UTC

BEAM POWER AMPLIFIERS...

FOREWORD

The advent of the 6L6 tube and the development of stable feedback are the two most important recent developments in audio amplification. The 6L6 tube uses a new method of electron beam control, resulting in a tube having extremely high efficiency, large power output, low power input and a very low harmonic content. Stable feedback reduces distortion, increases tube output, and reduces dynamic plate resistance. The advantages of both of these developments are incorporated fully in the amplifier described below.

OPERATION OF THE 6L6 BEAM POWER TUBES

Before designing the UTC 6L6 amplifiers, a thorough analysis was made of the operation of the 6L6 tube to determine the advantages and difficulties which might be encountered in normal practice. A pair of these tubes are rated to deliver 32 watts of audio power in self bias or 60 watts of audio power in fixed bias. In the self bias condition of operation, the 6L6 tube requires no driving power as positive grid excursions do not occur normally. However, there are occasions where peaks of power may be encountered which would tend to push these tubes above their normal self bias rating. To minimize the rapid increase in distortion which would occur under this condition, a low ratio transformer is necessary. It was found that appreciably more than the manufacturers' rating could be obtained from these tubes without objectionable distortion.

Upon analyzing the fixed bias condition of 6L6 tube operation, it was found that the manufacturers' rating of 60 watts was based under ideal conditions. This would imply a power supply with extremely good regulation, a bias supply of extremely low resistance and driver tubes having very low internal resistance. To approach these ideal conditions, a regulated power supply would have to be used, push-pull 2A3's would be required as drivers, and a very low resistance bias battery would be desirable. A compromise arrangement has been effected in the PAK fixed bias kits which gives practically the full output of the fixed bias condition with low power driver tubes and a normal mercury-vapor rectifier plate supply. The simplest method of obtaining the low voltage bias required is a small C battery. However, to stabilize the tubes, a small amount of self bias resistance is also used.

While the low power triode driver circuit would normally have poor regulation tending to increase distortion, a reduction in the plate resistance of the driver tubes is accomplished by the use of feedback to the grids of the driver tubes. The final design of the UTC PAK fixed bias amplifier kits was found to have a measured output of 55 watts at 3.5% distortion. Peak power considerably above this can be obtained.

Life tests were made on the 6L6 tubes under various conditions of operation covering a period of approximately 1000 hours. From the results obtained, it was found that for greatest stability and longest life, these tubes should preferably be operated self bias. Since the PAK self bias kits will deliver 35 watts, it is apparent that the self bias condition will take care of practically every PA or low power modulation requirement. An additional advantage of the self bias condition lies in the fact that transients of large value are limited. Consequently, there is less possibility of ruining speakers or other attendant equipment due to high power transients.

DISTORTION-STABILIZED FEEDBACK

Figs. 1 and 2 illustrate distortion curves of 6L6 tubes based upon Hygrade Sylvania data. Comparing the fixed and self bias operation, it is seen that distortion starts to rise rapidly in the fixed bias condition when the point of grid current flow is passed.

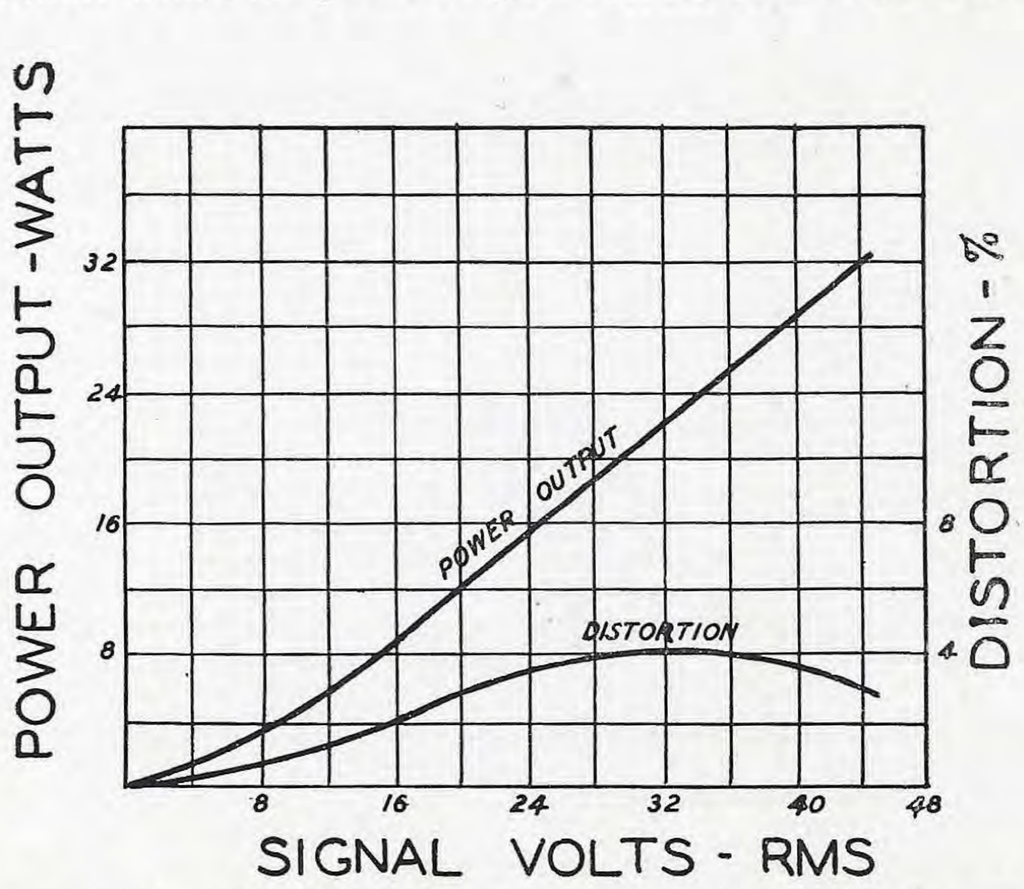


Fig. 1—Distortion versus power output for 2 self-biased, push-pull 6L6 tubes.

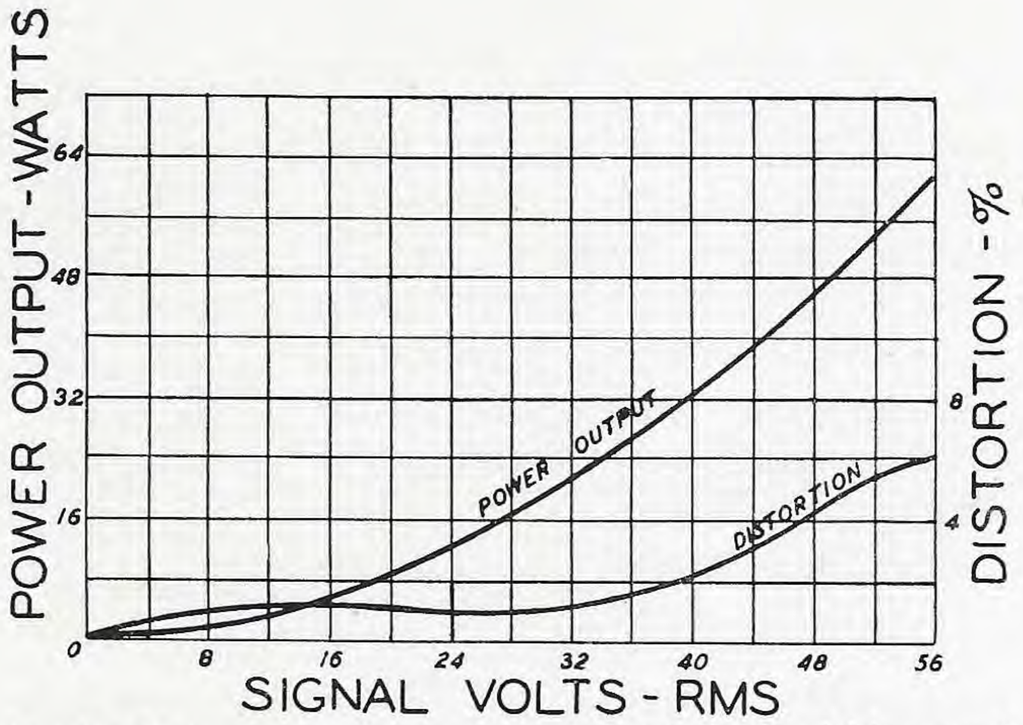


Fig. 2—Distortion versus power output for 2 fixed bias, push-pull 6L6 tubes.

Considerable progress has been made in the past few years on methods of reducing hum, noise and distortion in amplifier circuits, by feeding a portion of the energy from the output circuit back into the input circuit. While stabilized feedback of this type will produce almost unbelievable corrective results, it is very critical. The UTC Engineering Staff has developed a simple type of feedback circuit which is very stable and requires no adjustment. The general circuit for this feedback condition is illustrated in Fig. 5. A tertiary winding is provided on the output transformer with a ratio such that 10% of the voltage developed across the primary winding is fed back through this tertiary winding. The degenerative connection of this tertiary winding back to the input transformer windings produces a very great reduction in dynamic plate resistance and a 50% reduction in distortion. A simultaneous reduction in power sensitivity of about 55% is obtained. Fig. 3 illustrates a curve based upon Hygrade Sylvania data showing the relative percentage distortion vs. power output of a **single** 6L6 tube with and without feedback. The 50% harmonic distortion reduction shown in Fig. 3 would similarly effect the curves of Figs. 1 and 2. **It is interesting to note that UTC has done a considerable portion of the development work on feedback of this nature and has patents pending.**

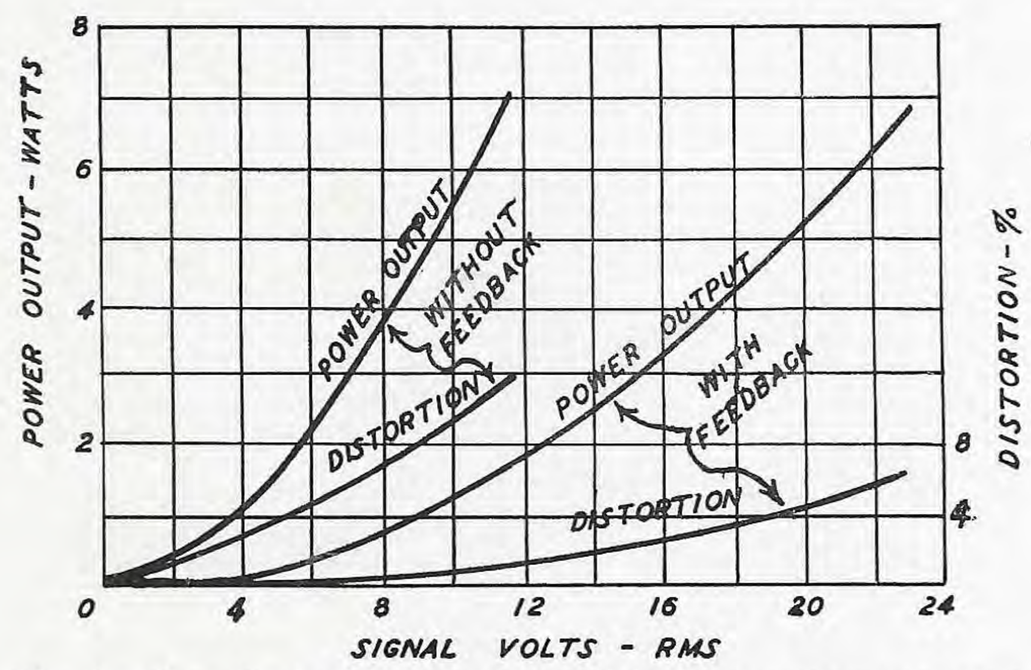


Fig. 3—The effect of feedback on distortion and power sensitivity of a single 6L6.

REDUCED PLATE RESISTANCE

The 6L6 tube, while a tetrode, has the common failing of pentodes and other high power sensitivity tubes in the fact that the dynamic plate resistance is quite high. In normal operation, the 6L6 plate resistance is 22,500 ohms. High plate resistance becomes an important factor where a tube is used with a load of varying impedance. Mr. Otto Schade of RCA recently analyzed a condition of this type where the load was that of a loud speaker. In Fig. 4A, we illustrate the effective circuit of a speaker coupled to an output tube. It is apparent from the figure that the voltage developed in the tube circuit is distributed between load resistance r, and the dynamic plate resistance R. If the plate to plate resistance of the tube circuit is 45,000 ohms and the reflected load at 1000 cycles is 6600 ohms, the actual voltage developed across the speaker system is .13 of the total voltage. However, at the point of resonance of the speaker system, the reflected speaker load increases to about

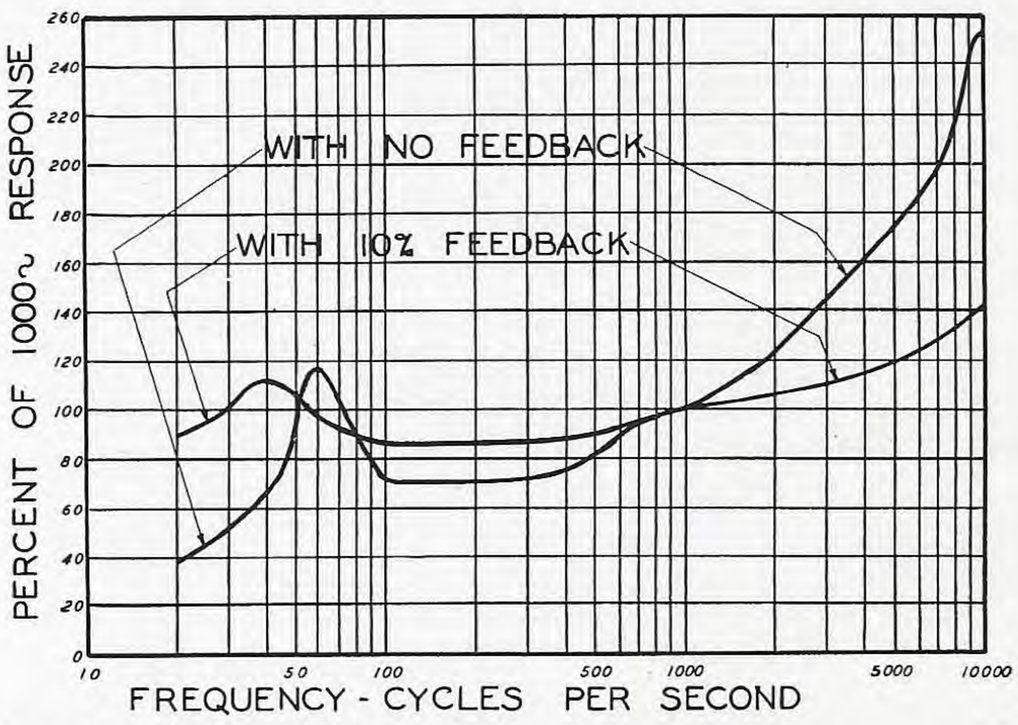


Fig. 4—The effect of feedback on frequency response. 6L6 tubes feeding a loud speaker.

66,000 ohms. At this point, .6 of the total voltage is developed across the speaker. It is obvious that a considerable increase in power to the speaker is obtained. The combination of this increase in power plus the original resonance of the speaker will naturally result in a very strong and frequently objectionable boom. This is a condition which is frequently encountered in console radio sets using pentode output tubes. In some cases, this cumulative output effect at a low frequency may cause rapid speaker failure. If an analysis is made of the same condition but using the UTC stabilized feedback arrangement, it is found that the plate resistance is reduced to approximately 7000 ohms. Under this condition, at 1000 cycles, the portion of the total voltage developed across the speaker is .5. At the resonance frequency, this ratio is .9. The difference between .5 and .9 is obviously much less than that encountered in the circuit not using feedback. Fig. 4 shows the effect of feedback on a speaker system as described above.

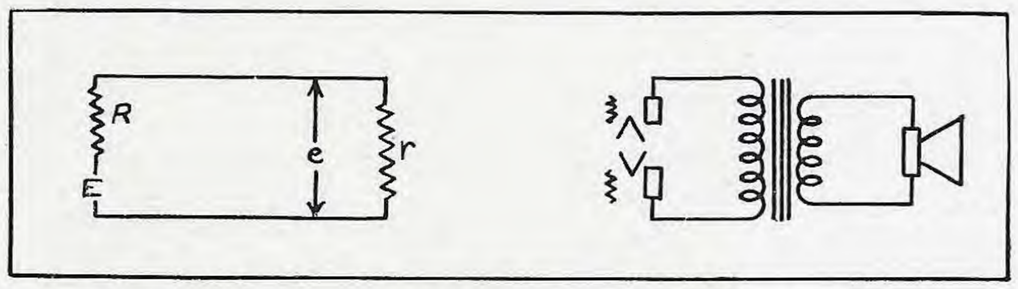


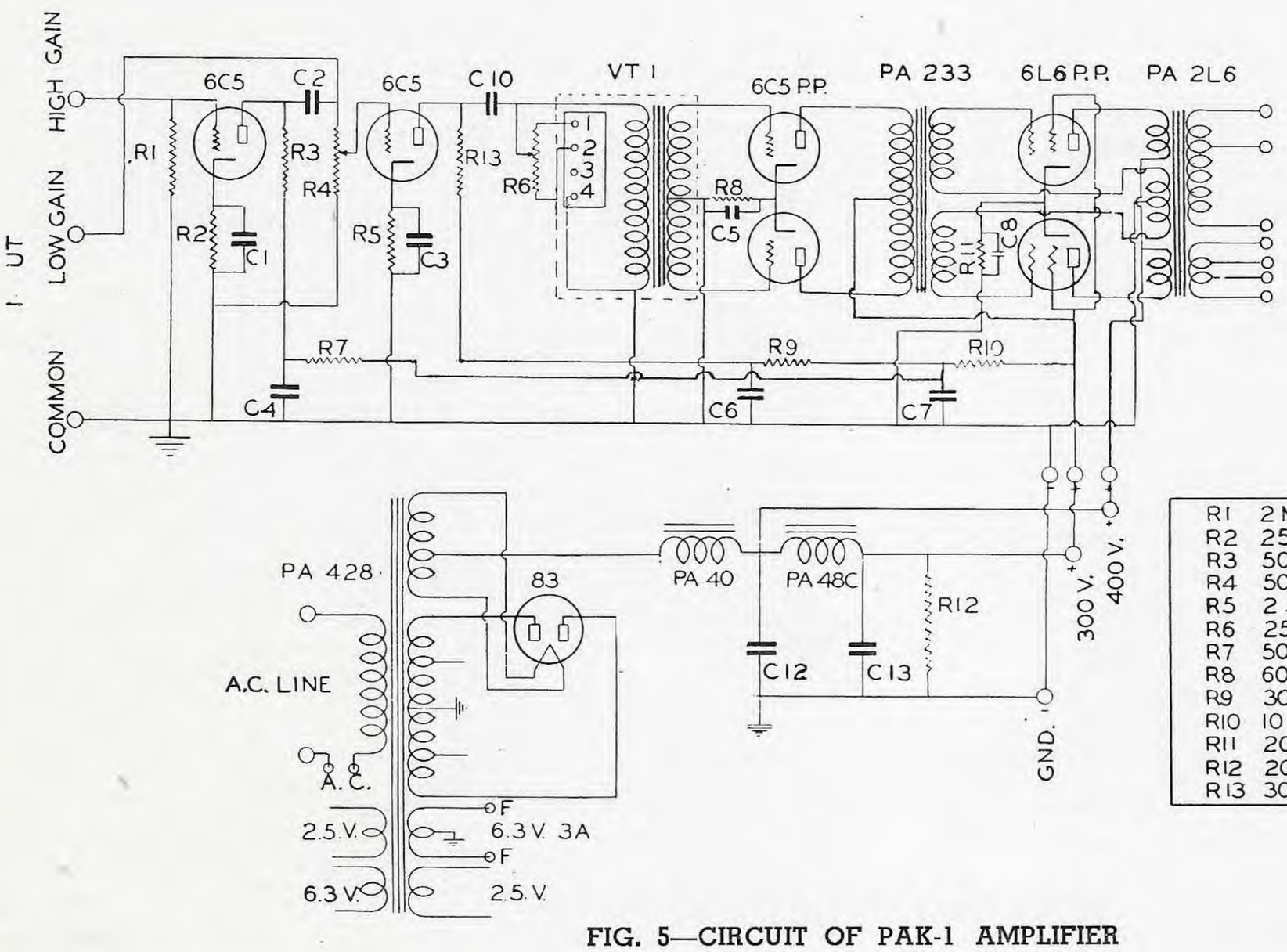
Fig. 4A—Equivalent circuit of push-pull 6L6 tubes feeding a loud speaker.

6L6'S AS DRIVERS

A similar condition to the above is encountered where a tube is used as a driver for a class AB or class B amplifier. At maximum power output, the grid impedance of such tubes is very low. The greatest power transfer will therefore occur only if the resistance of the driver circuit is low. In other words, if the reflected impedance of the output grid circuit at maximum swing were 1000 ohms, and the driver tube source impedance were 45,000 ohms, approximately 1/46 of the effective voltage would be delivered to the grid circuit. However, using feedback, the driver impedance can be reduced to 7000 ohms under which condition approximately 1/8 of the voltage would be delivered to the output grid circuit. The increase in efficiency is very great. In the UTC fixed bias PAK kits, the high plate resistance of the low power triode driver tubes is reduced in the same way permitting considerable driving power to be obtained from a relatively low power tube. Where high driving power and efficiency is required, the 2A3 tube is superior to the 6L6 tube because even though the power output of the 2A3 tube is less, it has a much lower plate resistance than the 6L6 tube.

CIRCUIT DETAILS

The high power sensitivity of the 6L6 lends itself very well to a simple, high gain amplifier using a minimum number of tubes. Fig. 5 illustrates the circuit of the UTC type PAK-1 amplifier. Four stages are used to give an overall gain of 118 DB. The circuit is simple and consists of a single 6C5 resistance coupled to a second 6C5, transformer coupled to push-pull 6C5's, which in turn drive the 6L6's with a special low ratio input transformer. In many cases, it is desirable to couple a relatively high level source into an audio amplifier of this type. Due to the high gain of the amplifier, it is poor practice to use a phonograph pickup or similar device into the first tube. This would mean that the volume control would always have to be operated over at one end and unnecessarily high hum level would result. To take care of this condition, an extra terminal is brought out on the PAK amplifiers from the second grid circuit. When a high level source is used, the high gain terminal (first grid) is shorted to ground, automatically eliminating the noise inherent in the first tube, and the source is fed directly into the second tube. The volume control of this amplifier is unusual in the fact that the calibrated etched plate reads directly in DB attenuation. This is of considerable advantage in predetermining the gain setting for different inputs.



R1	2 MEG.			C1	10 MFD. -35 V.
R2	2500	Ω		C2	.1 " -400 V.
R3	50 000	"		C3	10 " -35 V.
R4	500 000	"	POT.	C4	1 " -400 V.
R5	2 500	"		C5	10 " -35 V.
R6	25 000	"	POT.	C6	1 " -400 V
R7	50 000	"		C7	.1 " - "
R8	600	"		C8	10 " -35 V.
R9	30 000	"		C10	.5 " -400 V.
R10	10 000	"			
R11	200	"	-10 W.	C12	8 " -500 V.
R12	20 000	"	-20 W.	C13	8 " - "
R13	30 000	"			

FIG. 5—CIRCUIT OF PAK-1 AMPLIFIER

HIGH FIDELITY EQUALIZER CIRCUIT

There are many applications in PA and home amplifier operation where equalization is desirable. The use of an equalizer permits correction for acoustic conditions or for the poor response of microphones, pickups or loudspeakers. The UTC PAK amplifiers include a self contained equalization circuit which is brought out to a control on the chassis calibrated directly in DB. With the control rotated to the left, both low and high frequencies are raised simultaneously. With the control rotated to the right, low frequencies alone are increased. In the center, no equalization is effected. Fig. 8 illustrates typical frequency curves that are obtainable with this equalizer. In addition to the curves of Fig. 8, changes in the connections to the VT-1 Varitone unit can be made making possible the various other curves shown in Fig. 9. When the equalization is set at the zero point, the overall response is uniform from 60 to 10,000 cycles.

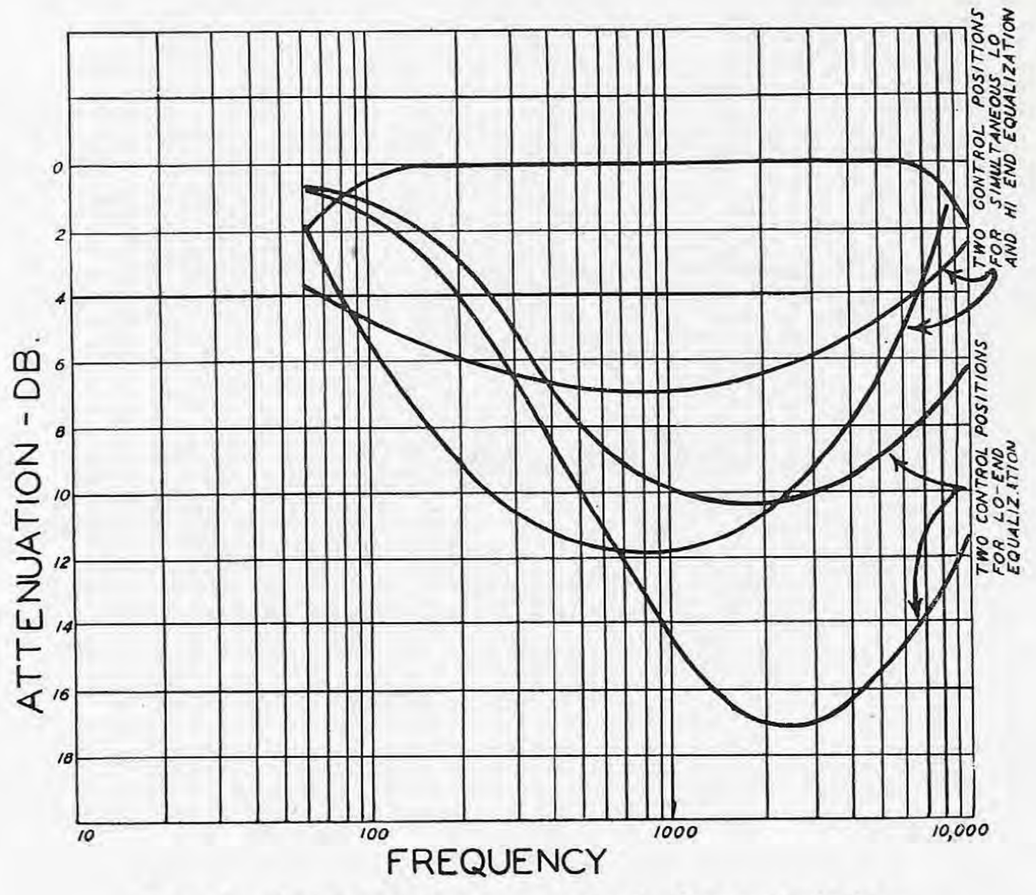


Fig. 8—Calibrated tone control characteristics.

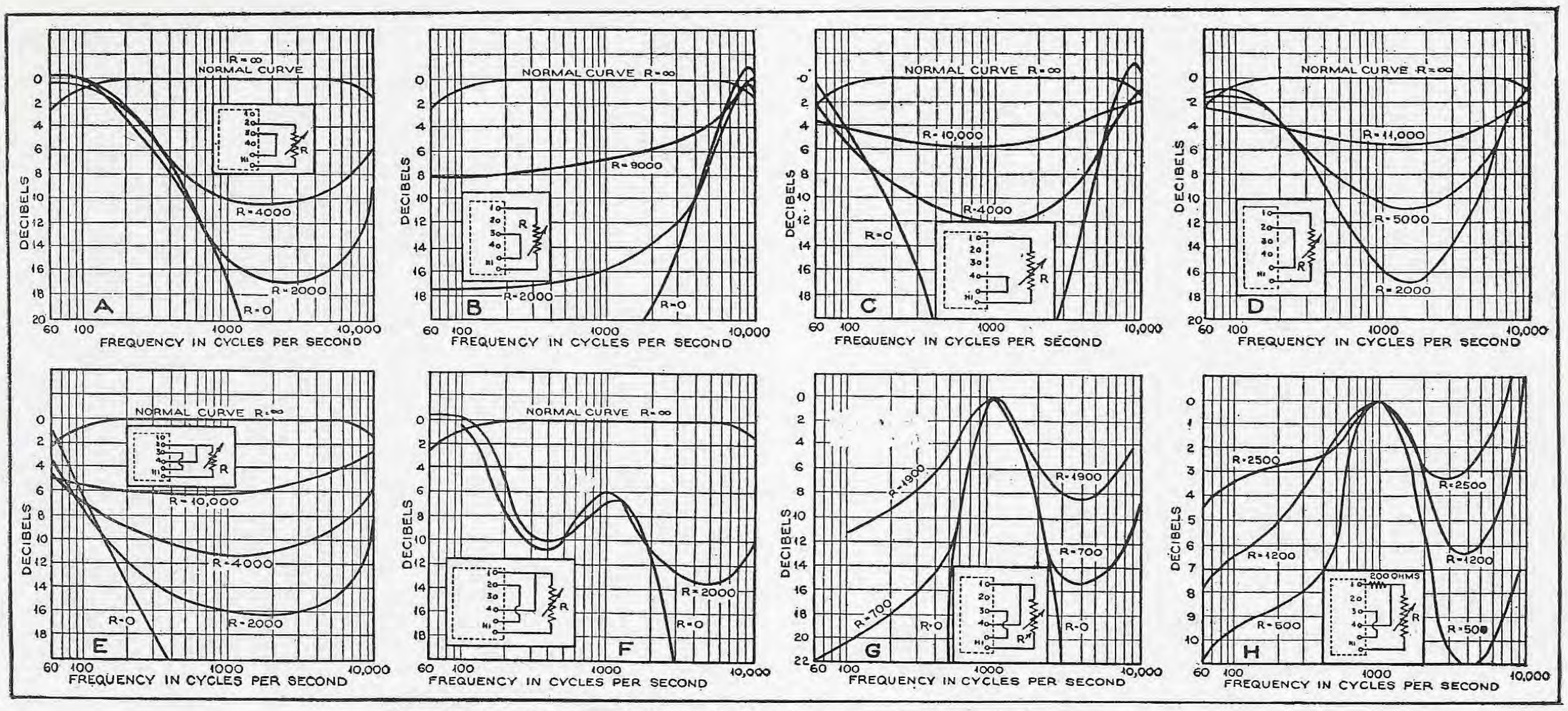


Fig. 9—Possible variations in VT-1 connections and characteristics.

A—The connections and resultant response curve shown above are used where it is desired to bring up the low frequencies.

B—The connections and resultant response curve shown above are used where it is desired to bring up the high frequencies.

C—This system of connections brings up the low and high frequencies simultaneously.

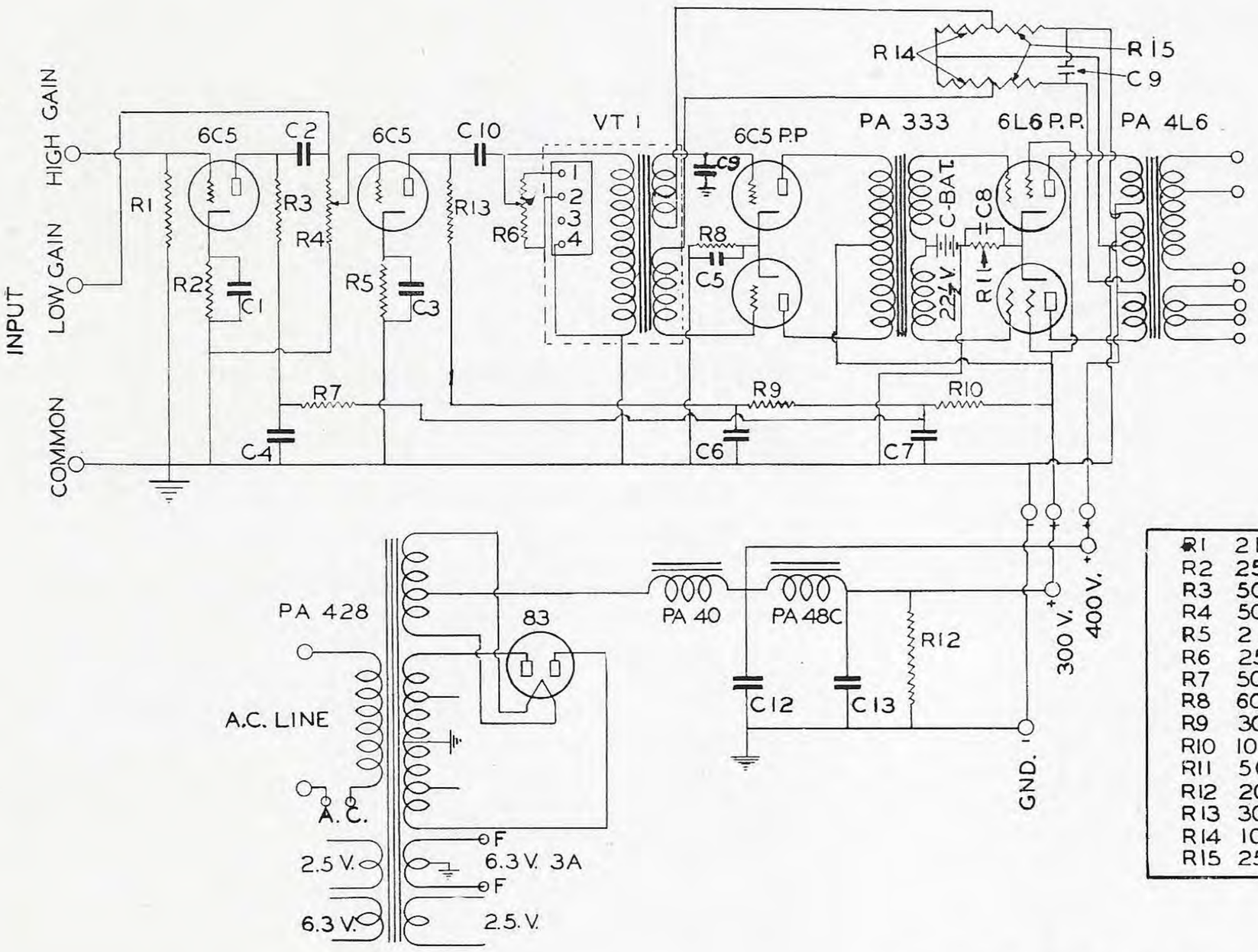
D—This system of connections brings up the low and high frequencies simultaneously. The equalization is appreciably sharper than in C, the slope of the curve being almost linear on both sides. This circuit is recommended only with an amplifier or receiver whose frequency response is unusually bad, such as a cheap midget radio.

E—This arrangement of connections brings up both highs and lows to a minor extent until almost all resistance is cut out, at which time the low frequencies are brought up sharply.

F—Many dynamic speakers, particularly when used with a poorly designed cabinet, have marked resonance at the low and high frequencies, generally in the vicinity of 400 and 4000 cycles. The system of connections above will absorb these resonances, as shown in the response curves.

G—This system of connections is generally used with zero resistance. A sharp single frequency filter is effected which eliminates practically all frequencies but 1000 cycles. This is ideal for reception of C W, as static, heterodyne and other QRM are eliminated, affording greater intelligibility and accuracy. This sharp 1000 cycle circuit is also excellent for use with A C bridges. All harmonics, etc., are completely eliminated.

H—This circuit is ideal for the amateur, or short wave DX fan. The audio frequency range can be reduced to just the essential frequencies for intelligible speech. All extraneous static, whistles, etc., are eliminated. This arrangement of connections is also used frequently where it is desired to demonstrate poor frequency response.



R1	2 MEG.		C1	10 MFD.	-35 V.
R2	2500	Ω	C2	.1 "	-400 V.
R3	50 000	"	C3	10 "	-35 V.
R4	500 000	" POT.	C4	1 "	-400 V.
R5	2 500	"	C5	10 "	-35 V.
R6	25 000	" POT.	C6	1 "	-400 V.
R7	50 000	"	C7	.1 "	- "
R8	600	"	C8	10 "	-35 V.
R9	30 000	"	C9	.006 "	-400 V.
R10	10 000	"	C10	.5 "	-400 V.
R11	50	" -10 W.			
R12	20 000	" -20W.	C12	8 "	-500 V.
R13	30 000	"	C13	8 "	- "
R14	10 000	"			
R15	250 000	"			

FIG. 6
CIRCUIT OF
PAK-2 AMPLIFIER

FIXED BIAS

The circuit diagram for the fixed bias PAK kits is shown in Fig. 6. The general nature of this circuit is identical to that of the self bias amplifier described above. The feedback circuit, however, is coupled back to the driver tubes permitting greater output and regulation in these tubes. The output transformer and input transformer are changed from that of the self bias unit. The bias resistor is also reduced very greatly in magnitude and a 22½ volt C battery is inserted in the grid circuit as the source of fixed bias. A mounting bracket is provided for this C battery underneath the audio deck.

MOBILE SERVICE

For mobile service, it is desirable that the full plate voltage of the genemotor be available for plate supply. The 22½ volt C battery is therefore used again for this service but the self bias resistor can be shorted out. Operating in this manner, a power output of 20 watts can be obtained using the audio section alone with a filtered 350 volt, 150 ma. genemotor, Fig. 7.

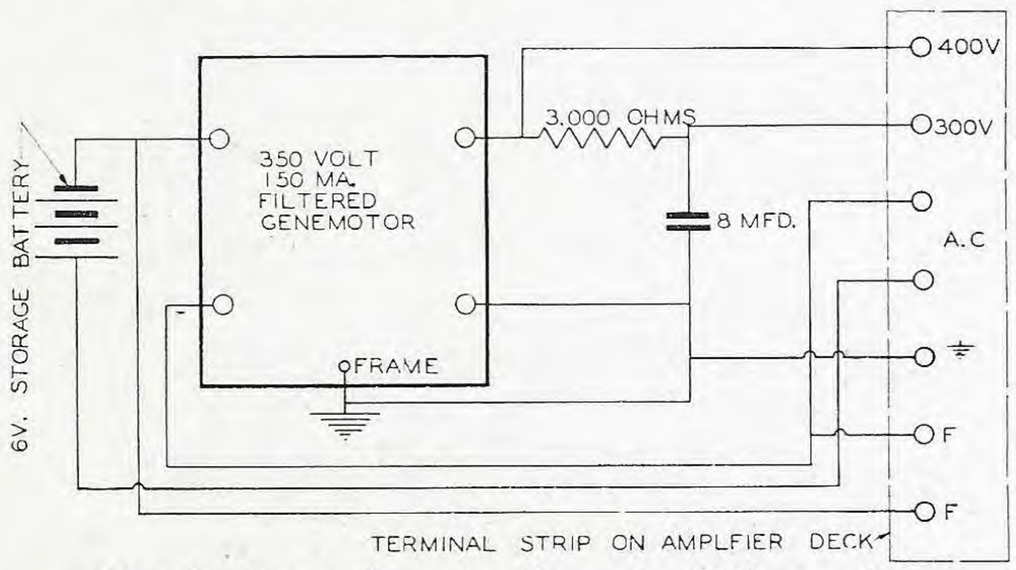
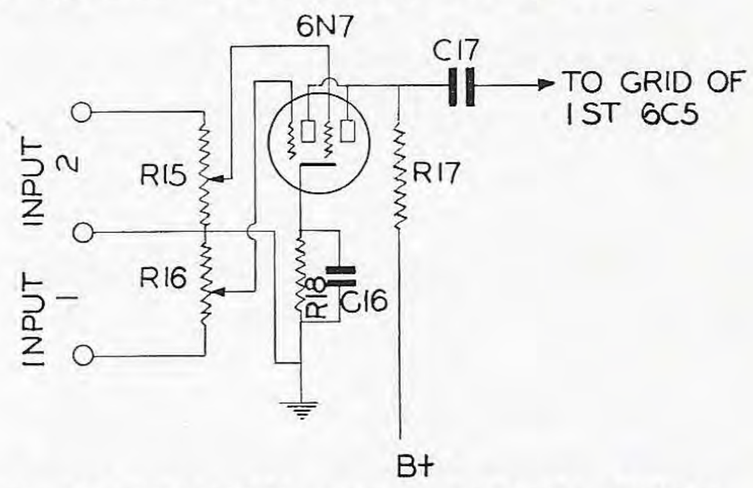


Fig. 7—Connections for 20 watt mobile service.

ELECTRON MIXER

Modern microphone technique frequently requires the use of more than one microphone simultaneously. With the increasing use of high impedance microphones, such as the crystal microphone and the ribbon microphone with self contained transformer, electron mixing has become the logical solution. An electron mixer tube can be readily added to the PAK amplifier kits. The circuit for this unit is illustrated in Fig. 10. The socket for this tube replaces the input terminal socket so that no additional drilling or alterations are required. The amplifier power switch can be replaced with a combined switch and volume control so that both mixer controls are available at the front of the chassis without any alteration.



CIRCUIT MODIFICATION FOR ELECTRON MIXING

R15	1 MEG	
R16	1	"
R17	50000 OHMS	1WATT
R18	3000	" "
C16	10 MFD.	35 VOLT.
C17	.1 "	400 "

FIG. 10

LOW IMPEDANCE INPUT

Low impedance input is generally quite difficult to obtain on a high gain amplifier of this type. One of the factors which makes it possible on the UTC PAK kits is the fact that the audio and power units are on separate chassis. The induced hum is naturally reduced very greatly. Another factor which helps minimize hum pickup is the very small input transformer used having dimensions only 1 7/16 x 1 7/16 x 1⅞ inches. The mounting arrangement for this unit on the audio chassis has been arranged at a position of minimum pickup. Also, due to its small size, a minimum of stray flux is intercepted. A number of special low impedance transformers of the UTC **ULTRA COMPACT** type are described on inside back cover.

MECHANICAL CHARACTERISTICS

Identical chassis are used for PAK kits. The combined overall dimensions of the two decks with perforated covers is 16½ x 12½ x 8 inches. These dimensions permit the amplifier to be readily mounted on a rack or in a cabinet. The use of separate chassis permits the small individual units to be very easily mounted in a radio set cabinet or in a portable amplifier cabinet with loudspeakers. The terminal strips which connect the power supply and audio amplifier are placed adjacent to each other on the chassis so that the length of cable is short and so that there is no possibility of improper connection. The terminal strip for the output of the amplifier is arranged so that the leads can be brought directly out from the strip through the perforated protective cover.

GLASS TUBES

Glass tubes are still preferred to metal tubes by many organizations. UTC PAK amplifiers can be readily converted for glass tube service. The change-over is made by replacing all 6C5 tubes with 6C6 tubes triode connected (screen suppressor and plate tied together). For the output tubes, glass type 6L6's which bear the designation 6L6G are available from Raytheon and other organizations.

Analyzing the above data, it is apparent that through the use of the 6L6 tube and stabilized feedback, it is now possible to make a simple high quality, high gain, high power audio amplifier at reasonable cost. With proper care and construction, the amplifiers described will be found capable of performing practically any PA service and any low power modulation function.

TYPE PAK AMPLIFIER KITS

THE UTC BEAM POWER AMPLIFIER KITS FEATURE:

HIGH POWER 35 watts self bias, 55 watts fixed bias.

HIGH GAIN 118 DB with provision for immediate change-over to 95DB.

SEPARATE CHASSIS for power supply and audio sections permitting maximum flexibility and minimum hum pickup.

STABILIZED FEEDBACK effects increase in output power and reduction in overall distortion.

EQUALIZER with calibrated control to bring up the low frequency end or to bring up both low and high frequencies simultaneously.

MOBILE OPERATION can be obtained using the audio chassis alone and filtered genemotor. 20 watts available.

RACK PANEL MOUNTING or rack cabinet mounting permissible. Combined overall dimensions 16½ x 12½ x 8 inches.

ELECTRON MIXING can be added to this kit with very little change.

PAK-1 Self bias amplifier kit. 35 watt operation. Output transformer impedances 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories such as resistors, condensers, sockets, calibration plates, chassis, dust covers, hardware . . . except tubes. All fully mounted. List price **$75.00**

PAK-1X Same as PAK-1, but with Varimatch modulation output transformer. Impedances available are 220, 408, 1180, 2350, 2400, 3000, 4000, 4670, 4750, 5560, 7000, 9150, 9470 ohms. List price **75.00**

PAK-2 Fixed bias amplifier kit. 55 watts operating condition. Output transformer with impedances of 500, 200, 16, 8, 5, 3, 1.5 ohms. Includes all accessories such as resistors, condensers, sockets, calibration plates, chassis, dust covers, hardware . . . except tubes. All fully mounted. List price **80.00**

PAK-2X Same as PAK-2, but with Varimatch modulation output transformer. Impedances available are: 237, 380, 1310, 1750, 2060, 2700, 3270, 4100, 5200, 6900, 8200, 11900, 16500 ohms. List price **80.00**

BROADCAST TYPE BEAM POWER AMPLIFIERS

While the present beam power tube has extremely high efficiency, large power output, high sensitivity and low harmonic content, its application to high fidelity equipment has been somewhat deterred due to the high dynamic plate resistance. In the previous part of this bulletin, the new UTC method of feedback has been described which eliminates this one disadvantage. The application of stabilized feedback in the UTC Linear Standard amplifier kits permits a very low plate resistance with a consequent non-critical loading characteristic and a very small harmonic distortion.

HIGH FIDELITY

There are four major factors to be considered in the design of high fidelity equipment. These may be noted as follows:

1. Wide frequency range
2. Low harmonic distortion
3. Low hum level
4. Ample power handling ability

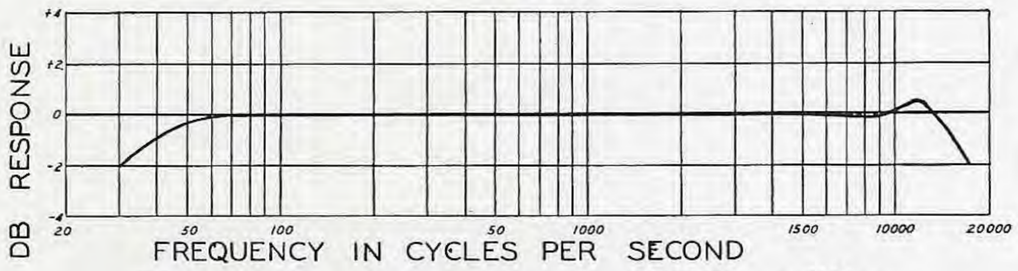


Fig. 1—Frequency response of LSK amplifier.

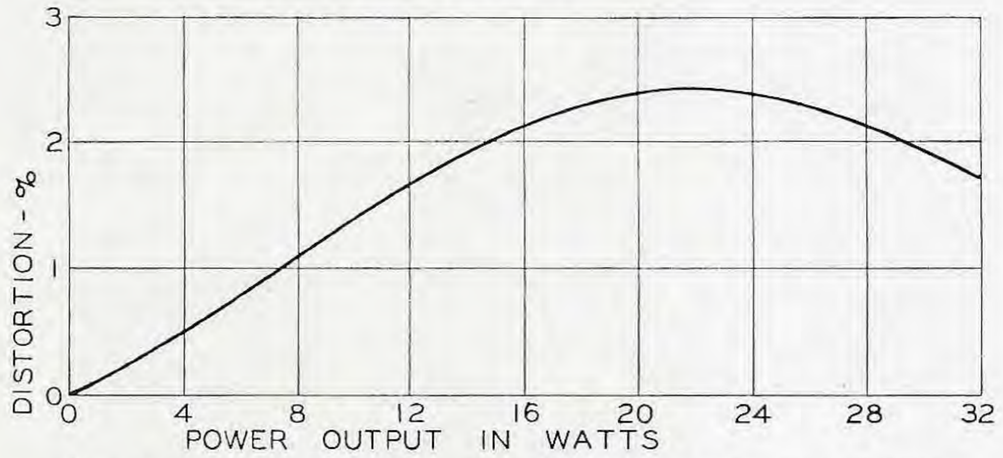


Fig. 2—Approximate distortion versus power output of LSK amplifier.

The keynote of the advance in wide range audio equipment has been the improvement in modern audio transformers. Fig. 1 illustrates the overall response curve of these amplifiers. A variation of less than 2 DB is obtained from 30 to 16,000 cycles.

From the angle of harmonic distortion, the 6L6 tube is ideal, particularly when combined with stabilized feedback. Fig. 2 illustrates the approximate harmonic distortion curve of the UTC LSK amplifier kits.

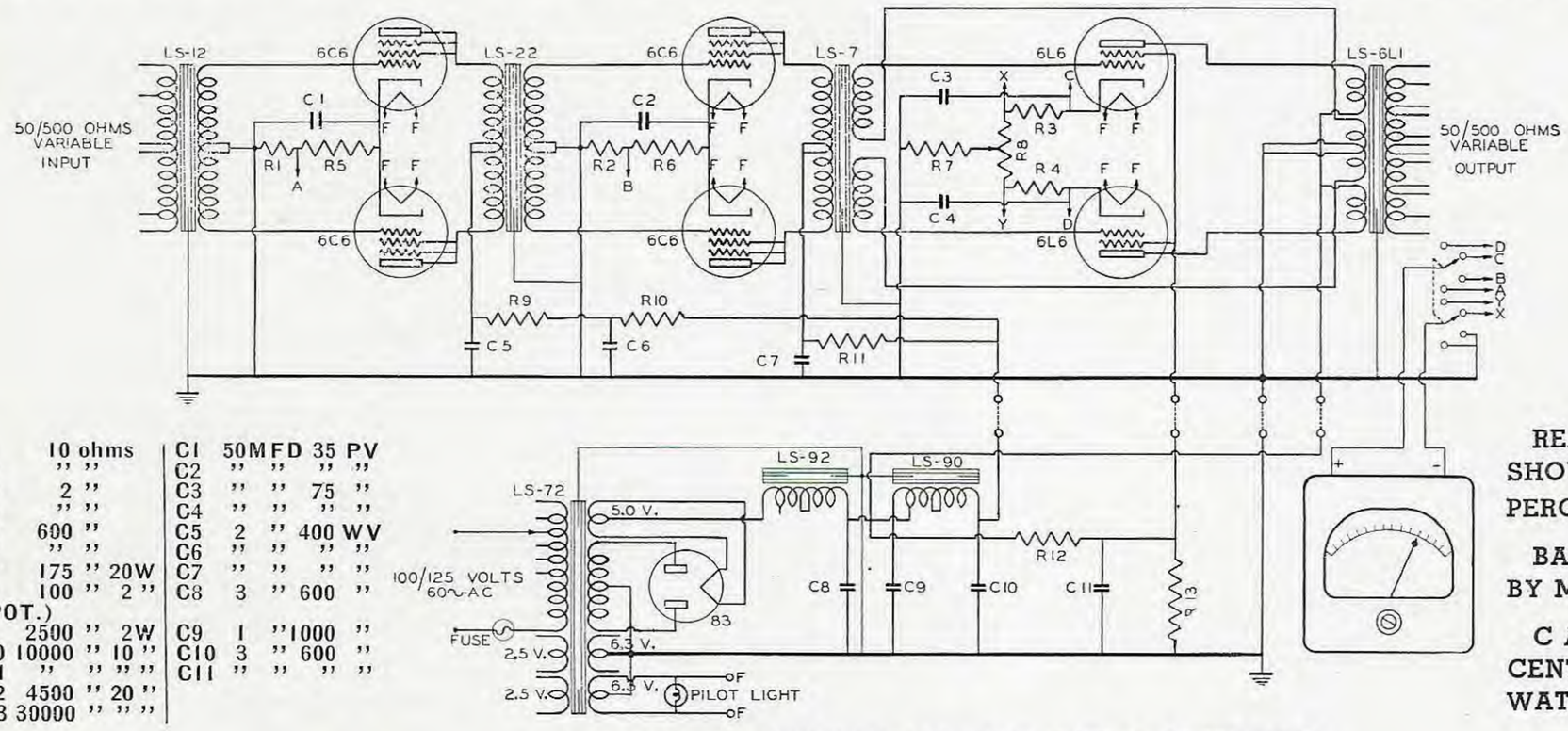
HUM LEVEL

Hum level in an amplifier is comprised of hum from the filament supply, plate supply, and inductive and electrostatic pickup. The use of pushpull stages throughout in the LSK amplifiers tends to balance out both filament and plate supply hum. In addition, the filter circuit in the plate supply is of the trap resonant type having very high efficiency. This is augmented by considerable resistance-capacity filtering in the early stages.

Inductive pickup at low levels becomes quite important. The UTC Linear Standard transformers are of the true hum balanced type, housed in a high permeability cast alloy shield, having five times the shielding effect of normal cast iron. A metallic shield in the coil structure nullifies stray electrostatic pickup. Pickup of both inductive and electrostatic nature between the power supply components and circuits and the audio units is reduced to a negligible value by the use of separate chassis for the power and audio sections.

POWER OUTPUT

The 6L6 tube is unique in its high efficiency and high power output. Using stabilized feedback, a pair of these tubes in pushpull will deliver more than twice the power output of a pair of low resistance triodes at considerably less distortion. To obtain maximum stability and simplicity, the tube should be operated under self bias conditions. On the basis of this type of operation, the two LSK kits have been designed for respective ratings of 30 and 60 watts. The 30 watt unit uses two 6L6 tubes, Class AB1, and will deliver appreciably more than its rated power when required. The 60 watt amplifier uses pushpull parallel tubes in a similar manner. The circuit is practically identical in both amplifiers and is illustrated in Fig. 3. The gain of the 30 watt unit is 83 DB and for the 60 watt amplifier, 86 DB.



R1	10 ohms		C1	50MFD	35 PV
R2	" "		C2	" "	" "
R3	2 "		C3	" "	75 "
R4	" "		C4	" "	" "
R5	600 "		C5	2 "	400 WV
R6	" "		C6	" "	" "
R7	175 "	20W	C7	" "	" "
R8 (POT.)	100 "	2 "	C8	3 "	600 "
R9	2500 "	2W	C9	1 "	1000 "
R10	10000 "	10 "	C10	3 "	600 "
R11	" "	" "	C11	" "	" "
R12	4500 "	20 "			
R13	30000 "	" "			

READING AT A, B, C, AND D SHOULD BE 100 PERCENT ±15 PERCENT FOR ZERO OUTPUT.

BALANCE C AND D READINGS BY MEANS OF R8.

C AND D READINGS RISE 20 PERCENT AT RATED OUTPUT OF 32 WATTS.

FIG. 3—CIRCUIT OF THE LSK-1 AMPLIFIER

CIRCUIT DETAILS

The input to the LSK amplifiers is low impedance with variable impedances from 50 to 500 ohms available. The input transformer is coupled to a pushpull 6C6 triode stage which is in turn transformer coupled to another pair of 6C6 triodes, driving the output 6L6 tubes through a special driver transformer. The 6C6 tube was chosen for the low level stages as it has very low hum level and very little tendency for microphonics. There is a considerable variation among tubes of this type. Where it is not convenient to check these tubes accurately, the RCA type 1603 or Raytheon FX-1 selected tubes can be used. Provision is made to balance the output 6L6G plate currents through the use of a potentiometer in the cathode circuits.

If metal tubes are preferred, 6C5's can be used in the first two stages, and regular 6L6's in the output stage.

METER CIRCUIT

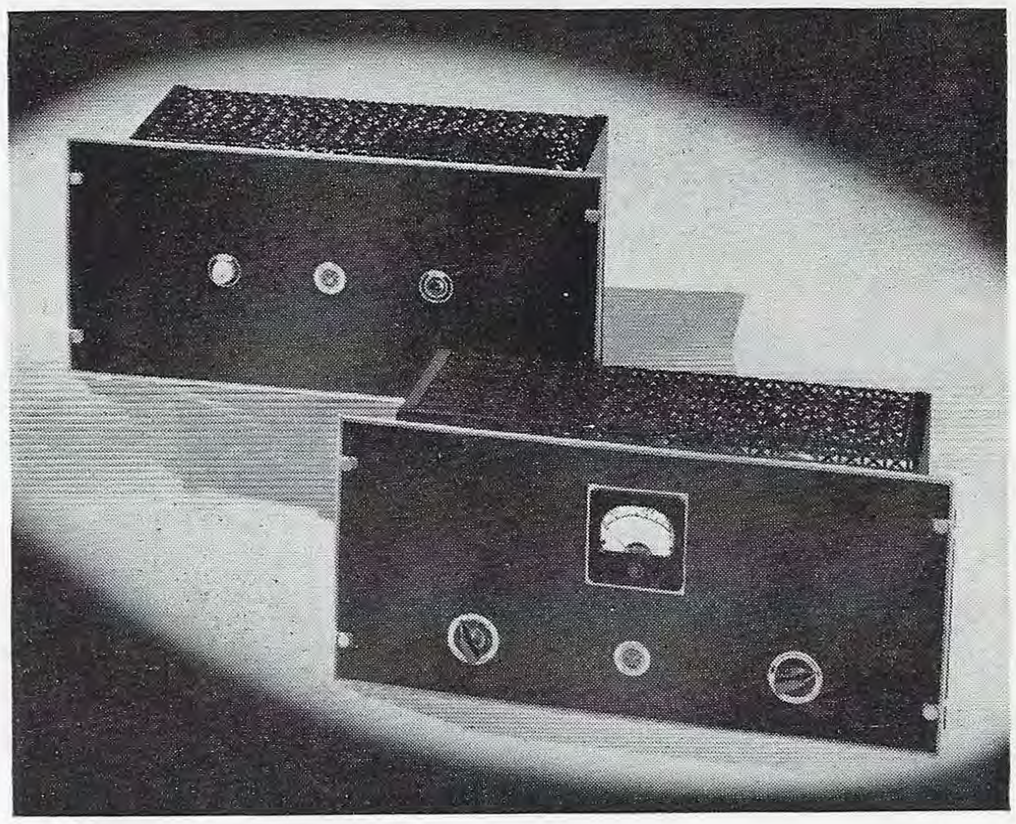
In most broadcast and other high quality equipment where stability is of paramount importance, it is advantageous to have a simple quick check on tube plate current. This not only checks the condition of the vacuum tubes, but will also show up leaky condensers, open circuits and oscillation. In the past, it has been customary to use a standard milliameter to check these currents. This would involve a knowledge of the correct current or a calibration chart. This is obviated in the LSK amplifiers through the use of a percentage system. A single milliameter is used to check the plate current of the first or second pushpull stages and the two output tubes individually. The meter is shunted over a properly designed portion of the cathode resister so that with normal plate current flow, the meter will read at the same scale position for any test position. The scale is calibrated in percentage with 100% as normal. Variations up to 15% can generally be neglected as they may be due to line voltage conditions and difference between tubes. The output tube plate current changes with power output and consequently the meter can be used as an approximate VI or overload indicator when connected in the 6L6G circuit.

MECHANICAL DETAILS

The LSK amplifiers are designed for mounting on a standard relay rack or in similar type cabinet units. The chassis is of the new depressed type. It is mounted on the rack with the bottom parallel to the front of the rack and the wiring exposed at the front (sub chassis wiring). An etched panel covers the exposed chassis but is readily removable for quick inspection or checking of the amplifier circuits. All external connections are made through locking type armored plugs so that a chassis can be quickly disconnected and removed if required. The audio panel includes the plate current meter and a four position switch. The balancing cathode potentiometer is also brought out to a control on the front of this panel. The power supply panel incorporates a quickly replaceable fuse and a pilot light.

The panel size of the type LSK-1 and LSK-2 kits is 8¾ x 19 inches. The depth, which includes the chassis and perforated protective cover, is 9 inches.

Only the highest quality accessory components are used in this equipment to assure maximum stability in operation under the continuous service encountered by commercial apparatus.

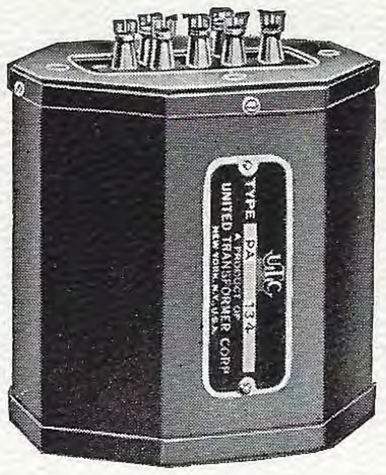


UTC BROADCAST TYPE BEAM POWER AMPLIFIER KITS

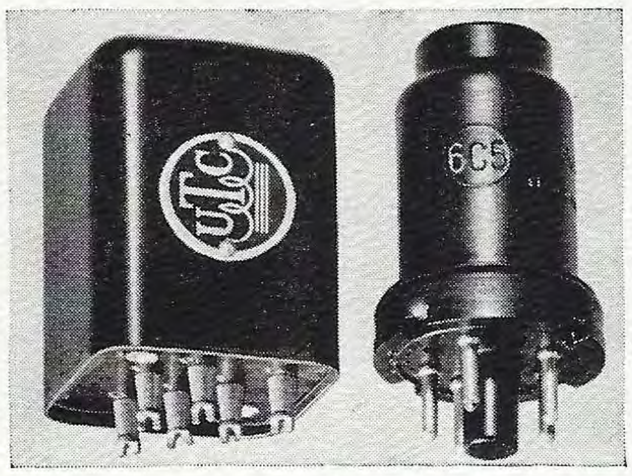
LSK-1 30 watt Linear Standard amplifier kit, rack type, including all accessories and meter. Input impedance 50, 125, 200, 250, 333, 500 ohms. Output impedances variable from 1.2 to 500 ohms to cover all voice coil and line requirements. List price, fully mounted, less tubes..... **$220.00**

LSK-2 60 watt amplifier, similar to the above, list price, completely mounted, less tubes **275.00**

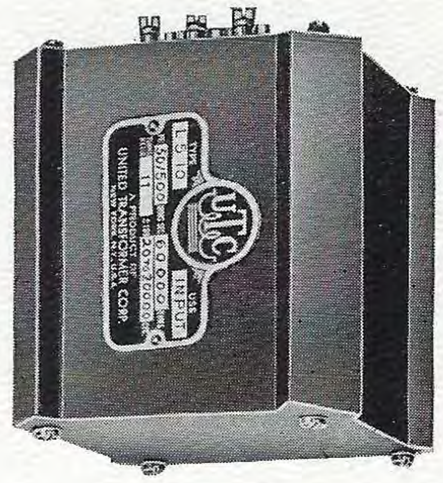
New UTC **Transformers for 6L6 Tubes . . .**



PA TYPE



ULTRA COMPACT—A TYPE



LS TYPE

PA-428
Power transformer for push-pull 6L6 tubes, self or fixed bias. Primary, 115 v. a.c., 50-60 cycles. Secondaries 450-0-450 at 250 ma.; 6.3 VCT-4A, 6.3 VCT-2A tapped at 2½ volts-3A, 2½ VCT-3A, 5 VCT-3A taps provided for bias supply. **$14.00**

PA-233
Input transformer from two 56, 6C6, 6C5, or similar tubes to 6L6's self bias. **$6.00**

PA-333
This input transformer is designed to operate from 6C5's, or similar driver tubes to two 6L6's fixed bias. **$6.00**

PA-433
From 45 or 2A3 plates to two or four fixed bias 6L6 grids. **$6.50**

***PA-2L6**
6600 ohms, plate to plate. Will match 35-40 watts output. Secondary impedance, 500, 200, 16, 8, 5, 3, 1.5 ohms. **$10.00**

***PA-4L6**
3800 and 3300 ohms, plate to plate. Will match two 6L6's fixed bias, 60 watts output; four 6L6's self bias, 60-80 watts output. Secondary impedance, 500, 200, 16, 8, 5, 3, 1.5 ohms. **$15.00**

A-10
Multiple line or microphone to single grid. Primary 500, 333, 250, 200, 125 or 50 ohms to 50,000 ohms secondary. **$10.00**

A-12
Multiple line or microphone to two grids. Primary 500, 333, 250, 200, 125 or 50 ohms to 80,000 ohms secondary. **$10.00**

A-14
Dynamic microphone to one or two grids. Primary 30 ohms to 50,000 ohms secondary. **$10.00**

*** These transformers incorporate the new UTC Feedback (patent applied for) Winding, which reduces harmonic distortion, increases available power and reduces plate resistance tremendously. No resistors or condensers are necessary.**

LS-12
Primary will match 500, 333, 250, 200, 125, or 50 ohm line as required for carbon, dynamic, ribbon, or other microphones and for low impedance pick-ups. Secondary in two sections; overall impedance 120,000 ohms. LS-1 case. **$20.00**

LS-7
Push pull 56, 6C5, or 6C6 triodes to 45, 42, 6L6, or 6F6 tubes in AB. LS-2 case. **$22.00**

LS-22
Input, 2 plates to two grids. Turn ratio 1.6:1 each side of center. Primary and secondary each in 2 sections. Maximum operating level +25 DB. LS-2 case. **$22.00**

***LS-6L1**
Primary, 6600 ohms plate to plate. Will match push pull 6L6's self bias 30 watts output. Secondary, 500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2. LS-3 case. **$30.00**

***LS-6L3**
Primary, 6600 ohms plate to plate. Will match same tubes as LS-6L1. Secondary, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2. LS-3 case. **$20.00**

***LS-6L4**
Primary, 3800 and 3300 ohms plate to plate. Will match (for 3800 ohms) two 6L6's fixed bias, 60 watts output; (for 3300 ohms) four 6L6's self bias, 60 watts output. Secondary, 500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2. LS-4 case. **$35.00**

LS-72
For use with self or fixed bias 6L6 tubes. Primary tapped for 100, 105, 110, 115, 120, 125 volts. Secondaries: 450 volts each side of center at 250MA, also tapped at 400 volts each side of center. 6.3 V.C.T. 4A, 6.3 V.C.T. 3A tapped at 2½ V.C.T. 3A; 2½ V.C.T. 3A; 5 V.C.T. 3A. LS-4. **$25.00**

LS-73
For use with four fixed bias 6L6 tubes. Primary tapped for 100, 105, 110, 115, 120, 125 volts. Secondaries 450 volts each side of center at 500 MA, also tapped at 400 volts each side of center. 6.3 V.C.T. 6A, 6.3 V.C.T. 4A tapped at 2½ V.C.T. 3A, 2½ V.C.T. 10A, 5 V.C.T. 6A. LS-5. **$35.00**

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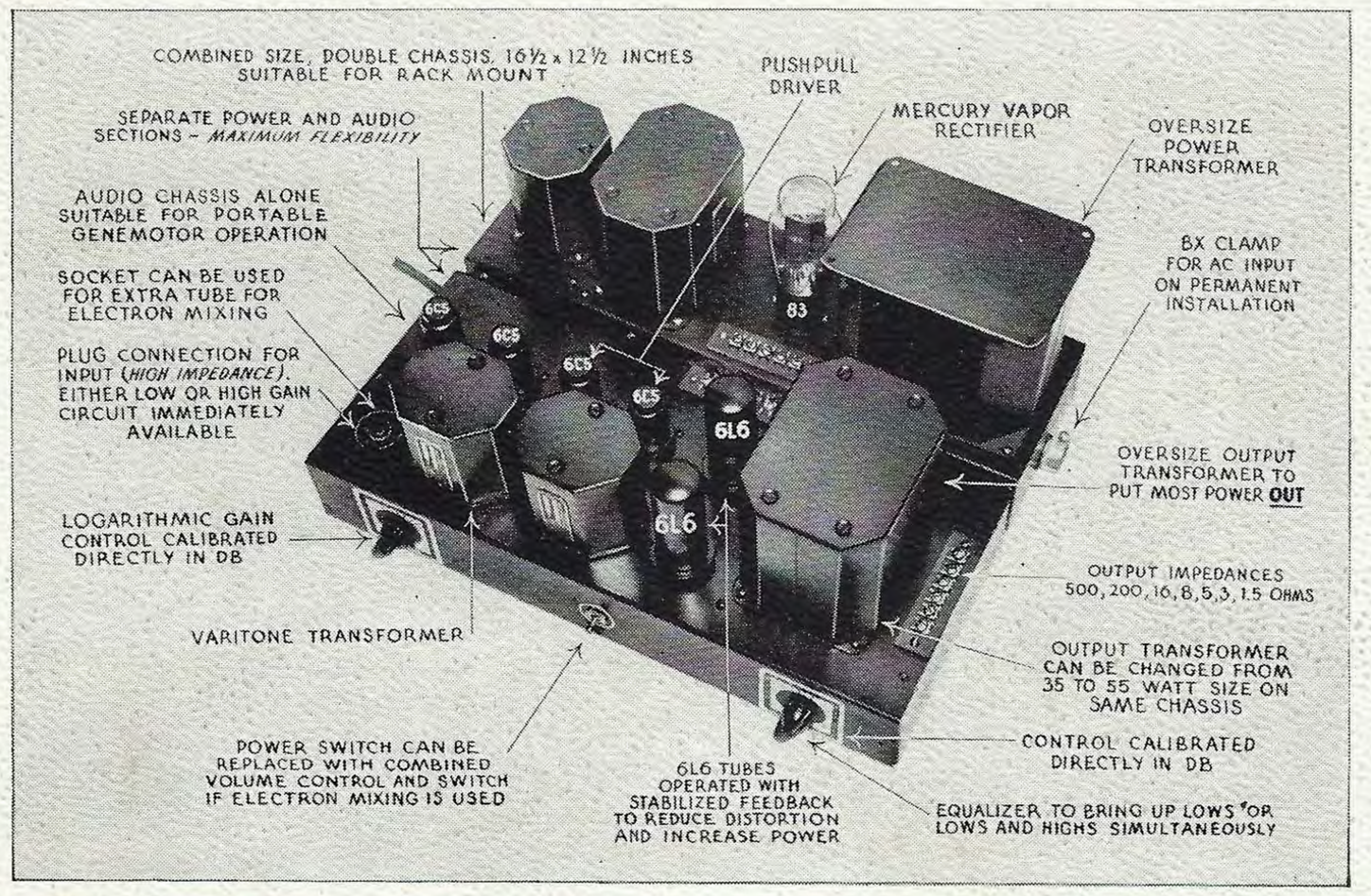
Most Complete Transformer Line in the World

QUALITY · RELIABILITY

UTC BEAM POWER AMPLIFIER KITS



The UTC organization manufactures the most complete and diversified group of transformers produced in the entire world. The scope of activity is partially illustrated by the following products which UTC produces.

- Broadcast quality audio transformers from —140 DB to 50 KW rating.
- Aircraft — portable audio and power components weighing but 6 oz. completely poured with compound in drawn metal containers.
- Television transformers linear from 30 to 200,000 cycles.
- High Q audio reactors with Q factor (L/R) as high as 200 and over.
- Saturable control reactors.
- Battery chargers and speaker field exciters.
- Rectifiers for broadcast and industrial applications.
- Automatic voltage regulators.
- Oscillation transformers.
- Plate and distribution transformers up to 200 KVA 100,000 volts.
- High potential and high current test sets.
- Audio and carrier frequency amplifiers for special applications.
- Amplifier kits.

Write to us if you are interested in any items running along parallel lines to the above. UTC consulting service is gratis.

UNITED TRANSFORMER CORP.

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