforded by both instruments due to incorporation of the exclusive

Fisher gold-cascode r-f amplifier. The MicroRay tuning indicator provides ease of tuning and exceptional accuracy on weak signals. A push-button FM muting-AM bandwidth control eliminates the effects of station interference. Further elimination of interference, as well as limiting of undesirable radiation, is provided by silver-plated shielding of the entire front end. The audio control portion of the 90-T includes a new presence control which lends emphasis and realism to solo passages. A 3-position sharp-cutoff rumble filter reduces low-frequency noise with minimum loss of frequency response. A similar filter is supplied to suppress noise in the high-frequency range. Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. **A-5**

Tape Magazine Repeater. Introduced by the Special Products Division of The Pentron Corporation, the Model A-4 recorder-playback unit makes possible the recording and continuous or intermittent

playback of sales messages or personalized announcements ranging in length from one to 55 minutes. Lower-priced playback-only models are also available. The unit meets many communication requirements in stores, railroad stations, airports, schools, etc. For further details and specifications, write Morhan Exporting Corporation, 458 Broadway, New York 13, N. Y. **A-6**

• American-Concertone Portable Recorder. The new "Globematic 60" tape recorder, affording half-track, full-track or stereophonic record and playback, weighs less than 35 pounds in its magnesium carrying case. Easily transportable for on-the-spot recording, it may be operated in either horizontal or vertical position. Control of all functions is provided by five pushbuttons on the front panel. The recorder accommodates reel sizes up to and



including 10½ in. and is designed for operating speeds of 7½ and 15 ips. A torque control switch is provided for change from 10½ in. to smaller reels. Phone jacks permit monitoring input to the record head or playback output while recording. The machine is equipped with three motors—a direct hysteresis-synchronous capstan-drive motor with timing accuracy of 99.8 per cent, and two high-speed take-up and rewind motors with self-compensating braking systems. Manufactured by American Electronics, Inc., 655 W. Washington Blvd., Los Angeles 15, Calif. **A-7**

ing out sub-audio frequencies without appreciable effect on bass response. Inter-
ORRadio Industries, Inc., Shamrock Circle, Opelika, Ala. The unit is designed to

HARVEY'S

...the place to go – if you want Hi-Fi!

Why HARVEY'S? That's elementary. The name has been synonymous with thoroughly dependable hi-fi shopping since the dawn of separate-component home music systems. With every high-fidelity component worthy of name in stock for immediate delivery... with a staff of audio consultants famed far beyond the confines of New York... with demonstration facilities second to none... and with a most attractive time-payment and trade-in policy — HARVEY'S is in a position to cater to every desire and whim of the beginning or advanced hi-fi enthusiast.

Right now, HARVEY'S is celebrating its 30th anniversary in the electronics business. Why not drop in soon and see all of the latest hi-fi gear, such as those described below, during our 30th Anniversary Sell-A-Bration.

Tandberg STEREO

Here's the answer to your tape recorder requirements—a 3-speed stereo playback system that gives you the finest in stereo sound reproduction, plus the complete facilities of a monaural recorder reproducer. The price of the Model—3 Stereo unit complete with two built-in, well-balanced amplifiers. Goodman Speaker, furniture cabinet, ... **$369.50**

(complete with microphone and carry case)

JANSZEN

for the finest in

Electrostatic Loudspeakers

When you hear this electrostatic loudspeaker system reproduce music that ranges from 500-30,000 cps anywhere in the room, you will really want to own one right away. Its four electrostatic radiators transform electrical energy directly into sound without break-up or audible resonances. The Janszen design provides for a performance response which brings the music to you without exaggerated and distorted highs. Sensitive listeners could do well to have a Janszen demonstrated. Model 130-M..... **$184.00**

THORENS

'Concert' Record Changer

Here's a precision, Swiss-built record changer whose performance is highly rated by audio enthusiasts. The simplicity of the CD-43 operation results from exacting design of the direct-drive motor that is governor-controlled. There is a 3-speed adjustment for control of exact pitch, plus intermix of 12", 10", and 7" records. Reject, repeat, adjustable pause controls, and automatic final record shut-off, plus tone arm tracking force adjustment, make this a real buy..... **$79.95**

KLH Loudspeaker System

The utilization of special cones and suspensions enables KLH speakers to offer unprecendented smoothness throughout the low and mid-frequency ranges. Typical of this superb line of loudspeakers is the Model Four speaker system housed in a 13½" H x 25" W x 12" D Cabinet. The system covers the complete range of musical interest with unusually low harmonic distortion, smooth response at low frequencies and an unparalleled freedom from irregularities in the mid-range. In mahogany **$224.00**

marantz Amplifier

It would be futile to try to enumerate in this space all of the features of this amplifier of amplifiers—you name it, it's got it! The fantastic care that goes into the selection of components and into the construction of the Marantz units has its parallel only in special types of military communications and telephone equipment—it is certainly well beyond the highest hi-fi standard. The resulting quality of amplification. freedom from noise and all other bugs, plus long-term reliability and ease of servicing (if that should ever become necessary!) make the initial investment an eminently worth-while one..... **$198.00**

FISHER MODEL 90-R

FM-AM Tuner

Combining engineering, excellence and dazzling performance the Fisher 90-R is truly representative of the renowned FISHER tradition for quality. Providing both maximum sensitivity and maximum signal-to-noise ration, without compromise, the 90-R may even bring in FM stations before you have connected the FM antenna! Incorporating the celebrated FISHER Gold Cascode RF amplifier, and companion circuitry, the 90-R has a rated sensitivity as low as 1 microvolt—with AM sensitivity better than 3 microvolts at full output. Price: **$199.50**

WEATHERS ML-1 Turntable

Announcing the new ML-1 "Synchro-matic Drive" turntable designed especially for modern phonograph pickups having extremely wide range response and low tracking force. The turntable uses a synchronous motor with a newly developed drive system which features an extremely accurate speed of 33⅓ rpm. The turntable and motor are assembled on a metal motor board which is 14⅛" x 15⅛".

K730—turntable, Base & FM Pickup with Diamond Stylus **$159.00**

ML-1 (on base) Price..... **$59.95**

FAIRCHILD XP-3 Cartridge

The XP-3 cartridge features an exceptional number of "firsts" that make it the most advanced phono transducer ever developed. A number of important theoretical as well as practical engineering problems have been solved in this product with the result that the XP-3 has unusually high compliance and virtually no detectible IM distortion.

A sub-miniature coil of unusual construction is damped by a completely new method of coil suspension, clarity and definition of sound becomes evident by a life-like separation of musical instruments and complex passages.

The XP-3 has a 0.7 mil. diamond and tracks any commercial record at two to four grams stylus pressure..... **$60.00** net

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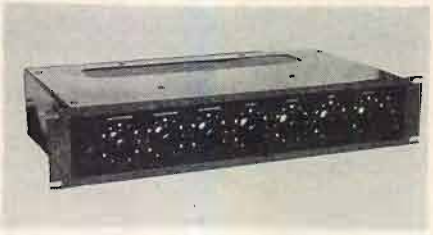
JUdson 2-1500

Versatile Audio Mixer. Featuring plug-in transformers, preamplifiers and line amplifiers, this instrument is suited equally well for use with recording equipment or public-address systems. The plug-in-units may be arranged to provide up to seven individually controlled input channels. Outputs of +20 dbm into 50, 250, or 600 ohms, or up to 30 volts into

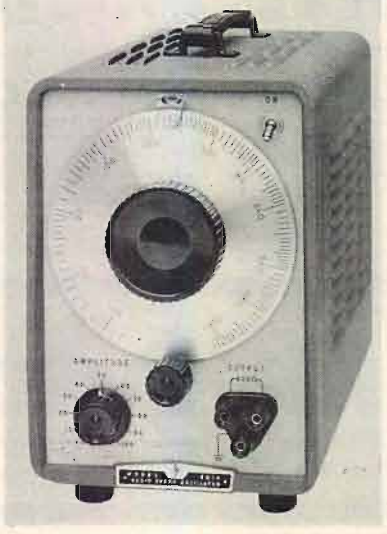


high impedance may be obtained from the line amplifiers. The inputs may be microphones, tape or disc players, or tuners. The rack-mounted Model 17 is pictured. Sloping panel models for table use are also available. All models are approximately 3½ inches high. Literature is available from Miami Instrument Co., Box 384, Tamiami Station, Miami 44, Fla. **A-8**

• **Bell FM-AM Tuner.** Styled to match the "new look" of the Bell amplifier line, the Model 2520 tuner is only 4 inches high and finished with saddle-tan vinyl leather. Technical features include completely shielded construction with the use of a grounded-grid r.f. stage which conforms to FCC radiation requirements, also Arm-

strong FM circuit with Foster-Seeley discriminator. Selector switch permits disabling AFC when desired. A logging scale is provided in addition to regular frequency-calibrated tuning scales. A built-in line cord antenna and an AM loop stick are incorporated for local reception, with external antenna connections provided for reception of distant stations. FM sensitivity is 2 microvolts for 20-db quieting. FM frequency response is 20 to 20,000 cps within ±1 db. Output connections include dual jacks for feeding tape recorder and amplifier simultaneously. Noise level on FM is 65 db below 30 per cent modulation. Bell Sound Systems, 555 Marion Road, Columbus 7, Ohio. **A-9**

• **Hewlett-Packard Sweep Oscillator.** A range of 20 to 20,000 cps on a single dial



sweep is a unique feature of the new Model 207A audio sweep oscillator recently announced by the Hewlett-Packard Company, 395 Page Mill Road, Palo Alto, Calif. The instrument employs an advanced version of the RC oscillator circuit, and achieves its unusual frequency range without bandswitching. Accuracy of the 207A is ±4 per cent including warmup drift and aging of tubes and components. The unit is designed essentially for motor drive and for testing audio circuits and components. Further information is available. **A-10**

Miniature Velocity Microphone. An improved method of ribbon assembly which prevents saging and spurious vibrational nodes, and a magnet system which greatly enhances efficiency, are incorporated in the new "Trix Sixty Special" bi-directional ribbon microphone. The unit com-

prises a relatively long corrugated limp aluminum ribbon which is encircled with four breath shields. Although designed primarily as a studio microphone, the Trix Sixty Special can be used with equal effectiveness for public address work because of its ability to deliver high reinforcement levels with freedom from feedback. Frequency response is 50 to 12,000 cps within ±2 db and output is −58 db. Size is 4 × 1⅜ ins. For complete details write to the Fen-Tone Corporation, 106 Fifth Ave., New York 11, N. Y. **A-11**

E-V Logarithmic Translator. Intended essentially for measuring wide ranges of levels with maximum low-level accuracy and in plotting frequency response characteristics of various components, the new Model 6700 Logarithmic Translator will find numerous applications in audio and acoustic research and development. The output voltage varies in average value proportionately to the logarithm of the input amplitude, and can be fed directly to any averaging-type indicator or

• **Hewlett-Packard Sweep Oscillator.** A

oscilloscope. The output can easily be resolved into a corresponding d.c. value with the aid of a simple r-c network. Operation with fast sweep plotters, such as oscilloscopes, is therefore readily available. In addition, the 6700 is equipped with a large meter which displays a linear decibel scale and a logarithmic voltage scale. Decibel range is 0–40 db; voltage range is 1 mv to 100 volts. Frequency range is 25 cps to 40 kc ±1 db. The 6700 is available in either a portable aluminum case or with a 7-inch standard rack panel. Manufactured by EV Instruments, division of Electro-Voice, Inc., Buchanan, Mich. **A-12**

NEW LITERATURE

Argonne Electronics Mfg. Corp., 165-11 South Road, Jamaica 33, N. Y., is now distributing a new 12-page catalog of imported and American-made miniaturized components, including a number of specialty and audio items. Catalog ARC-7 lists a large selection of transistor transformers, subminiature volume controls, phono cartridges and styli, miniature earphones, musical instrument pickups, plus a number of additional accessory items. **A-13**

United Audio Products, 202 E. 19th St., New York 3, N. Y., has recently published an attractive, colorful catalog describing the complete line of Wigo loudspeaker systems. Covered in the catalog are ten models, including single- and dual-cone tweeters, 8-in. midrange drivers, a 12-in. extended-range speaker, a 12-in. coaxial system, and 12- and 16-in. woofers. An excellent listing of high quality speakers, the catalog will be mailed free upon written request. **A-14**

B&K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill., has recently issued a well-illustrated 4-page brochure on the company's scanners, tube checkers, and specialized instruments for industrial and service shop use. Of particular interest is the B&K Dyna-Scan Model 1050, a portable video and audio generator which transmits picture or pattern and sound to any number of TV receivers. Requests for copies should specify Bulletin No. AP10. **A-15**

Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass., manufacturer of the AR-1 and AR-2 speaker systems, has prepared a new 4-page brochure on the AR-2. The brochure includes a brief explanation of the patented acoustic-suspension design, together with harmonic-distortion and frequency-response curves. This booklet will be mailed free upon written request. **A-16**

University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y., has just announced a new 12-page illustrated catalog covering the company's complete line of loudspeakers and speaker components for high-fidelity and commercial-industrial applications. Full product descriptions, specifications, and application information, as well as prices, are incorporated into the catalog. This is one of the most complete publications of its kind ever issued, covering speaker items ranging from University do-it-yourself (KWIKIT) enclosure kits for home music systems to submergence-proof speakers for marine usage. Everyone interested in audio should have a copy. **A-17**

• **Cabinart,** a Division of G & H Wood Products Co., Inc., 99 N. 11th St., Brooklyn 11, N. Y., announces a handsome multicolored catalog which lists and pictures the company's complete line of high-fidelity equipment cabinets and speaker enclosures. Dimensional drawings provide complete information concerning the placement of individual components. Your copy will be mailed free upon request. **A-18**

LOUDNESS, ITS DEFINITION

(*from page 40*)

value, the calculated loudness levels ($L_{calc.}$) are shown. The three associated values of L_k, $L_{obs.}$, and L_{calc} in each column represent the data for one complete test. For example, in Table VIII, the first tone is described as having ten components, and for the first test shown each component was adjusted to have a loudness level (L_k) of 67 db. The results of the test gave an observed loudness level ($L_{obs.}$) of 83 db for the ten components acting together, and the calculated loudness level ($L_{calc.}$) of the same tone was 81 db. The probable error of the observed results in the tables is approximately ± 2 db.

In the next series of data, adjacent components had a difference in loudness level of 5 db, that is, the first, third, fifth, etc., components had the loudness level given opposite L_k, and the even numbered components were 5 db lower. (Tables X and XI.)

In the following set of tests (Tables XII and XIII) the difference in loudness level of adjacent components was 10 db.

The next data are the results of tests made on the complex tone generated by the Western Electric No. 3A audiometer. When analyzed, this tone was found to have the voltage level spectrum shown in Table XIV. When the r.m.s.

TABLE XIV

VOLTAGE LEVEL SPECTRUM OF NO. 3A AUDIOMETER TONE

Frequency	Voltage Level	Frequency	Voltage Level
152	− 2.1	2128	−11.4
304	− 5.4	2280	−16.9
456	− 4.7	2432	−14.1
608	− 5.9	2584	−16.2
760	− 4.6	2736	−17.4
912	− 6.8	2880	−17.5
1064	− 6.0	3040	−20.0
1216	− 8.1	3192	−19.4
1368	− 7.6	3344	−22.7
1520	− 9.1	3496	−23.7
1672	−10.0	3648	−25.6
1824	− 9.9	3800	−24.6
1976	−14.1	3952	−26.8

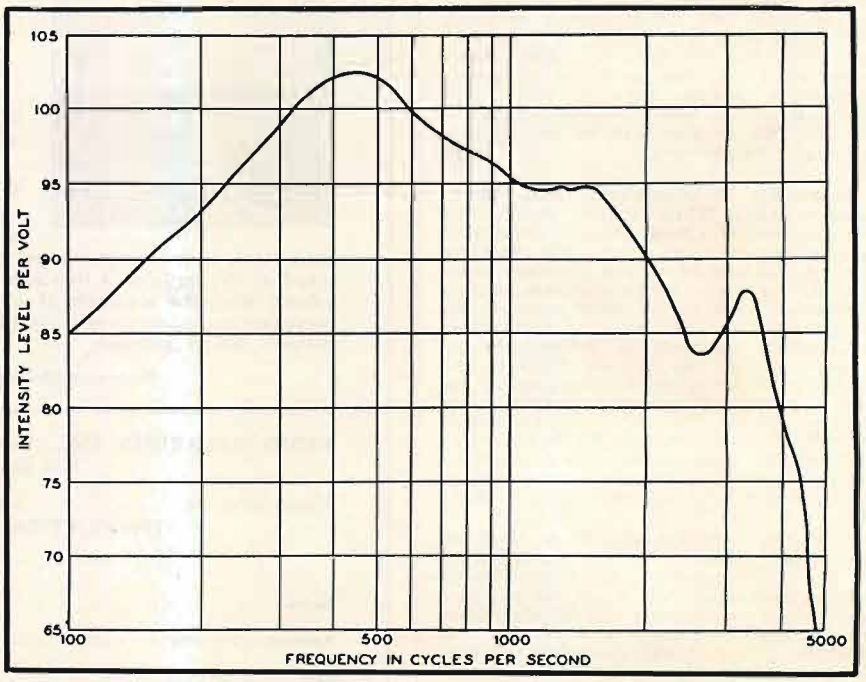


Fig. 13. Calibration of receivers for tests on the No. 3A audiometer tone.

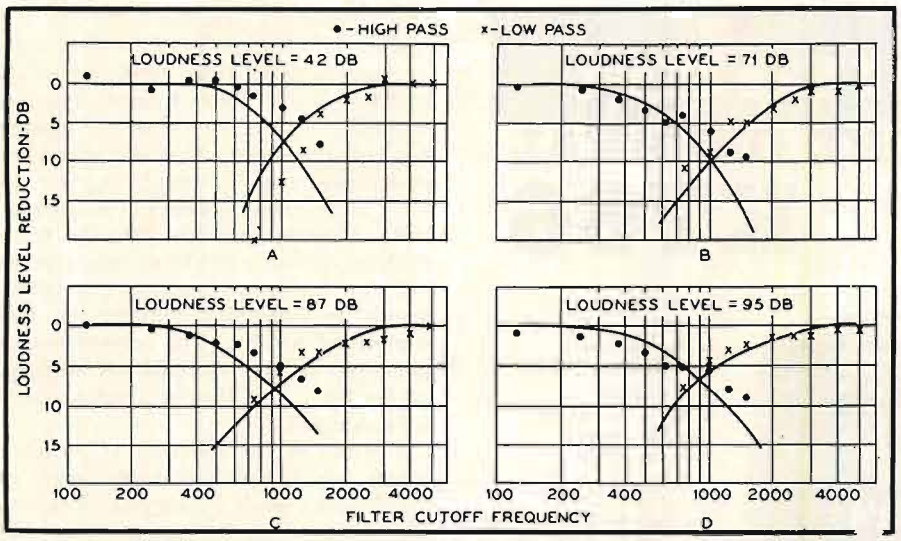


Fig. 14. (A to D)—Loudness level reduction tests on the No. 3A audiometer tone.

voltage across the receivers used was unity, that is, zero voltage level, then the separate components had the voltage levels given in this table. Adding to the voltage levels the calibration constant for the receivers used in making the loudness tests gives the values of β for zero voltage level across the receivers. The values of β for any other voltage level are obtained by addition of the level desired.

Tests were made on the audiometer tone with the same receivers[11] that were used with the other complex tones, but in addition, data were available on tests made about six years ago using a different type of receiver. This latter type of receiver was recalibrated (*Fig.* 13) and computations made for both the old and new tests. In the older set of data, levels above threshold were given instead of voltage levels, so in utilizing it here, it was necessary to assume that the threshold levels of the new and old tests were the same.

Computations were made at the levels tested experimentally and a comparison of observed and calculated results is shown in Table XV.

The agreement of observed and calculated results is poor for some of the tests, but the close agreement in the recent data at low levels and in the previous data at high levels indicates that the observed results are not as accurate as could be desired. Because of the labor involved these tests have not been repeated.

At the time the tests were made several years ago on the No. 3A Audiometer tone, the reduction in loudness level which takes place when certain components are eliminated was also determined. As this can be readily calculated with the formula developed here, a comparison of observed and calculated results will be shown. In *Fig.* 14A, the ordinate is the reduction in loudness level resulting when a No. 3A Audiometer tone having a loudness level of 42 db was changed by the insertion of a filter which eliminates all of the components above or below the frequency indicated on the abscissa. The observed data are the plotted points and the smooth curves are calculated results. A similar comparison is shown in *Figs.* 14B, C and D for other levels.

This completes the data which are available on steady complex tones. It is to be hoped that others will find the field of sufficient importance to warrant obtaining additional data for improving and testing the method of measuring and calculating loudness levels.

[11] See Calibration shown in *Fig.* 1.

TABLE XV

A. Recent Tests on No. 3A Audiometer Tone

R.m.s. Volt. Level....	−38	−55	−59	−70	−75	−78	−80	−87	−89	−100	−102
$L_{obs.}$.....	95	85	79	61	56	41	42	28	22	2	2
$L_{calc.}$.....	89	74	71	57	49	44	40	28	25	7	4

B. Previous Tests on No. 3A Audiometer Tone

R.m.s. Volt. Level....	+10	−9	−40	−49	−60	−69	−91
$L_{obs.}$.....	118	103	77	69	61	50	2
$L_{calc.}$.....	119	103	82	73	56	41	6

In view of the complex nature of the problem this computation method cannot be considered fully developed in all its details and as more accurate data accumulates it may be necessary to change the formula for b. Also at the higher levels some attention must be given to phase differences between the components. However, we feel that the form of the equation is fundamentally correct and the loudness function, G, corresponds to something real in the mechanism of hearing. The present values given for G may be modified slightly, but we think that they will not be radically changed.

A study of the loudness of complex sounds which are not steady, such as speech and sounds of varying duration, is in progress at the present time and the results will be reported in a second paper on this subject.

APPENDIX A. EXPERIMENTAL METHOD OF MEASURING THE LOUDNESS LEVEL OF A STEADY SOUND

A measurement of the loudness level of a sound consists of listening alternately to the sound and to the 1000-cps reference tone and adjusting the latter until the two are equally loud. If the intensity level of the reference tone is L decibels when this condition is reached, the sound is said to have a loudness level of L decibels. When the character of the sound being measured differs only slightly from that of the reference tone, the comparison is easily and quickly made, but for other sounds the numerous factors which enter into a judgment of equality of loudness become important, and an experimental method should be used which will yield results typical of the average normal ear and normal physiological and psychological conditions.

A variety of methods have been proposed to accomplish this, differing not only in general classification, that is, the method of average error, constant stimuli, etc., but also in important experimental details such as the control of noise conditions and fatigue effects. In some instances unique devices have been used to facilitate a ready comparison of sounds. One of these, the alternation phonometer,[12] introduces into the comparison important factors such as the duration time of the sounds and the effect of transient conditions. The merits of a particular method will depend upon the circumstances under which it is to be used. The one to be described here was developed for an extensive series of laboratory tests.

[12] D. Mackenzie, "Relative sensitivity of the ear at different levels of loudness," *Phys. Rev.* 20, 331 (1922).

TO BE CONCLUDED

IMPROVED LOUDNESS CONTROL

(*from page 30*)

amplitude. The superiority of the proposed circuit is that the change to gain-control operation can be made in this manner at any loudness level without changing the midfrequency level (i.e., the apparent loudness) by more than one db.

It is noted that the response of this circuit closely approximates the Fletcher-Munson contours only over a loudness range of 40 db. No apology will be made for this limitation, as the more complicated circuits previously described do no better. More serious, perhaps, is the fact that the total range of variation is limited to some 60 db at high and middle frequencies, and to 20 db at low frequencies. However, since this range represents the difference in loudness between a lion's roar and the background noise of a quiet residence,[4] the limitation is probably of minor significance. If a further range of variation is desired, the control can be supplemented with the stepped attenuator shown in *Fig.* 4, which will provide a 0–20–40 db variation in loudness level. The attenuator should be separated from the master loudness control by an isolating amplifier.

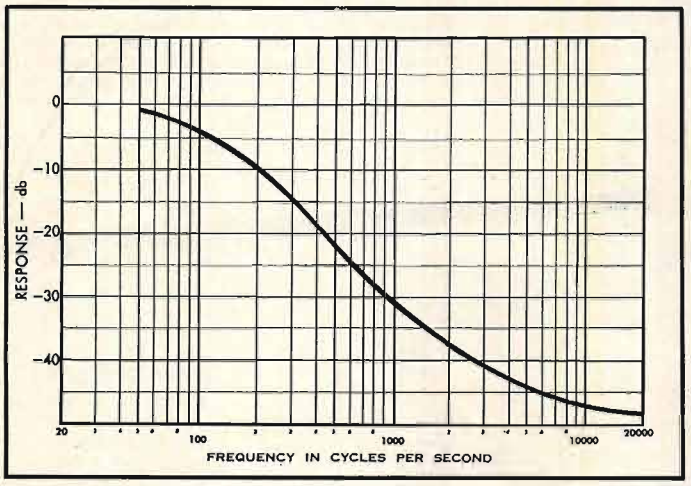


Fig. 3. Frequency response of a two-stage integrating network.

No treble compensation is included, as the Fletcher-Munson curves have all very nearly the same shape at the high-frequency end, and the author prefers to effect this correction by means of a separate tone control. However, if it is desired to explore the possibilities of adding high-frequency compensation, R_1 and/or R_3 can be shunted by capacitors.

Circuit Location

As a matter of general note, the amount of distortion generated in an amplifier can depend materially on the location of the frequency-selective circuits. In general, it is good practice to place near the output those circuits that emphasize low frequencies (or reduce highs), while high-frequency boost (or bass cut) should be located near the input. The reason for this rule is as follows. By far the greatest part of the distortion components developed in an amplifier are at higher frequency than the signal. Accordingly, a treble-cut (bass-boost) network at the output will reduce the distortion-to-signal ratio, while a treble-boost (bass-cut) circuit will accentuate all distortion fed into it. However, extreme bass cut should not be incorporated so early in the circuit that hum becomes appreciable.

The loudness control, which is essentially a bass-boost circuit, should therefore be placed as near the amplifier output as other circuit considerations will permit. Unfortunately, the control must usually be located near the input, to avoid overloading the succeeding stages. The answer, of course, is to seek the best compromise. It goes without saying that no frequency-selective circuit should be expected to function properly

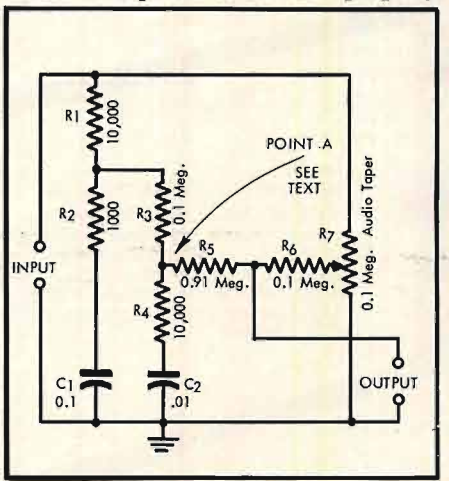


Fig. 4. Loudness control converted to a stepped attenuator circuit, the type more commonly known as a "contour control."

[4] "*Reference Data For Radio Engineers.*" Second Edition, Page 177.

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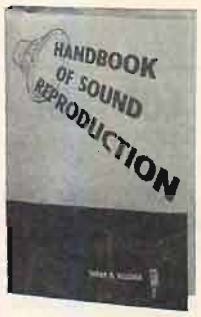

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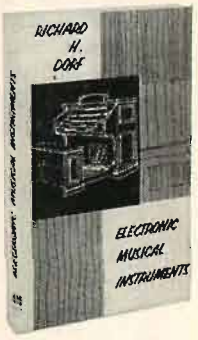

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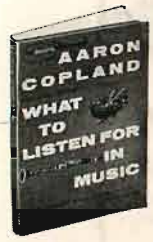

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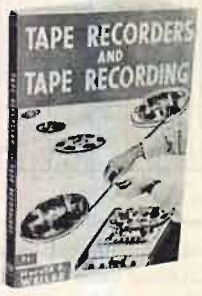

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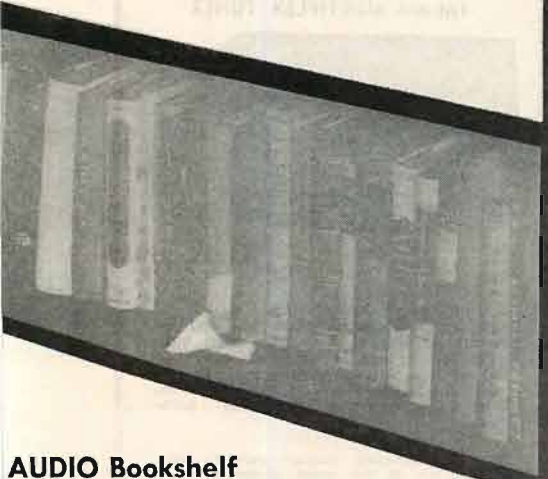

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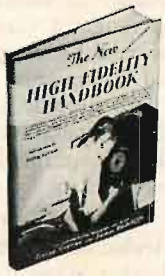

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if it is placed within a feed-back loop.

It should be remembered that the published Fletcher-Munson contours represent the response of the "average" ear, and can be expected to deviate widely from the response of any individual ear. Therefore, any painstaking attempt to match the curves with mathematical exactness would be a bit ridiculous. For this reason, it is suggested that components of plus or minus 5 per cent tolerance would be quite satisfactory.

If it is desired, the impedance level of the circuit can be raised or lowered, without affecting the response of the control, by multiplying all resistors by a common factor, and dividing all capacitor values by the same factor. The limits of variation are set, of course, by circuit considerations—the amount of loading of the previous stage that can be tolerated, the impedance to be presented to the succeeding stage, the susceptibility to hum pickup and so on. Æ

RECORD REVUE

(*from page 53*)

Rimsky-Korsakoff: Le Coq d'Or (The Golden Cockerel) (complete). Ballets Russes Orch., Horvath.
Concert Hall XH 1512

The revived Concert Hall label, under Crowell-Collier management (C-C Clubs), has snared this orchestra for ballet recordings in cooperation with something called the International Ballet Guild, dedicated to the preservation of ballet and in particular the famous Diaghilev tradition. Here is the complete score of a ballet that we ordinarily hear only in the usual concert excerpts; and once more, the pleasure in the discovery of the whole music, familiar and unfamiliar, is great for home listening. Indeed, this particular bit of Rimsky goes up a lot in the estimation as one finds out how it originally was supposed to sound.

In this performance the Ballet Russes orchestra, wherever it may be, plays most danceably and with fine musicianship; the music would seem to be familiar enough to the players, as well as the dancing that goes with it. Or perhaps it is merely a well-known style, for an experienced ballet orchestra. Nice recording in the sound, big and rather close, though there is some distortion in louder parts as I hear it.

Prokofiev: Romeo and Juliet (complete ballet). Ballets Russes Orch., Bashich.
Concert Hall 2XH 1513 (2)

Here is another in the new Ballets Russes series—but, alas, it is a different kettle of fish. Prokofieff (it can be *ff* or *v*), to be sure, is in the line of great Russian ballets and out of the Diaghilev tradition; but evidently he isn't too well known by this orchestra—or maybe the music is just too hard.

Admittedly, the string parts in one of the main themes go dreadfully high; but other orchestras manage without trouble. The string playing in this performance is just plain excruciating and there are other bloopers and falterings that mar the recording to a point where I can only wonder how it came to be issued. Sounds like a first-time run-through by a very inexperienced orchestra—which this one surely is not.

It's a lovely, sweet, warm ballet as well as a stark one in many places and, aside from the above, it gets a sympathetic treatment here. The tempi are notably different from some of the earlier concert recordings, notably by the Bostou Symphouy; maybe these dance players are right.

Gluck: Alceste (Italian version). Flagstad, Jobin, etc. Geraint Jones Orch. and Singers, Jones. **London XLLA 49 (4)**

Monster albums of this sort are enough to floor any critic but I played every bit of this one—eight sides—and followed the Italian and English text from beginning to end. It was worth it.

Flagstad isn't exactly the ideal voice for the 18th century Gluck from a musicological viewpoint; but if you let that bother you, you will miss one more great appearance of the grand lady and, moreover, you'll miss a presentation that gets to the heart of Gluck's music and drama, whether its style is perfect or no.

As always, much that Flagstad sings is uneven, the coarse sounds inevitably mixed with the lovely ones. She has trouble "getting started"; her old upward slide is as prevalent as ever. But in the grand second act, where she has the stage almost to herself and most of the music, she is utterly moving—a very great performance of music requiring to the last degree a noble musical mind and a tremendous spiritual dignity.

This is the original Italian version, composed (in that paradoxical age) for Vienna before Gluck moved to Paris; its operatic reforms, real enough at the time, seem mostly insignificant to us today in the face of its far clearer adherence to the older traditions of static, noble opera tragedy. (The French version is considerably rearranged, even to the plot and sequence of scenes.)

With the musical know-how that is so lacking in our own mixed performances, this production combines Flagstad with a French leading tenor (the tenor was used in the French version, though the original calls for male castrato) and an English chorus and orchestra for a suave and beautifully unified performance. The choral singing, so extensive in Gluck opera, is superb of its sort. Recording is as good as always in London operas. Æ

50-WATT AMPLIFIER

(*from page 23*)

resistance of about 47,000 ohms should be connected in series with R_{11}.

With the test signal audible, the feedback should be connected, and a note made of whether the output is increased or decreased. If the feedback increases the output, the connections to the output transformer must be reversed. If the feedback decreases the output, then the connections are correct, and the feedback may be permanently connected with the extra resistance removed. This method removes the risk of oscillation and possible damage to the output tubes and transformer.

Performance

The maximum power output of an R-C coupled amplifier may be defined as the maximum power obtainable without driving the output tubes to grid current, and this is easily observable on a 'scope. Under these conditions, the output measured across various dummy resistance loads on the secondary of the

WO866 transformer, is shown in *Fig.* 4. An output of 50 watts is obtained with an equivalent plate-to-plate load of 5000 ohms, and this corresponds with this transformer to a secondary load resistance of 10.7 ohms. For a 15-ohm secondary load, the WO866 transformer ratio gives a primary load of 7000 ohms, and into this load 40 watts can be obtained. With two 15-ohm speakers in parallel an output of about 60 watts would be obtained, with somewhat greater distortion. Plate-to-plate loads below 4000 ohms give increased distortion and are not recommended. At frequencies above and below 500 cps the speaker impedance is usually greater than the nominal value, and the effective load is, therefore, higher.

Figure 5 shows the frequency response at a power output of about 1 watt into a load of 10.7 ohms. The level response with the absence of peaks over the whole frequency range from 10 to 100,000 cps indicates that the stabilizing circuits are very satisfactory with an output transformer having the characteristics described earlier. In consequence the amplifier is completely free of any tendency to parasitic oscillation under drive. The tendency for the response to fall below 10 cps is typical of a stabilized amplifier with feedback, and greatly assists low-frequency stability when a preamplifier is connected to the same plate supply.

Maximum power is obtainable over the audio band from 30 cps to over 20,000 cps, (*Fig.* 6). The same figure shows that at maximum power, second and third harmonic distortion are each less than 0.1 per cent at 500 cps. The increases at 100 and 5000 cps are the results of the stabilizing circuits reducing effective feedback at high and low frequencies. This, however, is a small price to pay for the clean performance resulting from good stability. The harmonic distortion was measured up to 15,000 cps, and listening tests confirmed the merits of the results shown. It should also be noted that these figures for distortion are measured at full power over the whole frequency range.

Maximum power output is obtained with an input drive of 0.5 volt rms, and the hum level is –73 db with the input open-circuited, or better than –90 db with the input short circuited. The feedback is 22 db at 500 cps with a 10.7-ohm secondary (24-volt output). For use with load impedances other than this, the feedback resistor R_{11} (4700 ohms) should be altered in proportion to the resulting output voltage.

Acknowledgements

The authors wish to record their thanks to their colleague D. M. Leakey for his considerable help and advice during the design of this amplifier. The article presented here is a slightly shorter version of one published in *Wireless World,* April 1957, whose editor we wish to thank for allowing us to republish. Æ

REFERENCES

Thomas Roddam, "Stabilizing feedback amplifiers. *Wireless World,* Vol. 57, March 1951, p. 112–115.

D. M. Leakey and R. B. Gilson,, "U.L. output transformers." *Wireless World,* Vol. 62, January 1956, p. 29–32.

AMATEUR FILM EQUIPMENT

(*from page 26*)

rangement makes it possible, in recording for the film, to record, for instance, the background music without interruption on track 1, while the spoken text and the noises are recorded later on track 2. Recording faults on track 2 do not influence the recordings on track 1. This arrangement greatly facilitates a subsequent sound recording. In order to fulfill the functions described, Moviphon B is equipped with an amplifier, which can be switched to record and to playback. This amplifier, shown on *Fig.* 3, employs three transistors. A rectifier-type level indicating meter serves for controlling of the modulation, since, because the maximum direct-current voltage is approximately 30 volts, a magic-eye tube cannot be used. The bias and erase high-frequency is supplied by an oscillator which employs two transistors. The d.c. voltage for the operation of the amplifier and of the oscillator is taken from a rectifier supply which, as previously mentioned, obtains its a.c. voltage from the Movilux 8B. To permit double-track operation, one record-play head each and one erase head has been provided for each track.

The Amplifier

The input of the amplifier is at low impedance and arranged in such a manner that the dynamic Zeiss Ikon Mikrophon ZDM II can be connected directly. Full modulation is obtained with 0.2 mv at the input. At the output, the amplifier supplies approximately 2 volts at an impedance of 2000 ohms, which is sufficient to feed a separate power amplifier or a radio receiver. The details of switching can be seen in the schematic, *Fig.* 4.

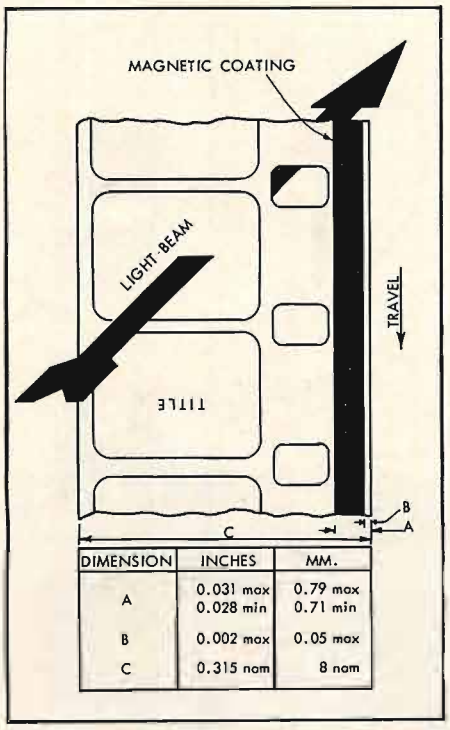
For sound recording the picture film is placed in the projector and the tape is placed in the recorder. Starting marks guarantee finding the proper beginning. Then the Moviphon B is switched to play the desired track and the level is adjusted, as a trial, to the desired modula-

tion. Now the Movilux B is started, and Moviphon B runs at the same time. Now the sound recording can start. After one track is finished, the other track is recorded in the same manner.

For reproduction, the film and the tape are replaced in the machines, aligned at the starting marks, so that they will be reproduced in synchronism.

Finally, machines have been developed in which the film proper carries a magnetic sound track. There is no doubt that these machines are especially simple in their operation, because the film contains both picture and sound. Thus a different running-off speed is out of question, because the device is a unit of picture and sound. However, at the present state of the art, the reproduction quality does not yet compare with the quality of a tape machine with a speed of 3¾ ips. The reasons are these: With 8-mm films, the film speed, in case a projection of 16 pictures per second is chosen, is approximately 2⅜ ips. This speed is so slow and the width of the sound track is so limited that, in comparison with the separately running tape, certain losses of frequency response and dynamic range cannot be avoided. The film measurements are shown on *Fig.* 5. In addition, it is disadvantageous to be forced to place the magnetic sound strip on the comparatively stiff film, in comparison with the use of a flexible magnetic tape. It is a known fact that for the recording and reproduction of high frequencies, intimate contact between the sound carrier and the magnetic head plays a decisive part.

The quality obtainable at present will,



DIMENSION	INCHES	MM.
A	0.031 max 0.028 min	0.79 max 0.71 min
B	0.002 max	0.05 max
C	0.315 nom	8 nom

Fig. 5. Standard dimensions of an 8-mm sound film.

without any doubt, be improved for technological reasons as the years go on. Even today, it has reached the point which is entirely satisfactory for most amateurs.

In conclusion, it should be pointed out that, with picture-sound combination films, the relative locations of the picture and the associated sound track are arranged on the film at a specific distance from each other. This arises out of the necessity that, during the film performances, the film must be moved intermittently, while the sound track must, of course, run continuously. Thus, with 8-mm films, the sound spot belonging to a certain picture, is located 54 frames ahead of the picture. This leads to difficulties when it becomes necessary to cut a film which, for instance, may have become damaged at the perforations. The system described eliminates this disadvantage completely. Æ

AUDIO MIXER

(from page 28)

the preamp. A simple half-wave, voltage-doubler, selenium-rectifier type that proved satisfactory in one case was used. A full-wave circuit which will result in a lower ripple component is given in *Fig.* 5. This is highly recommended over the half-wave type.

To reduce hum to a minimum a 50-ohm hum-bucking potentiometer and 27 volts of bias were used in the heater circuit as shown in *Fig.* 5. The power supply was constructed on a small separate chassis and located as far as possible from the preamplifier chassis.

Hum was quite a problem when an open frame power transformer was used and the completed unit was housed in a steel cabinet. Under these conditions critical orientation of the power transformer with respect to the mixer transformer was required to reduce magnetic coupling. It was necessary to use a completely shielded power transformer, a well shielded mixer transformer and to house the unit in an aluminum cabinet with aluminum panel. All leads should be as short and direct as possible.

The mixer shown in *Fig.* 1 was housed in a very small cabinet. Although it resulted in an extremely compact unit, considerable care was required in locating and orienting the transformers. The builder may minimize these problems with the use of a wider cabinet to allow greater spacing between hum-critical component parts.

Although this is probably the most inexpensive, practical circuit for a ten channel mixer it gives satisfactory performance and is suitable for many applications. Æ

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LETTERS

(*from page 7*)

various manufacturers' products can not be answered. In many instances, choice is purely a matter of personal preference; in others it would obviously be unfair to give relative ratings to any equipment. To questions of choice, the reply must *always* be "no answer".

(*a*) There will always be new developments, and this applies to high fidelity equipment, automobiles, cosmetics, toothpaste, and pastry flours. By buying components you can usually integrate new developments with a minimum of cost, since certain units will always be represented and are almost certain to be a part of any new development. This applies to amplifiers, record changers or turntables, tuners, preamps, and speakers.

(*b*) For absolute top quality we should choose tape for stereo; for convenience and lower cost, we should plan to accommodate stereo discs (when they arrive).

(*c*) We don't think so—for the mass market—until a thoroughly workable tape magazine becomes available. Those who want the best will use high-quality tape machines; those who want convenience will use discs. However, don't sell the disc short—some of those we have heard are approaching present monaural LP's in quality.

(*d*) We have only a few on the market so far, but there is no reason why they shouldn't be equally as good in time as present vacuum-tube equipment.

(*e*) For many applications, yes. But they are not likely to be so much better that the vacuum tube will become obsolete.

(*f*) Yes, in time.

(*g*) Probably, although many manufacturers make stereo conversions available at not too great a cost. Principal loss would be in having to scrap one head when you convert.

(*h*) Unless you are able to design and build all of the equipment, you should get the conversion kit offered by the manufacturer and follow his instructions.

(*i*) Few regular preamps have position for tape head input. Presumably there is not sufficient demand at present. Furthermore, it would seem that differences in heads might make it preferable to use a tape playback preamp designed especially for the machine.

(*j*) Not necessary if you can get a suitable preamp with the facilities you require. However, if you want to dub from a phonograph record, you might find a combination preamp limiting.

(*k*) Could, but demand is probably not sufficient. Read (*j*) again.

(*l*) Two channels—from source to loudspeaker—will probably always be necessary for stereo reproduction, and naturally they take up considerable room. Furthermore, since a stereo system uses almost everything in duplicate, it can't help but be more expensive than a single system.

(*m*) No answer.

(*n*) One could make out a good case for biamplification, though there are some disadvantages too. Theory is good, however.

(*o*) Would depend on crossover frequency, but the ratio for bass/treble amplifiers would be somewhere around 2 or 3 to 1; for three-way systems, we would suggest a bass-midrange-treble ratio of about 3:2:2. In every case it would depend on efficiency of the woofer.

(*p*) Four, two for each channel, assuming a two-way speaker system. For a three-way system, six amplifiers would be required—three for the left channel and three for the right. (ED.) Æ

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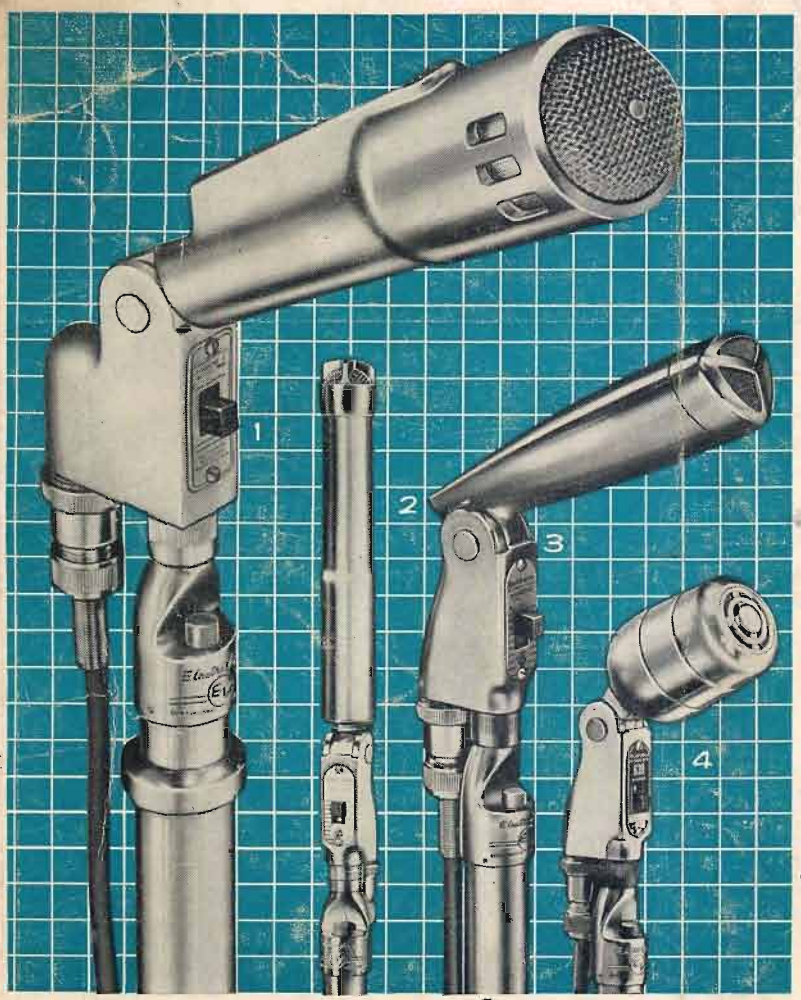

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Biflex loudspeakers are the result of the practical application of a new principle in loudspeaker design developed by ALTEC. The speakers have an efficient frequency range far greater than any other type of single voice-coil speaker and equal to or exceeding the majority of two or three-way units. This truly amazing frequency range which is guaranteed when the speaker is properly baffled, is the result of the ALTEC developed viscous damped concentric mid-cone compliance.

This unusual compliance serves as a mechanical crossover, providing the single voice-coil with the entire cone area for the propagation of the lower frequencies and reducing the area and mass for the more efficient reproduction of the higher ranges. Below 1,000 cycles per second the inherent stiffness of the Biflex compliance is such that it effectively couples the inner and outer sections of the cone into a single integral unit. The stiffness of the compliance is balanced to the mechanical resistance and inertia of the peripheral cone section so that the mass of this outer section effectively prevents the transmission of sounds above 1,000 cycles beyond the mid-compliance and the cone uncouples at this point permitting the inner section to operate independently for the reproduction of tones above 1,000 cycles. Proper phasing between the two sections is assured by the controlled mechanical resistance provided by the viscous damping applied to the mid-compliance.

In each of the three Biflex speakers this outstanding cone development is driven by an edge-wound aluminum ribbon voice-coil operating in an extremely deep gap of regular flux density provided by an Alnico V magnetic circuit shaped for maximum efficiency.

Biflex speakers are perhaps the only true high fidelity single voice-coil speakers made, and can be considered to fill the complete speaker necessity for any system or as the bass speaker component for more comprehensive systems intended to cover the entire audio spectrum. Ask to hear these outstanding speakers at your dealer's.

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