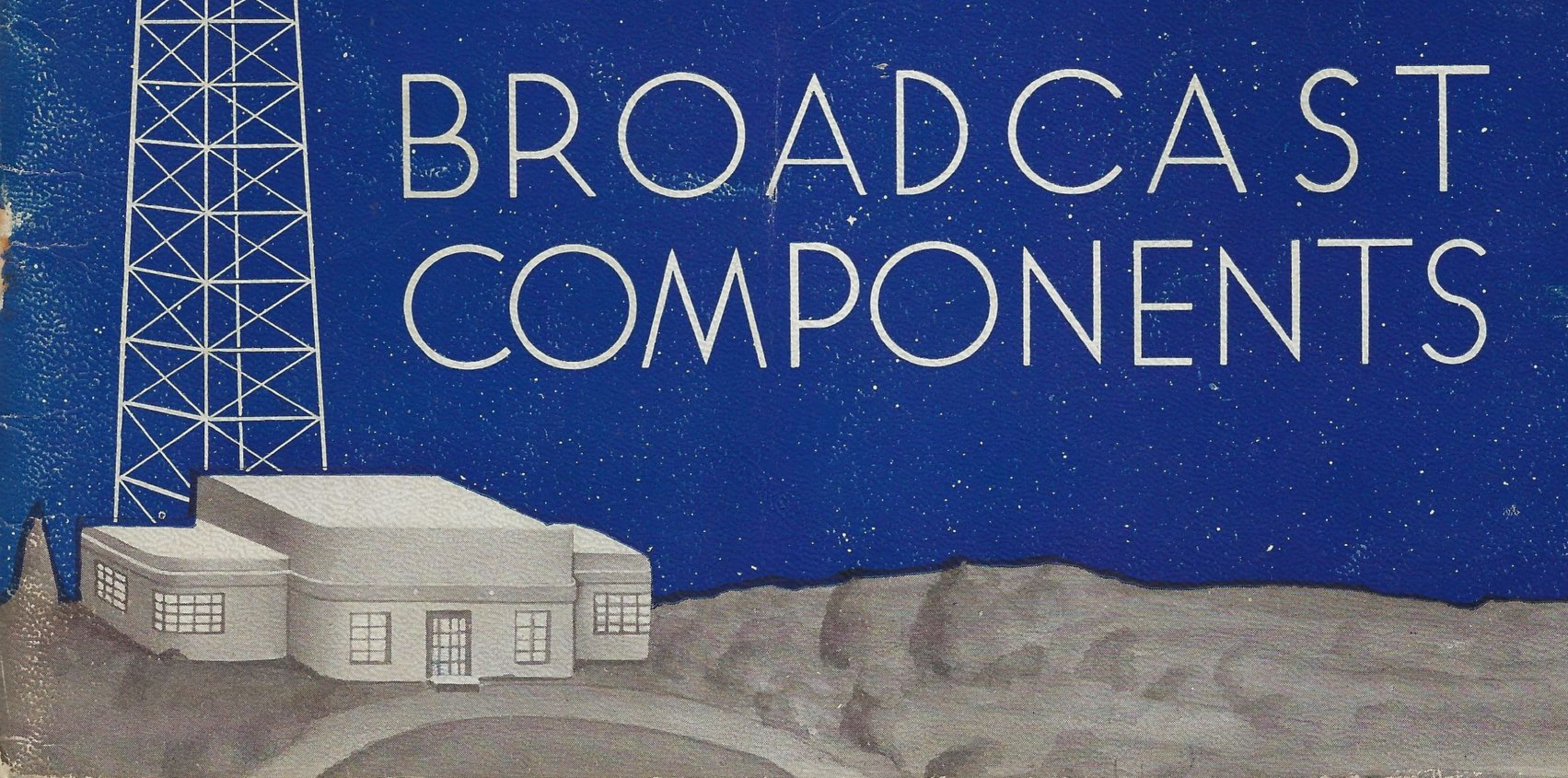
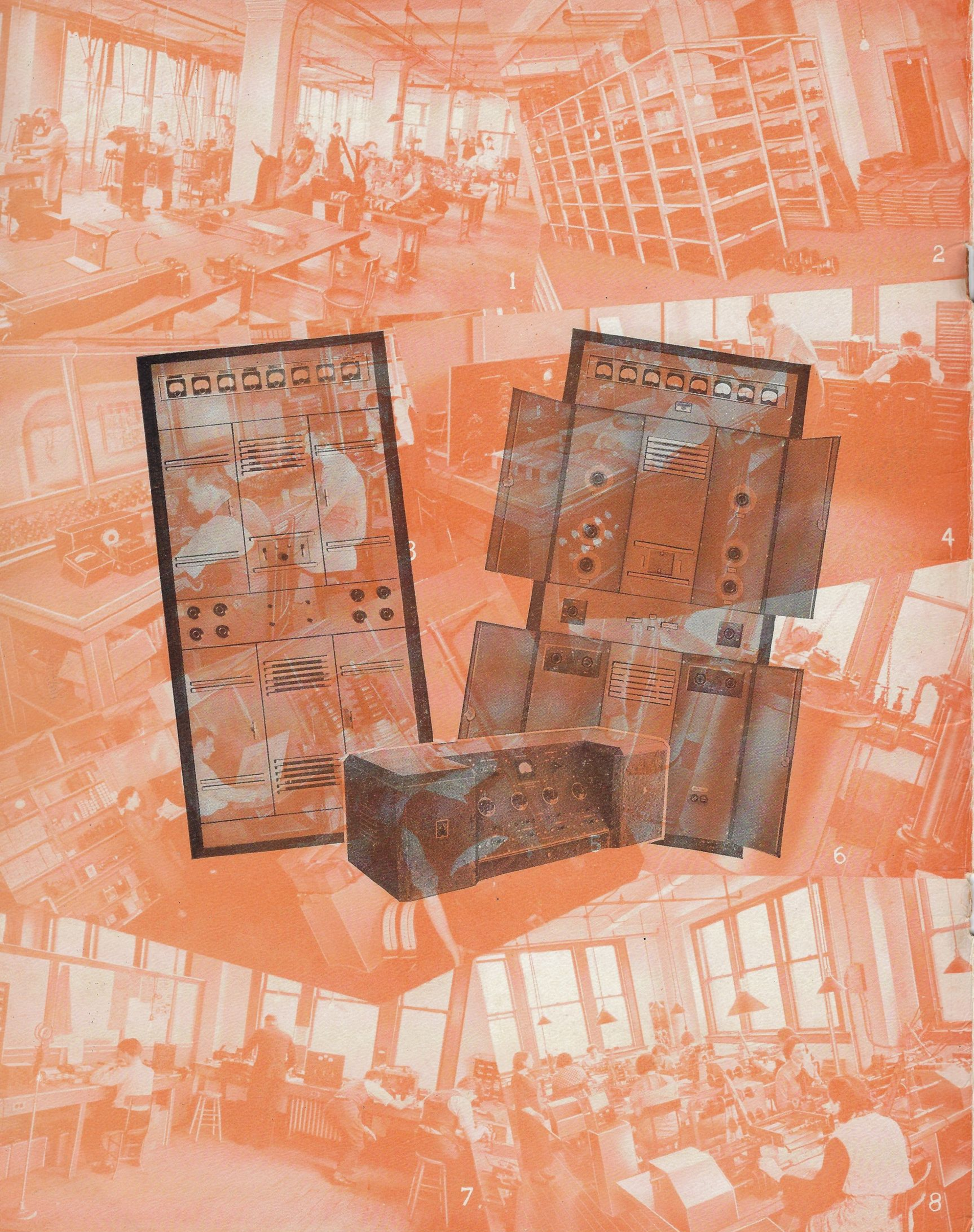
UTC

BROADCAST COMPONENTS

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LINEAR STANDARD AUDIO TRANSFORMERS

Present day communications and broadcast development is characterized by an ever increasing use of wide range high fidelity equipment. The point has been reached where the sole factor governing the frequency response of matching and amplification equipment is the fidelity of the transformers used. The important factors of audio transformer performance are:

(a) Uniform frequency response over the entire audio range.
(b) Negligible wave form distortion and phase shift.
(c) High efficiency.
(d) Thorough shielding; both magnetic and electro-static.
(e) Positive reliability.
(f) Flexibility.

UNIFORM FREQUENCY RESPONSE

Three major factors effect the frequency response of an audio transformer. These are the primary inductance, leakage reactance and distributed capacitance. The impedance of the primary inductance varies directly with frequency, and consequently is very low at the low frequencies. As this primary inductance is directly in shunt with the source impedance, a definite power loss is obtained. Figure 4 illustrates the effect of this shunting inductance on the low frequency transformer response.

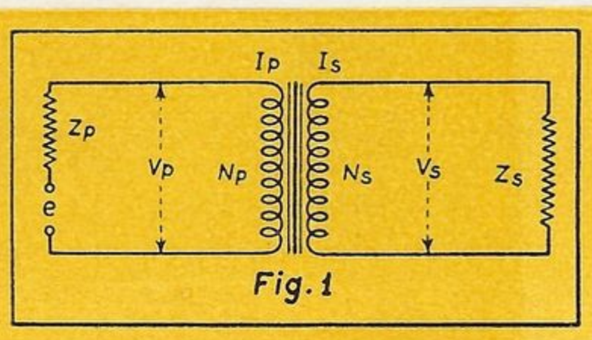


Fig. 1

Electrical circuit of an ideal transformer, with 100-percent efficiency.

The distributed capacitance acts in an identically similar manner, shunting the effective source or load impedance. Figure 5 illustrates the loss due to distributed capacity in a typical audio circuit.

The leakage reactance acts as a series inductance between the source and load impedance. Its impedance increases with frequency, and therefore high leakage reactance tends to effect poor high frequency response. Leakage reactance is of particular importance in driver transformers where very close coupling must be maintained between driver tubes and the class B grids.

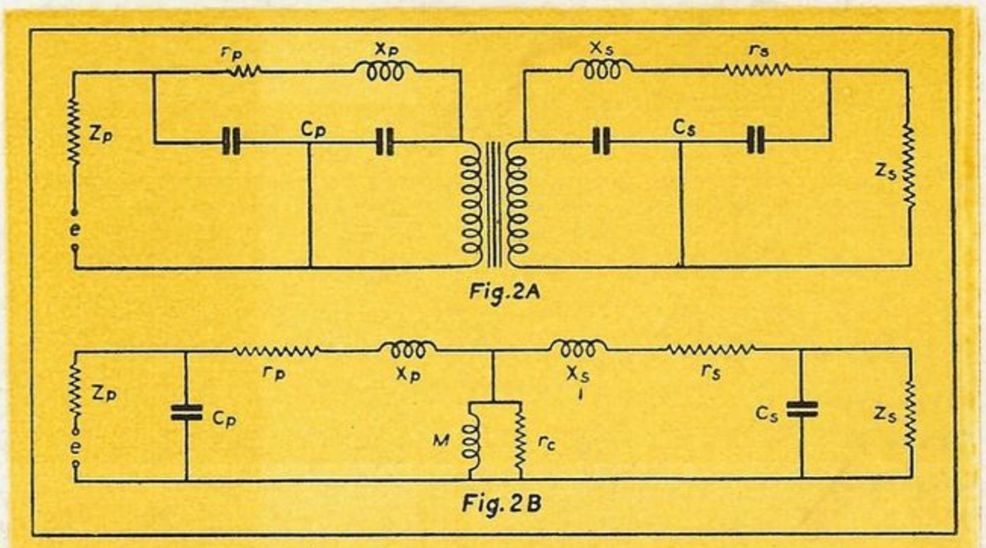


Fig. 2A illustrates a physical transformer. In Fig. 2B is shown the equivalent T network of the same transformer.

UTC DESIGN FACTORS

To increase the primary inductance of a given core structure, it is necessary to increase the transformer turns. Unfortunately, an increase in turns effects an increase in both leakage reactance and distributed capacitance. To eliminate the necessity of increasing turns, the permeability of the transformer core material may be increased. Research in this field has developed the nickel iron magnetic alloys. One of the limiting factors in the use of nickel iron alloys is their sensitive nature with reference to mechanical, thermal, or magnetic abuse. This feature was fully realized when UTC Hiperm alloy was developed. This nickel iron alloy has a very high permeability at the low flux densities encountered in audio units, and also has low hysterisis loss. However, it is not extremely sensitive to shock and will stand reasonable amounts of DC without excessive saturation.

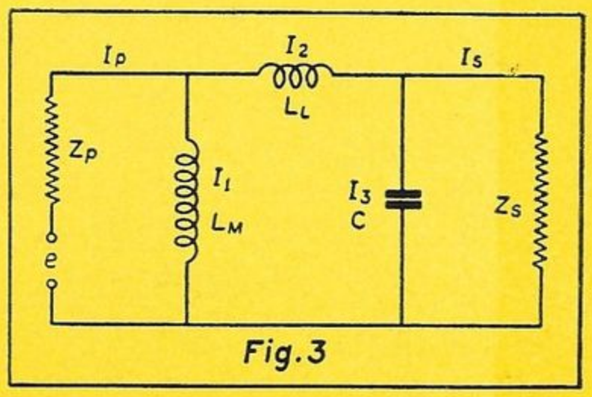


Fig.3

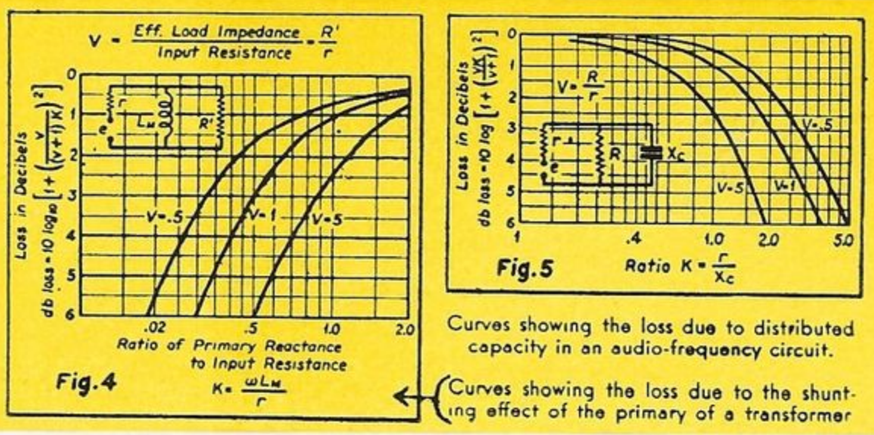
A simplification of the equivalent transformer circuit shown in Fig. 2B.

The methods used in UTC transformers to obtain low leakage reactance and distributed capacitance are quite involved. A semi-toroidal coil structure is used in most transformers, such that the coils cover more than 50% of the magnetic circuit. This results in appreciably better coupling than in the normal shell type of transformer, where the coil covers only 20% of the magnetic path. In addition to this, practically all the coil structures incorporate accurate and multiple interleaving of windings. The use of narrow coil sections effects extremely low turn to turn and layer to layer capacitance in UTC audio transformers, with the result that the total distributed capacitance is extremely low.

WAVE FORM DISTORTION

Wave form distortion in audio transformers is the result of three major factors: saturation of the core material, non-symmetrical coupling in push pull windings, and resonance in the coil structure. The design of all UTC transformers is such that if the power ratings indicated in the catalog tabulation are maintained, no distortion due to magnetic saturation is possible.

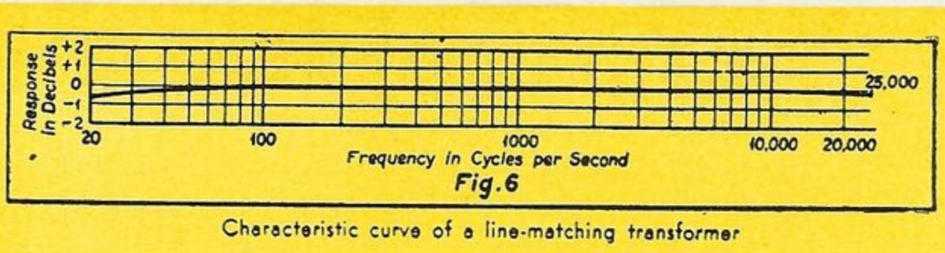
The use of coils having very low distributed capacity in UTC audio transformers naturally results in a minimum of resonance effect. This is of particularly great importance with reference to phase shift, where stabilized feed back is to be used. A number of the large communications concerns have already chosen UTC transformers, as having a minimum of phase shift and resonant distortion.



Push pull windings are so arranged in UTC transformers that absolute symmetry, both capacitive and inductive, is obtained. The alternate primary and secondary sections are accurately interleaved so that the balance of windings is better than one part in 10,000. As previously mentioned, this is of paramount importance in both input and output transformers for class B tube operation.

HIGH EFFICIENCY

It is obvious that the loss in power transfer of a transformer should be kept as low as possible. While not of paramount importance in low level audio units, this factor is appreciable in output transformers. Some contemporary transformers recently tested in the UTC audio laboratories have shown transfer losses as high as 3 DB. This would mean that with 100 watts available in the plate circuit of the output tubes, only 50 watts would be delivered to the load. With due consideration of these factors, all UTC linear standard transformers are designed for minimum insertion loss, in no case exceeding 1 DB under worst operating conditions.



Characteristic curve of a line-matching transformer

SHIELDING

Practically all of the new high fidelity microphones and other sound sources developed during the past few years require relatively high amplification. One of the important difficulties encountered with high gain amplification equipment is the hum pickup in audio transformers operating at low level. The UTC engineering staff has done most of the pioneering in the methods of reducing hum pickup. One of the most important developments was the use of a hum balancing coil structure of semi-toroidal design in which two sets of accurately balanced coils are used. If stray flux should cut across the transformer, it will induce voltages in both sets of coils but in opposite direction, so that neutralization is obtained. In addition to the balanced coil structure, additional shielding is positively necessary. Standard UTC transformers are housed in an alloy shield of very high efficiency to obtain substantial hum reduction. Low level transformers also have internal alloy shields of Hiperm alloy properly arranged such that effective filtering of stray flux results.

To eliminate the longitudinal pickup occurring in audio transformers because of capacitive coupling between the primary and secondary, UTC linear standard transformers incorporate special electrostatically shielded coil structures. To effect positive grounding the shield leads are brought out to a separate lug on the terminal board.

RELIABILITY

To assure positive reliability, all UTC transformer components and prefabricated parts are fully checked throughout the entire production process. This is possible because of the fact that every part and product used in finished UTC units is fabricated in the company plant. Coils are varnish impregnated under a 24-hour vacuum-baking cycle, and all units are fully sealed in their cases with moisture-proof insulating compound. The dependability of these units is one of the important reasons for their rapid acceptance in the broadcast field and in foreign countries.

FLEXIBILITY

The multiple line windings and other split tapped windings used in UTC Linear Standard units were developed by the UTC engineering staff a number of years ago. Through excellent coupling and balanced construction, a wide group of impedance combinations can be obtained without impairing the audio range or efficiency of any audio transformer in the Linear Standard group.

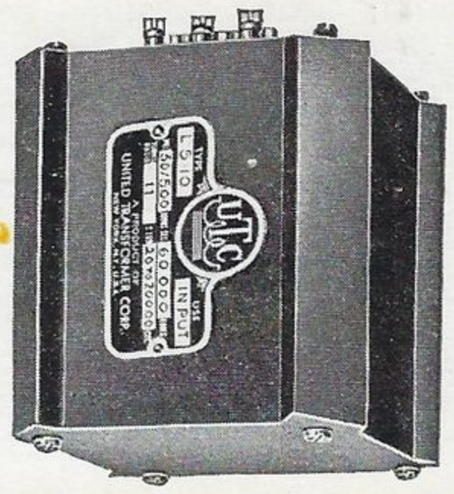
SPECIAL UNITS

In addition to the information contained herein and in the balance of this bulletin, we suggest that you write to the UTC Engineering Department if any particular audio problems are encountered. Due to the critical nature of high fidelity audio equipment, a very large portion of the UTC linear standard units are produced directly to customers' specifications. These special units cost little more than the standard equivalent items and comparatively good deliveries are possible.

OVERALL DIMENSIONS

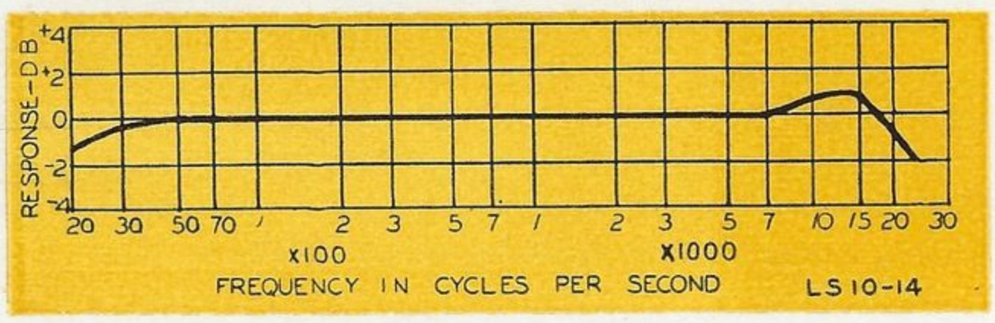
	Mtg. Dim.
LS-1	1 15/16 x 2 7/16
LS-2	2 11/16 x 3 11/16
LS-3	4 3/16 x 5 1/32
LS-4	5 3/4 x 5 3/4
LS-5	7 1/4 x 7 1/4

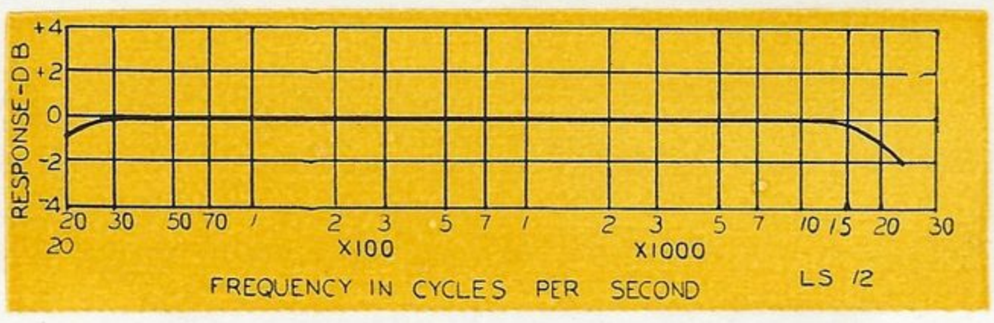
L	W	H
2 9/16	3 3/16	3 11/16
3 1/2	4 3/8	4 5/8
5	5 3/4	5 3/16
6 7/16	6 7/16	5 3/8
8	8	6 1/2

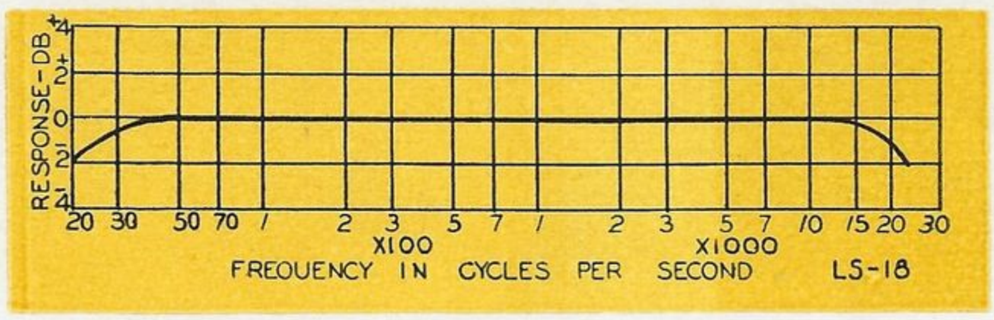


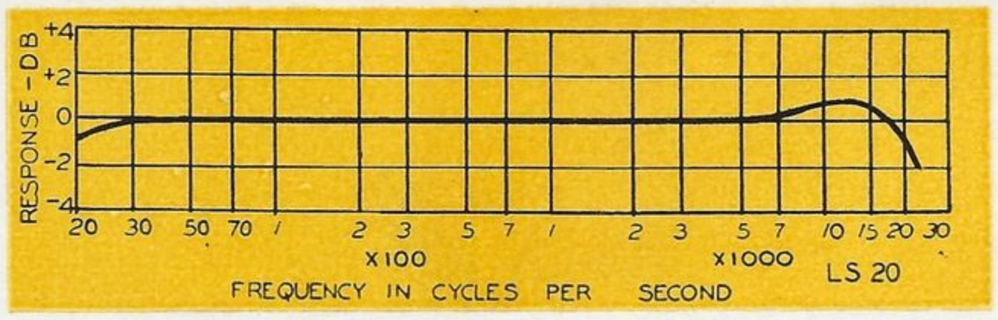
LINEAR STANDARD AUDIO TRANSFORMERS

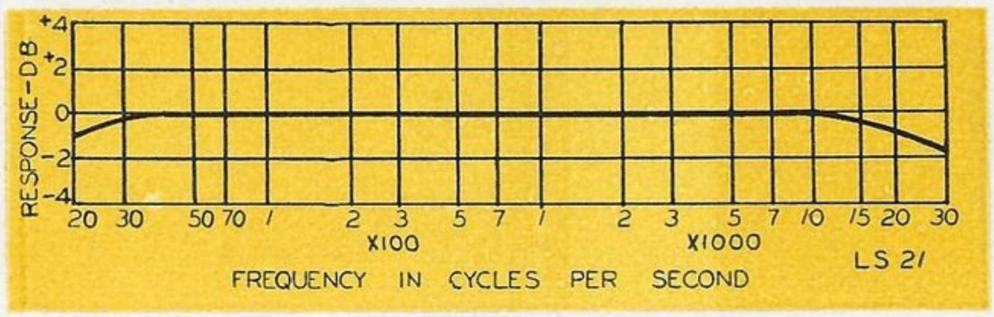
The UTC Linear Standard audio transformer line covers every requirement in the high fidelity field. These units, which are now being used by R. C. A., G. E. and numerous other organizations, represent the acme in transformer development. All standard units are guaranteed to be ± 1 DB from 30 to 20,000 cycles. Standard and special transformers are available in sizes from minus 130 DB operating level to 50 KW audio output.

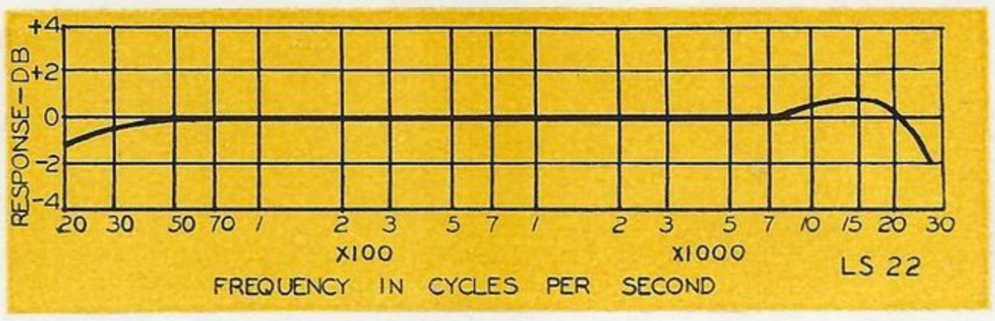


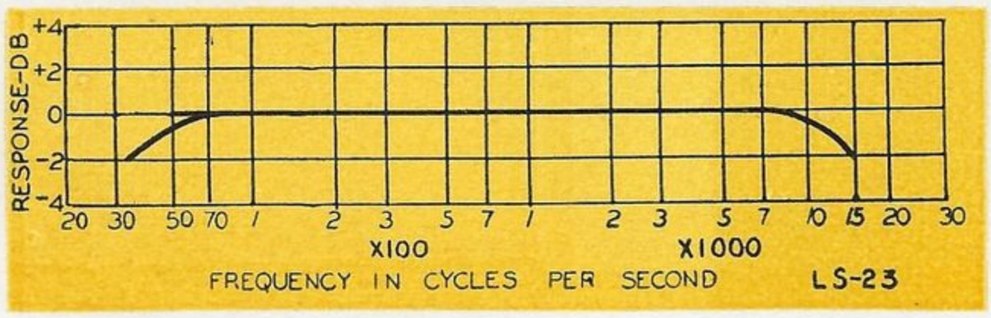


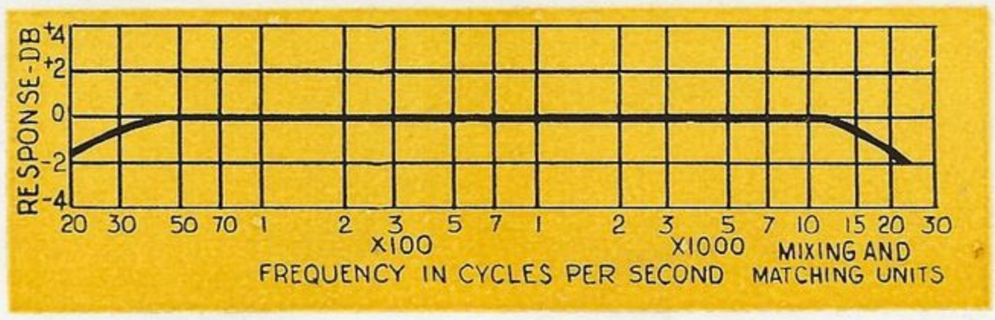












LOW IMPEDANCE TO GRID TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Hum-balanced plus	Relative hum-pickup reduction	Max. Unbalanced DC in primary	Case No.	List Price
LS-10	Low impedance mike, pick-up, or multiple line to grid	50, 125, 200, 250, 333, 500 ohms	60,000 ohms in two sections	20-20,000	+23 DB	Dual alloy shield	—74 DB	5 MA	LS-1	15.00
LS-10X	As above	As above	50,000 ohms	30-20,000	+20 DB	Quadruple alloy shield	—92 DB	0	LS-1	20.00
LS-12	Low impedance mike, pick-up, or multiple line to push pull grids	50, 125, 200, 250, 333, 500 ohms	120,000 ohms overall, in two sections	20-20,000	+23 DB	Dual alloy shield	—74 DB	5 MA	LS-1	20.00
LS-12X	As above	As above	80,000 ohms overall, in two sections	30-20,000	+20 DB	Quadruple alloy shield	—92 DB	0	LS-1	25.00
LS-14	Low impedance mike, pick-up, or parallel mixer to grid	2.5, 5.5, 10, 15, 22, 30, 38, 60 ohms	60,000 ohms in 2 sections	20-20,000	+23 DB	Dual alloy shield	—74 DB	5 MA	LS-1	20.00
LS-14X	As above	As above	50,000 ohms	30-20,000	+20 DB	Quadruple alloy shield	—92 DB	5 MA	LS-1	25.00
LS-15	Three isolated lines or pads to one or two grids	30, 50, 200, 250 ohms each primary	60,000 ohms overall, in two sections	20-20,000	+20 DB	Dual alloy shield	—74 DB	5 MA	LS-1	20.00
LS-15X	As above	As above	As above	30-20,000	+20 DB	Quadruple alloy shield	—92 DB	5 MA	LS-1	25.00
LS-18	High level multiple line to push pull grids	50, 125, 200, 250, 333, 500 ohms	50,000 ohms overall, in two sections	20-20,000	+30 DB	Alloy casting	—50 DB	5 MA	LS-2	22.00

MIXING TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Hum-balanced plus	Relative hum-pickup reduction	Max. Unbalanced DC in primary	Case No.	List Price
LS-30	Mixing, low impedance mike, pickup, or multiple line to multiple line	50, 125, 200, 250, 333, 500 ohms	50, 125, 200, 250, 333, 500 ohms	20-20,000	+23 DB	Dual alloy shield	—74 DB	5 MA	LS-1	15.00
LS-30X	As above	As above	As above	30-20,000	+20 DB	Quadruple alloy shield	—92 DB	3 MA	LS-1	20.00
LS-31	Three isolated lines or pads to multiple line	30, 50, 200, 250 ohms each primary	50, 125, 200, 250, 333, 500 ohms	20-20,000	+22 DB	Dual alloy shield	—74 DB	5 MA	LS-1	20.00
LS-31X	As above	As above	As above	30-20,000	+20 DB	Quadruple alloy shield	—92 DB	3 MA	LS-1	25.00
LS-32	Mixing, low impedance mike, pickup, or parallel mixer to multiple line	2.5, 5.5, 10, 15, 22, 30, 38, 60 ohms	50, 125, 200, 250, 333, 500 ohms	20-20,000	+23 DB	Dual alloy shield	—74 DB	5 MA	LS-1	20.00

The values of unbalanced DC shown will effect approximately 1.5 DB additional loss at 30 cycles.

PLATE, CRYSTAL, PHOTOCELL, AND BRIDGING TO LINE TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Hum-balanced plus	Relative hum-pickup reduction	Max. Unbalanced DC in primary	Case No.	List Price
LS-50	Single plate to multiple line	8,000 to 15,000 ohms	50, 125, 200, 250, 333, 500 ohms	20-20,000	+23 DB	Dual alloy shield	—74 DB	1 MA	LS-1	15.00
LS-51	Push pull low level plates to multiple line	8,000 to 15,000 ohms each side	50, 125, 200, 250, 333, 500 ohms	20-20,000	+23 DB	Dual alloy shield	—74 DB	1 MA	LS-1	15.00
LS-37	Crystal microphone or pickup to multiple line	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000 cycles measured with resistive source	+20 DB	Dual alloy shield	—74 DB	0	LS-1	15.00
LS-38	Crystal microphone or pickup to multiple line, with internal equalizer	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	Equalized for crystal-transformer combination	+20 DB	Dual alloy shield	—74 DB	0	LS-1	20.00
LS-39	Photocell, high-mu triode, diode or overbiased detector to multiple line	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+22 DB	Dual alloy shield	—74 DB	.2 MA	LS-1	15.00
LS-150	Bridging transformer from 50 to 500 ohm line to multiple line	4,000 ohms, bridging	50, 125, 200, 250, 333, 500 ohms	20-30,000	+23 DB	Dual alloy shield	—74 DB	1 MA	LS-1	15.00
LS-151	Bridging transformer from 50 to 500 ohm line to multiple line	16,000 ohms, bridging	50, 125, 200, 250, 333, 500 ohms	20-30,000	+25 DB	Dual alloy shield	—74 DB	1 MA	LS-1	15.00

INTERSTAGE AUDIO TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Hum-balanced plus	Relative hum-pickup reduction	Max. Unbalanced DC in primary	Case No.	List Price
LS-20	Single plate to single grid	8,000 to 15,000 ohms. Also for bridging 50/500 ohm line	60,000 ohms; 2:1 turn ratio	20-20,000	+23 DB	Dual alloy shield	—74 DB	0 MA	LS-1	10.00
LS-21	Single plate to push pull grids	8,000 to 15,000 ohms. Also for bridging 50/500 ohm line	135,000 ohms; turn ratio 1.5:1 each side. Primary and secondary each in two sections	20-20,000	+23 DB	Dual alloy shield	—74 DB	0 MA	LS-1	13.00
LS-22	Push pull plates to push pull grids	8,000 to 15,000 ohms	38,000 ohms each secondary, turn ratio 1.6:1 each side of center. Primary and secondary each in two sections	20-20,000	+26 DB	Alloy casting	—50 DB	1 MA	LS-2	22.00
LS-24	Single plate or multiple line to one or two grids	High impedance primary 8,000 to 15,000 ohms. Low impedance primary 50, 125, 200, 250, 333, 500 ohms	60,000 ohms; 2:1 turn ratio Secondary impedance 60,000 ohms overall	30-15,000	+23 DB	Dual alloy shield	—74 DB	1 MA	LS-1	20.00

The values of unbalanced DC shown will effect approximately 1.5 DB additional loss at 30 cycles. It is recommended that interstage transformers be parallel fed using our LS 94 or LS 95 reactors or with a resistance of 1 to 3 times the tube plate resistance, and a .25 or .5 mfd. condenser.

DRIVER TRANSFORMERS

Type No.	Application	Primary Impedance	Reflected Secondary Impedance	± 1 db from	Max. Level	Max. Unbalanced DC in Primary	Case No.	List Price
LS-5	Driver, multiple line to class B 838's, 805's, ZB-120's, 203A's and similar tubes.	50, 125, 200, 250, 333, 500 ohms	2,000 ohms; 1:2 overall turns ratio	30-20,000	+36 DB	5 MA	LS-2	30.00
LS-6	Driver, push pull 45's, 59's, 2A3's, 6A5G's, etc. to push pull 845 or 211D grids.	800 to 2,000 ohms	.11 primary impedance turns ratio 1:3 overall	30-20,000	+33 DB	5 MA	LS-2	22.00
LS-7	Push pull 56, 6C5 or similar plates to A prime 45's, 42's, 6F6's, 2A3's.	8,000 to 15,000 ohms	.45 primary impedance turn ratio 1.5:1 overall	30-20,000	+25 DB	1 MA	LS-2	22.00
LS-47X	Driver from push pull 2A3's, 6A5G's, or 300A's to class B 838's, 203A's, 805's, or ZB120's.	800 to 1,000 ohms	.1 pri. impedance turns ratio, Pri/½ Sec. 3.2:1	30-20,000	+33 DB	5 MA	LS-2	22.00
LS-48	Driver transformer push pull 845's to 204 or 849 grids in class B.	1,000 to 2,000 ohms	.038 pri. impedance turns ratio, Pri./½ Sec. 5.1:1	30-20,000	+42 DB	15 MA	LS-4	35.00
LS-49	Push pull parallel 2A3, 6A5G, or 300A tubes to four 838, 203A, 805, or ZB120 tubes.	800 to 2,000 ohms	.028 pri. impedance turns ratio, Pri./½ Sec. 6.0:1	30-20,000	+39 DB	10 MA	LS-4	30.00

HIGH LEVEL MATCHING TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary	± 1 db from	Max. Level	Case No.	List Price
LS-33	High level line matching.	50, 125, 200, 250, 333, 500 ohms.	1.2, 2.5, 5, 7.5, 10, 15, 20, 30, 50, 125, 200, 250, 333, 500 ohms	30-20,000	15 Watts	LS-2	15.00
LS-34	High level line matching.	50, 125, 200, 250, 333, 500 ohms.	1.2, 2.5, 5, 7.5, 10, 15, 20, 30, 50, 125, 200, 250, 333, 500 ohms	30-20,000	30 Watts	LS-3	20.00

OUTPUT TRANSFORMERS TO HIGH IMPEDANCE (RF) LOAD

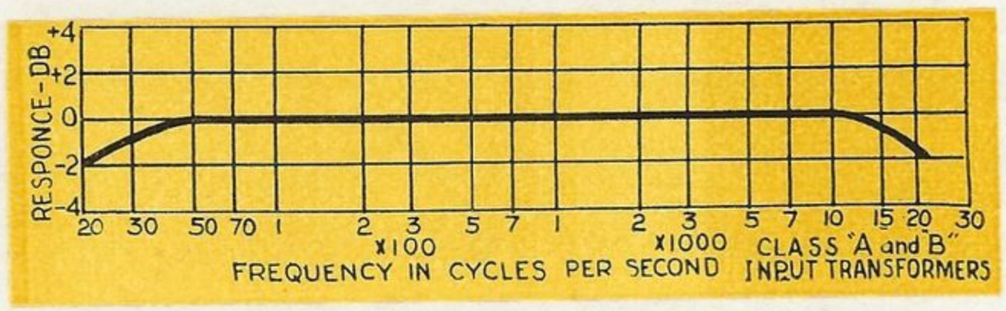
Type No.	Primary will match following tubes	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Case No.	List Price
LS-56	Push pull 2A3's, 6A5G's, 300A's, 275A's, 6A3's	5,000 ohms plate to plate and 3,000 ohms plate to plate	6000, 5000, 4000, 1800, 1500, 1000, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	20-20,000	+36 DB	LS-2	20.00
LS-845M	845 tubes class AB	8,800 ohms plate to plate	5000, 3500, 2500, 2100, 1250, 600	20-20,000	+42 DB	LS-5	50.00
LS-66	Class B 203A, 838, ZB120, 805	9,000 ohms plate to plate	5000, 3500, 2500, 2100, 1250, 600	30-20,000	+46 DB	LS-5	70.00
LS-67	Class B 203A, 838, ZB120, 805	9,000 ohms plate to plate	10000, 2500	30-20,000	+46 DB	LS-5	70.00
LS-69	Class B 849, 204A	10,500 ohms plate to plate	6000, 5000, 4000, 1800, 1500, 1000	30-20,000	+52 DB	LS-6*	200.00
LS-169	Push pull parallel 849's class B or six push pull parallel 204A's	5,250 ohms plate to plate	5000, 4200, 3300, 1500, 1250, 830	30-20,000	+55 DB	LS-7*	400.00

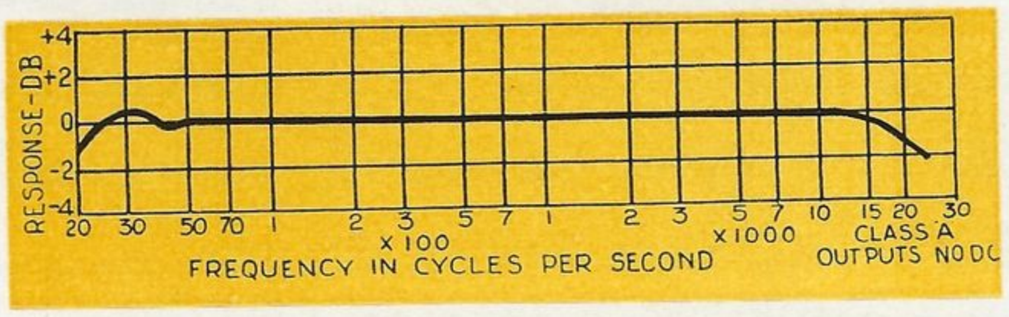
* oil filled

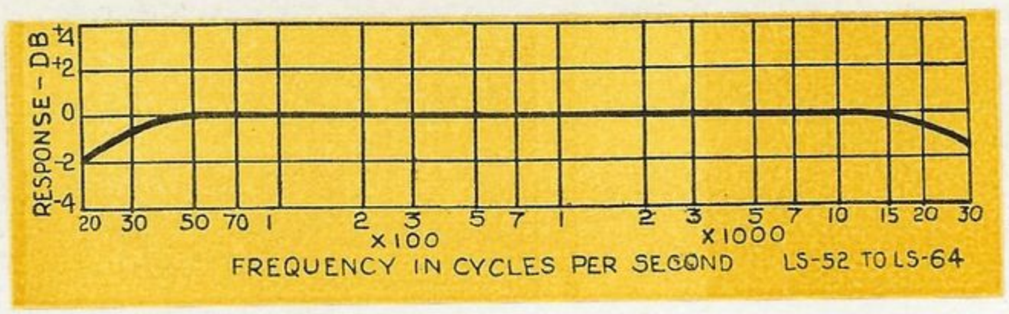
The values of unbalanced DC shown will effect approximately 1.5 DB additional loss at 30 cycles.

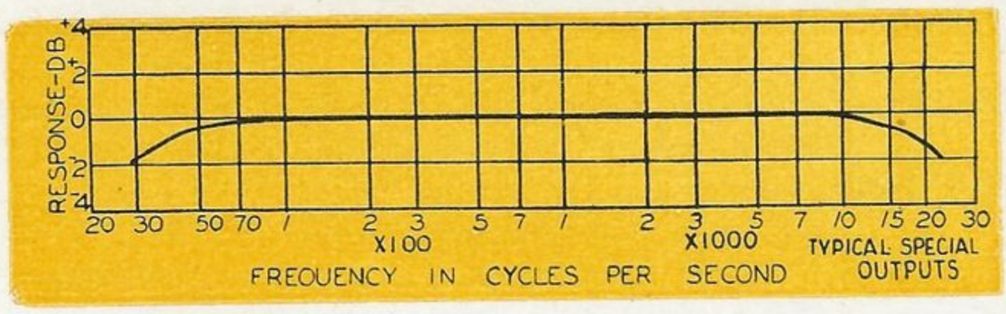
OUTPUT TRANSFORMERS TO LINE AND VOICE COIL

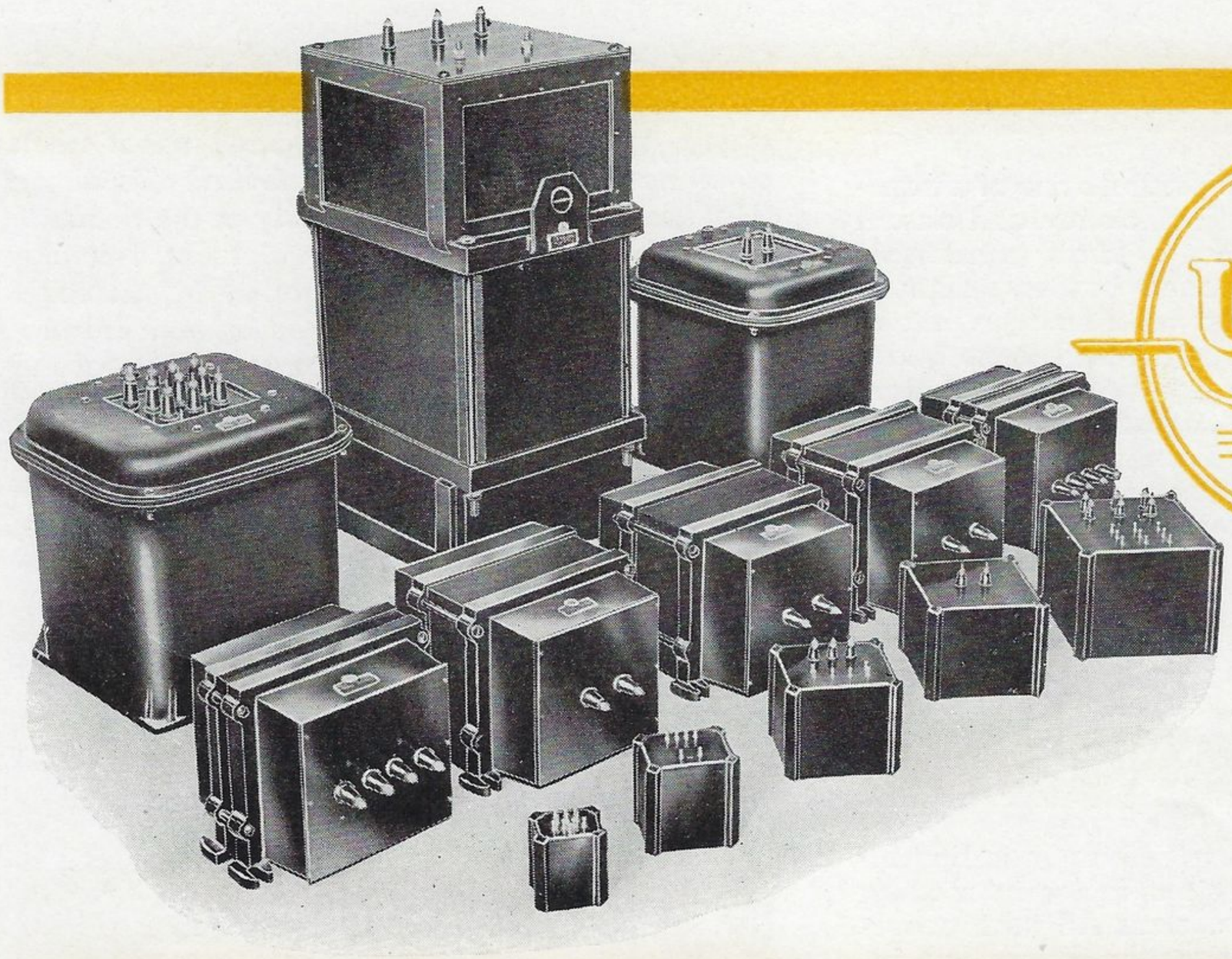
Type No.	Primary will match following tubes	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Case No.	List Price
LS-52	Push pull 245, 250, 6V6, 42 or 2A5 A prime	8,000 ohms	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	20.00
LS-54	Same as above	8,000 ohms	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	14.00
LS-55	Push pull 2A3's, 6A5G's, 300A's, 275A's, 6A3's	5,000 ohms plate to plate and 3,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	20.00
LS-57	Same as above	5,000 ohms plate to plate and 3,000 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	14.00
LS-58	Push pull parallel 2A3's, 6A5G's, 300A's, 6A3's	2,500 ohms plate to plate and 1,500 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+39 DB	LS-4	30.00
LS-61	Push pull 6B5, 6A6, 53, 6F6, 71A, 59, 79, 89, class B46, 59's	10,000 ohms plate to plate and 6,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	20.00
LS-63	Same as above	10,000 ohms plate to plate and 6,000 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	14.00
LS-64	Push pull 845's class A	18,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+39 DB	LS-4	35.00
LS-2451	Push pull 45's A prime, class B 46's-59's, 48's, 25L6's	6,000 ohms plate to plate and 3,500 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+36 DB	LS-2	20.00
LS-6L1	Push pull 6L6's self bias, incorporates tertiary winding for stabilized feed back	6,600 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+38 DB	LS-3	30.00
LS-6L3	Same as above	6,600 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+38 DB	LS-3	20.00
LS-6L4	Push pull 6L6's fixed bias or push pull parallel 6L6's self bias with tertiary winding for stabilized feed back	3,800 ohms plate to plate and 3,300 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+40 DB	LS-4	35.00
LS-845	845 tubes class AB	8,800 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	30-20,000	+42 DB	LS-5	50.00











LINEAR STANDARD POWER EQUIPMENT

When a commercial organization purchases components for broadcast or other communications equipment, the first factor which must be considered is the dependability of the apparatus. A two hour shut-down on a broadcast schedule may be worth many times the cost of an inferior component used. Since the actual functional operation of broadcast and similar equipment is greatly dependent upon the transformers used, considerable care should be taken in the choice of these units.

TEMPERATURE RISE

A conservatively designed transformer should not have a temperature rise exceeding 40 to 55 degrees Centigrade above ambient temperature. This is due to the danger of injury to the coil insulation when exposed to final temperatures of 85 degrees and above. Figure 1 illustrates the effective temperature rise obtained, as compared to the radiating surface and losses, of a power transformer. It is apparent from this that it is not only the size of a transformer, but also the efficiency as compared to the size, which controls the final temperature rise. In view of this, UTC power transformers employ the finest silicon steel and compact windings of high efficiency. To effect a high heat radiation coefficient all power components are given a dull black finish.

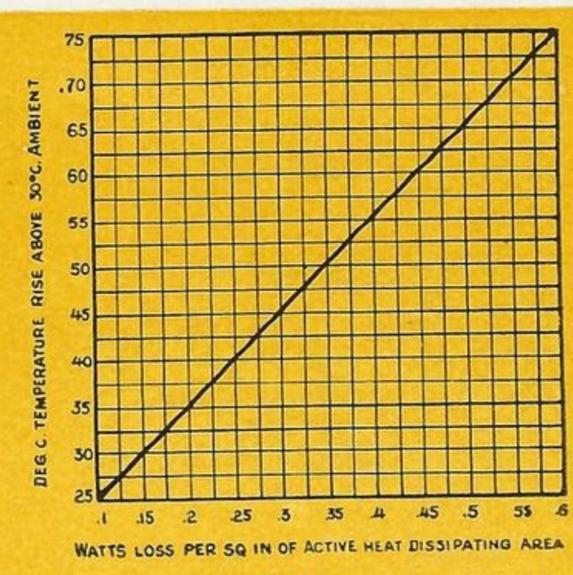


FIG. 1

LOSSES—EFFICIENCY

As stated above, the temperature rise of a transformer is related with both efficiency and size. It is frequently assumed that a large transformer will be superior from the angle of loss, efficiency and heating, as compared to a smaller unit of equivalent rating. This is not true if large quantities of material are coupled with poor design. A large quantity of steel operated at the same flux density as a smaller quantity will result in an iron loss directly proportional to the bulk of the cores. Similarly, the larger bulk of copper used may have higher losses. Care has been taken in all UTC designs to obtain the optimum ratios so that greatest efficiency and safety factor are obtained.

REGULATION

The regulation of plate transformers is becoming an exceedingly important factor in modern amplifiers using class B or class AB tube operation. A low temperature rise transformer will inherently have good regulation. In addition to this, the ratio of copper to steel in UTC plate and power transformers is such that the transformer resistance and leakage reactance is kept at a very low value. The regulation of all power transformers over 1,000 watts is better than 5%. The increase is only slight in units below this power rating.

INSULATION

The insulation used in power transformer equipment must have a high safety factor, taking into consideration the most severe conditions which may be encountered in service. As previously stated, temperature has a decided effect upon most insulating materials. To obviate this effect, UTC uses mica almost exclusively at the points of high voltage stress in power equipment. This material while costly, is unequalled in dielectric strength, is practically unaffected by temperature, and is impervious to the injurious effects of the ozone caused by high voltage corona. All UTC power equipment is given a 24-hour vacuum-baking cycle with the coils thoroughly impregnated with a moisture-proof insulating varnish. In addition to the impregnating process, most smaller power components are poured in a complete enclosing casting with a high heat transfer insulating compound. Due to the large black surface obtained from the enclosing casting, these transformers will generally run cooler encased than as open units.

MECHANICAL CHARACTERISTICS

Within normal limits of weight, UTC transformers are produced in the familiar rectangular black casting which assures a high dissipating area and which can be mounted with lugs on either top or bottom. In the larger units, end castings are used which completely enclose and protect the coil, but which leave the laminations directly exposed to the air to obtain maximum radiation. Both poured and open units are well clamped to prevent vibration.

PLATE TRANSFORMERS

Type No.	Application	Primary Voltage 50/60 cycles	High Voltage	Approximate DC Voltage Out of Filter	DC Current	List Price
LS-181	For push pull 845, 800, etc.	100, 110, 120, 220, 230, 240	1500-1250-0-1250-1500	1250-1050	200 MA	45.00
LS-182	Class B 203, 838, ZB120, etc.	100, 110, 120, 220, 230, 240	1500-1250-0-1250-1500	1250-1050	350 MA	60.00
LS-183	Class B 805 or push pull parallel 203A's, etc.	100, 110, 120, 220, 230, 240	1750-1500-0-1500-1750	1500-1250	400 MA	75.00
LS-184	Class B 204A, 849, HF200, HF300, 250TH, HK354, 100TH, etc.	100, 110, 120, 220, 230, 240	3500-3000-2500-0-2500-3000-3500	3000-2500-2100	500 MA	110.00
LS-185	For combined class B and class C stages as above	100, 110, 120, 220, 230, 240	3500-3000-2500-0-2500-3000-3500	3000-2500-2100	1.2 amp.	250.00
LS-186	Three phase plate transformer for high power class B and class C service	200, 210, 220. Three phase	For full wave rectifier	10,000-7500	1 amp.	600.00

COMBINED PLATE AND FILAMENT TRANSFORMERS

Type No.	Application	Primary Voltage 50/60 cycles	High Voltage	Filament Windings	Case No.	List Price
LS-180	For pre-amplifier service	110	225-0-225 15 MA	6.3 V.C.T.-2A 6.3 V.C.T.-.5A	LS-1	10.00
LS-180H	Same as above but in hum-balanced construction (dual coils symmetrically arranged to neutralize stray fluxes)				LS-1	13.00
LS-190	Low power amplifier and receiver service	100, 105, 110, 115, 120, 125	350-300-0-300-350 125 MA	5 V.C.T.-3A 2.5 V.C.T.-6A 6.3 V.C.T.-3A	LS-3	18.00
LS-190H	Same as above but in hum-balanced construction (dual coils symmetrically arranged to neutralize stray fluxes)				LS-3	25.00
LS-191	Oscillograph and low power amplifiers	100, 105, 110, 115, 120, 125	325-250-0-250-325 35 MA	5 V.C.T.-3A 2.5 V.C.T.-2A 6.3 V.C.T.-2A	LS-2	15.00
LS-70	High power amplifier service	100, 105, 110, 115, 120, 125	425-375-0-375-425 200 MA	5 V.C.T.-3A 2.5 V.C.T.-3A 2.5 V.C.T.-10A 6.3 V.C.T.-1A 6.3 V.C.T.-3A	LS-4	25.00
LS-72	For fixed or self bias 6L6's, 300A's	100, 105, 110, 115, 120, 125	525-450-0-450-525 250 MA 70-0-70 50 MA	5 V.C.T.-3A 2.5 V.C.T.-3A 2.5 V.C.T.-3A 6.3 V.C.T.-1A 6.3 V.C.T.-3A tapped at 5 V.C.T.-6A	LS-4	25.00
LS-73	For push pull parallel 6L6's, 300A's, 2A3's	100, 105, 110, 115, 120, 125	500-400-0-400-500 500 MA 70-0-70 50 MA	5 V.C.T.-6A 2.5 V.C.T.-10A 2.5 V.C.T.-3A 6.3 V.C.T.-4A 6.3 V.C.T.-6A tapped at 5 V.C.T.-6A	LS-5	35.00

FILAMENT TRANSFORMERS

Type No.	Application	Primary Voltage 50/60 Cycles	Secondary Voltage	Insulation Voltage	Case No.	List Price
LS-80	866 rectifiers	100, 110, 120, 220, 230, 240	2.5 V.C.T.-10A	12,000	LS-3	15.00
LS-82	872 rectifiers	100, 110, 120, 220, 230, 240	5 V.C.T.-20A	12,000	LS-3	20.00
LS-84	203A, 845, etc. HF200, HF300	100, 110, 120, 220, 230, 240	10 V.C.T.-8A	12,000	LS-3	15.00
LS-85	Combined filament transformer for 866 rectifiers and 845 or 203A audio tubes	100, 110, 120, 220, 230, 240	2.5 V.C.T.-10A 10 V.C.T.-8A	10,000	LS-3	25.00
LS-88	6.3 volt tubes	105, 115, 125	6.3 V.C.T.-2A	2,500	LS-1	7.50
LS-87A	7.5 volt tubes	105, 115, 125	7.5 V.C.T.-9A	2,500	LS-3	17.50
LS-118	849, 204A, HF300	100, 110, 120, 220, 230, 240	11 V.C.T.-10A	2,500	LS-3	20.00
LS-120	866 bridge rectifier	100, 110, 120, 220, 230, 240	2.5 V.C.T.-10A 2.5 V.C.T.-5A 2.5 V.C.T.-5A	12,000	LS-3	25.00
LS-121	872 bridge rectifier	100, 110, 120, 220, 230, 240	5 V.C.T.-20A 5 V.C.T.-10A 5 V.C.T.-10A	12,000	LS-4	35.00
LS-83	872A, 575 or 869 rectifiers	100, 110, 120, 220, 230, 240	5 V.C.T.-20A	35,000	Spec.	40.00
LS-89A	Three 869 rectifiers	100, 110, 120, 220, 230, 240	5 V.C.T.-60A	35,000	Spec.	50.00

POWER SUPPLY FILTERS

All broadcast equipment developed during the past few years is of the AC operated type. This has naturally brought up the problem of hum from the power supplies used for plate voltage supply. Since in a rectifying system the attenuation of all frequencies is desired, a low pass filter is used which theoretically should have a cutoff point at zero frequency. Unfortunately this is not obtainable in practice. For practical purpose, the magnitude of the reactors and capacitors used must be governed by the actual minimum requirements of the rectifier service. Figure 1 illustrates a chart which is ideal for computation of the approximate ripple using a choke input filter. The application of this chart is apparent.

It is important to remember that the ripple frequency of a 60 cycle single phase power supply is 120 cycles. If a three phase rectifier is used, this frequency is 180 cycles. In most cases, the attenuation of higher harmonics by the power supply filter is very great, and consequently the total ripple can be taken as the effective ripple from the fundamental frequency.

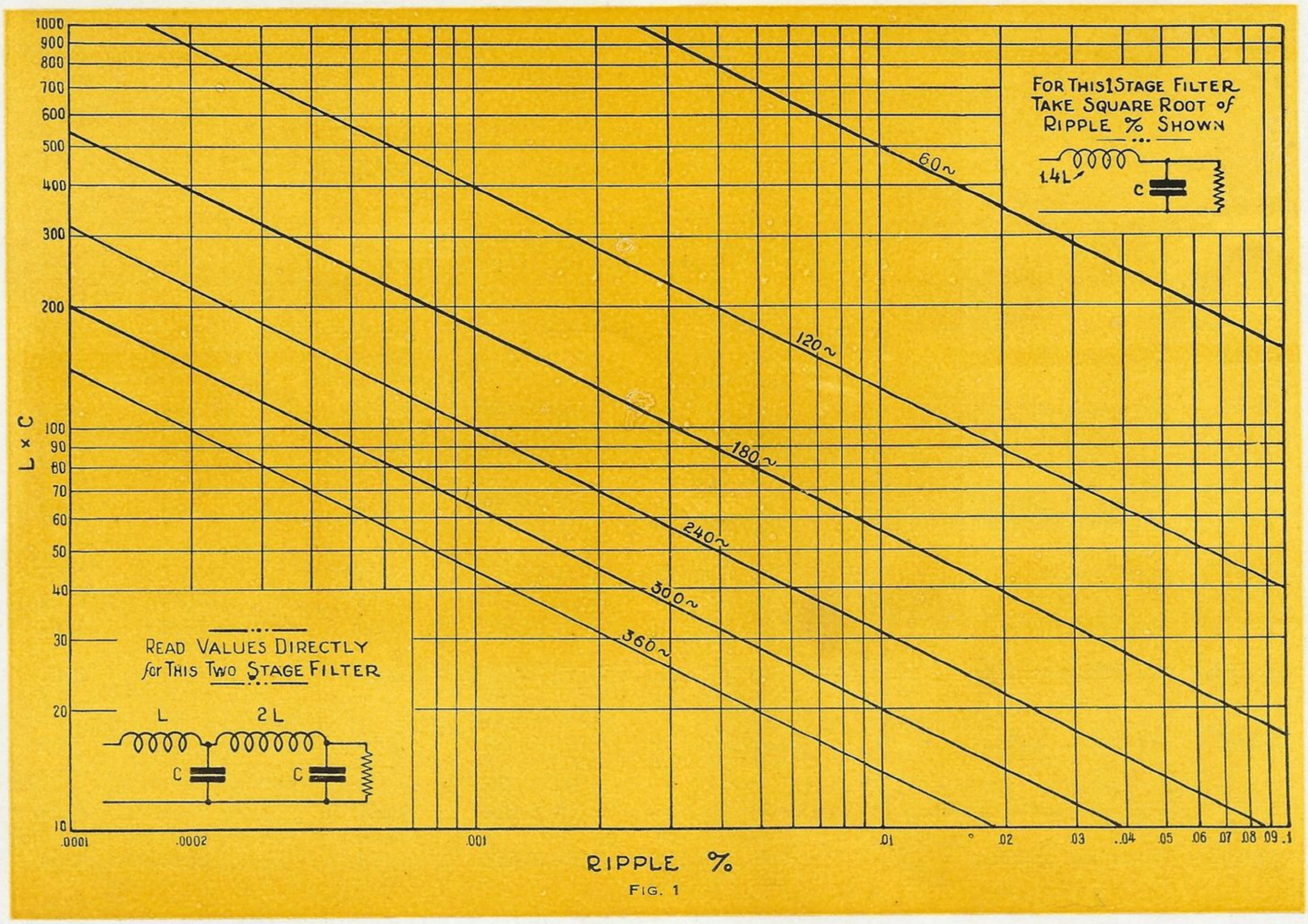
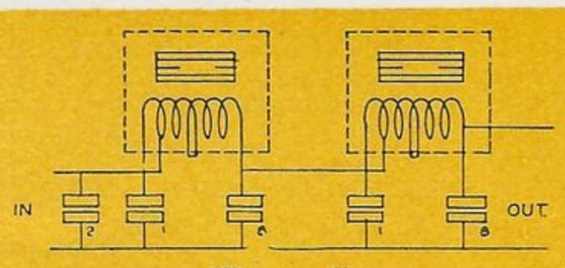


FIG. 1

RESONANT CIRCUITS

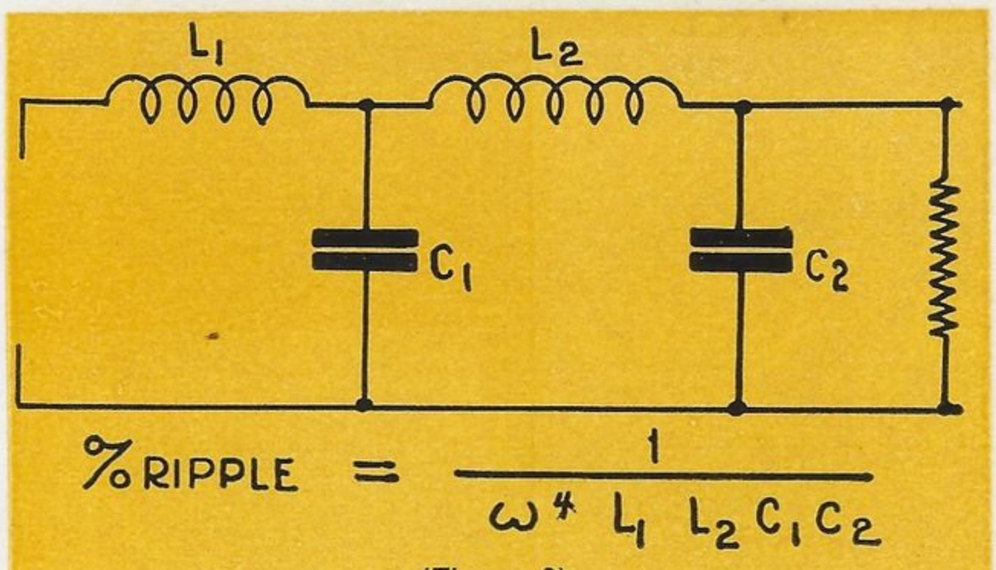
To improve the filtering efficiency, resonant or hum bucking circuits are sometimes used. The most practical device of this nature is the UTC hum bucking choke which is available in a number of standard ratings. In typical rectifiers, the use of hum bucking chokes will increase the filter efficiency four times as compared to an equivalent amount of inductance and capacity in a standard filter. Figure 4 illustrates a typical hum bucking circuit using condenser input. If a choke input filter is used, the first choke should not be used hum bucking.



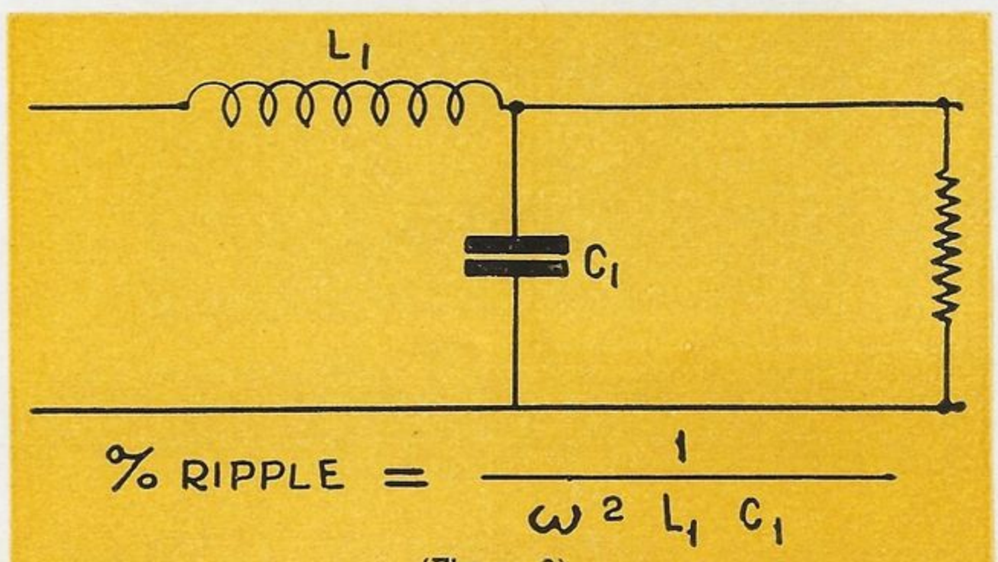
(Figure 4)

CAUTIONS

It is important in the use of Figure 1 that the actual inductance value under operating conditions be known. The inductance of filter chokes varies appreciably with DC, and many contemporary units have been found overrated, being rated without the normal DC through the winding. Curves are shown below on a number of typical UTC units to illustrate the variation of effective inductance with saturating DC.



(Figure 2)



(Figure 3)

FILTER, SWINGING, AND AUDIO CHOKES

Type No.	Application	Inductance	DC Current	DC Resistance	Insulation Voltage	Case No.	List Price
LS-90	Filter choke with hum bucking tap	Series-50 hy Parallel-12.5 hy	50 MA 100 MA	510 ohms 128 ohms	2000	LS-2	8.50
LS-91	Filter choke with hum bucking tap	Series-14 hy Parallel-3.5 hy	125 MA 250 MA	200 ohms 50 ohms	2000	LS-2	8.50
LS-92	Filter choke with hum bucking tap	Series-16 hy Parallel-4 hy	175 MA 350 MA	96 ohms 24 ohms	2500	LS-3	15.00
LS-93	Filter choke with hum bucking tap	Series-26 hy Parallel-6.25 hy	200 MA 400 MA	112 ohms 28 ohms	3500	LS-4	25.00
LS-97	Swinging choke	8-40 hy	200 MA	100 ohms	2500	LS-3	15.00
LS-980	Filter choke with hum bucking tap	Series-14 hy Parallel-3.5 hy	400 MA 800 MA	90 ohms 22.5 ohms	5000	LS-4	25.00
LS-98	Swinging choke	8-40 hy	400 MA	90 ohms	5000	LS-4	25.00
LS-96	Filter choke with hum bucking tap	Series-20 hy Parallel-5 hy	500 MA 1 amp	90 ohms 22.5 ohms	7500	LS-5	40.00
LS-94	Parallel feed and filter choke	Series-320 hy Parallel-80 hy	3 MA 6 MA	6400 ohms 1600 ohms	1000	LS-1	10.00
LS-95	Parallel feed and filter choke	Series-720 hy Parallel-180 hy	5 MA 10 MA	3600 ohms 900 ohms	1000	LS-2	20.00
LS-950	Filter choke with hum bucking tap	Series 100 hy Parallel-25 hy	35 MA 75 MA	1000 ohms 250 ohms	1500	LS-2	10.00
LS-99	Filter choke with hum bucking tap	Series-20 hy Parallel-5 hy	1 amp 2 amp	50 ohms 12.5 ohms	10000	Spec.	60.00
LS-105	Swinging choke	8-40 hy	1 amp	50 ohms	10000	Spec.	60.00
LS-1110	Filter choke with hum bucking tap	Series-20 hy Parallel-5 hy	350 MA 700 MA	80 ohms 20 ohms	5000	LS-5	32.00
LS-1120	Filter choke with hum bucking tap	Series-12 hy Parallel-3 hy	700 MA 1.4 amp	65 ohms 16 ohms	7500	Spec.	40.00

MODULATION REACTORS

Type No.	Application	Inductance	DC Current	DC Resistance	Insulation Voltage	Case No.	List Price
LS-101	Modulation reactor	50 hy	175 MA	350 ohms	5000	LS-4	25.00
LS-102	Modulation reactor	50 hy	350 MA	250 ohms	5000	LS-5	40.00
LS-103	Modulation reactor	50 hy	500 MA	175 ohms	7500	Spec.	60.00
LS-104A	Modulation reactor	50 hy	1.3 amp	75 ohms	20000	Spec.	300.00

OVERALL DIMENSIONS

H1 Case 1 7/8 x 2 3/8 x 3
H2 Case 2 3/8 x 3 x 3 3/4

MOUNTING DIMENSIONS

H1 1 3/8
H2 1 11/16 x 2 3/8

HIPERM ALLOY TRANSFORMERS

The UTC Hiperm alloy audio and power transformers are specifically designed for portable and compact service. While light in weight and small in dimensions, neither dependability nor fidelity has been sacrificed. The frequency characteristic of the Hiperm alloy audio units is uniform from 30 to 20,000 cycles. These units are similar in general design and characteristics to the Linear Standard audio units, and incorporate a Hiperm alloy nickel iron core. The outer case is of high conductivity alloy finished in high polish black enamel. Through the use of tapped metallic inserts, these transformers can be mounted with the terminals either up or down, and with no waste space. A hum balanced coil structure is used on all audio units to insure minimum pickup. The electrostatic shields are brought out to separate terminals on the terminal strip.

LOW IMPEDANCE TO GRID AND MIXING TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Max. Unbal. DC in prim'y	Case No.	List Price
HA-100	Low impedance mike, pickup, or multiple line to grid	50, 125, 200, 250, 333, 500 ohms	60,000 ohms in two sections	30-20,000	+22 DB	5 MA	H-1	12.50
HA-100X	Same as above but with tri-alloy internal shield to effect very low hum pickup.						H-1	17.50
HA-101	Low impedance mike, pickup, or multiple line to push pull grids	50, 125, 200, 250, 333, 500 ohms	120,000 ohms overall, in two sections	30-20,000	+22 DB	5 MA	H-1	15.00
HA-101X	Same as above but with tri-alloy internal shield to effect very low hum pickup.						H-2	20.00
HA-103A	Low impedance mike, pickup, or parallel mixer to grid	2.5, 5.5, 10, 15, 22, 30, 38, 60 ohms	60,000 ohms in two sections	30-20,000	+22 DB	5 MA	H-1	15.00
HA-108	Mixing, low impedance mike, pickup, or multiple line	50, 125, 200, 250, 333, 500 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+22 DB	5 MA	H-1	12.50
HA-108X	Same as above but with tri-alloy internal shield to effect very low hum pickup						H-1	17.50
HA-130X	Three isolated lines or pads to one or two grids with tri-alloy internal shield	30, 50, 200, 250 ohms each primary	60,000 ohms overall, in two sections	30-20,000	+22 DB	5 MA	H-1	20.00

INTERSTAGE AUDIO TRANSFORMERS

Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Max. Unbal. DC in prim'y	Case No.	List Price
HA-105	Single plate to single grid	8,000 to 15,000 ohms	60,000 ohms 2:1 turn ratio	30-20,000	+22 DB	0	H-1	9.00
HA-106	Single plate to push pull grids	8,000 to 15,000 ohms	135,000 ohms 1.5:1 ratio, each side	30-20,000	+22 DB	0	H-1	11.00
HA-107	Push pull plates to push pull grids	8,000 to 15,000 ohms	35,000 ohms eachsecondary 1.5:1 turn ratio overall	30-20,000	+25 DB	1 MA	H-2	15.00

PLATE, CRYSTAL, AND PHOTOCELL TO LINE TRANSFORMERS

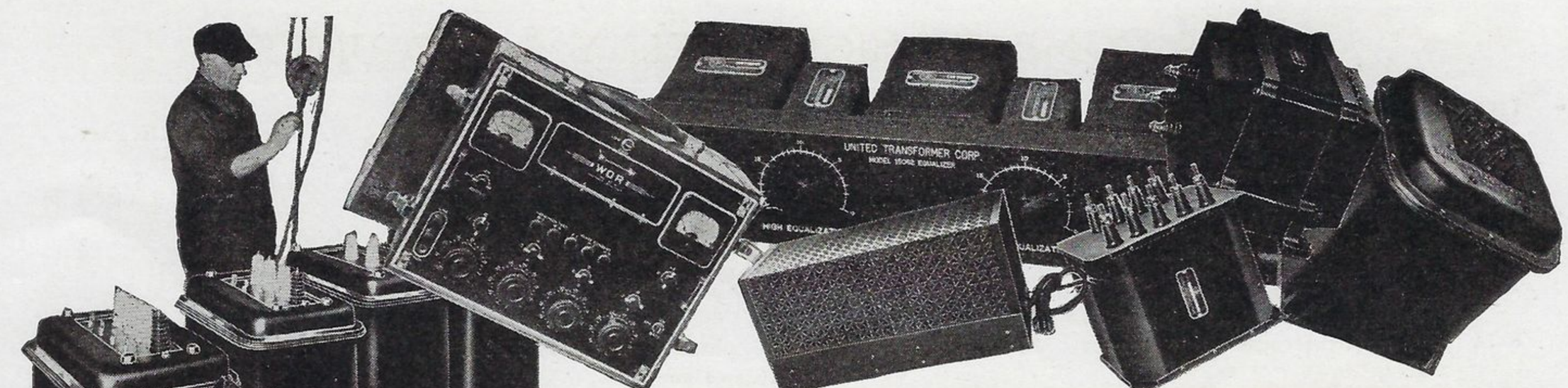
Type No.	Application	Primary Impedance	Secondary Impedance	± 1 db from	Max. Level	Max. Unbalanced DC in Primary	Case No.	List Price
HA-111	Crystal microphone or pickup, to multiple line	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000 measured with resistive load	+20 DB	0	H-1	12.50
HA-111E	Crystal microphone or pickup, to multiple line, with internal equalizer	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	Equalized to correct for crystal matching	+20 DB	0	H-1	17.50
HA-112	Photocell, high-mu triode, diode or overbiased detector to multiple line	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+22 DB	.2 MA	HA-1	12.50
HA-113	Single plate to multiple line	8,000 to 15,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+22 DB	1 MA	HA-1	12.50
HA-114	Push pull low level plates to multiple line	8,000 to 15,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+22 DB	1 MA	HA-1	12.50

POWER TRANSFORMERS

Type No.	Application	Primary Voltage 50/60 cycles	High Voltage	Filament Windings	Case No.	List Price
HP-122	Pre-amp. power supply using 84 rectifier	115	220-0-220 15 MA	6.3 V.C.T.-.5A 6.3 V.C.T.-1.2A	H-2	10.00
HP-123	Pre-amp. or tuner power supply using 84 rectifier	115	275-0-275 35 MA	6.3 V.C.T.-.5A 6.3 V.C.T.-2A	H-3	15.00

FILTER AND AUDIO CHOKES

Type No.	Application	Inductance	DC Current	DC Resistance	Insulation Voltage	Case No.	List Price
HC-115	Parallel feed and filter choke	Series-400 hy Parallel-100 hy	2.5 MA 5 MA	7000 ohms 1750 ohms	1000	H-1	8.50
HC-116	Parallel feed and filter choke	Series-600 hy Parallel-150 hy	8 MA 16 MA	4000 ohms 1000 ohms	1000	H-2	15.00
HC-117	Filter choke with hum bucking tap	60 hy	15 MA	3000 ohms	1000	H-1	8.50
HC-127	Filter choke with hum bucking tap	60 hy	40 MA	1000 ohms	1500	H-2	15.00



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.

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.

Audio equalizers and filters.

Saturable control reactors.

Battery chargers and speaker field exciters.

Rectifiers for broadcast and industrial applications.

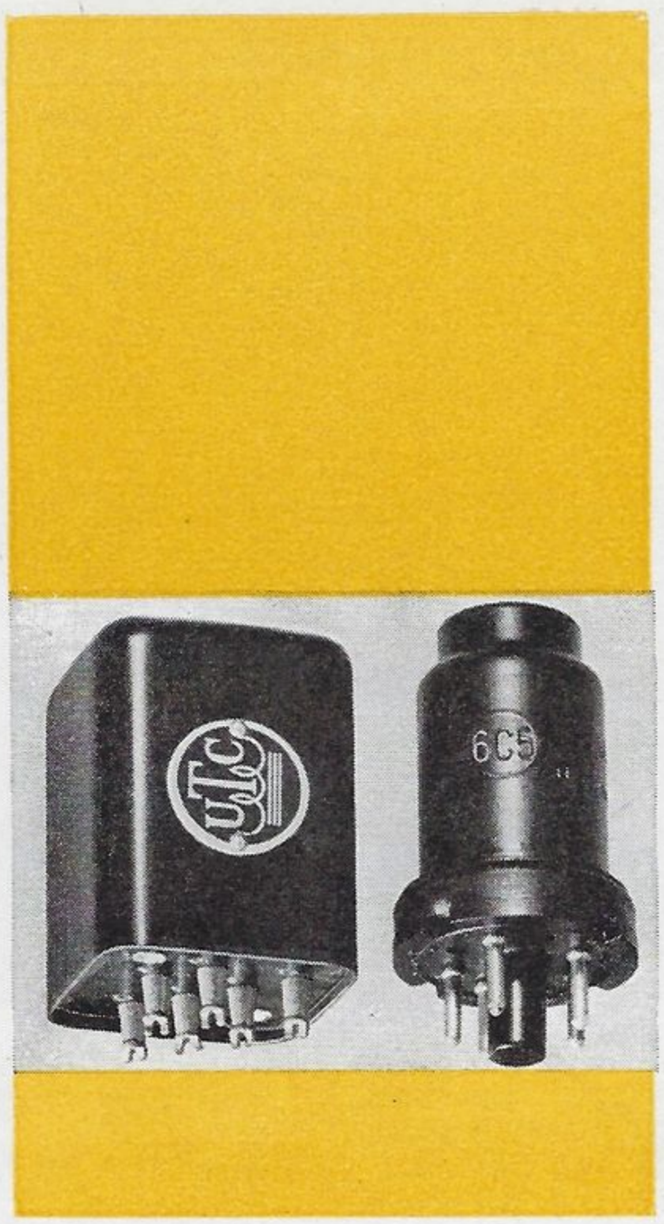
Automatic voltage regulators.

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.



ULTRA COMPACT AUDIO UNITS

The UTC Ultra compact audio units represent the acme in small, light-weight units where portability or size is of paramount importance. Through the use of new design methods, high fidelity is obtainable in all individual units, the frequency response being ± 2 DB from 30 to 20,000 cycles on all units. There is no need to resonate one unit in an amplifier to compensate for the droop of another unit.

All units employ true hum balancing coil structure, which combined with a high conductivity outer case, afford a maximum of inductive shielding.

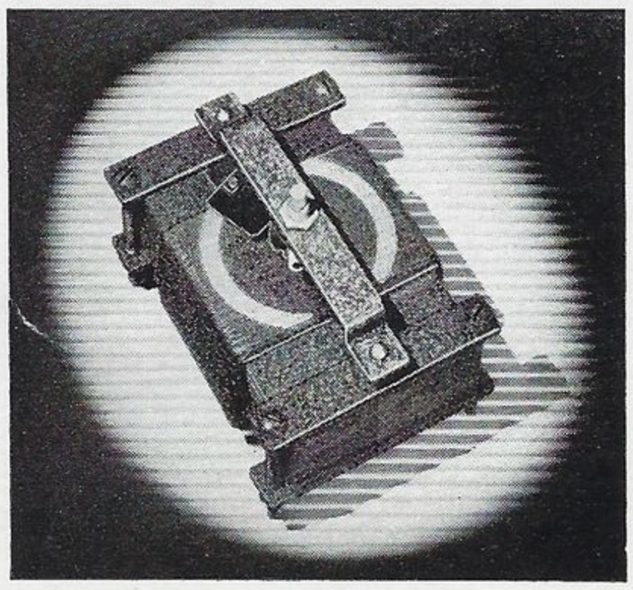
Ultra compact audio units weigh only 5½ ounces and have overall dimensions of 1 7/16" x 1 7/16" x 1 15/16". Mounting dimensions are 1⅛" between centers.

ULTRA COMPACT HIGH FIDELITY AUDIO UNITS

Type No.	Application	Primary Impedance	Secondary Impedance	± 2 db from	Max. Level	List Price
A-10	Low impedance mike, pickup, or multiple line to grid	50, 125, 200, 250, 333, 500 ohms	50,000 ohms	30-20,000	+20 DB	$10.00
A-12	Low impedance mike, pickup, or multiple line to push pull grids	50, 125, 200, 250, 333, 500 ohms	80,000 ohms overall, in two sections	30-20,000	+20 DB	10.00
A-14	Dynamic microphone to one or two grids	30 ohms	50,000 ohms overall, in two sections	30-20,000	+20 DB	9.00
A-16	Single plate to single grid	8,000 to 15,000 ohms	60,000 ohms, 2:1 turn ratio	30-20,000	+20 DB	8.00
A-18	Single plate to two grids	8,000 to 15,000 ohms	80,000 ohms overall, 2.3:1 turn ratio overall	30-20,000	+20 DB	9.00
A-20	Mixing, low impedance mike, pickup, or multiple line to multiple line	50, 125, 200, 250, 333, 500 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+20 DB	10.00
A-24	Single plate to multiple line	8,000 to 15,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000	+20 DB	10.00
A-26	Push pull low level plates to multiple line	8,000 to 15,000 ohms each side	50, 125, 200, 250, 333, 500 ohms	30-20,000	+21 DB	10.00
A-27	Crystal microphone to multiple line	100,000 ohms	50, 125, 200, 250, 333, 500 ohms	30-20,000 measured with non-inductive source	+20 DB	10.00
A-30	Audio choke, 300 henrys @ 2 MA 6000 ohms D.C., 75 henrys @ 4 MA 1500 ohms D.C., inductance with no D.C. 450 henrys					7.00

UTC VARITRAN CONTROL UNITS

The UTC VARITRAN employs a sliding contact riding over the turns of an auto-transformer winding to effect continuously variable non-interrupted voltage control. A newly developed method of construction is employed in these units, making possible a very compact, simple and rugged structure. Uses for VARITRAN units are limitless, some of the most popular being listed below.



LINE VOLTAGE CONTROL to correct varying line voltage from 80 to 130 volts is obtainable.

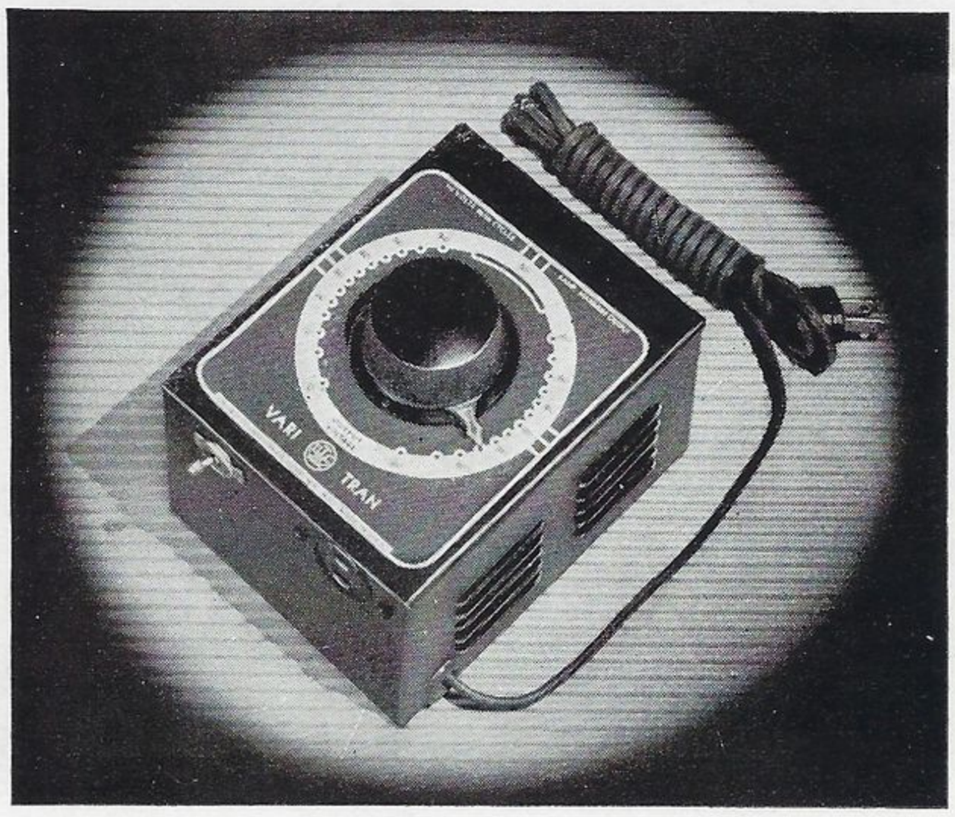
RECTIFIER VOLTAGE CONTROL over a continuous range from zero to maximum voltage without any reduction in regulation can be obtained, using the UTC VARITRAN.

LIGHTING CONTROL of a stepless nature can be obtained with the VARITRAN for the control of lights for theatre dimming, studio lighting, stand-in and printing controls in the photographic field.

MOTOR SPEED CONTROL of an ideal form can be obtained with the VARITRAN due to the smooth starting and fine adjustment possible. Foot operated models are available.

HEATING CONTROL is essential for electric furnaces, welding equipment, soldering irons and other electrical apparatus. This can be obtained accurately and economically with the UTC VARITRAN.

BREAKDOWN TESTING requires a control which does not interrupt the circuit, alter the wave shape, or have abrupt steps in voltage increase. The VARITRAN is ideal for such service.



VARITRAN RATINGS

The standard VARITRAN units are designed for 115 volts, 50 to 60 cycle primary, and have a continuously variable output voltage from zero to 130 volts. The secondary rating is at 115 volts. The current at lower voltages cannot be increased. In other words, the 570 watt VARITRAN is designed to control the voltage to any low which draws a maximum of 5 amps at 115 volts.

Model V-1, 570 watts—5 amp. maximum rating, complete with cord, plug and switch, net **$10.00**

Model V-2, same as V-1, but uncased, with terminal strip for rack or panel mounting, net **$9.00**

Model V-3, 850 watts maximum rating, 7.5 amps, uncased, with terminal board and provisions for mounting, net **$14.00**

Model V-4, 1250 watts,—11 amps. maximum rating, uncased, net **$20.00**

Model V-5, 2000 watts maximum rating, 17.5 amps, uncased, net **$32.00**

Other sizes of VARITRANS are available in both 220 and 110 volt models up to 50 KVA.

AUTOMATIC VOLTAGE REGULATORS

UTC manufactures a number of types of automatic voltage regulators for various applications. In one type, a VARITRAN control with a motor drive is incorporated, using a voltage sensitive device to operate the motor. Other units are available which do not incorporate mechanical parts. Designs are available in ratings of .5, 1, 2, 5, 7.5, 10, 15 and 25 KVA.

For additional information write to the UTC Engineering Staff, giving full details as to the application and degree of control necessary.

UTC VARIACTORS

There are many applications in the broadcast and communications field where a saturable reactor can be applied to rectifier or other circuits for improvement of regulation or voltage control. UTC VARIACTORS are designed to customers' specifications and can be manufactured to take care of practically every rectifier requirement.

Fig. 1 illustrates the appearance of a saturable reactor and Fig. 2 its application to a typical rectifier circuit.

As the DC load increases in an ordinary rectifier, the output voltage will drop due to the voltage drop in the transformer and filter circuits. Using a VARIACTOR the increase in DC can be employed to saturate the AC reactance which is in series with the rectifier transformer primary, with the result that the voltage at the output of the filter can be maintained constant or even increased if desired, with increasing load.

Approximate prices for VARIACTORS as applied to power supply rectifiers to improve regulation are noted below:

SV-1—For power supplies from 50 to 100 watts (designed to application) ..... Net **$20.00**

SV-2—For power supplies from 125 to 250 watts (designed to application) ..... Net **$30.00**

SV-3—For power supplies from 275 to 500 watts (designed to application) ..... Net **$40.00**

SV-4—For power supplies from 600 to 1200 watts (designed to application) ..... Net **$50.00**

SV-5—For power supplies from 1500 to 2500 watts (designed to application) ..... Net **$75.00**

DIMMER REACTORS

Dimmer reactors of the VARIACTOR type are frequently employed for theatre lighting applications or for special photographic applications where very close and gradual control of light is desired. These units are designed to be used with an external rheostat and an external source of 110 volts DC for the saturating winding (rectifier can be supplied if desired).

DR-1—250 W. dimmer reactor, 120 V. input, output 110 V. to complete blackout ..... Net **$10.00**

DR-2—As above, but 500 W. ..... Net **$17.00**

DR-3—As above, but 1000 W. ..... Net **$25.00**

DR-4—As above, but 2500 W. ..... Net **$45.00**

VARIACTOR TYPE RECTIFIERS

UTC manufactures complete rectifiers both with and without VARIACTOR control for many of the larger communications organizations. Quotations will be furnished when specifications are submitted.

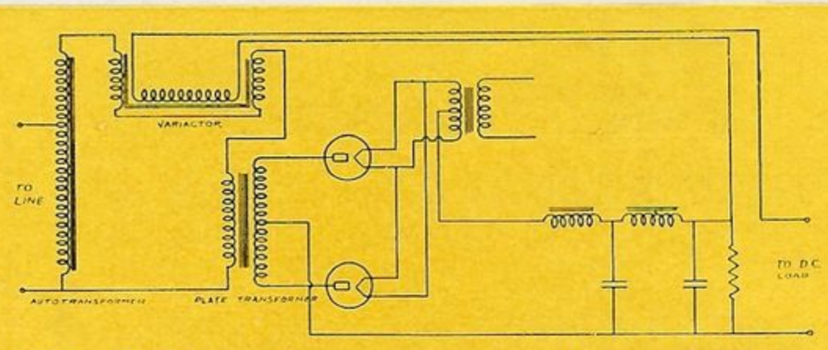


FIG. 2—Autotransformer necessary only if plate transformer has no low voltage taps on primary or higher voltage taps on secondary

VARIACTOR CONTROLLED CARRIER MODULATION

Through the use of special circuits (patents applied for) UTC VARIACTORS can be applied to control the class C input of a final RF stage in a direct ratio to the audio output from the modulator stage with the result that controlled carrier transmission is obtained.

Fig. 3 illustrates the percentage of modulation obtained in ordinary and controlled carrier transmitters at various audio levels.

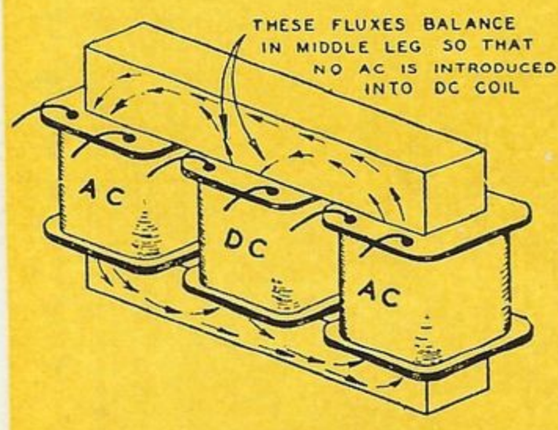


FIG. 1—Appearance of Saturable Reactor

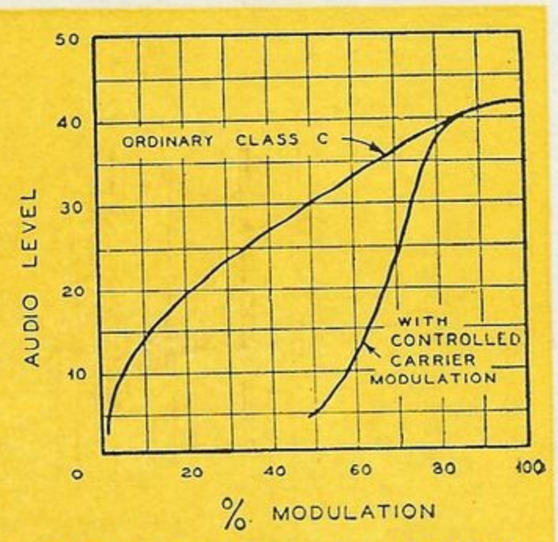


FIG. 3—Percentage of Modulation in Ordinary and Controlled Carrier Transmitters at Various Audio Levels

UTC ENGINEERING CHARTS

Below and on the following pages a number of charts are illustrated which have been used extensively in the UTC Engineering Laboratories. They cover practically the entire gamut of radio engineering problems and should prove of value to all radio engineers.

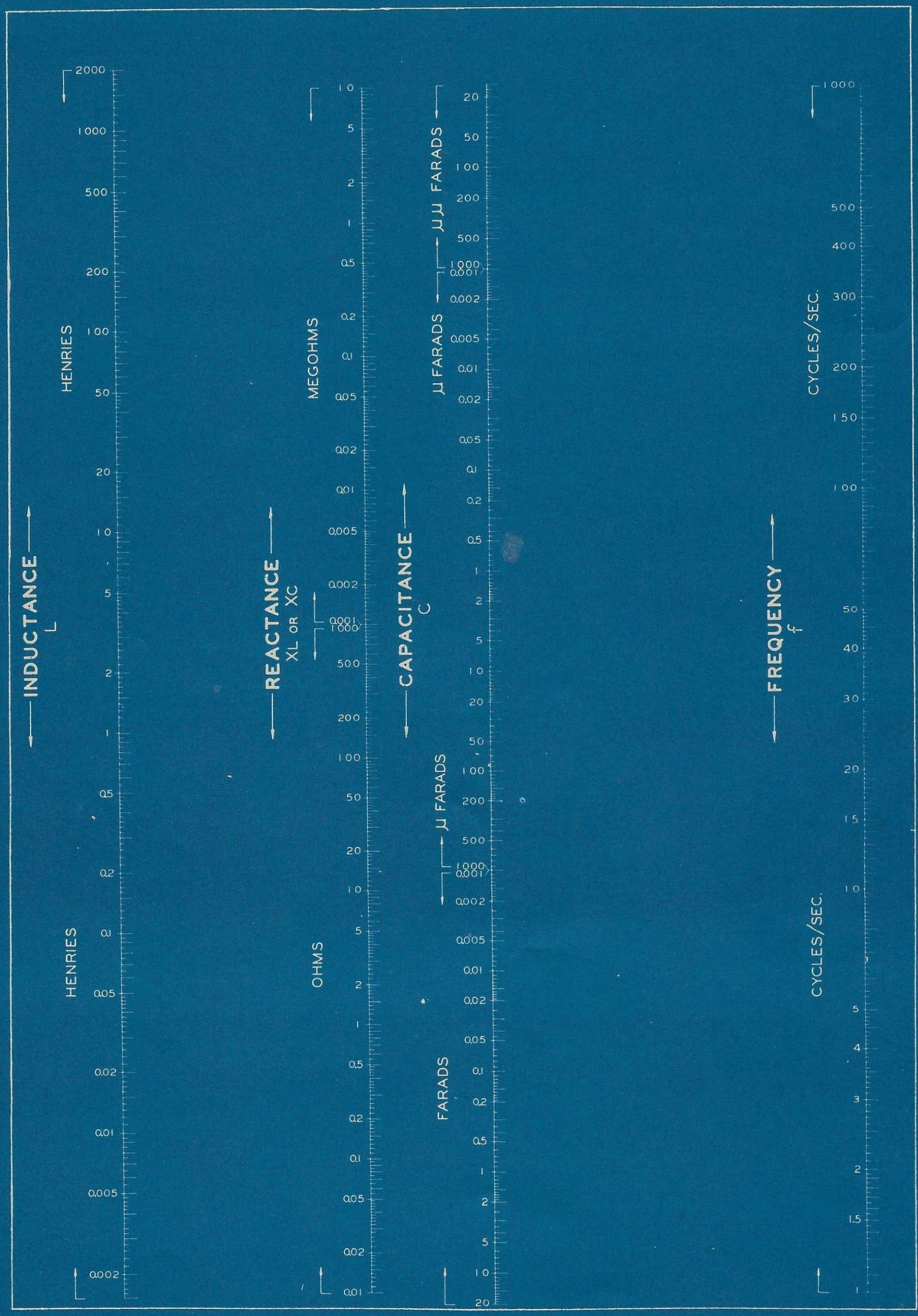
Some of the sources used for these charts are: Brush Development Laboratories, Bryan Davis Publishing Co., Radio, Inc., Hygrade Sylvania.

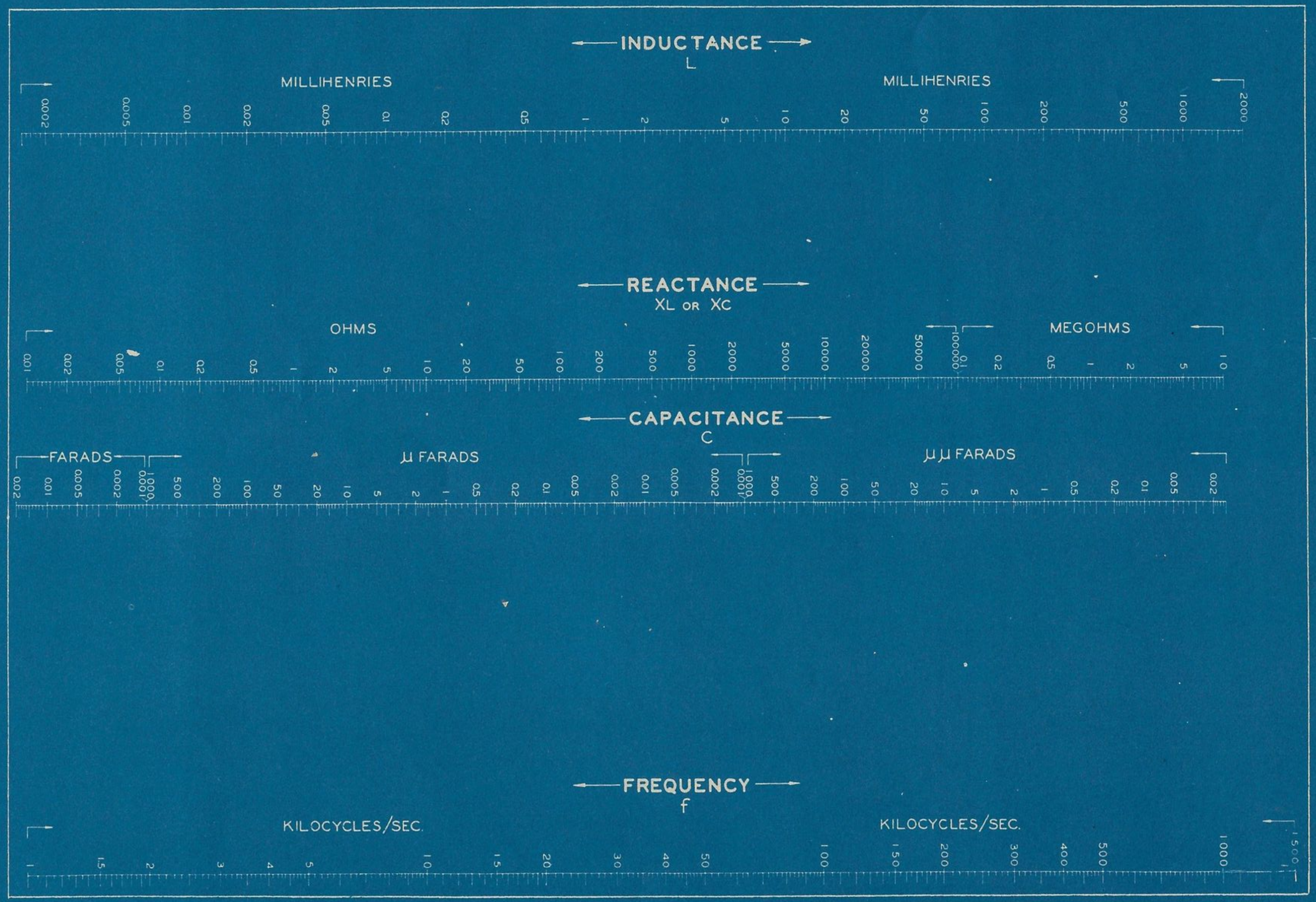
Decibels Versus Watts Output, Levels

D.B.	Watts	D.B.	Watts	D.B.	Watts	D.B.	Watts
—20	0.00006	0	0.006	20	0.600	40	60.00
—19	0.000076	1	0.0076	21	0.759	41	75.90
—18	0.000095	2	0.0095	22	0.948	42	94.87
—17	0.00011	3	0.0119	23	1.185	43	118.59
—16	0.00015	4	0.0153	24	1.518	44	151.8
—14	0.00023	6	0.0237	26	2.371	46	237.18
—13	0.000303	7	0.0305	27	3.036	47	303.60
—12	0.000397	8	0.0380	28	3.795	48	379.50
—11	0.000474	9	0.0474	29	4.743	49	474.37
—10	0.0006	10	0.060	30	6.000	50	600.00
— 9	0.00076	11	0.0759	31	7.590	51	759.00
— 8	0.00095	12	0.0948	32	9.487	52	948.75
— 7	0.00119	13	0.1187	33	11.859	53	1185.94
— 6	0.60152	14	0.1518	34	15.180	54	1518.00
— 5	0.00190	15	0.1898	35	18.975	55	1897.50
— 4	0.00237	16	0.2372	36	23.718	56	2371.88
— 3	0.00303	17	0.3037	37	30.360	57	3036.00
— 2	0.00397	18	0.3795	38	37.950	58	3795.00
— 1	0.00471	19	0.4744	39	47.43	59	4743.75
						60	6000.00

A straight edge across known values in any two columns will locate the corresponding values in the other two columns.

For example, take an inductance of 1 henry at 50 cycles. Locating a straight edge across these points we find that the corresponding reactance is approximately 310 ohms and that the capacity required for resonance is 10 mfd.




INDUCTANCE
L
MILLIHENRIES
0.002
0.005
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
200
500
1000
2000
MILLIHENRIES
REACTANCE
XL OR XC
OHMS
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
200
500
1000
2000
5000
10000
20000
50000
100000
MEGOHMS
0.1
0.2
0.5
1
2
5
10
CAPACITANCE
C
FARADS
1.0
0.001
0.0001
0.002
0.005
0.01
0.02
0.1
0.2
0.5
1
2
5
10
20
50
100
200
500
μ FARADS
0.0001
0.001
0.002
0.005
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
10
20
50
100
200
500
μμ FARADS
FREQUENCY
f
KILOCYCLES/SEC.
1
1.5
2
3
4
5
10
15
20
30
40
50
100
150
200
300
400
500
1000
1500
KILOCYCLES/SEC.

DB VERSUS VOLTAGE, CURRENT AND POWER

Power Ratio	Voltage or Current Ratio	—db+	Voltage or Current Ratio	Power Ratio
10^{-1}		10		10
10^{-2}	10^{-1}	20	10	10^{2}
10^{-3}		30		10^{3}
10^{-4}	10^{-2}	40	10^{2}	10^{4}
10^{-5}		50		10^{5}
10^{-6}	10^{-3}	60	10^{3}	10^{6}
10^{-7}		70		10^{7}
10^{-8}	10^{-4}	80	10^{4}	10^{8}
10^{-9}		90		10^{9}
10^{-10}	10^{-5}	100	10^{5}	10^{10}
1.000	1.000	0	1.00	1.00
.977	.989	.1	1.01	1.02
.955	.977	.2	1.02	1.05
.933	.966	.3	1.04	1.07
.912	.955	.4	1.05	1.10
.891	.944	.5	1.06	1.12
.871	.933	.6	1.07	1.15
.851	.923	.7	1.08	1.18
.832	.912	.8	1.10	1.20
.813	.902	.9	1.11	1.23
.794	.891	1.0	1.12	1.26
.776	.881	1.1	1.14	1.29
.759	.871	1.2	1.15	1.32
.741	.861	1.3	1.16	1.35
.724	.851	1.4	1.18	1.38
.708	.841	1.5	1.19	1.41
.692	.832	1.6	1.20	1.45
.676	.822	1.7	1.22	1.48
.661	.813	1.8	1.23	1.51
.646	.804	1.9	1.25	1.55
.631	.794	2.0	1.26	1.59
.617	.785	2.1	1.27	1.62
.603	.776	2.2	1.29	1.66
.589	.767	2.3	1.30	1.70
.575	.759	2.4	1.32	1.74
.562	.750	2.5	1.33	1.78
.550	.741	2.6	1.35	1.82
.537	.733	2.7	1.37	1.86
.525	.724	2.8	1.38	1.91
.513	.716	2.9	1.40	1.95
.501	.708	3.0	1.41	2.00
.490	.700	3.1	1.43	2.04
.479	.692	3.2	1.45	2.09
.468	.684	3.3	1.46	2.14
.457	.676	3.4	1.48	2.19
.447	.668	3.5	1.50	2.24
.437	.661	3.6	1.51	2.29
.427	.653	3.7	1.53	2.34
.417	.646	3.8	1.55	2.40
.407	.638	3.9	1.57	2.46
.398	.631	4.0	1.59	2.51
.389	.624	4.1	1.60	2.57
.380	.617	4.2	1.62	2.63
.372	.610	4.3	1.64	2.69
.363	.603	4.4	1.66	2.75
.355	.596	4.5	1.68	2.81
.347	.589	4.6	1.70	2.88
.339	.582	4.7	1.72	2.95
.331	.575	4.8	1.74	3.02
.324	.569	4.9	1.76	3.09
.316	.562	5.0	1.78	3.16
.309	.556	5.1	1.80	3.24
.302	.550	5.2	1.82	3.31
.295	.543	5.3	1.84	3.39
.288	.537	5.4	1.86	3.47
.282	.530	5.5	1.88	3.55
.275	.525	5.6	1.91	3.63
.269	.519	5.7	1.93	3.72
.263	.513	5.8	1.95	3.80
.257	.507	5.9	1.97	3.89
.251	.501	6.0	2.00	3.98
.246	.496	6.1	2.02	4.07
.240	.490	6.2	2.04	4.17
.234	.484	6.3	2.07	4.27
.229	.479	6.4	2.09	4.37
.224	.473	6.5	2.11	4.47
.219	.468	6.6	2.14	4.57
.214	.462	6.7	2.16	4.68
.209	.457	6.8	2.19	4.79
.204	.452	6.9	2.21	4.90
.200	.447	7.0	2.24	5.01
.195	.442	7.1	2.27	5.13
.191	.437	7.2	2.29	5.25
.186	.432	7.3	2.32	5.37
.182	.427	7.4	2.34	5.50
.178	.422	7.5	2.37	5.62
.174	.417	7.6	2.40	5.75
.170	.412	7.7	2.43	5.89
.166	.407	7.8	2.46	6.03
.162	.403	7.9	2.48	6.17
.159	.398	8.0	2.51	6.31
.155	.394	8.1	2.54	6.46
.151	.389	8.2	2.57	6.61
.148	.385	8.3	2.60	6.76
.145	.380	8.4	2.63	6.92
.141	.376	8.5	2.66	7.08
.138	.372	8.6	2.69	7.24
.135	.367	8.7	2.72	7.41
.132	.363	8.8	2.75	7.59
.129	.359	8.9	2.79	7.76
.126	.355	9.0	2.82	7.94
.123	.351	9.1	2.85	8.13
.120	.347	9.2	2.88	8.32
.118	.343	9.3	2.92	8.51
.115	.339	9.4	2.95	8.71
.112	.335	9.5	2.99	8.91
.110	.331	9.6	3.02	9.12
.107	.327	9.7	3.06	9.33
.105	.324	9.8	3.09	9.55
.102	.320	9.9	3.13	9.77
.1000	.316	10.0	3.16	10.00
.0977	.313	10.1	3.20	10.23
.0955	.309	10.2	3.24	10.47
.0933	.306	10.3	3.27	10.72
.0912	.302	10.4	3.31	10.96
.0891	.299	10.5	3.35	11.22
.0871	.295	10.6	3.39	11.48
.0851	.292	10.7	3.43	11.75
.0832	.288	10.8	3.47	12.02
.0813	.285	10.9	3.51	12.30
.0794	.282	11.0	3.55	12.59
.0776	.279	11.1	3.59	12.88
.0759	.275	11.2	3.63	13.18
.0741	.272	11.3	3.67	13.49
.0724	.269	11.4	3.72	13.80
.0708	.266	11.5	3.76	14.13
.0691	.263	11.6	3.80	14.45
.0676	.260	11.7	3.85	14.79
.0661	.257	11.8	3.89	15.14
.0646	.254	11.9	3.94	15.49
.0631	.251	12.0	3.98	15.85
.0617	.248	12.1	4.03	16.22
.0603	.246	12.2	4.07	16.60
.0589	.243	12.3	4.12	16.98
.0575	.240	12.4	4.17	17.38
.0562	.237	12.5	4.22	17.78
.0550	.234	12.6	4.27	18.20
.0537	.232	12.7	4.32	18.62
.0525	.229	12.8	4.37	19.05
.0513	.227	12.9	4.42	19.50
.0501	.224	13.0	4.47	19.95
.0490	.221	13.1	4.52	20.42
.0479	.219	13.2	4.57	20.89
.0468	.216	13.3	4.62	21.38
.0457	.214	13.4	4.68	21.88
.0447	.211	13.5	4.73	22.39
.0437	.209	13.6	4.79	22.91
.0427	.207	13.7	4.84	23.44
.0417	.204	13.8	4.90	23.99
.0407	.202	13.9	4.96	24.55
.0398	.200	14.0	5.01	25.12
.0389	.197	14.1	5.07	25.70
.0380	.195	14.2	5.13	26.30
.0372	.193	14.3	5.19	26.92
.0363	.191	14.4	5.25	27.54
.0355	.188	14.5	5.31	28.18
.0347	.186	14.6	5.37	28.84
.0339	.184	14.7	5.43	29.51
.0331	.182	14.8	5.50	30.20
.0324	.180	14.9	5.56	30.90
.0316	.178	15.0	5.62	31.62
.0309	.176	15.1	5.69	32.36
.0302	.174	15.2	5.75	33.11
.0295	.172	15.3	5.82	33.88
.0288	.170	15.4	5.89	34.67
.0282	.168	15.5	5.96	35.48
.0275	.166	15.6	6.03	36.31
.0269	.164	15.7	6.10	37.15
.0263	.162	15.8	6.17	38.02
.0257	.160	15.9	6.24	38.90
.0251	.159	16.0	6.31	39.81
.0246	.157	16.1	6.38	40.74
.0240	.155	16.2	6.46	41.69
.0234	.153	16.3	6.53	42.66
.0229	.151	16.4	6.61	43.65
.0224	.150	16.5	6.68	44.67
.0219	.148	16.6	6.76	45.71
.0214	.146	16.7	6.84	46.77
.0209	.145	16.8	6.92	47.86
.0204	.143	16.9	7.00	48.98
.0200	.141	17.0	7.08	50.12
.0195	.140	17.1	7.16	51.29
.0191	.138	17.2	7.24	52.48
.0186	.137	17.3	7.33	53.70
.0182	.135	17.4	7.41	54.95
.0178	.133	17.5	7.50	56.23
.0174	.132	17.6	7.59	57.54
.0170	.130	17.7	7.67	58.88
.0166	.129	17.8	7.76	60.26
.0162	.127	17.9	7.85	61.66
.0159	.126	18.0	7.94	63.10
.0155	.125	18.1	8.04	64.57
.0151	.123	18.2	8.13	66.07
.0148	.122	18.3	8.22	67.61
.0145	.120	18.4	8.32	69.18
.0141	.119	18.5	8.41	70.79
.0138	.118	18.6	8.51	72.44
.0135	.116	18.7	8.61	74.13
.0132	.115	18.8	8.71	75.86
.0129	.114	18.9	8.81	77.62
0126	.112	19.0	8.91	79.43
.0123	.111	19.1	9.02	81.28
.0120	.110	19.2	9.12	83.18
.0118	.108	19.3	9.23	85.11
.0115	.107	19.4	9.33	87.10
.0112	.106	19.5	9.44	89.13
.0110	.105	19.6	9.55	91.20
.0107	.104	19.7	9.66	93.33
.0105	.102	19.8	9.77	95.50
.0102	.101	19.9	9.89	97.72
.0100	.100	20.0	10.00	100.00

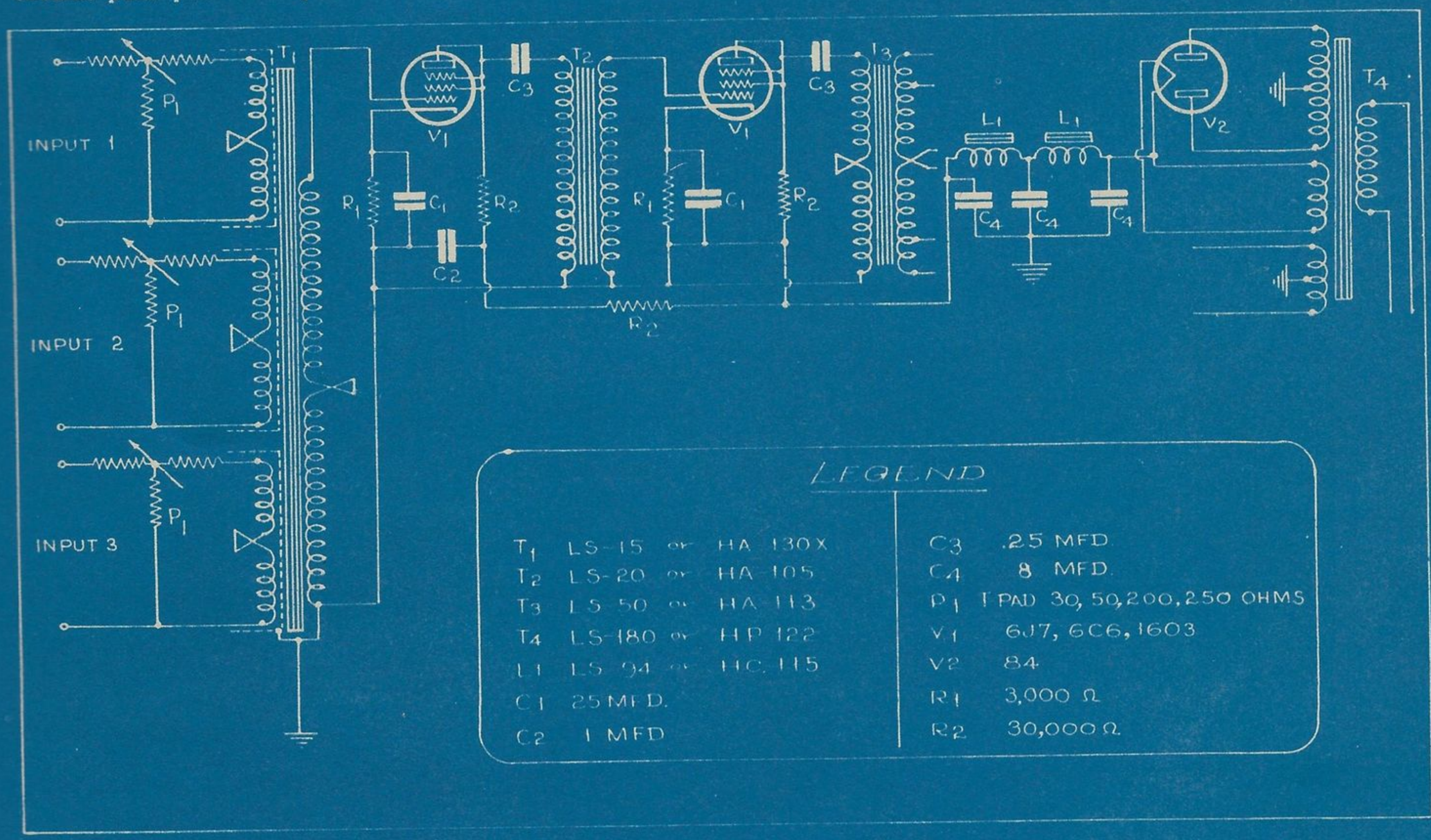
UTC AMPLIFIER CIRCUITS

The amplifier circuits illustrated below and on the following pages are conservative and of tried and proven nature. They are intended to illustrate typical modern amplifier practice rather than for exact duplication. For this reason metering circuits and equipment have been omitted as well as other minor modifications which depend upon the application and type of installation desired.

Two common features will be found in the power amplifier circuits; push pull tube operation, and adjustable bias for the individual output tubes. Both of these factors are designed to keep hum at a minimum and reduce amplitude distortion.

Circuits for high power modulators ranging from 2.5 to 50 KW are available upon application. Full details as to tubes preferred and general specifications should be submitted when requesting these circuits.

Write to the UTC amplifier division if you have an amplifie problem not covered by the circuits shown.



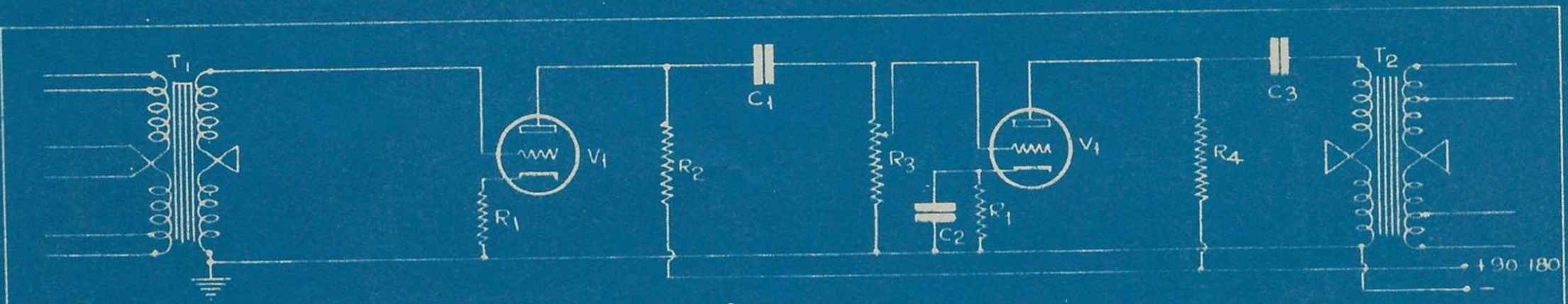
LEGEND

T_1	LS-15 or HA 130X	C_3	.25 MFD.
T_2	LS-20 or HA 105	C_4	8 MFD.
T_3	LS 50 or HA 113	P_1	PAD 30, 50, 200, 250 OHMS
T_4	LS-180 or HP 122	V_1	6J7, 6C6, 1603
L_1	LS 94 or HC 115	V_2	84
C_1	25 MFD.	R_1	3,000 Ω
C_2	1 MFD	R_2	30,000 Ω

A. C. PRE-AMPLIFIER-MIXER

GENERAL DETAILS

1. Three channel isolated inputs from mixer using special input transformer.
2. Input impedances depend upon pads. Each primary will take 30/50 or 200/250 ohms.
3. Gain 47 DB. For remote applications one or two additional audio stages should be employed adding 25 DB gain per stage.
4. Output O level.
5. Output impedances 50, 125, 200, 250, 500 ohms.
6. Frequency response 30 to 15000 cycles.
7. Battery or AC operation.
8. Low hum-pickup. (Tri-alloy shielded input transformer.)



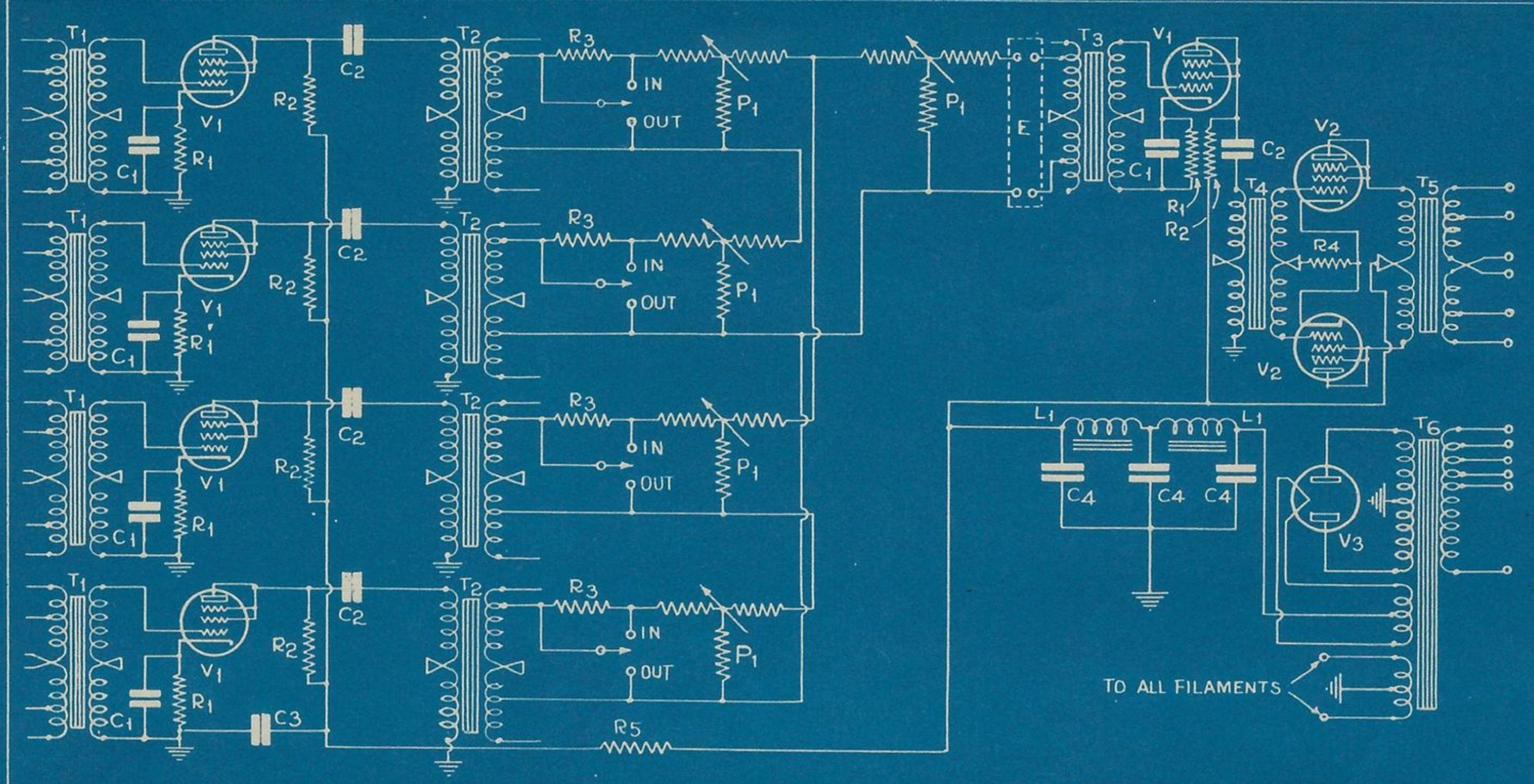
LEGEND

T_1	A-10	R_4	30,000Ω
T_2	A-24	C_1	.05MFD.
R_1	3,000 Ω	C_2	1 0MFD.
R_2	150,000Ω	C_3	.25MFD.
R_3	500,000Ω	V_1	955

MICROPHONE PRE-AMPLIFIER

GENERAL DETAILS

1. Single position semi-fixed gain pre-amplifier for permanent remote or PA application.
2. Gain 45 DB.
3. Output O level.
4. Input and output impedances 50, 200, 250, 500 ohms.
5. Frequency response 30 to 15000 cycles.
6. Screwdriver gain control.
7. Compactness inherent through use of acorn tubes and Ultra compact transformers. Circuit constants eliminate necessity for cathode by-pass in first stage.



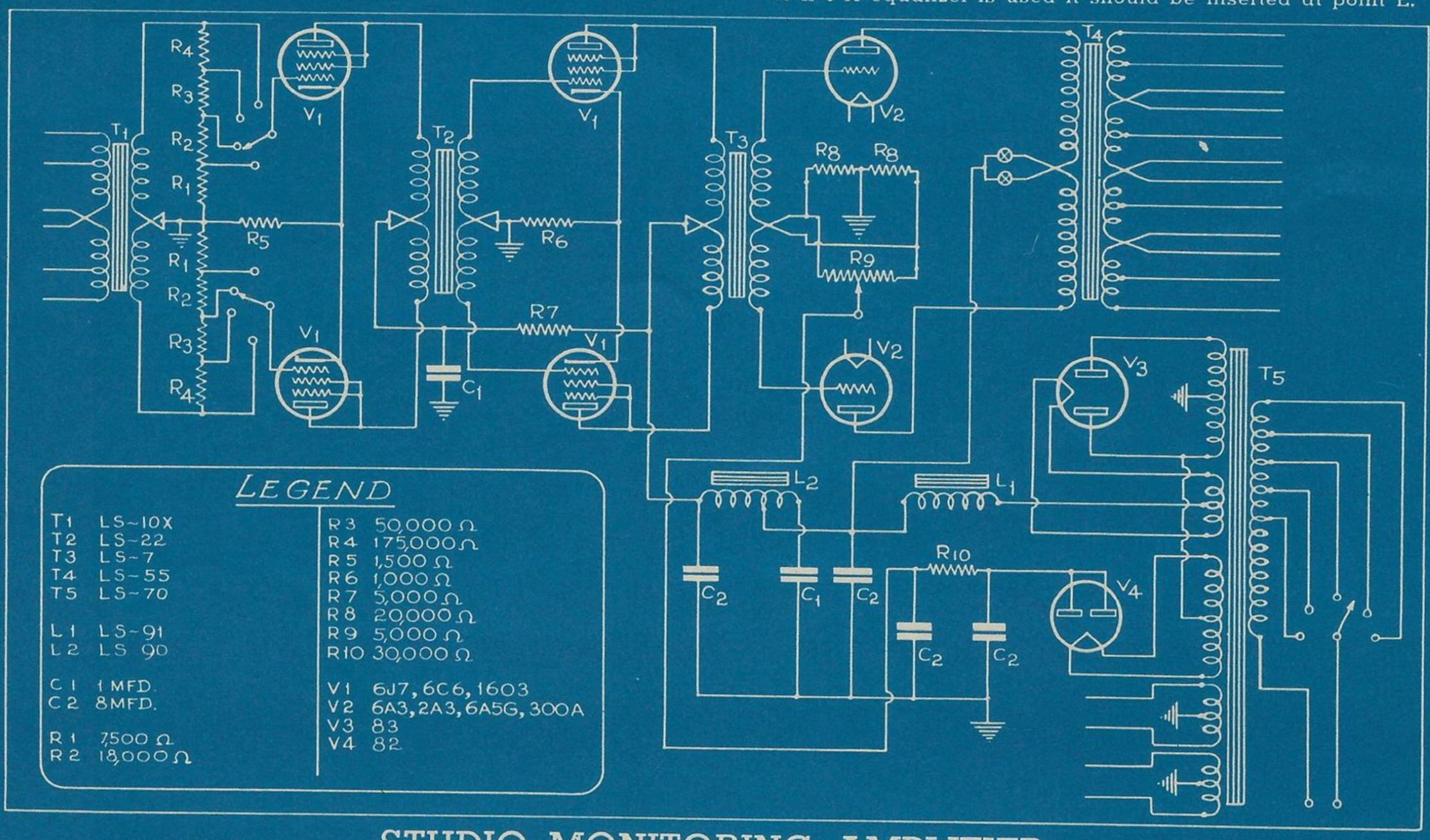
—LEGEND—

T1	LS~10X	R1	3M Ω	(each)	C1	25 MFD.	(each)	V1	6J7, 6C6, 1603
T2	LS~50	R2	30M Ω	"	C2	.25	" "	V2	89, 42
T3	LS~10	R3	200 Ω	"	C3	1	" "	V3	80
T4	LS~21	R4	500 Ω	"	C4	8	" "		
T5	LS~61	R5	10M Ω	"	L1	LS~90	"		
T6	LS~190				P1	200 Ω T-PADS			

CONSOLE TYPE PRE-PROGRAM AMPLIFIER

GENERAL DETAILS

1. Four completely independent input amplifier channels to effect high level mixing.
2. Total gain 70 DB. 25 DB gain in individual channels.
3. Output level +15 DB.
4. Input and output impedances 50, 125, 200, 250, 500 ohms.
5. Frequency response 30 to 15000 cycles.
6. Low hum pickup (tri-alloy shielded input transformers).
7. If 3-A equalizer is used it should be inserted at point E.



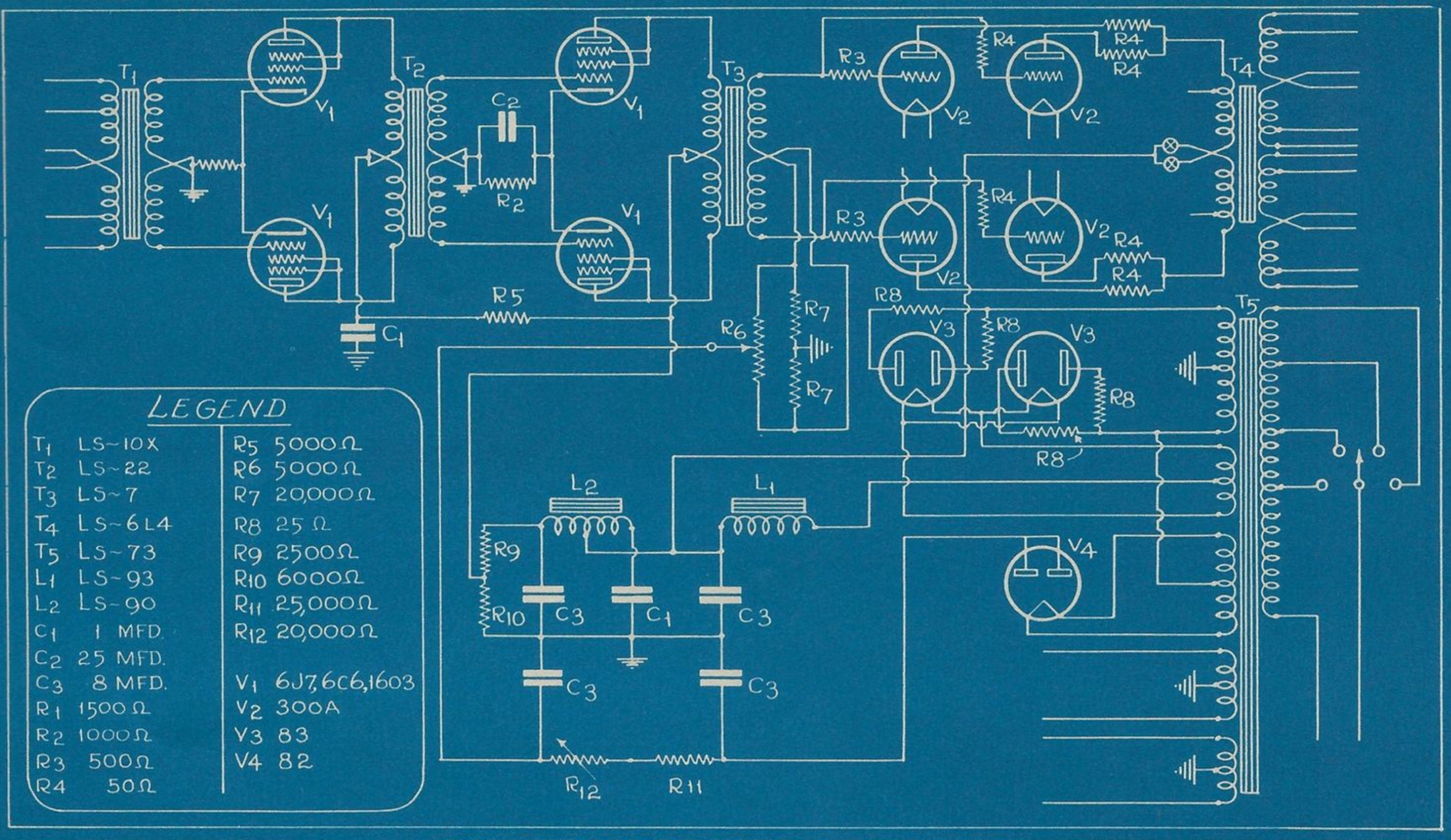
LEGEND

T1	LS~10X	R3	50,000 Ω	V1	6J7, 6C6, 1603
T2	LS~22	R4	175,000 Ω	V2	6A3, 2A3, 6A5G, 300A
T3	LS~7	R5	1,500 Ω	V3	83
T4	LS~55	R6	1,000 Ω	V4	82
T5	LS~70	R7	5,000 Ω		
L1	LS~91	R8	20,000 Ω		
L2	LS 90	R9	5,000 Ω		
C1	1 MFD.	R10	30,000 Ω		
C2	8MFD.				
R1	7,500 Ω				
R2	18,000 Ω				

STUDIO MONITORING AMPLIFIER

GENERAL DETAILS

1. Ideal medium power amplifier for monitoring, audition, driver, or home use.
2. Gain 70 DB with three 10 DB steps of gain reduction.
3. Power output 13 watts using 2A3's, etc., 20 watts using 300A's.
4. Input impedances 50, 125, 200, 250, 500 ohms. Output impedances 500, 250, 200, 50, 30, 20, 15, 10, 7.5, 5, 2.5 ohms.
5. Frequency response 30 to 15000 cycles. Negligible distortion.
6. Low hum pickup effected through use of tri-alloy shielded input and three push pull stages.
7. Bridging input transformer can be used with 10 DB gain reduction.



AUDITION-DRIVER AMPLIFIER

GENERAL DETAILS

1. Due to low plate resistance of output tubes this amplifier has excellent regulation in output circuit. As a driver amplifier this unit will readily drive a 500 watt class B stage. Ideal for loud speaker operation.

2. Gain approximately 75 DB.

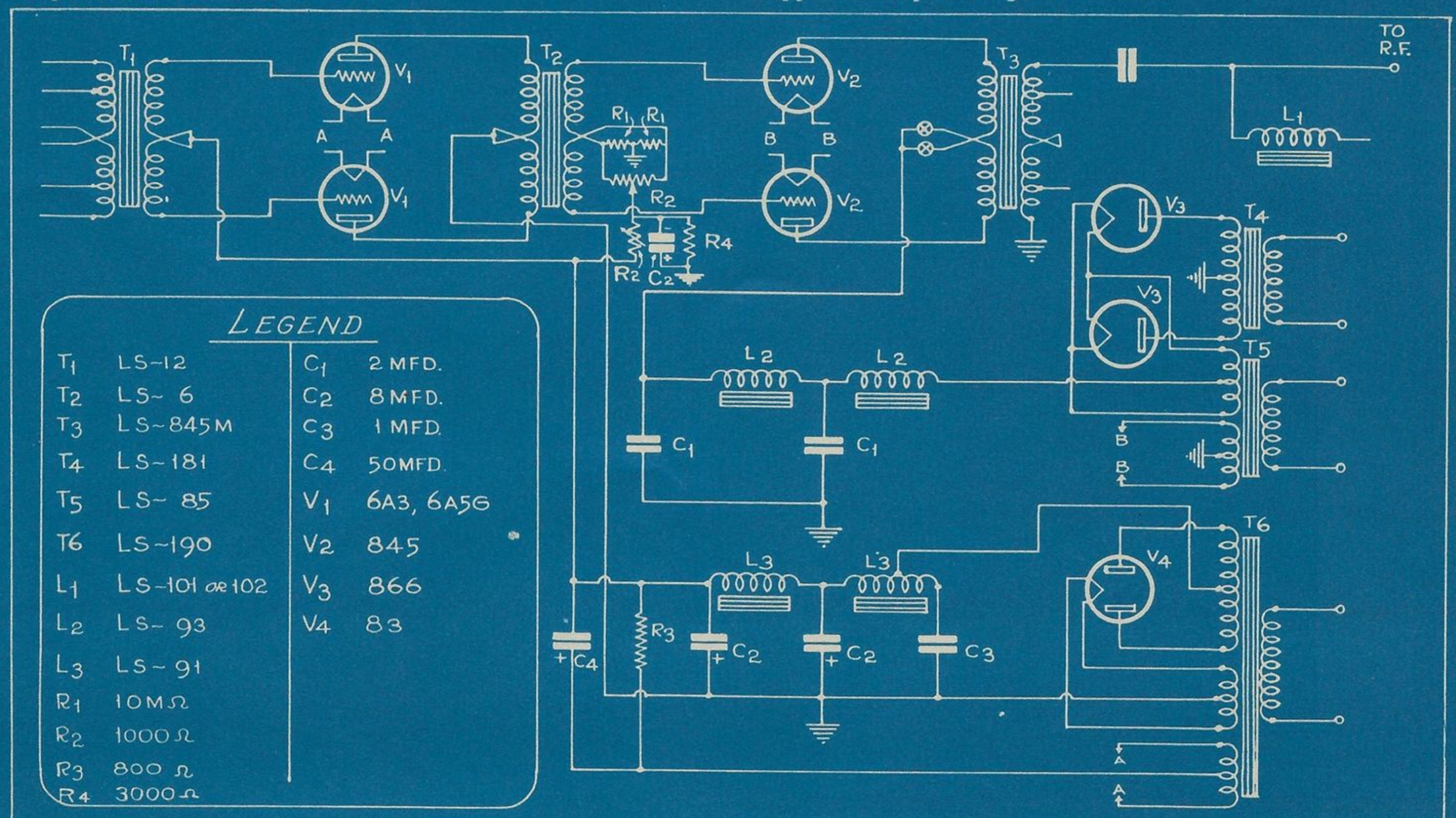
3. Power output 50 watts.

4. Input impedances 50, 125, 200, 250, 500 ohms. Output impedances for line and voice coil.

5. Frequency response 30 to 15000 cycles. Negligible distortion.

6. Low hum pickup through use of three push pull stages and tri-alloy shielded input transformer.

7. Bridging input transformer can be substituted with approximately 10 DB gain reduction.



100 WATT AMPLIFIER-MODULATOR

GENERAL DETAILS

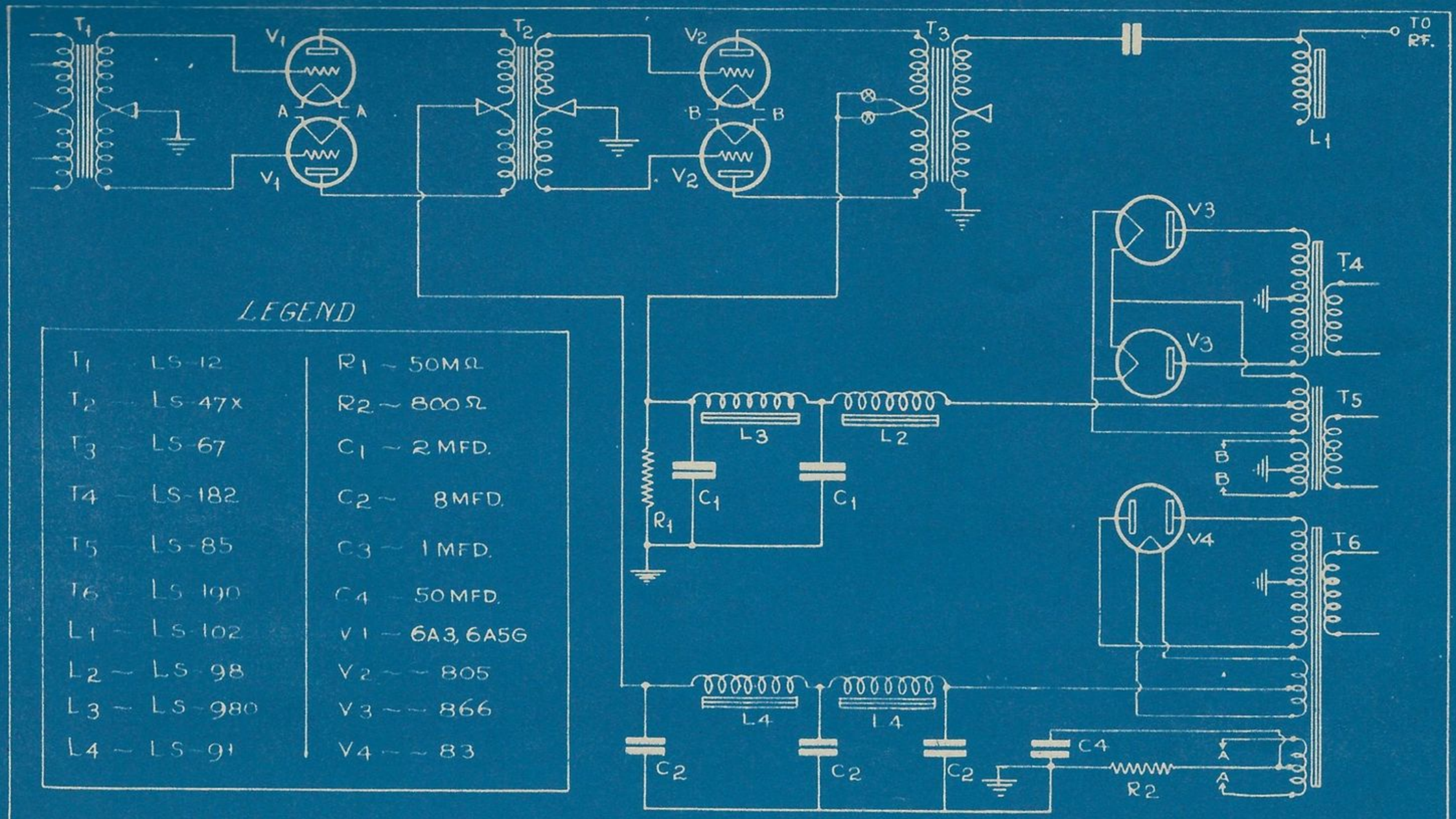
1. The output stage of this amplifier is operated AB to effect low distortion and good regulation in the audio output circuit.

2. Power output 100 watts.

3. Input impedance 50, 125, 200, 250, 500 ohms. Output impedance universal for RF load. The LS-845 output transformer can be used if line and voice coil output impedances are desired.

4. Frequency response 30 to 14,000 cycles.

5. The circuit is unusual in that the plate supply used for the driver tubes is used as the bias supply for the output tubes. The driver tube filaments are approximately 300 volts below ground potential.



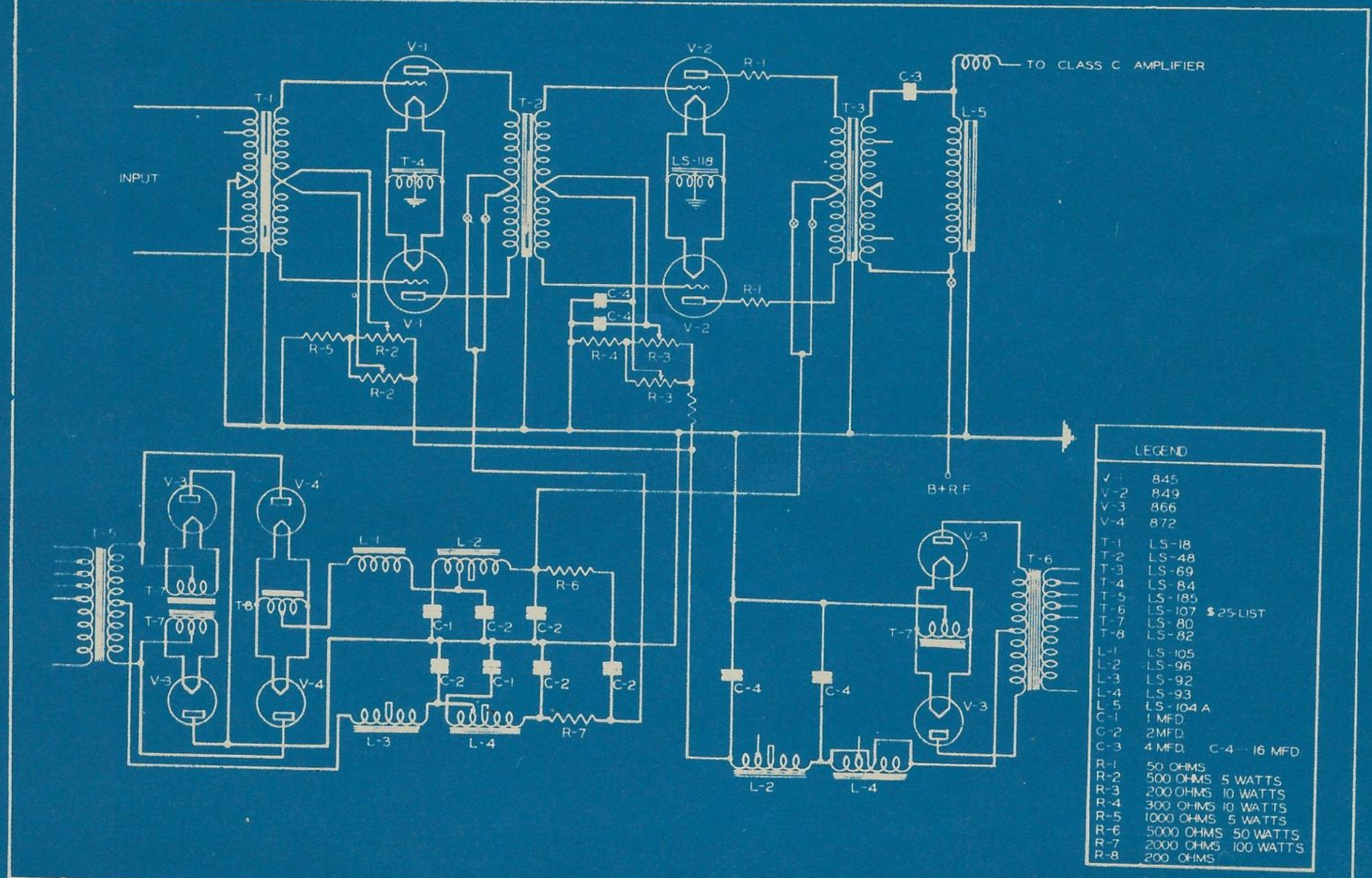
LEGEND

T_1	LS-12	R_1	50MΩ
T_2	LS-47x	R_2	800Ω
T_3	LS-67	C_1	2 MFD.
T_4	LS-182	C_2	8 MFD.
T_5	LS-85	C_3	1 MFD.
T_6	LS-190	C_4	50 MFD.
L_1	LS-102	V1	6A3, 6A5G
L_2	LS-98	V2	805
L_3	LS-980	V3	866
L_4	LS-91	V4	83

250 WATT MODULATOR

GENERAL DETAILS

1. Class B output stage. 838's, ZB-120's, etc. can be used in place of the 805's with slight reduction in output power.
2. Power output 250 watts.
3. Input impedances 50, 125, 200, 250, 500 ohms. Output impedances 10000/2500 ohms. For other RF loads use LS-66 output transformer.
4. Frequency response 30 to 14000 cycles. Low distortion.
5. The output tubes are operated with zero bias. For larger power output a small bias voltage may be desirable.



LEGEND

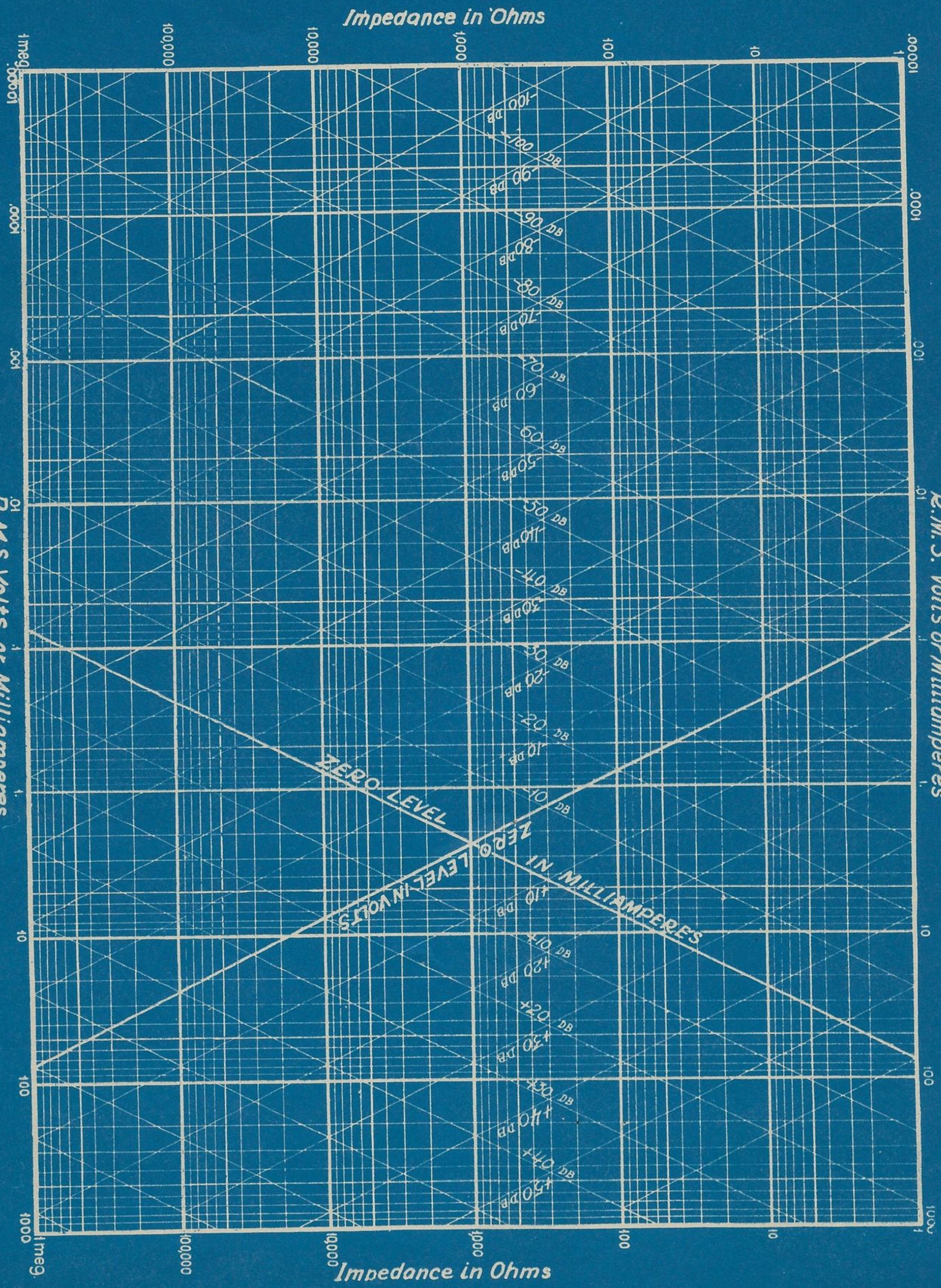
V-1	845
V-2	849
V-3	866
V-4	872
T-1	LS-18
T-2	LS-48
T-3	LS-69
T-4	LS-84
T-5	LS-185
T-6	LS-107 $25-LIST
T-7	LS-80
T-8	LS-82
L-1	LS-105
L-2	LS-96
L-3	LS-92
L-4	LS-93
L-5	LS-104 A
C-1	1 MFD
C-2	2 MFD.
C-3	4 MFD. C-4 — 16 MFD
R-1	50 OHMS
R-2	500 OHMS 5 WATTS
R-3	200 OHMS 10 WATTS
R-4	300 OHMS 10 WATTS
R-5	1000 OHMS 5 WATTS
R-6	5000 OHMS 50 WATTS
R-7	2000 OHMS 100 WATTS
R-8	200 OHMS

1000 WATT MODULATOR

GENERAL DETAILS

1. Class B output stage. Class AB driver.
2. Power output 1000 watts.
3. Input impedances 50, 200, 250, 500 ohms. Output impedances 6000, 5000, 4000, 1800, 1500, 1000 ohms.
4. Frequency response 30 to 14000 cycles. Low distortion.
5. Duplex bridge rectifier for 849 and 845 plate supply.
6. Common bias supply for driver and output stages.

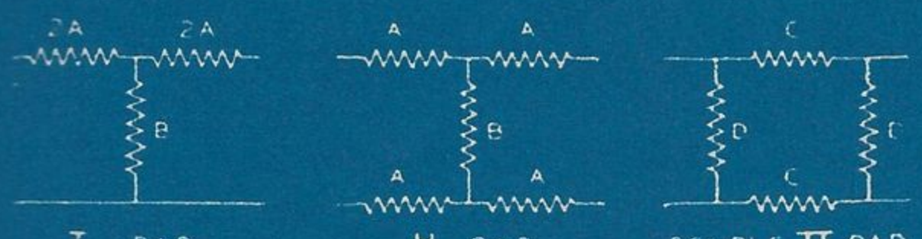
To use this chart, the measured value of volts or milliamperes is located at the bottom of the chart. This is extended vertically to the position where it intersects the correct horizontal impedance line. The sloping line corresponding to this point of intersection is the DB level. As an example, let us take a case where 8 volts is measured across 10 ohms. Extending the 8 volts line vertically to the point where it intersects the 10 ohm horizontal line, we coincide with the sloping voltage line of plus 30 DB.



ACOUSTICAL LEVELS

Various Noises and Orchestral Effects	Sound Pressure — Dynes per Sq. Cm.	Particle Velocity — Cm. per Sec.	Movement of Air — Millimeters at 1,000 Cycles	Sound Intensities — Microwatts per Sq. Cm.	Power Level — Decibels
Threshold	0.000204	0.0000050	2.22×10^{-8}	10^{-10}	0
	0.000363	0.0000089	3.95×10^{-8}	3.165×10^{-10}	5
	0.000645	0.0000158	7.00×10^{-8}	10^{-9}	10
	0.001146	0.0000281	1.25×10^{-7}	3.165×10^{-9}	15
Whisper 4′ from source	0.00204	0.000050	2.22×10^{-7}	10^{-8}	20
	0.00363	0.000089	3.95×10^{-7}	3.165×10^{-8}	25
Soft Violin 12′ from source	0.00645	0.000158	7.00×10^{-7}	10^{-7}	30
	0.01146	0.000281	1.25×10^{-6}	3.165×10^{-7}	35
	0.0204	0.0005	2.22×10^{-6}	10^{-6}	40
	0.036	0.00089	3.95×10^{-6}	3.165×10^{-6}	45
Bell F4 160′ from source	0.0645	0.00158	7.00×10^{-6}	10^{-5}	50
Ordinary Conversation 3′ from source	0.1146	0.00281	1.25×10^{-5}	3.165×10^{-5}	55
	0.204	0.0050	2.22×10^{-5}	10^{-4}	60
	0.363	0.0089	3.95×10^{-5}	3.165×10^{-4}	65
Bell F2 160′ from source	0.645	0.0158	7.00×10^{-5}	10^{-3}	70
	1.146	0.0281	1.25×10^{-4}	3.165×10^{-3}	75
Full Orchestra					
Bell F4 6′ from source	2.04	0.15	2.22×10^{-4}	10^{-2}	80
	3.63	0.089	3.95×10^{-4}	3.165×10^{-2}	85
	6.45	0.158	7.00×10^{-4}	10^{-1}	90
	11.46	0.281	1.25×10^{-3}	0.3165	95
	20.4	0.5	2.22×10^{-3}	1.0	100
Bell F2 6′ from source	36.3	0.89	3.95×10^{-3}	3.165	105
Thunder	64.5	1.58	7.00×10^{-3}	10.0	110
Hammer 2′ from source	114.6	2.81	1.25×10^{-2}	31.65	115
	204	5.0	2.22×10^{-2}	100.00	120
	363	8.9	3.95×10^{-2}	316.5	125
Threshold of pain	645	15.8	7.00×10^{-2}	1000.0	130

ATTENUATION NETWORK DATA



T PAD H PAD DOUBLE π PAD

NOTE Z_L (LINE IMPEDANCE) 500 OHMS; $\int$ = 11513

ATTENUATION	$A=\frac{Z_L}{2}\times\tanh\left(\frac{N\int}{2}\right)$	$B=\frac{Z_L}{\sinh(N\int)}$	$C=\frac{Z_L}{2}\times\sinh(N\int)$	$D=\frac{Z_L}{\tanh\left(\frac{N\int}{2}\right)}$
NO DB	A	B	C	D
.1	1.440	43420	2.879	86850
.2	2.878	21720	5.755	43440
.3	4.318	14480	8.635	28950
.4	5.758	10850	11.52	21710
.5	7.193	8685.	14.40	17380
.6	8.635	7232.	17.29	14480
.7	10.07	6198	20.17	12420
.8	11.51	5421.	23.06	10870
.9	12.95	4818.	25.95	9656.
1.0	14.38	4333.	28.85	8690.
2.0	28.65	2152.	58.08	4364.
3.0	42.75	1420.	88.08	2925.
4.0	56.58	1049.	119.3	2209.
5.0	70.03	822.4	152.0	1785.
6.0	83.08	669.4	186.8	1505.
7.0	95.65	558.0	224.0	1308.
8.0	107.7	473.1	264.3	1162.
9.0	119.1	405.9	308.0	1050.
10.0	129.9	351.3	355.8	962.5
15	174.5	183.6	680.8	756.3
20	204.5	101.0	1238.	611.2
25	223.5	56.40	2216.	559.5
30	234.7	31.65	3949	532.7
35	241.3	17.79	7027.	518 0
40	245.1	10.00	12500	510.1
45	247.2	5.624	22230	505.7
50	248.5	3.163	39530	503.2
55	249.2	1.775	70300	501.8
60	249.5	1.0	125000	501.0
65	249.8	.5623	222300	500.5
70	249.8	.3163	395400	500.4
75	249.9	.1779	703000	500.2
80	249.9	10	1250000	500.1
85	250.0	.05620	2223000	500.1
90	250.0	.03161	3954000	500.0
95	250.0	.01879	7027000	500.0
100	250.0	.010	12500000	500.0

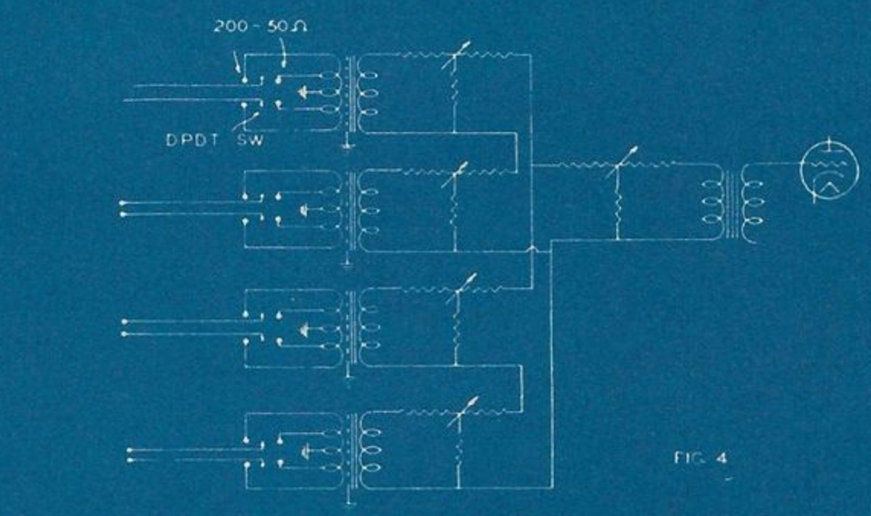
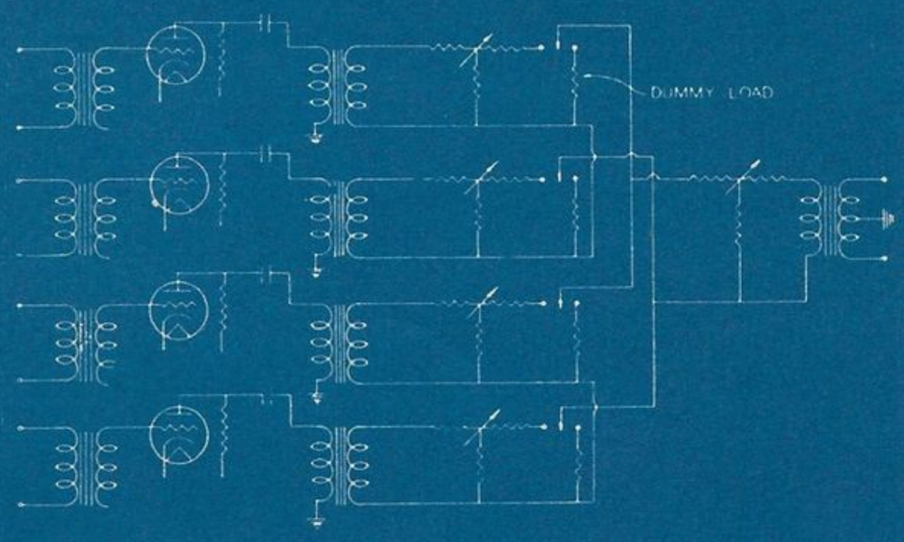


FIG. 4



Typical Low and High Level Mixers

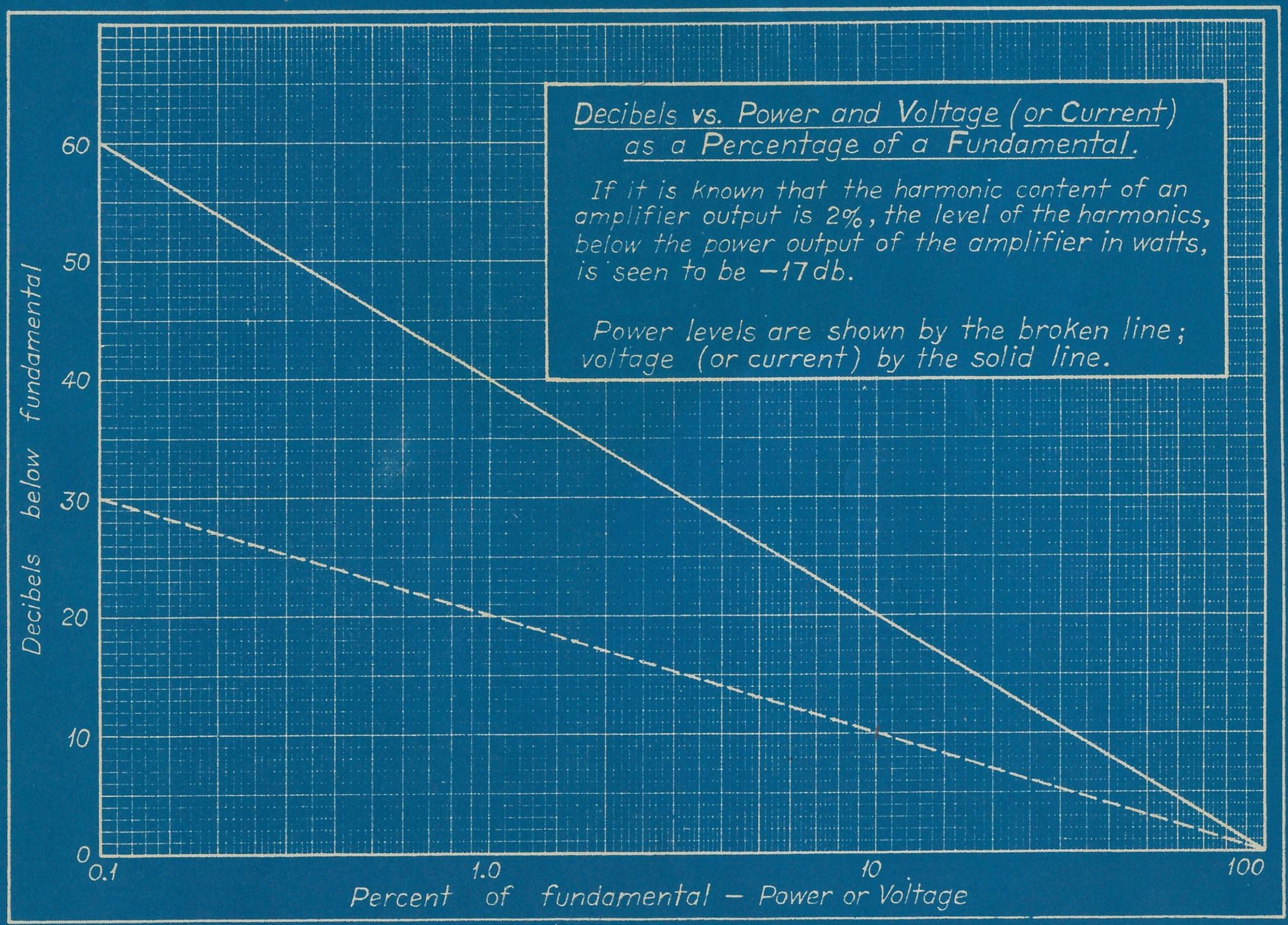
It is often necessary to couple two sources of input, such as a tuner and microphone, to an amplifier. To properly do this and still obtain full efficiency from the amplifier gain control, some attenuation should be available at one of the sources. This is readily done with an attenuator based on the illustrated chart. The data shown has been computed to great accuracy, and is suitable for use in making attenuators for laboratory or professional applications. Obviously, a group of fixed attenuator units can be made into a variable pad. For example, a 10 DB T type network would use 2 series resistors of 260 ohms each and one shunt resistor of approximately 350 ohms.

For a line impedance other than 500 ohms multiply all resistor value by Z/500 where Zx is the impedance desired

Decibels vs. Power and Voltage (or Current) as a Percentage of a Fundamental.

If it is known that the harmonic content of an amplifier output is 2%, the level of the harmonics, below the power output of the amplifier in watts, is seen to be −17 db.

Power levels are shown by the broken line; voltage (or current) by the solid line.



UTC

EQUALIZERS

Communication

EQUALIZERS and FILTERS

The past few years have effected a great increase in the overall fidelity of audio amplification systems. This improvement in fidelity has been greatest in the audio amplifier itself. While new tubes and circuit developments have aided the progress of amplifier fidelity, the development of improved audio transformers is the keynote of this advance.

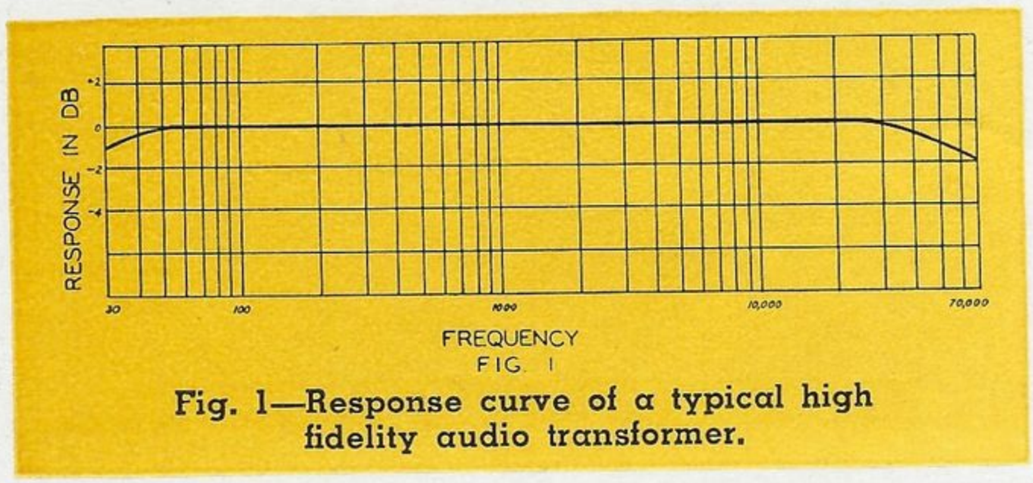


FIG. 1

Fig. 1—Response curve of a typical high fidelity audio transformer.

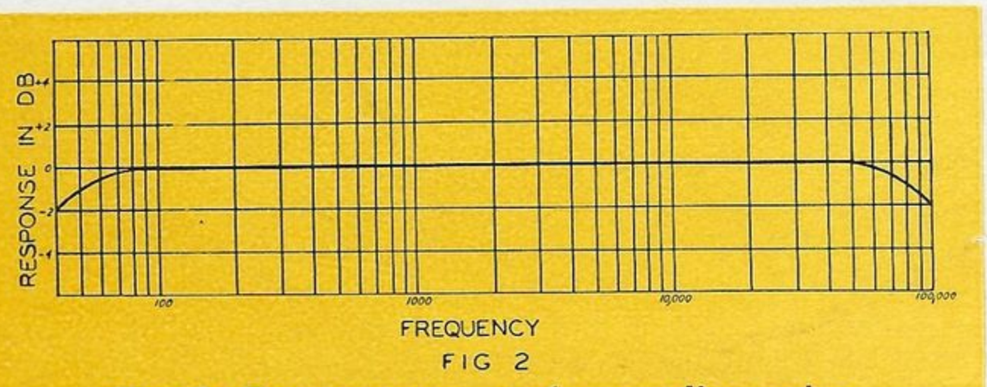


FIG 2

Fig. 2—Response curve of an audio-carrier frequency transformer.

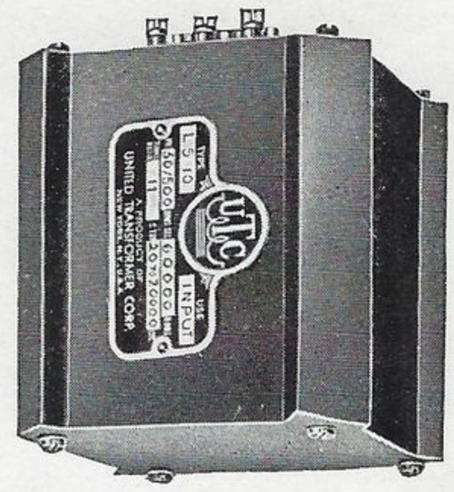


Fig. 1 illustrates a typical high fidelity transformer as available for audio work. This transformer is a Linear Standard unit operating from pushpull 2A3's to a broadcast line. Fig. 2 illustrates an audio-carrier frequency transformer having a response far beyond the audio range to cover carrier and television frequencies. Special transformers of this and other natures are made by UTC directly in accordance with specifications.

NECESSITY for EQUALIZATION

Due to the great progress attained in the fidelity of modern amplifying equipment, the emphasis has now shifted to improvement of the pickup and power reproducing units used in conjunction with this equipment. An analysis of the operation of microphones and speakers will readily indicate that absolutely uniform response is almost impossible. The action of these electro-acoustic devices is complicated by the mechanical reactance and capacitance which function in addition to the electrical characteristics. While there have been many developments in recent years effecting improvements in these devices, it is still necessary, in most cases, to resort to equalization to obtain a uniform overall response. Equalization, as a general term, refers to the introduction of a device in a communication circuit acting to compensate for the defects in that circuit.

Another major use of equalizing networks is in the compensation of telephone and other lines from pickup points to broadcast stations, from broadcast studios to transmitters, etc. The characteristics of telephone lines vary appreciably depending upon their length, the number of repeaters used, and to a minor extent upon humidity conditions. Where lines of appreciable length are used, it is very desirable that the equalization be adjustable to take care of varying conditions.

Few engineers realize what actually can be done with equalizers to obtain linear response from non-linear devices. Most pickups, loud speakers and lines can be almost perfectly equalized. A point to bear in mind when equalizing is the attendant loss in gain. The magnitude of this loss is shown in the curves below. However, with modern amplification equipment, it is not difficult to obtain an additional 20 or 30 DB where required.

SIMPLEST EQUALIZERS

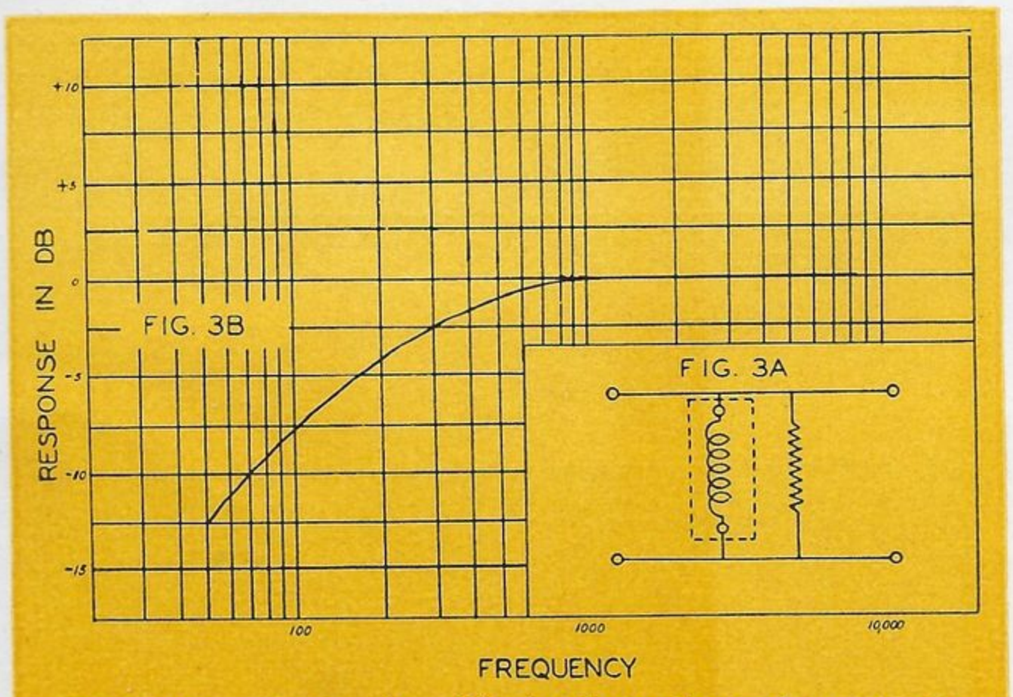


Fig. 3 (a and b)—Simplified schematic and response curve of a dialogue equalizer. This type is represented in the UTC line by the HE-816.

The simplest forms of equalizers consist of a capacitor or reactor so inserted in a circuit that the attenuation obtained bears a fixed relation to frequency. Fig. 3A illustrates a simple form of shunt inductor used to equalize the response of a dynamic microphone at the lower frequencies. The frequency response obtained is illustrated in Fig. 3B. This equalizer is technically termed a dialogue equalizer and is represented in the UTC line by the HE-816.

Fig. 4A illustrates a simple network using a series condenser. The resistors shunting the condensers in this case determine the maximum attenuation possible. In other words, at the frequency where the capacitive reactance approaches infinity, the total series loss-impedance of the equalizer would not exceed the value of the resistor shunting the condenser. In simplified form, this system would appear as in Fig. 4B where Rs is a source impedance, R_1 is a load impedance, R is the shunt resistor, and Z_1 is the effective impedance of the capacitor at any given frequency. It is apparent that the voltage E developed across R_1 would be equal to

$$E = e \frac{R_1}{R_1 + Rs + \frac{1}{\frac{1}{R} + \frac{1}{Z_1}}}$$

with proper correction for the phase relationship.

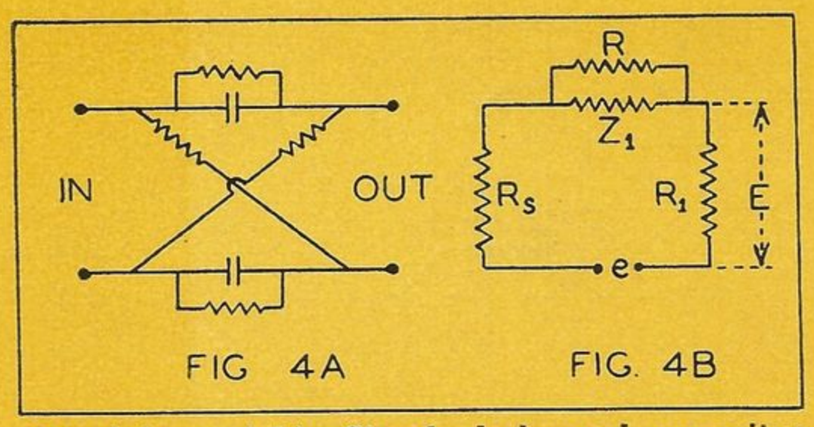


Fig. 4 (a and b)—Simple balanced capacitor equalizer and its equivalent circuit

RESONANT EQUALIZERS

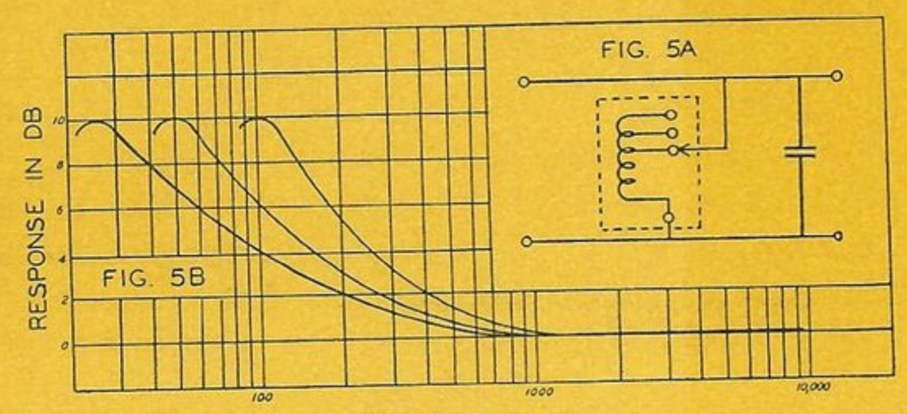


Fig. 5 (a and b)—Simplified schematic and typical response curves of the HC-18 low frequency equalizer. For control of equalization a series resistor as in Fig. 6A may be used.

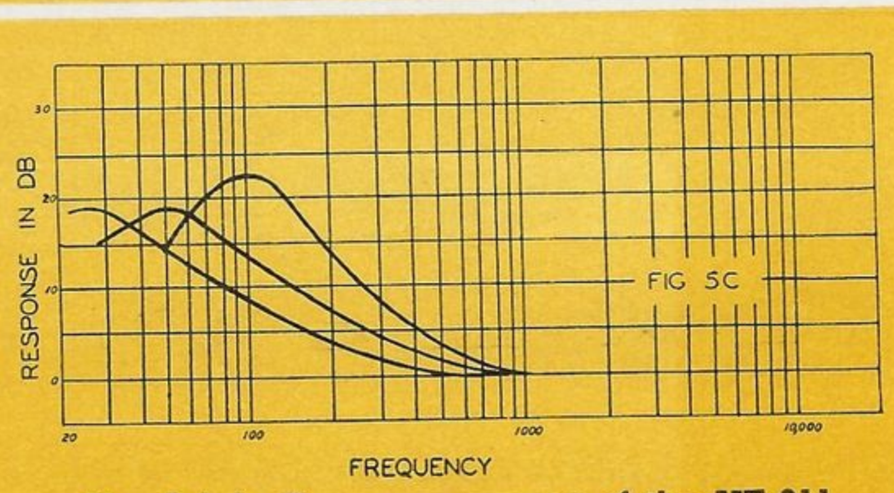


Fig. 5 (c)—Response curves of the HE-811 low frequency equalizer.

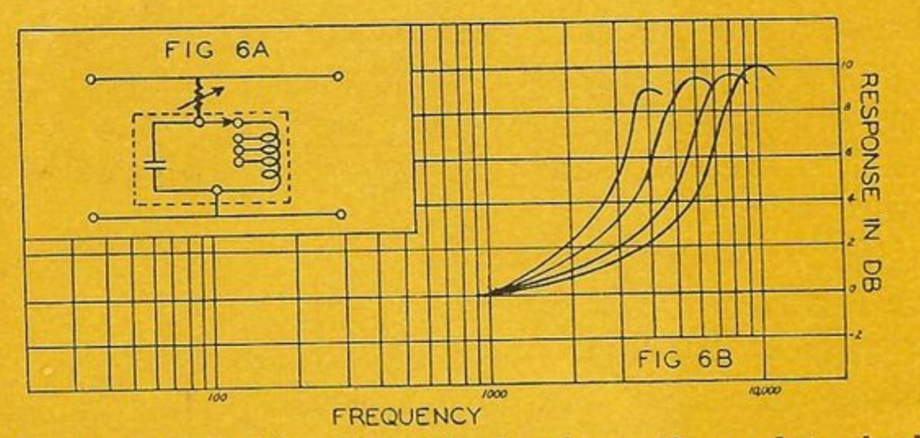


Fig. 6 (a and b)—Simplified schematic and typical response curves of the HC-19 high frequency equalizer.

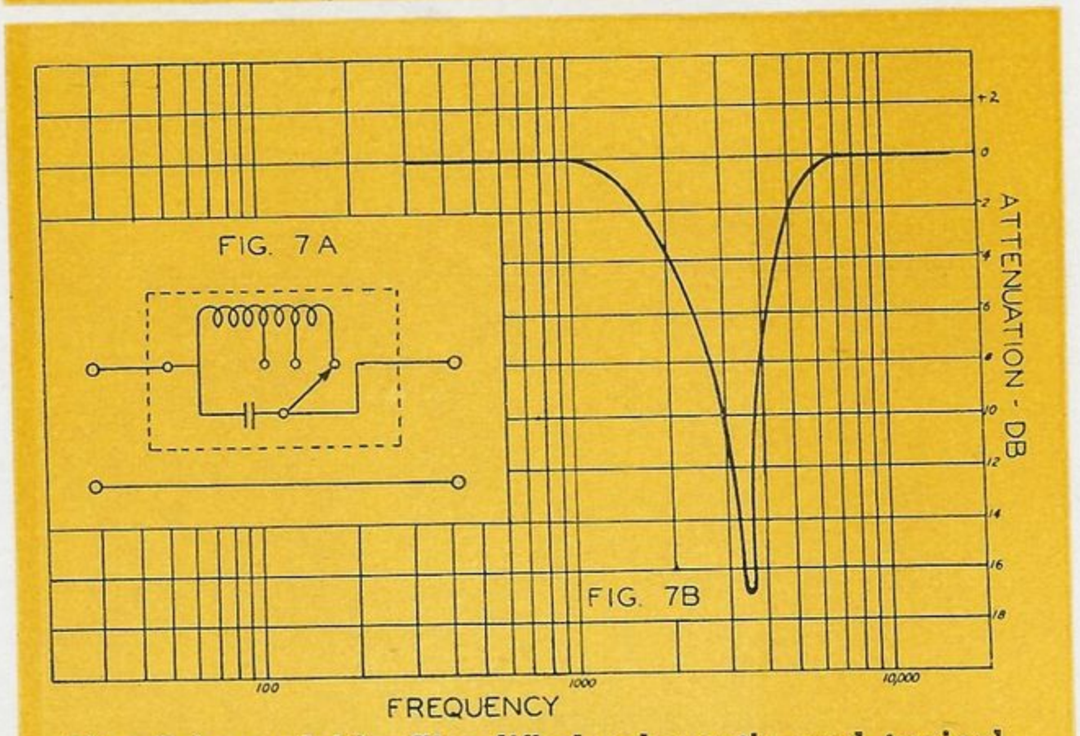


Fig. 7 (a and b)—Simplified schematic and typical response curve of the HC-20 scratch filter.

The second type of equalizer which is more commonly used because of its sharper characteristics and its greater efficiency consists of a capacitor and reactor tuned to resonance at the frequencies at which equalization is desired. If such a network is placed in shunt with a line, voltage will be built up appreciably at resonance. The HC-18 unit which is of this type, has taps provided on the high Q inductor so that the resonant frequency can be changed to either 25, 50 or 100 cycles. The simplified schematic and typical curves obtainable are shown in Figs. 5A and 5B. This equalizer is frequently used to compensate for low frequency losses in disc and film recording, and the low frequency loss sometimes encountered with microphones of the crystal and carbon type. Where it is necessary to obtain a greater equalization than is afforded by the HC-18, a double section unit, the HE-811, provides double the obtainable equalization and a sharper curve. Fig. 5C illustrates the curves of this unit. The HC-19 UTC equalizer is a high frequency unit of the same type. The high Q inductor is tapped so that resonance can be obtained at either 4000, 6000, 8000 or 10,000 cycles. The simplified circuit and typical frequency curves obtainable are shown in Figs. 6A and 6B. Similarly, to obtain double the equalization of this unit and a sharper curve, the HE-812, tapped at the same frequencies, is provided.

HE-811 equalizer. Other equalizers in H-3 case are of similar appearance

AUDIO EQUALIZERS

The standard filters and equalizers described below are designed for use on 500 ohm lines. 200 ohm designs are available at a 10% increase in cost. When ordering, specify type number and desired impedance. If other impedances are desired within a range of 10 to 4000 ohms, a 20% increase in prices is effective. In some of the filters and equalizers described, a small amount of phase shift is encountered. This is rarely noticeable in communications and recording practice. Where it is not desirable for technical reasons, this phase distortion can be compensated through the use of special networks. Compensation of this nature is not readily possible where the units are used for universal application or with variable equalization control.

HC-18

This is a single section low frequency equalizer including a condenser and tapped inductor for resonant frequencies (maximum equalization) at 25, 50 or 100 cycles. Equalization can be controlled from zero to 10 DB maximum through an external series resistor. HA-2 case. Net **$15**

HE-811

This is a two section low frequency equalizer similar in characteristics to the HC-18. The two section construction increases the available equalization to 25 DB and sharpens the attenuation characteristic. HA-3 case. Net **$25**

HC-19

This is a single section high frequency equalizer including a high power factor condenser and high Q inductor tapped for resonance (maximum equalization) at 4000, 6000, 8000, or 10,000 cycles. The equalization can be controlled from zero to 10 DB through the use of an external series resistor. HA-1 case. Net **$13**

HE-812

This is a two section high frequency equalizer similar to the HC-19. The two section construction permits a maximum equalization of 25 DB and a sharper attenuation curve. HA-2 case. Net **$20**

RECORDING FILTERS and EQUALIZERS

HC-20

This is a simple half section scratch filter of the series resonant type. Taps on the high Q inductor effect resonance or peak attenuation at 2500, 3500 or 4200 cycles. The attenuation at the resonant frequency is 18 DB. This filter is also frequently used for reducing the resonance peaks in cutters and pickups used with recordings. HA-1 case. Net **$13**

HE-201

This is a full section scratch filter with taps on the inductor for peak attenuation at 3500, 4200, or 5500 cycles. The attenuation at the resonance frequency is 30 DB. This unit is frequently used for reducing sharp peaks in pickups and cutters. HA-2 case. Net **$20**

HE-202

This is a pickup equalizer for hill and dale recordings. This equalizer is designed to properly compensate for the low end droop and the high end rise of vertical recordings. This is a fixed equalizer. HA-2 case. Net **$20**

SPECIAL UNITS

Due to the wide application of equalizers in the radio and communications fields, there are naturally many cases which are not taken care of by the standard UTC units described in this bulletin. A special division of the UTC plant takes care of the design and manufacture of special coils, filters and equalizers for these applications. Due to flexible facilities, quick deliveries and reasonable prices are available. Where an equalizer is desired similar to a standard UTC unit but with reasonable modifications in impedance or frequency, the increase in cost is only 20%. The UTC Research Laboratories and Staff are at your disposal to assist you in your equalizer and filter problems.

RECORDING EQUALIZERS

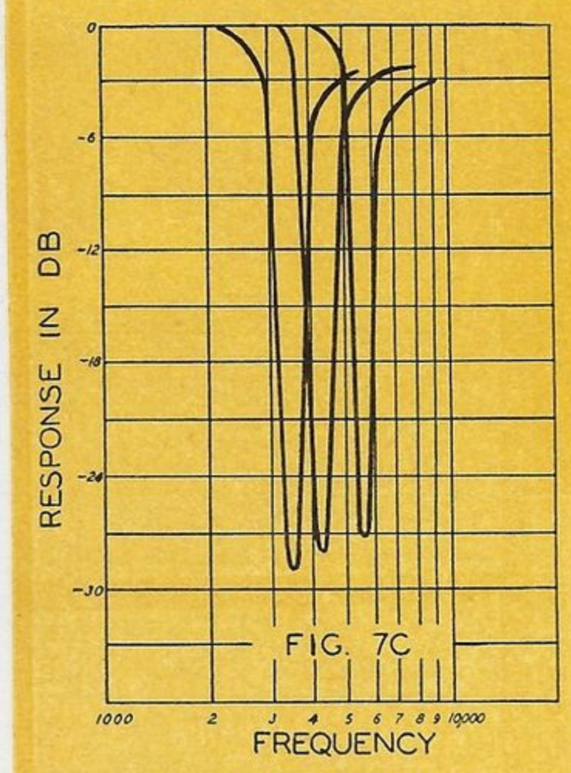


Fig. 7C—Response curves of the HE-201 scratch filter.

The HC-20 scratch filter is a typical filter of the series type used for reducing surface noise on disc recording. The HC-20 coil is tapped for sharp resonance and maximum loss at 2500, 3500 or 4200 cycles. Figs. 7A and 7B illustrate the simplified schematic and typical frequency curve. The HE-201, tapped at 3500, 4200, and 5500 cycles, is provided to obtain a greater attenuation and sharper curve than the HC-20. See Fig. 7C.

Where the surface noise covers a wide range of frequencies, it is customary to use a low pass filter which cuts off all objectionable higher frequencies. The curve of a unit of this type is shown in Fig. 17.

Another popular application of equalizers in the recording field lies in a play back equalizer to compensate for the original equalization used when recording. In hill and dale recording, the higher frequencies are brought up while recording to effect a large ratio of signal to surface noise. Simultaneously, the low frequencies are reduced so that the amplitude will not overrun the track. Fig. 7D illustrates the circuit and curve obtainable with an equalizer designed to compensate for these effects on play back.

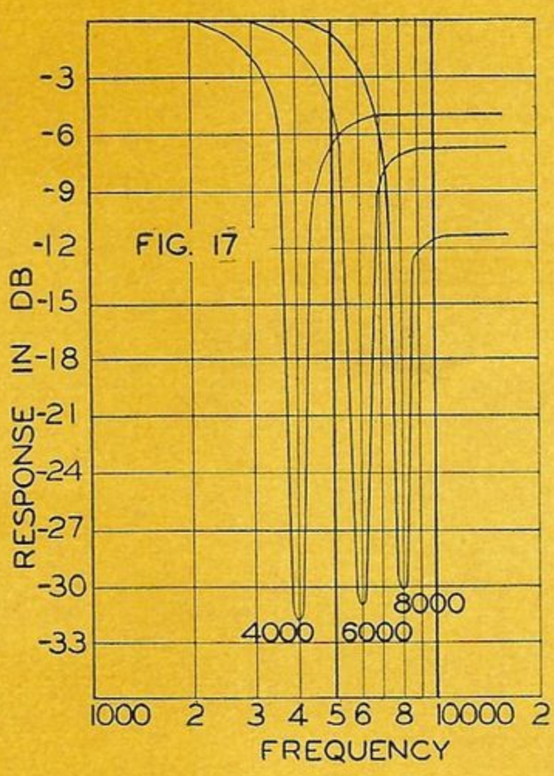


Fig. 17—Response curves of the HE-814 "M" derived type filter.

HIGH Q COILS

It is imperative in the design of equalizers or filters for audio and carrier circuits that the reactor coils and condensers have a low effective resistance when compared to their "pure" impedance. The direct current resistance of inductances is in no way a criterion of the actual A.C. resistance presented by the inductances. This A.C. resistance, called "effective resistance" is a composite of the copper and steel losses of the reactor. Either loss may be predominant, depending upon the reactor design, and the frequency and voltage applied. The effective resistance of a coil determines its usefulness in a circuit, whether parallel or series tuned. The degree of effectiveness of a reactor is called "Q" and is defined as the "pure" impedance at a particular frequency divided by the effective resistance ($Q = \frac{2\pi FL}{r}$). UTC manufactures various types of high Q coils directly to customers' specifications for special service. Some of these units are described in the latter part of this bulletin. The coils are usually supplied to an accuracy of 2%, though closer limits can be obtained where requested. The construction of these high Q reactors is such that the change in the effective resistance and inductance is almost negligible for a temperature latitude of 0° to 100° C. and for practically any humidity condition. It should be observed, however, that high Q inductors, particularly those used for low audio frequencies vary widely in inductance with applied voltage. It is therefore desirable when ordering high Q coils that the exact operating conditions be specified with special attention to the voltage developed across the inductor.

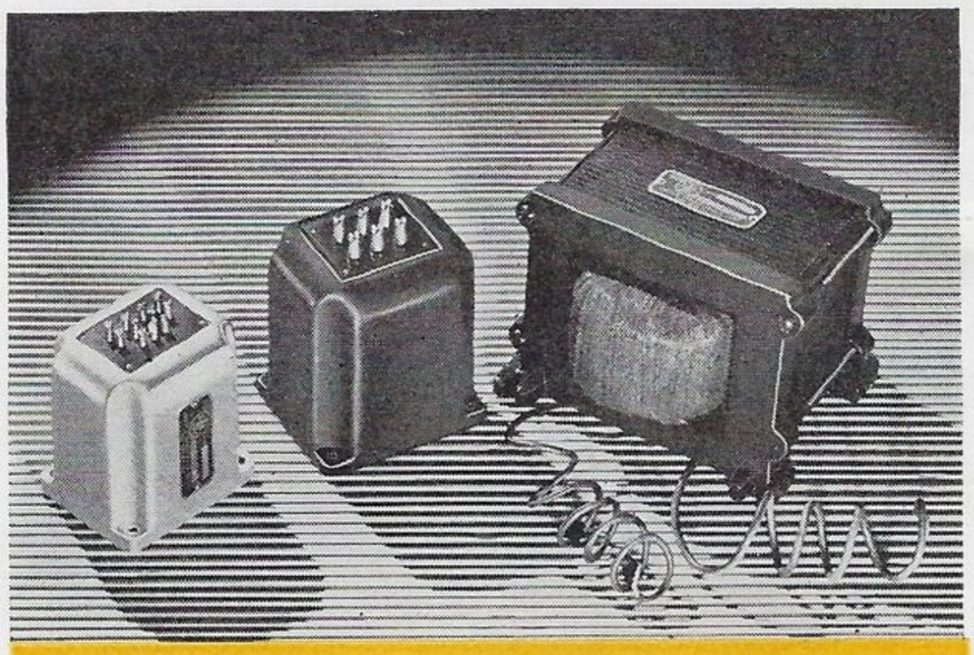


Fig. 10—UTC manufactures special units for most commercial organizations. Illustrated from left to right: Oscillation transformer for RCA—High Q inductor for GE—wide range swinging reactor for Western Union

EQUALIZER COILS

For development projects and some other applications, it is sometimes desirable to purchase equalizer coils alone which can then be worked up in various experimental circuits. UTC manufactures various types of equalizer coils as described below. Due to the wide variation in inductance required, no coils are carried in stock. Delivery can be made on units of this type within one week of receipt of order. Unless otherwise specified, these coils will be held within an accuracy of 2% of customers' specifications. It is important when ordering high Q coils that the frequency and AC voltage to be developed across the coil be specified. If this information is not available, details as to the circuit and method of application may be sufficient.

HE-10

Equalizer coils for service up to 1000 cycles. Any inductance up to 100 henries. HA-2. Net **$7**

HE-11

Equalizer coils for service up to 1000 cycles. Any inductance up to 200 henries. HA-2. Net **$15**

HE-12

Equalizer coils for service from 100 to 2000 cycles. Any inductance up to 30 henries. HA-1. Net **$6**

HE-13

Equalizer coils for service from 250 to 3000 cycles. Any inductance up to 30 henries. HA-2. Net **$7.50**

HE-14

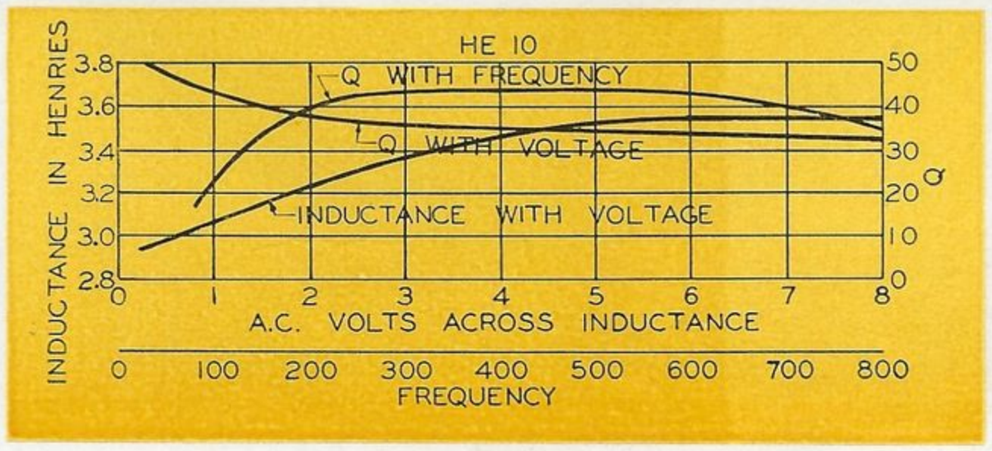
Equalizer coils for service from 500 to 6000 cycles. Any inductance up to 10 henries. Light weight construction (4 oz.) special case 2" x 2½" x 1½". Net **$8**

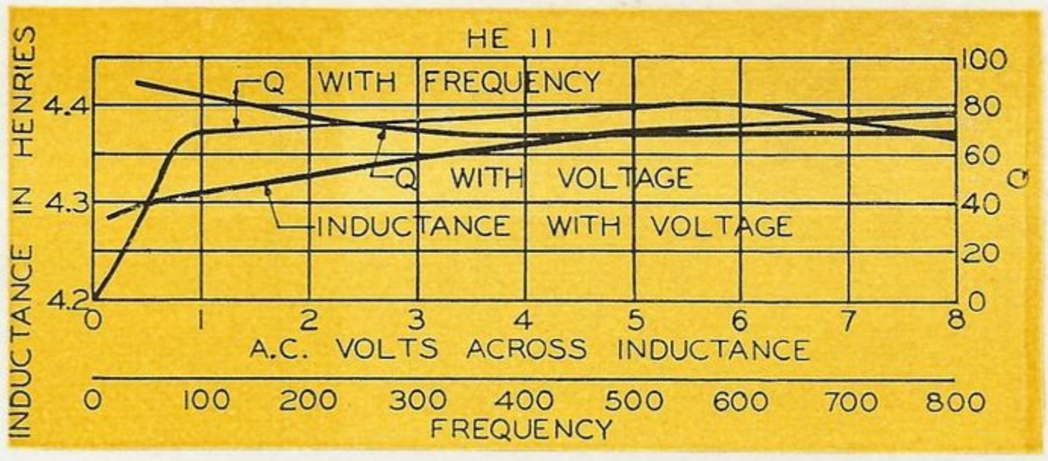
HE-15

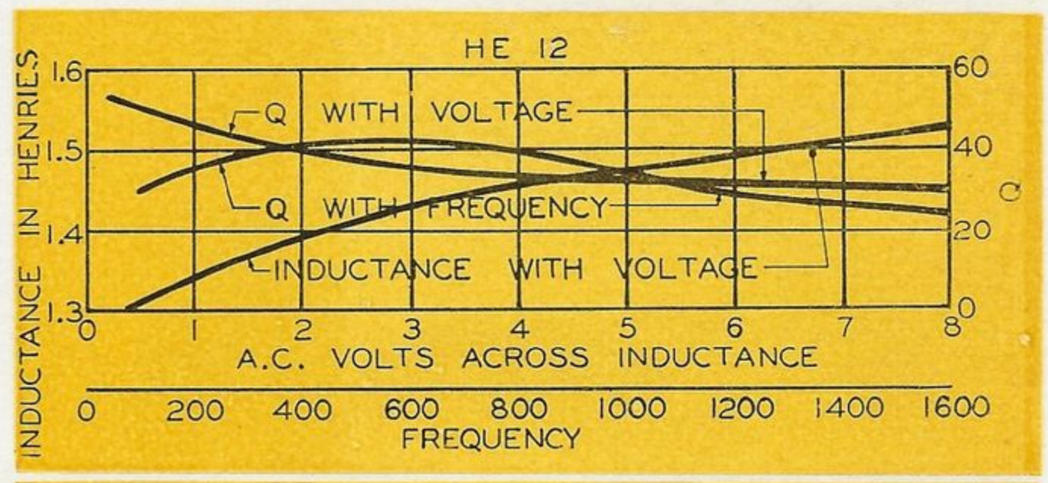
Equalizer coils for service from 1000 to 50,000 cycles. Any inductance up to 8 henries up to 5000 cycles. Any inductance up to 1 henry at 10,000 cycles. .25 henry at 20,000 cycles. HA-2. Net **$10**

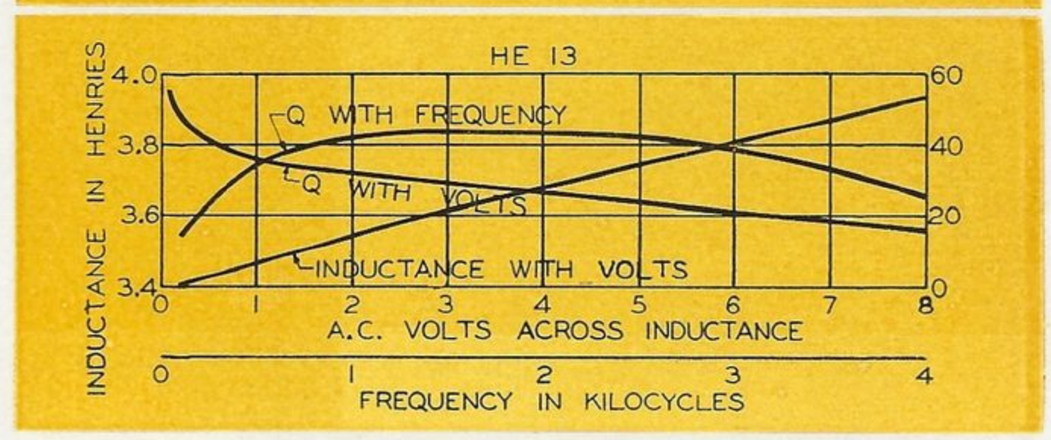
HE-16

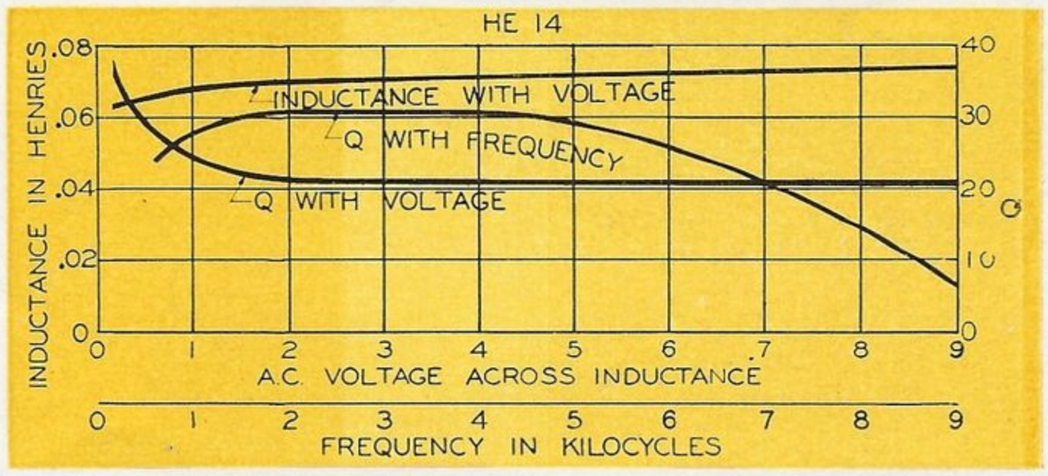
Equalizer coils for speaker networks—Low frequency section 1 to 18 Mhy. Net **$5**

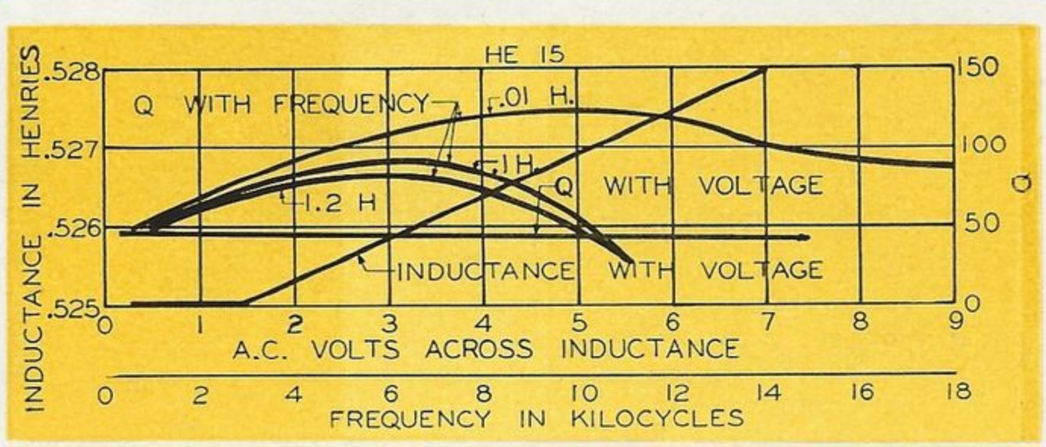


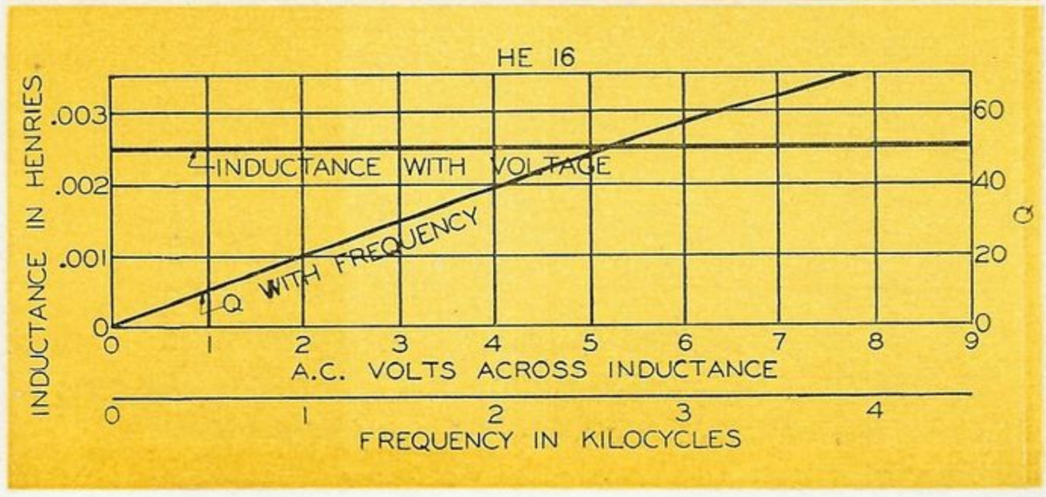












UNIVERSAL EQUALIZER

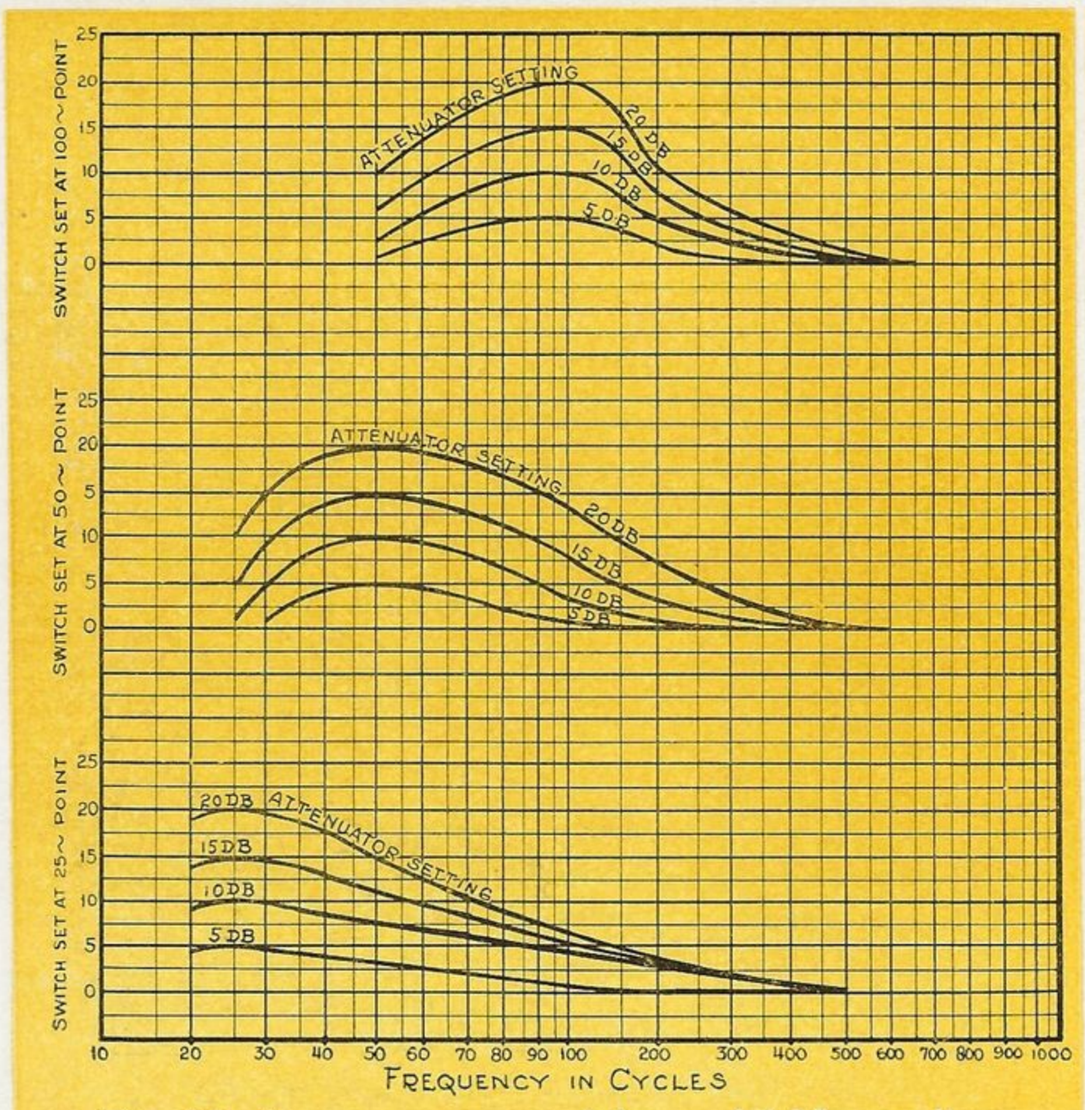


Fig. 9A—Response curves of the model 3A equalizer for low frequency equalization.

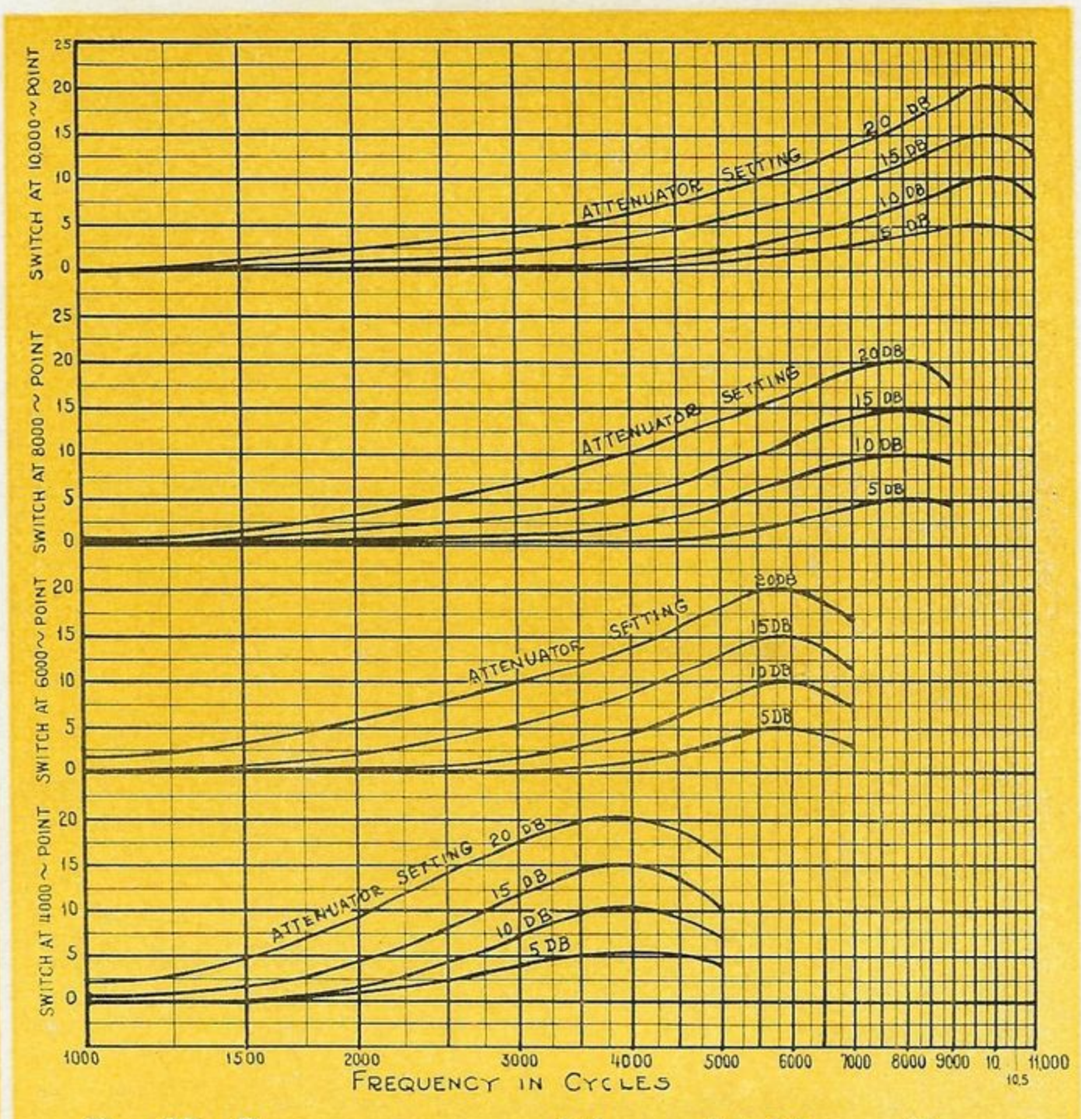


Fig. 9B—Response curves of the model 3A equalizer for high frequency equalization.

Most of the problems encountered in broadcast and recording practice are of a nature where the exact equalization required may not be definitely known, or where the conditions, such as in a broadcast line, may change over a period of time. For such applications, it is desirable that the equalizer be highly universal and flexible in application. An equalizer which fulfills all these requirements is illustrated in Fig. 8. This unit, UTC Model 3A equalizer, is the ideal device for recording or broadcast purposes. The low end control is a sharply tuned unit tapped for resonance at 25, 50 or 100 cycles with a calibrated T attenuator permitting accurately controlled equalization from zero to 25 DB. The high frequency end incorporates taps for resonance at 4000, 6000, 8000 and 10,000 cycles, and a calibrated T control from zero to 25 DB. Typical curves obtainable with this unit are shown in Figs. 9A and 9B. The high and low end controls have negligible effect upon each other and thus permit simultaneous control of either end. Another advantage of the flexibility of this equalizing panel is the ease of adjustment when switching from one line to another or one microphone to another where rapid changes in equalization are required. The calibrated attenuators and frequency switches permit instantaneous predetermined adjustment.

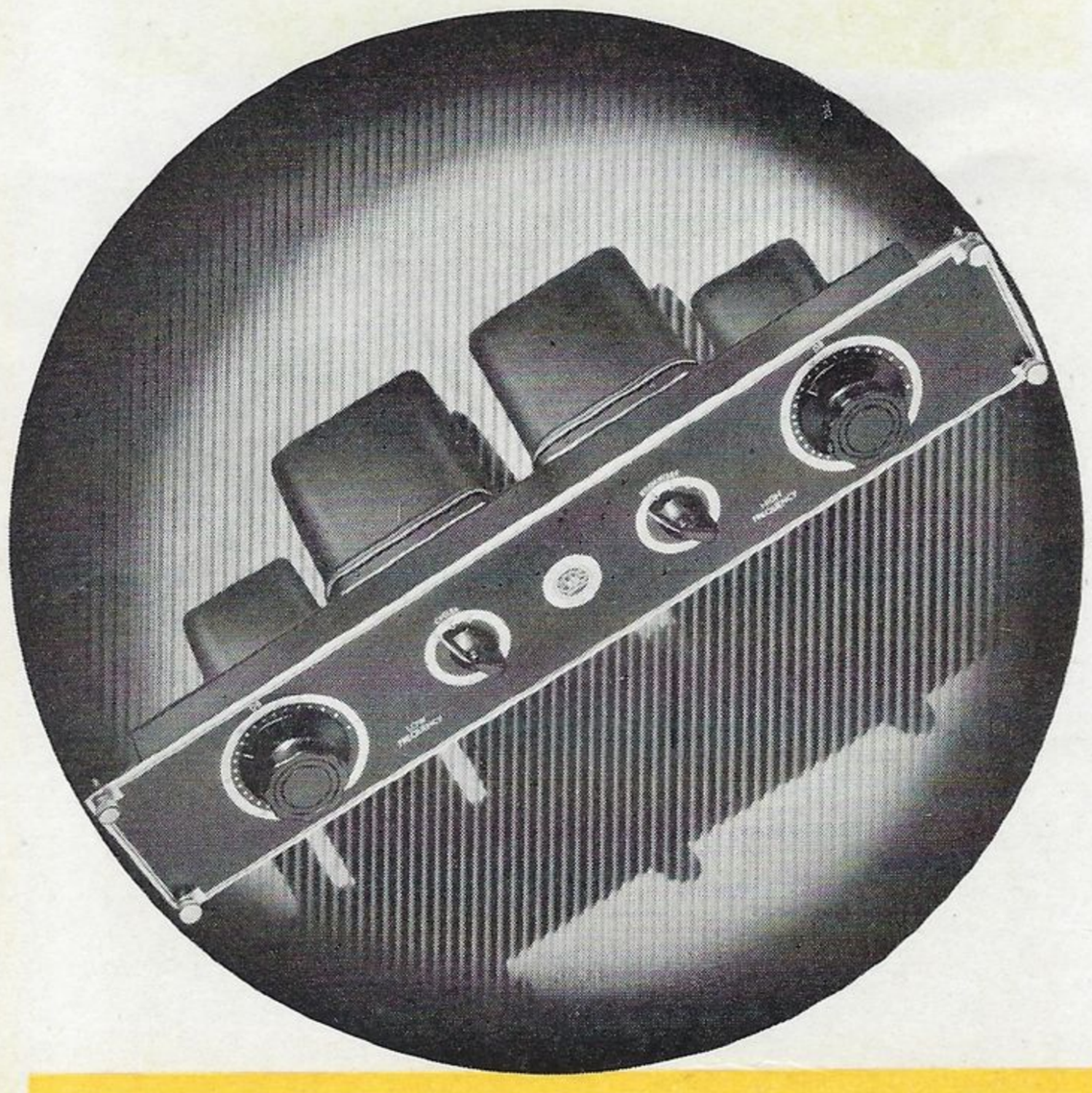


FIG. 8 - THE UTC MODEL 3A EQUALIZER

UNIVERSAL BROADCAST RECORDING EQUALIZER

Model 3A equalizer. This is an accurately calibrated, quickly adjustable combined low and high frequency equalizer. The construction is of the depressed chassis etched panel, rack mount type. Four controls are provided on the panel. The low frequency controls include a switch for adjusting the maximum equalization frequency to 25, 50, or 100 cycles and a calibrated T-pad for exact adjustment of the amount of equalization. The high frequency portion of this unit includes a switch to obtain resonance at 4000, 6000, 8000 or 10,000 cycles, and a similar calibrated control reading directly in DB. This unit is an ideal device for equalizing lines, pickup and recording equipment, due to its flexible nature. Where rapid change-over is required in service from one line to another, or from recording to play back, it is merely necessary to pre-determine the required setting. The actual adjustment of the controls can be taken care of almost instantaneously. Dimensions of panel 3½" x 19". Depth 7½". Net price to broadcast stations or recording studios **$85**

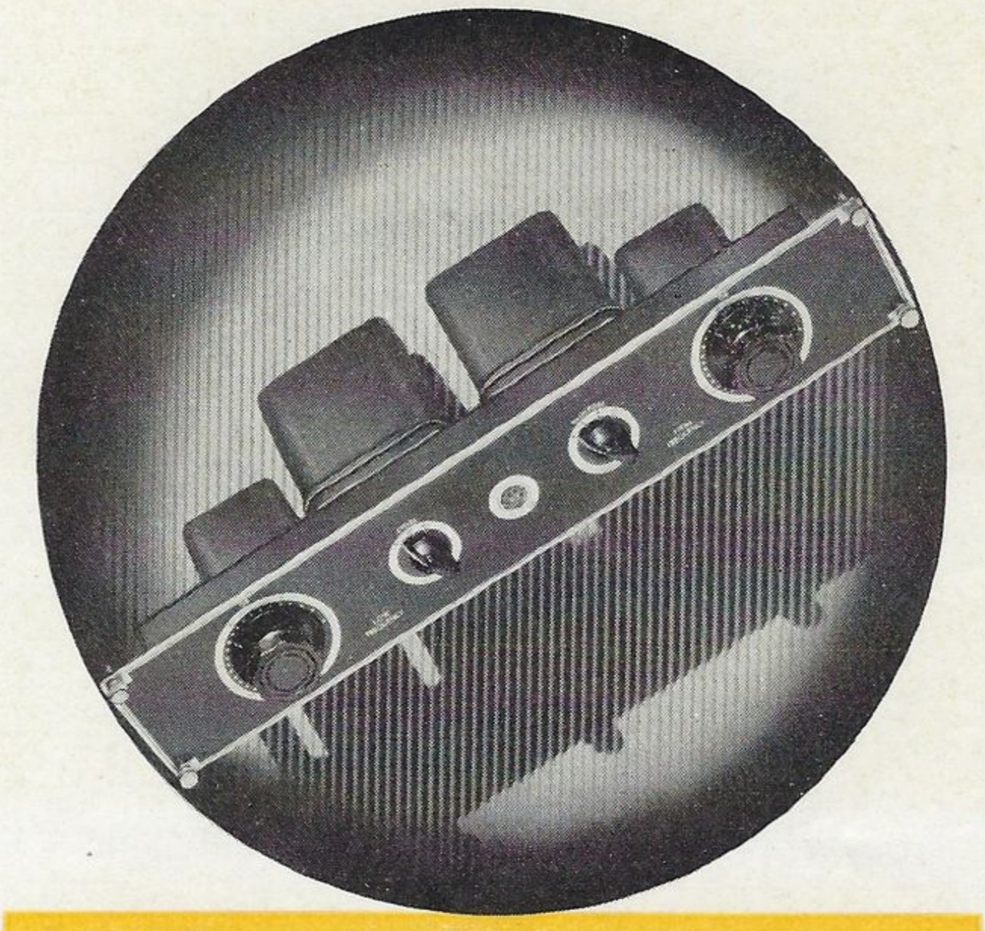
UNIVERSAL ATTENUATOR

Contrasted to the equalization of audio circuits, there are many applications where attenuation is desired. Low frequency attenuation is essential for recording on disc. It is also frequently desirable for dialogue equalization and for compensation of the exaggerated lows or rumbling inherent in some microphones, and under some pickup conditions. Low frequency attenuation is also advantageous in PA and theatre sound systems, to eliminate overloading of speakers and also to add crispness to speech. Hum reduction is naturally obtained at the same time.

High frequency attenuation is advantageous for reduction of scratch, parasitics, and other noises inherent in high fidelity equipment. It is also frequently desirable on musical programs to "soften" or mellow the tone.

UTC has developed a special attenuator of universal characteristics for such service. The model 3-D attenuator has a low frequency control switch by which the cutoff frequency can be adjusted to 100, 150, or 250 cycles, and a high frequency tap switch for 4000, 6000, 8000 and 10,000 cycles. Attenuation controls are provided for both high and low frequency units so that the degree and rapidity of attenuation can be adjusted to the requirements of the particular application. Figure 26 illustrates the curve of this unit with maximum attenuation settings for the various cutoff frequencies.

Dimensions of etched metal panel 3½" x 19"; 7" deep. Net price **$60**



MODEL 3D ATTENUATOR

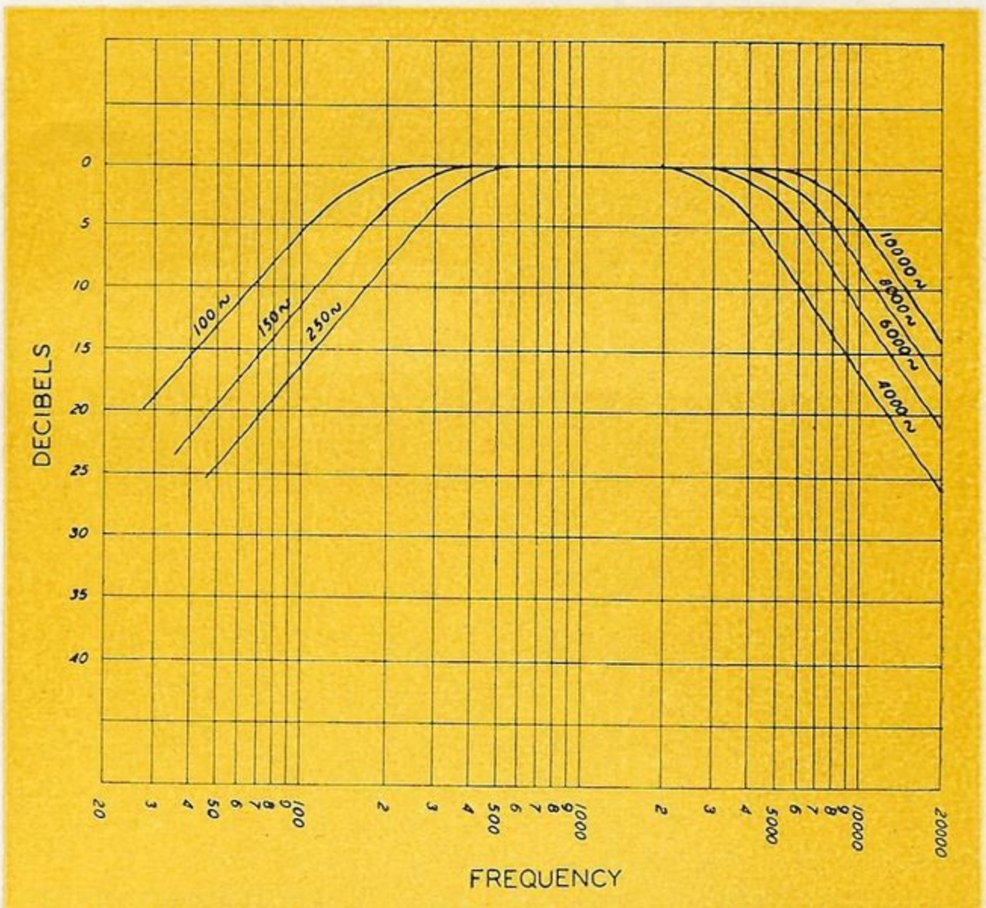


Fig. 26 — Characteristic Curves of Universal Attenuator Model 3D

APPLICATION OF EQUALIZERS

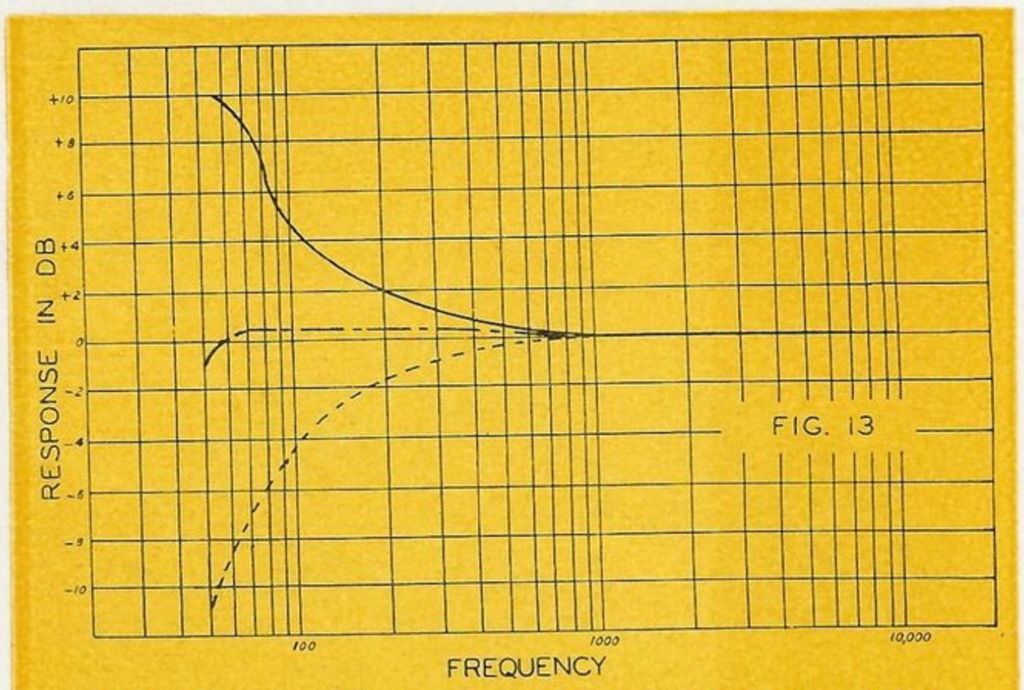


Fig. 13—Equalization of the low end of a typical recording with the model 3A equalizer.

The necessity of these equalizers is not as greatly appreciated on paper as when one actually hears the comparison between normal devices and properly equalized devices. The low end frequency characteristic of a typical recording, for example, may appear as shown in Fig. 13. Properly equalized with the Model 3A equalizer correctly adjusted, the curve of equalization would be as shown in the solid line and the equalized curve would be as shown in the dash line. This resultant is practically linear. Fig. 14 shows a similar application of this equalizer to sound on film recording and the possible resultant curve. Fig. 15 shows another application of the Model 3A equalizer to a telephone line used for broadcast service and the possibilities of correction. There is no doubt that with proper care many low fidelity broadcast or recording units can be sufficiently equalized or compensated to produce almost unbelievable improvement in overall quality.

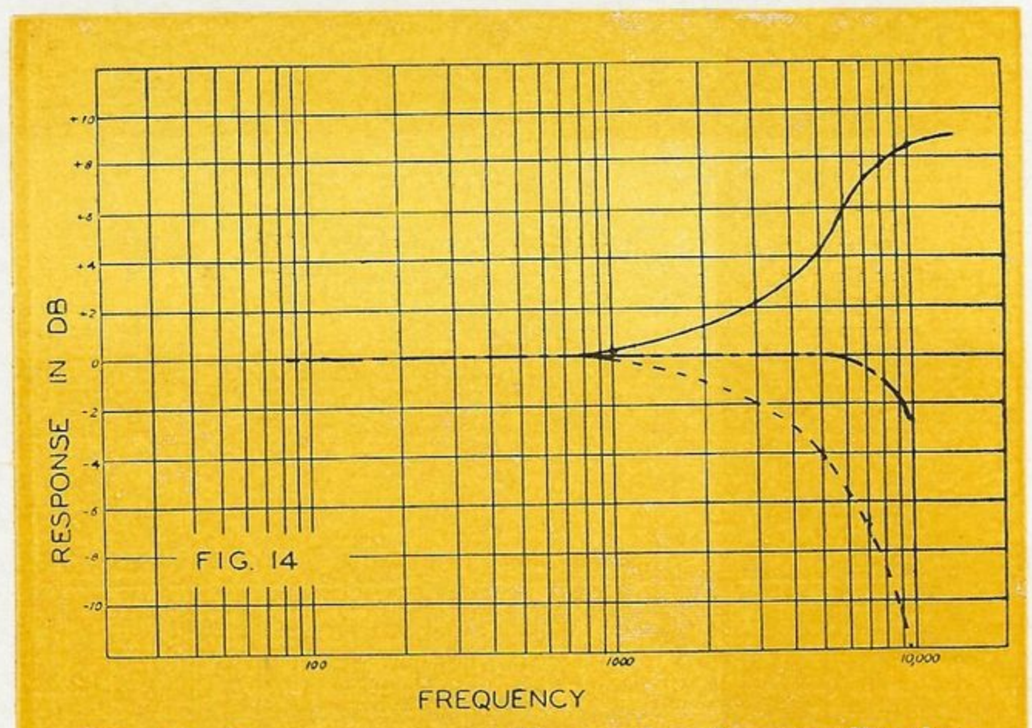


Fig. 14—Response curves illustrating the equalization of a sound on film recording with the model 3A equalizer.

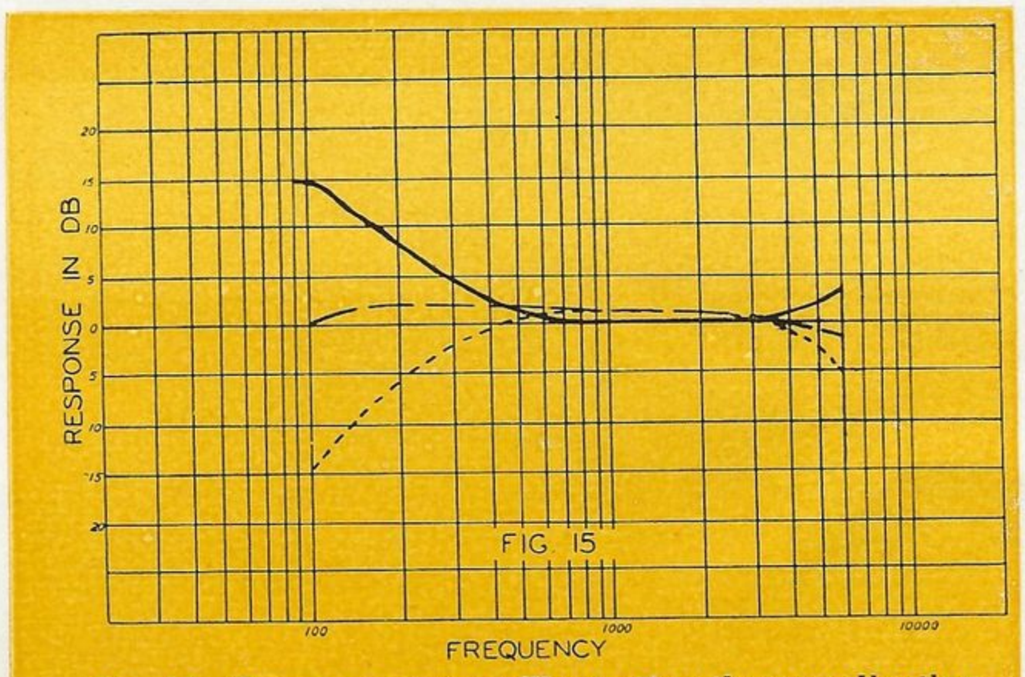


Fig. 15—Response curves illustrating the equalization of a telephone line with the model 3A equalizer.

DIVIDER NETWORKS

Another application of audio equalizers is in the equalization system or divider network used with high fidelity speaker combinations. These combinations are generally classified in two types; the two way system which involves a low frequency and a high frequency speaker with a proper dividing network, and the three way system which incorporates a low frequency speaker or "woofer", a middle range speaker, and a high frequency speaker or "tweeter". UTC manufactures these speaker networks in two types of construction. One is a rack mount construction on a 3½" x 19" standard rack panel similar in appearance to the model 3A unit illustrated in Fig. 8. The other construction is in a simple sheet steel housing designed for BX wiring and for mounting adjacent to the loud speakers. The units are special and designed directly to specifications of the customer.

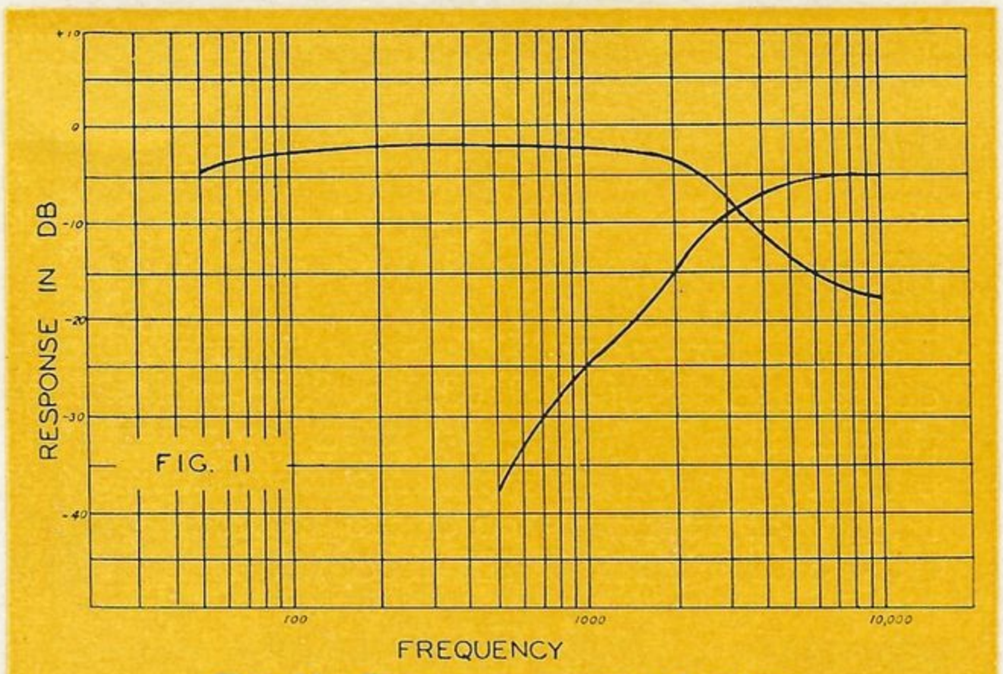


Fig. 11—Response curves of a two way dividing network.

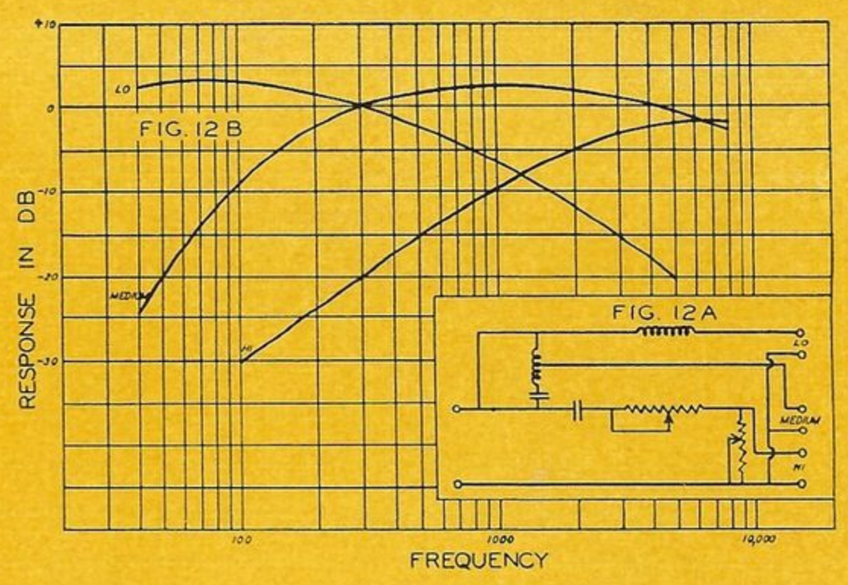


Fig. 12 (a and b)—Schematic and response curves of a three way dividing network.

WAVE FILTERS

In communication work it is often necessary to exclude certain bands of frequencies and permit others to pass and vice versa. There is an infinite variety of variations and combinations possible depending upon the use to which such a device is put. These units are known as wave filters and may generally be classified as high pass, low pass, band pass, or band eliminators. Unless otherwise specified the filters designated are for insertion in a 500 ohm line. Fig. 16 illustrates the frequency response of the HE-813 which is tapped to pass all low frequencies (thus known as low pass) up to 4000, 6000 or 8000 cycles; and to exclude all other frequencies. The HE-814 is a modified type known as an "M" derived wave filter, whose purpose is to provide a sharp attenuation at certain frequencies. The HE-815 is a high pass wave filter designed to exclude low frequencies as illustrated in Fig. 18.

It is often necessary in certain devices to pass only a given frequency under test and exclude all others. These wave filters, designated as band pass filters, are illustrated in Figs. 19, 20, 21 and 22. The attenuation curves for the HE-817 and 819 are for a pure sine wave. If any considerable amount of second harmonic is present, this unwanted frequency will be present in the output. The HE-818 and HE-820 incorporate an additional filter to exclude the second harmonic present in the original wave form.

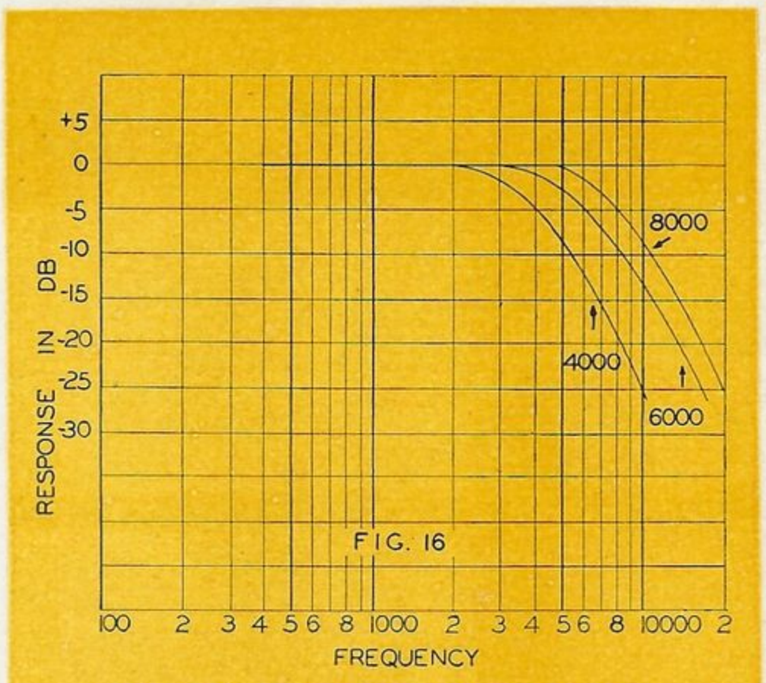


Fig. 16—Reponse curves of the HE-813 low pass filter.

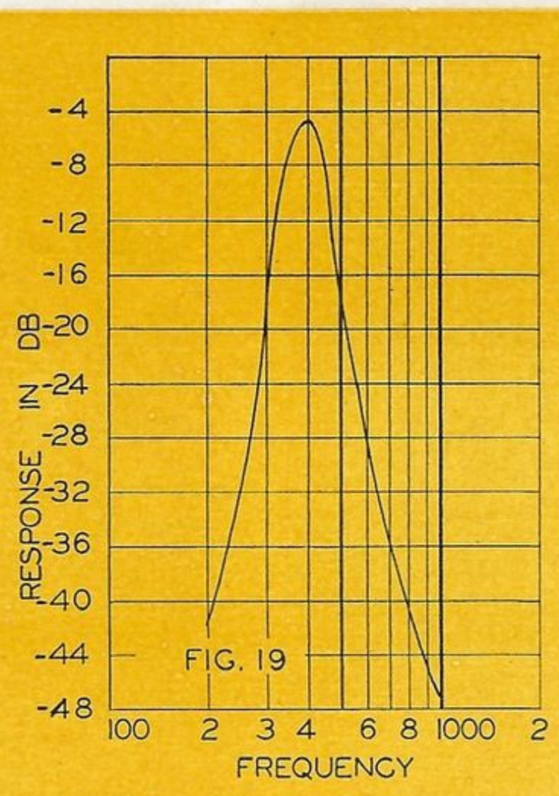


Fig. 19—Typical response curve of the HE-817 band pass filter.

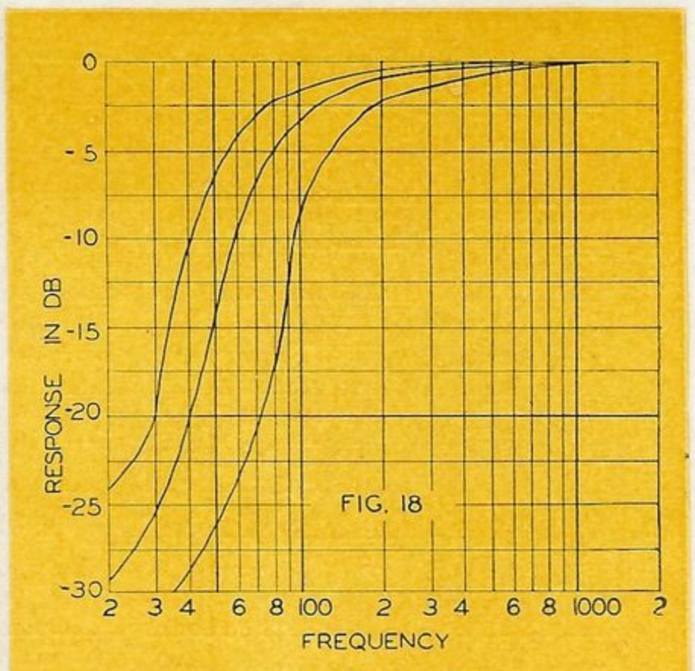


Fig. 18—Response curves of the HE-815 high pass filter.

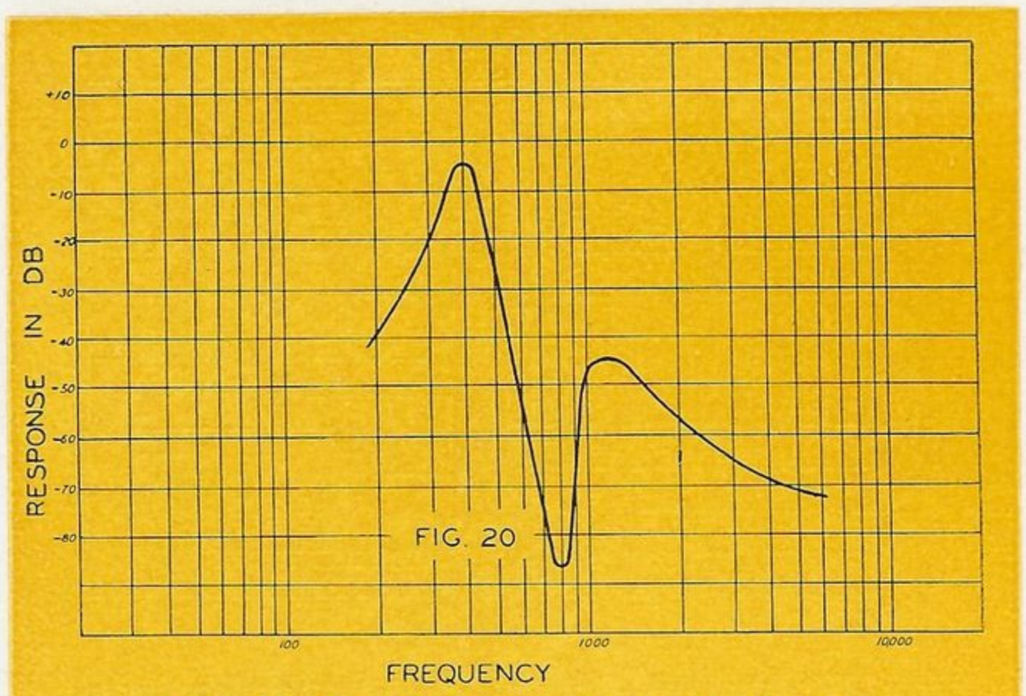


Fig. 20—Typical response curve of the HE-818 band pass filter.

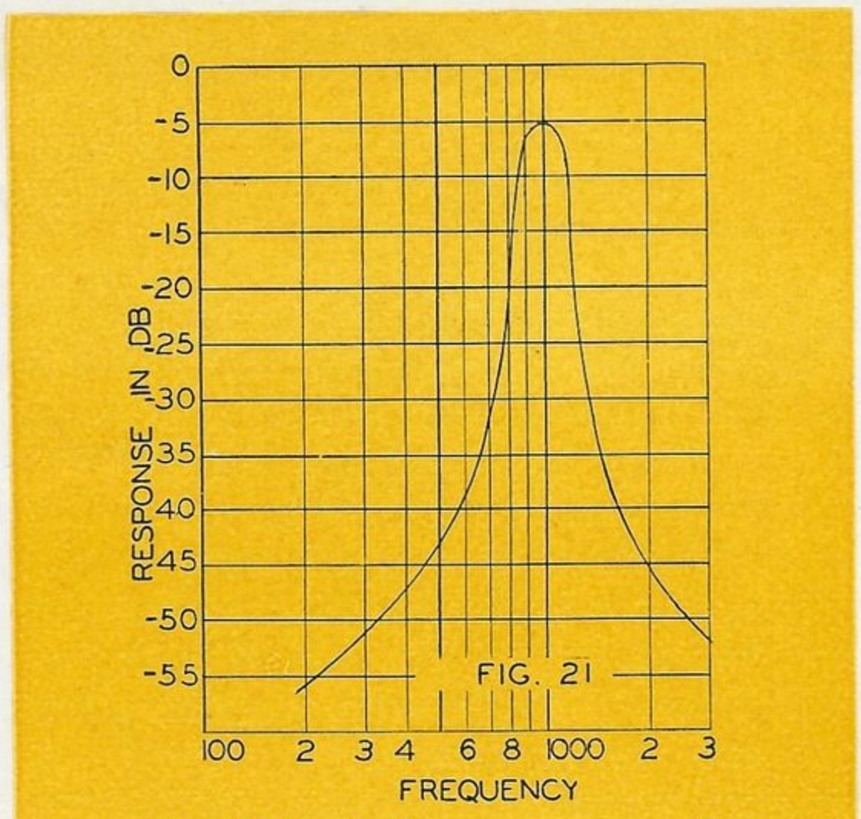


Fig. 21—Typical response curve of the HE-819 band pass filter.

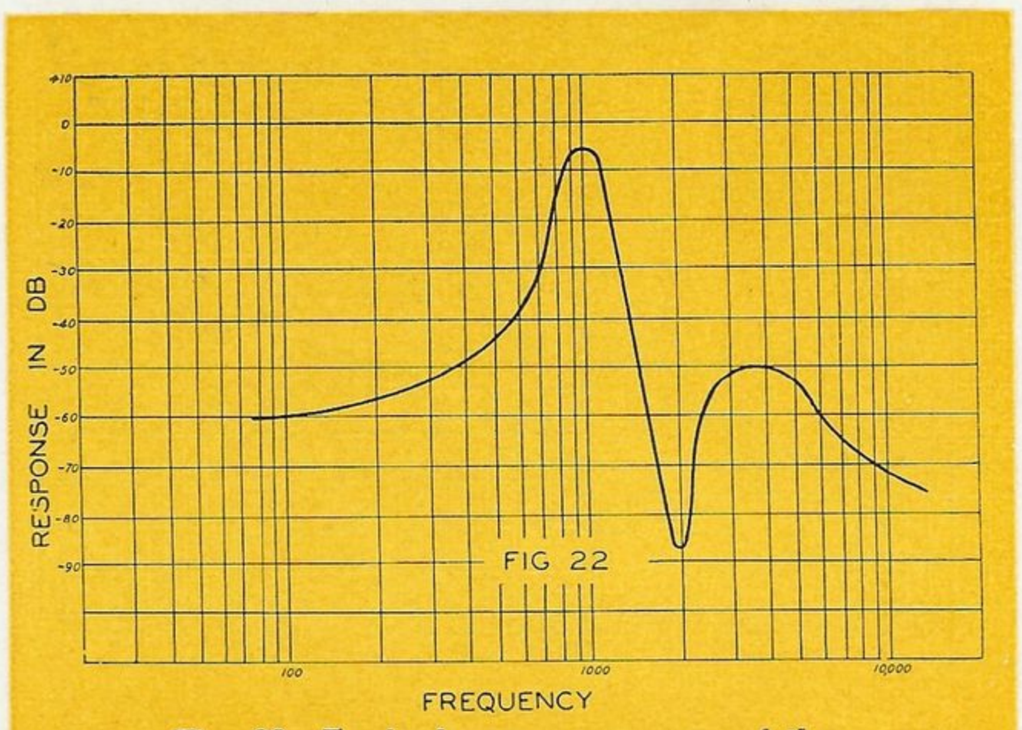


Fig. 22—Typical response curve of the HE-820 band pass filter.

LOW PASS and HIGH PASS FILTERS

HE-813

This is a low pass "K" section filter with cut-off frequencies of 4000, 6000 or 8000 cycles. This simple filter is frequently used for noise suppression in receiver work and for checking the fidelity of receivers or audio devices by the suppression method. HA-1 case. Net **$13**

HE-814

This is a low pass "M" section filter having pass frequencies of 3500, 5000 or 6500 cycles which correspond to cut-off frequencies of 4000, 6000 and 8000 cycles. This type of filter is used quite frequently for suppression of noise in broadcast and recording equipment. This is also ideal for demonstrating the effect of high frequencies in audio fidelity and for suppressing parasitic noises in high fidelity receivers. HA-2 case. Net **$20**

HE-815

This is a high pass "K" section filter tapped for cut-off frequencies of 65, 100 or 150 cycles. The high pass filter has many applications in the audio field. Some of these may be enumerated as follows:

1. Dialogue equalizer for adding crispness and intelligibility to speech by the elimination of unnecessary low frequencies.
2. Compensation for exaggerated lows or rumbling inherent in some microphones, particularly of the velocity type.
3. Elimination of low frequencies in high power, PA and theatre sound systems. By eliminating the low frequencies which are not essential to PA work and to some theatre work, the available power output from the loud speaker equipment is increased tremendously. It is the low frequencies which tend to overload this loud speaker equipment and also tend to have injurious effects on the equipment.
4. Hum elimination is naturally obtained with a filter of this type.
5. Reduction of low frequencies is of prime importance in recording on disc. In these applications, the low frequency amplitude must be reduced appreciably with respect to the middle and high frequencies if it is not to overrun the track. This filter is housed in a HA-3 case. Net **$20**

BAND PASS FILTERS
BRIDGE FILTERS

HE-817

This is a band pass filter having general application to bridge work and wave form analysis. The pass frequency is 400 cycles, the attenuation at 200 and 800 cycles being greater than 40 DB. HA-3 case. Net **$22**

HE-818

This is a band pass filter having a pass frequency of 400 cycles. To increase the effectiveness of this filter in precision bridge work and harmonic analysis, an 800 cycle rejection section is incorporated with the result that the second harmonic is attenuated appreciably more than in the simple band pass structure. HA-3 case. Net **$27**

HE-819

This is a band pass filter having general application to bridge work and wave form analysis. The pass frequency is 1000 cycles, the attenuation at 500 and 1500 cycles being greater than 40 DB. HA-2 case. Net **$22**

HE-820

This is a band pass filter having a pass frequency of 1000 cycles. To increase the effectiveness of this filter in precision bridge work and harmonic analysis, a 2000 cycle rejection section is incorporated with the result that the second harmonic is attenuated appreciably more than in the simple band pass structure. HA-3 case. Net **$27**

BAND PASS—BAND REJECTION FILTERS FOR AIRCRAFT SERVICE

Various forms of blind landing equipment and direction finding equipment require audio filters. UTC specializes in this type of material, and being closely associated with the field, can frequently eliminate many of the difficulties encountered. Write to the UTC Filter Laboratory for technical information.

TYPE BA-189 FILTER

This unique filter was developed by UTC in conjunction with the Department of Commerce for use on their radio ranges for aircraft navigation. The radio beam producing the "On Course" signal was formerly broken into by the pilot in order to establish two-way voice communication. The present system used allows simultaneous voice and beam range by the insertion of this combination band pass and band rejector filter. The beam signal is superimposed on the voice transmission in the land transmitter. The purpose of the filter is to automatically separate the beam signal from the voice range to prevent either half from interfering with the other. The band rejector portion of the circuit eliminates the narrow range of frequencies containing the 1020 cycle signal, allowing the remainder of the voice range to pass through to the pilot's earphones. The indicating device signifying "On Course" is operated by means of the band pass portion of the filter through which only the 1020 cycle signal passes, eliminating the remainder of the voice range.

Through the use of special core materials and new design principles, UTC has developed this unit to an extremely compact and lightweight form. The complete unit occupies a space of only 3" x 3½" x 5" and weighs only 4¾ pounds. In its standard form, it is completely poured with moisture-proof insulating compound to insure permanent stability and dependability.

Price upon application.

Equalizers with built in control are frequently advantageous. Left to right: Special equalizer with built in tap switch—Special equalizer with built in T pad for control — selectable band pass—band eliminator filter made for U. S. War Dept.

SIMPLE INDEPENDENT EQUALIZERS

It is frequently desired to obtain equalization directly in amplifier circuits at the normal high impedances present in such circuits. For amplifier equalization, universal characteristics are not necessary. UTC has developed two equalizers for such service both of which have resonant frequencies at 100 and 7000 cycles. Figure 27 illustrates the curves obtainable from these units with various settings of the controls. The HE-830 equalizer is designed for use in the plate circuit of a standard triode, while the HE-831 is designed to be used in a similar manner in the plate circuit of a pentode voltage amplifier. Both of these units should preferably be operated at levels not exceeding plus 20 DB. These units are strongly recommended for applications requiring a simple equalizer of fixed frequency characteristics.

HE-830 ..... Net **$16**
HE-831 ..... Net **$16**

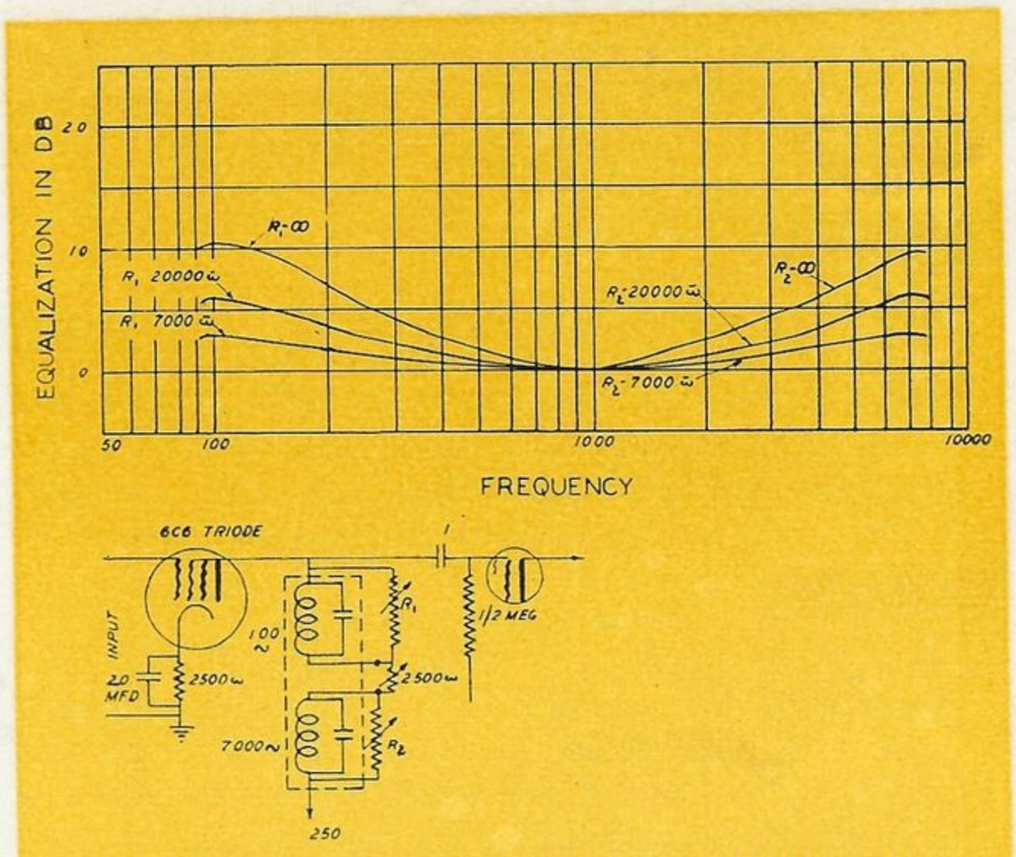


Fig. 27A—Typical Curves Obtainable with Triode Type Resonant Equalizer

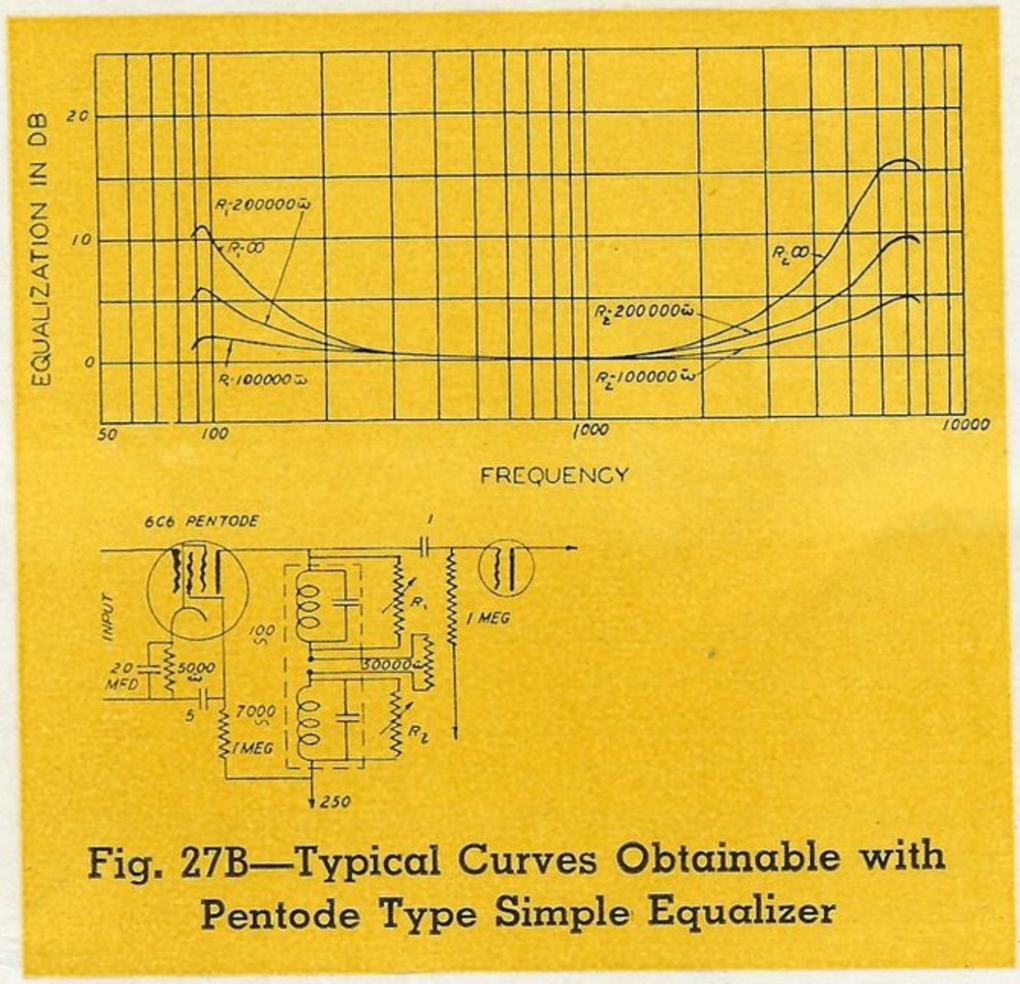


Fig. 27B—Typical Curves Obtainable with Pentode Type Simple Equalizer

VARITONE EQUALIZERS

UTC VARITONE equalizers are simple, inexpensive, units incorporated in a special transformer structure which permits low end, high end, or combined low and high end equalization. These units are not recommended where broadcast fidelity is desired.

VT-1—Primary 500 ohms or 15000 ohms. Secondary to 1 or 2 grids. ..... List price **$8.50**

VT-2—Bridges across 500 ohms or 15000 ohms. No secondary. ..... List price **$6.00**

VT-3—Fixed equalizer—10 DB at 80 and 7000 cycles. 15000 ohms. ..... List Price **$5.00**

VT-4—Similar to VT-2 but with built-in equalization control ..... List price **$6.00**

SOUND EFFECTS FILTERS

The use of filters to obtain unusual sound effects is now finding wide application in broadcast technique in dramatic, comedy, and advertising continuity. The UTC sound effects filter Model 4B was originally developed for the Columbia Broadcasting System and is now used extensively by many broadcasting stations. Sound effects are obtainable with this filter to simulate most distorted acoustic and audio conditions such as telephone, radio receiver, distance, etc. New applications are being discovered continuously by sound effects technicians.

Figure 23 illustrates the appearance of the Model 4B filter. Four controls are provided on the 3½ x 19 inch panel. A switch is provided for the low pass section to obtain cut off frequencies of 500, 1000, 2000, and 4000 cycles. The switch also has an "out" position which cuts the filter out of the circuit. A calibrated pad control is provided to govern the degree and rapidity of attenuation beyond the cutoff frequency. The high pass section is arranged with a similar pair of controls. The frequency switch has taps for 500, 1000, 2000, and 4000 cycles in addition to the "out" position and a calibrated attenuator is provided. Figures 24 and 25 illustrate the attenuation characteristics of both high pass and low pass sections when set at maximum attenuation.

The universal characteristics and calibrated panel of the Model 4B filter are of inestimable value. In addition to taking care of practically every application to which a unit of this type can be applied, the settings can be predetermined and obtained instantaneously as required. Net **$70**

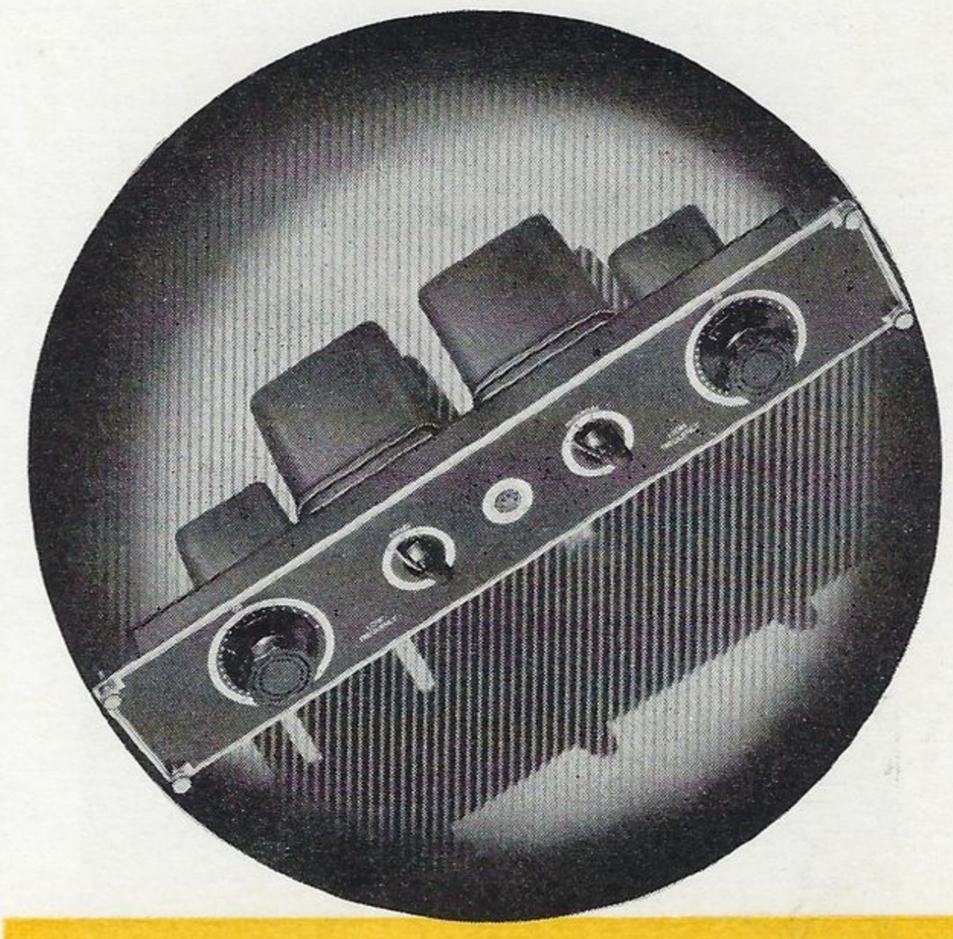


Fig. 23—Model 4B Filter

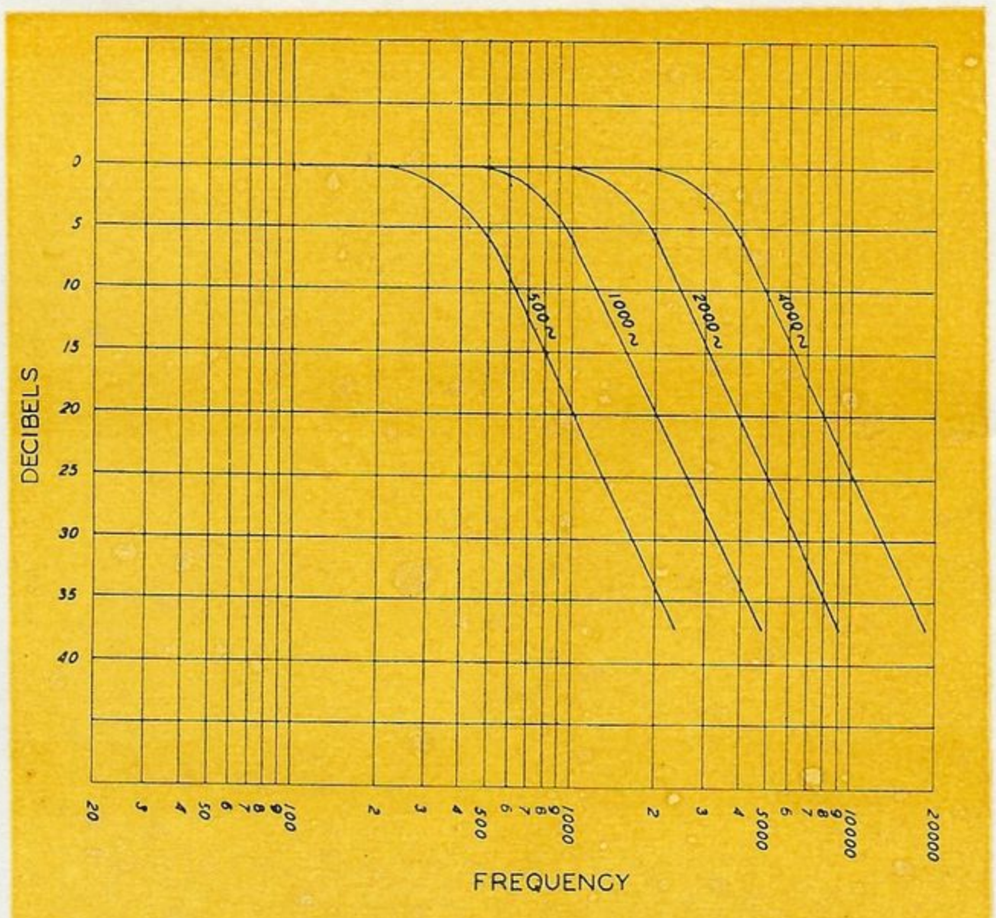


Fig. 25—Low Pass Characteristics of Sound Effects Filter

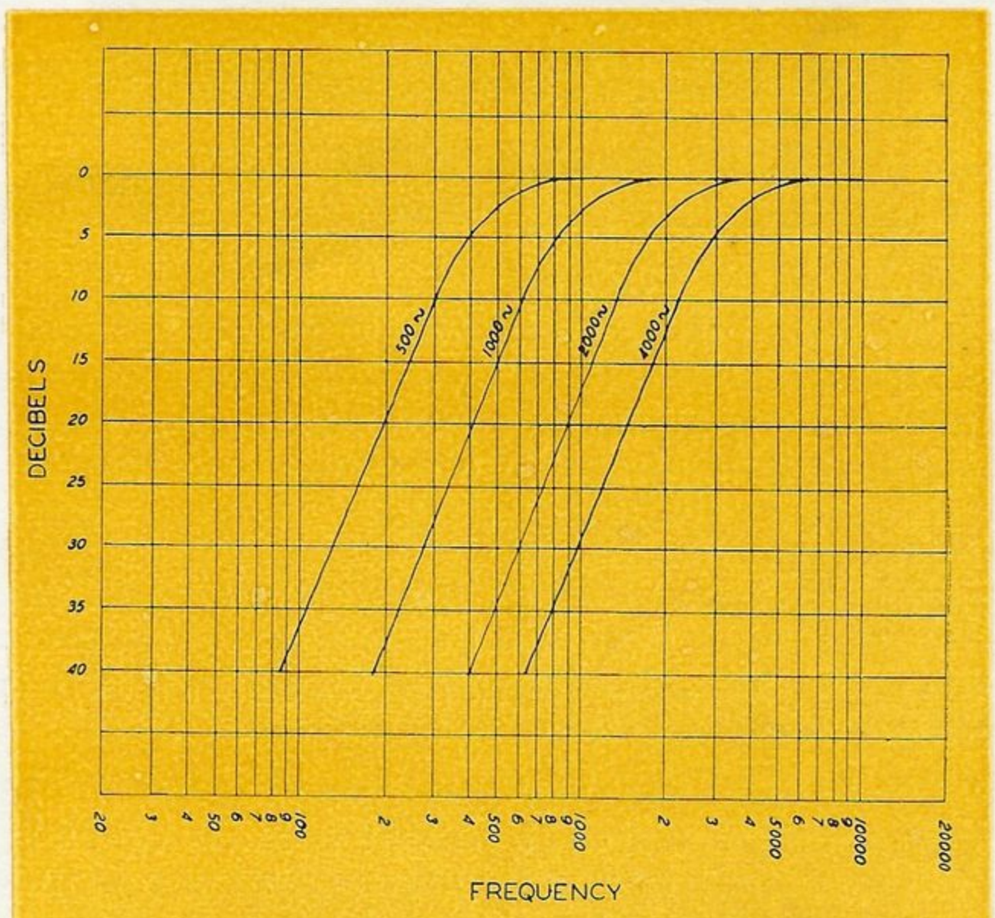
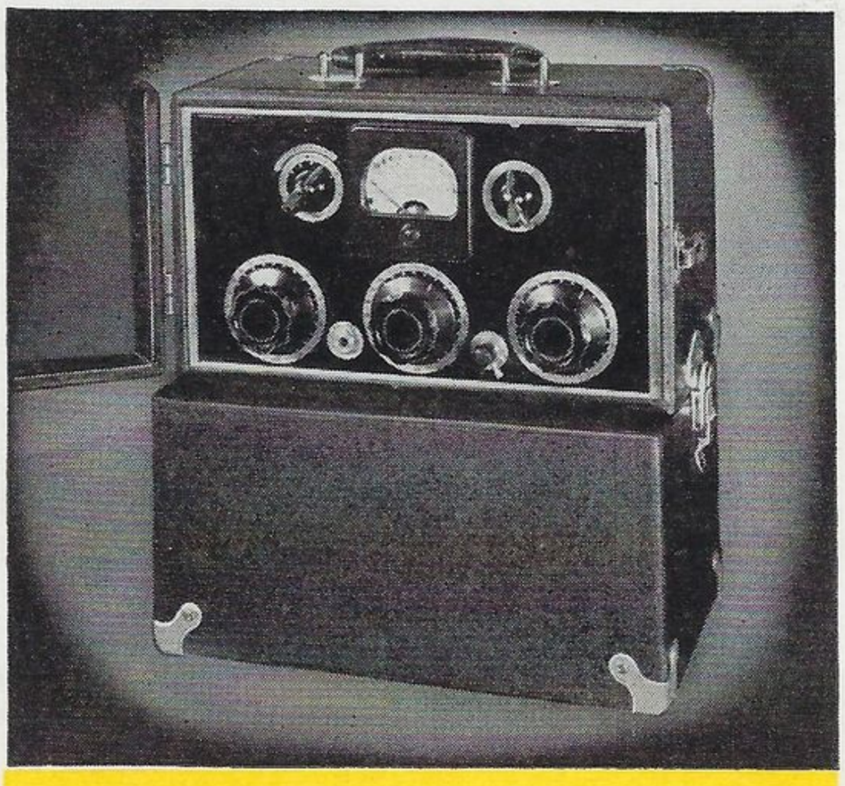


Fig. 24—High Pass Characteristics of Sound Effects Filter

REMOTE AMPLIFIERS

The past few years have shown a marked increase in nemo or remote pickup broadcast service. UTC has developed the model 2-A remote amplifier as an ideal unit for such service. The unit consists of three major portions; the mixer circuit, the audio amplifier and the AC power supply.

The mixer circuit of the model 2-A amplifier is unique in the fact that two separate primary windings are provided on the input transformer. Each of these primary windings is electro-statically shielded and arranged for series or parallel connection so that 30, 50, 200 or 250 ohm impedance can be obtained. A mid-point is obtainable only on the 200 or 250 ohm arrangement.



MODEL 2A—REMOTE AMPLIFIER

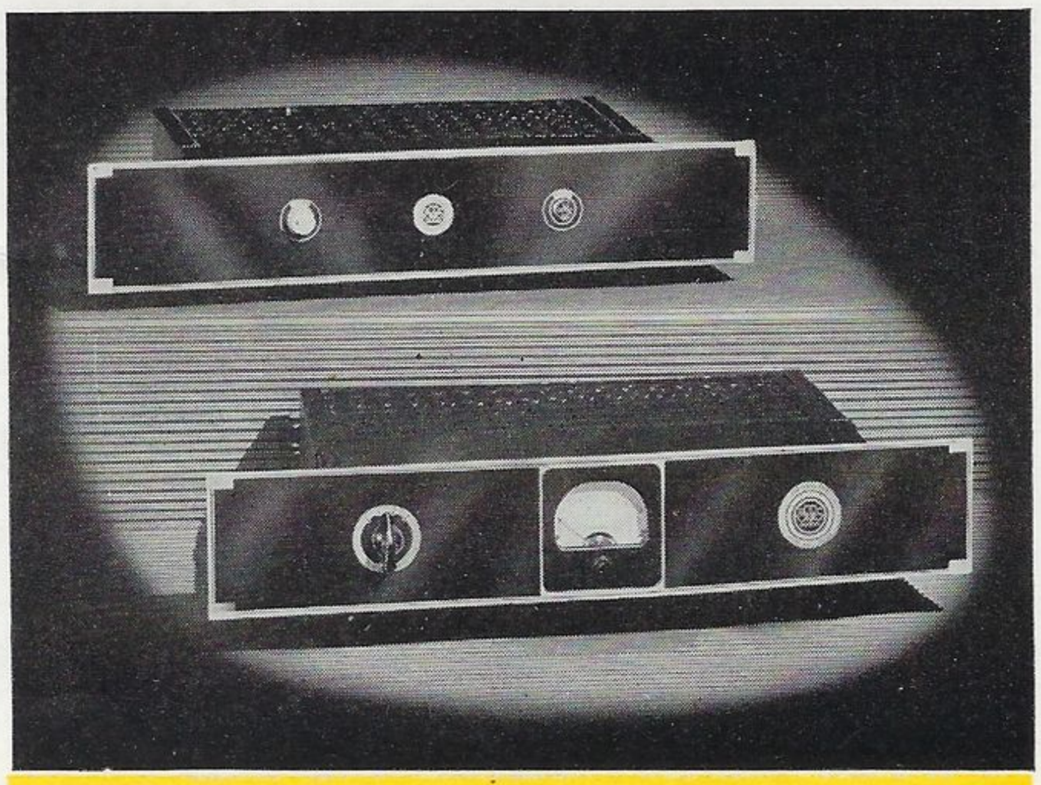
The use of individual windings permits the individual pads to be chosen in accordance with actual needs. In other words, a two position mixer might consist of one 50 ohm pad and one 250 ohm pad, or two 250 ohm pads. The input transformer incorporates UTC tri-alloy shielding so that hum pickup is at an absolute minimum. The use of a high level master gain control assures low noise level as amplifier noise is reduced in the same ratio as the incoming signal.

The four stage audio amplifier provides 95 DB gain and has output impedances of 50, 125, 200, 250, or 500 ohms. The frequency response is uniform from 40 to 15,000 cycles and where desired, some line equalization can be obtained by operating the 200 ohm output impedance into a 500 ohm telephone line. The harmonic content is under ½%. The noise level is approximately 60 DB weighted below the maximum output of plus 7 DB.

The construction and wiring of this unit is extremely simple and shielded throughout, so that there is no possibility of picking up RF or similar interference in noisy locations. A standard Weston volume indicator meter with special modifications is employed for checking the individual plate currents of the four tubes. It also operates as a volume indicator in the final switch position.

The power supply for the model 2-A amplifier must have an output of approximately 200 V. at 8 ma. and 6.3 V. at 1.2 a. In its standard form, an AC power supply is provided in a separable box so that the audio and power sections may be spaced at some distance. In locations where AC is not obtainable, the AC power supply can be removed from the power supply box and batteries used instead, or if desired, a spare box with batteries can be maintained so that any model 2-A amplifier can be changed from AC supply to battery supply almost instantaneously.

The construction of the 2-A amplifier is extremely compact, the overall dimensions including power supply, being 8 x 14 x 16 inches. The total weight is only 27 pounds. It is supplied wired and calibrated including tubes, pads, and AC power supply. When ordering specify input impedance for pads. Standard models are supplied with plugs. Where required, Cannon or other plugs can be supplied at slight additional cost. Net **$160**

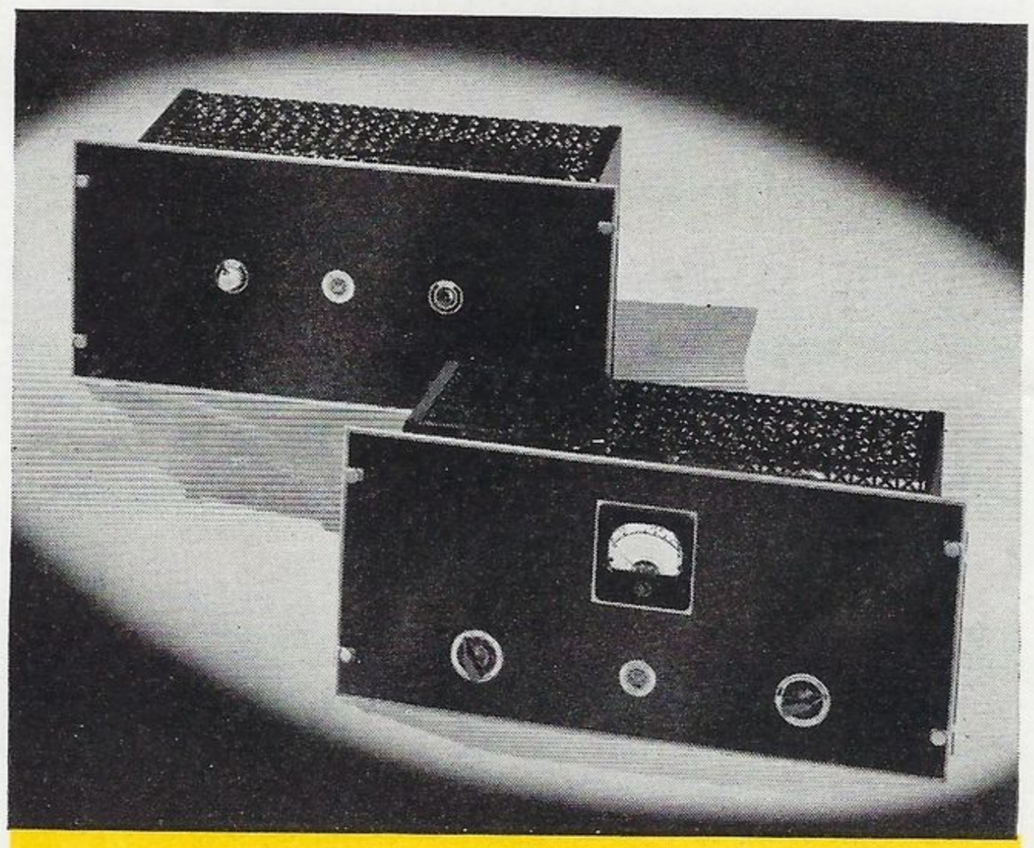


STUDIO PREAMPLIFIER

STUDIO PRE-AMPLIFIER

The UTC 5A-6A pre-amplifier is designed to the best broadcast standards for studio service. Through the use of tri-alloy shielding on the input transformer, and extremely fine filtering in the power supply, the hum level is practically negligible. The noise level is approximately 60 DB weighted below the maximum output of plus 7 DB. The frequency response is uniform from 30 to 14,000 cycles.

Both input and output transformers on this amplifier have universal line windings which can be accommodated to 50, 125, 200, 250, or 500 ohms. The audio amplifier is arranged so that either 1, 2, 3 or 4 stages can be used with respective gains of 25, 50, 73 or 95 DB. The audio amplifier employs a single Weston meter with a tap switch to check the plate current of all tubes individually. The power supply is provided with a pilot light and a fuse which is readily replaceable from the front of panel. The appearance of the 5A-6A pre-amplifier is very attractive and similar to the other UTC broadcast products. Etched panels are used, having dimensions 3½" x 19". This unit is supplied wired and calibrated including tubes. Net **$125**



7A-8A HIGH FIDELITY AMPLIFIER

STUDIO MONITORING AMPLIFIER

The UTC model 7A-8A studio amplifier has been designed for audition and monitoring service, or for home radio service, where the absolute maximum in fidelity is desirable. It is also suitable for driver service for 100W. or 250W. broadcast stations.

Three push pull stages are used, all transformer coupled. The first two stages employ 6C5 or 6C6 triode tubes. The output stage can be arranged for either 2A3 or 300A tubes. The power output is 15W. The gain is 85 DB with noise level 60 DB weighted below maximum output. The frequency response is uniform from 30 to 14,000 cycles.

The input transformer used has primary impedances of 50, 125, 200, 250, and 500 ohms. The output transformer can be altered to suit the particular requirements of the user. Standard transformers are available for driver service, for broadcast line and universal voice coils, or for high impedances up to 6,000 ohms, simultaneously with the voice coil windings.

A meter and switch is provided on the audio panel to check the plate current of the first stage, second stage and the individual tubes in the output stage. A control is provided in the output stage to balance the plate current of the output tubes. This is extremely important in high power output stages to effect a minimum of hum and distortion. The power supply panel incorporates a readily replaceable pilot light and fuse. These units are finished in the UTC attractive etched metal panels with dimensions 8¾" x 19". The model 7A-8A unit is supplied complete, wired and calibrated with 2A3 tubes. Net **$160**

The UTC model 7AX amplifier is identical to the model 7A-8A unit, except for the output tubes. Four 2A3's can be used in the output stage, providing 30W. of undistorted power or four 300A's can be provided which will afford 50W. of audio power. This amplifier is an ideal driver for 500W. class B stages and for all high power PA functions. Panel size and other details as above. Net..... **$220**

MOST COMPLETE TRANSFORMER LINE IN THE WORLD

UTC LINEAR STANDARD COMPONENTS*

UTC Linear Standard components are ideal high fidelity units for broadcast and recording service. The frequency response is guaranteed uniform from 30 to 20,000 cycles, and the shielding and insertion loss is maintained at extremely low values. These units are unequalled for studio and speech input equipment.

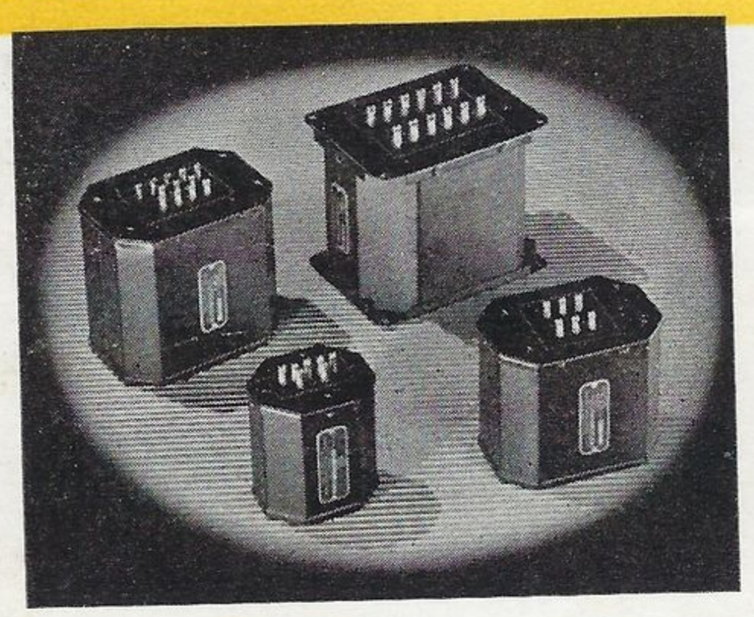
UTC HIPERM ALLOY COMPONENTS*

UTC Hiperm Alloy Components are similar to the Linear Standard units but of a more compact design and employ a light-weight high conductivity case so that these units can be employed for portable and compact service. They are used extensively in recording and remote pickup equipment.

ULTRA COMPACT HIGH FIDELITY AUDIO UNITS*

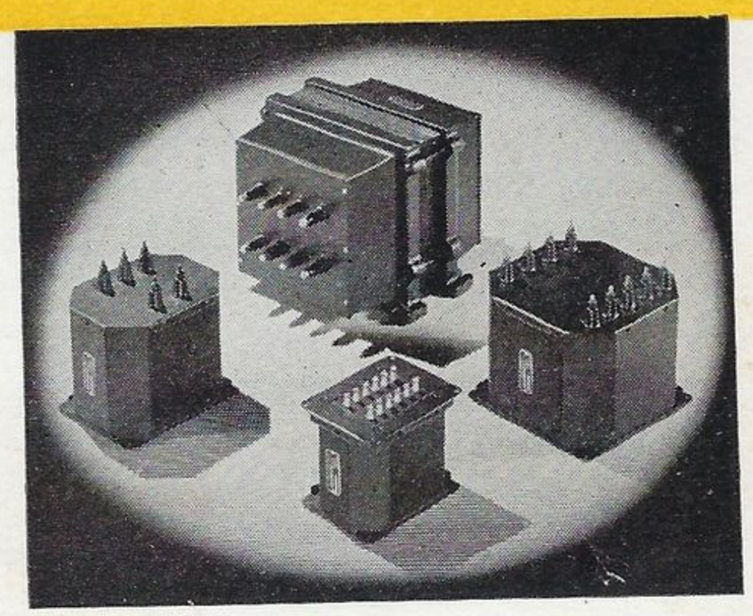
The UTC ultra compact audio units are extremely small and weigh only 5½ ounces. The fidelity however, is excellent, the frequency response being uniform ±2 DB from 30 to 20,000 cycles. These units are ideal for remote pickup equipment and similar applications where both weight and size are paramount factors.

UTC PUBLIC ADDRESS COMPONENTS



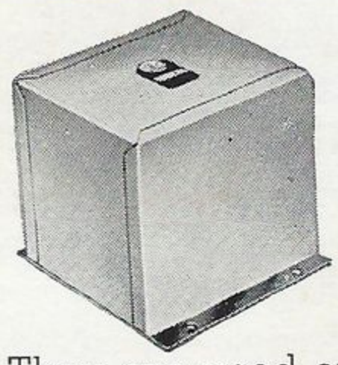
The Public Address series of units is a popular priced line having medium fidelity. A complete line of input, output and power components is provided, suitable for every public address and amateur transmitting function. Units of this class are used extensively by commercial communications companies for service where broadcast fidelity is not essential.

UTC VARIMATCH TRANSFORMERS



The UTC VARIMATCH transformers consist of a series of driver and output units for every transmitting and P. A. application. Through a unique coil arrangement a very wide range of impedances is obtainable. Obsolescence is practically eliminated with these units, inasmuch as any one unit will match any tubes within its power range.

UTC CHROMSHIELD TRANSFORMERS



The UTC CHROMSHIELD transformers are a group of very inexpensive units designed to take care of all P. A. and transmitting functions. These units are vacuum treated and poured in chromium plated cases of uniform appearance. They are used extensively where price is a paramount factor, in both commercial and amateur equipment.

UTC REPLACEMENT TRANSFORMERS

UTC replacement transformers are available for every type of manufacturing and service requirement. Audio units, filter chokes and filament transformers are available in regular channel mounting. Power transformers are available in flush or vertical mounting with and without shells.

UTC AMPLIFIER KITS

A complete series of amplifier kits is available in the UTC P. A. grade from .1 watts to 250 watts output. These units incorporate dual mixers, VARITONE tone control and many other unique features. They are used extensively for both P. A. and amateur transmitter applications.

*** Full details are incorporated in this bulletin.**

Write to Technical Division—U.T.C.—72 Spring St., N. Y. C., for catalogues on any of the above items not described in this bulletin.

BELIEVE IT OR NOT

WITH APOLOGIES

UTC's leadership in transformer design is substantiated by the fact that some of the largest commercial organizations turn to UTC with their special transformer problems. Some of the more interesting units recently made by UTC for such organizations are almost in the "Believe It or Not" class.

One organization* required a 60,000 AMP. transformer in a space approximately seven inch cube. Ever other supplier contacted said "Impossible."

UTC MADE IT.

One of the important elements in the "U. S. Safety in the Air" program involved a special filter for use on planes. The excessive weight of this filter made the system impractical.

UTC, however, reduced the weight from over thirty pounds to 3¼ POUNDS.

The use of high carrier frequencies for special communication service made necessary high power amplifier equipment for test service.

UTC designed the amplifier equipment for one organization* and supplied the audio transformers for service up to 100,000 CYCLES.

Hum pickup on portable amplifiers and pre-amplifiers was the bugaboo of one communications organization.†

They are now buying UTC because, as their Engineering Department stated, "We wouldn't have believed it possible if we hadn't actually made complete laboratory tests." The input transformers supplied to this organization weigh only eighteen ounces, have a frequency characteristic uniform from 30 to 14,000 cycles, and a hum pickup 90 DB lower than similar units of standard construction.

A special carrier frequency problem encountered by one company,** required a high power, air-cooled, audio transformer with 30,000 VOLTS insulation and frequency response good up to 150,000 CYCLES.

A unique transformer winding licked this problem.

A complete group of speech input and remote pickup amplifiers manufactured by one company,¶ were not usable due to high hum level.

UTC suggested the use of the LS-10X (tri-alloy shield) input transfomer, which eliminated the problem completely.

One of America's foremost radio comedians wanted to imitate the voice of America's foremost news announcer on his program.

The UTC 4 B sound effects filter made the job perfect.

TO OUR KNOWLEDGE

* The largest research organization in the world.

† Largest radio receiver organization in the world.

** Largest radio communications company in the world.

¶ Largest electrical manufacturer in the world.

INDEX

LINEAR STANDARD

AUDIO TRANSFORMER INTRODUCTION — Page 3-4-5-6
Line to Grid Transformers — 7
Mixing Transformers — 7
Matching and Bridging Transformers — 8
Interstage Transformers — 8
Driver Transformers — 9
Output Transformers — 9-10
POWER EQUIPMENT INTRODUCTION — 10-11
Plate Transformers — 12
Power Transformers — 13
Filament Transformers — 13
FILTER DESIGN — 14
Filter and Modulation Reactors — 15

HIPERM ALLOY

Complete Listing — 16-17

ULTRA COMPACT

Complete Listing — 18

VARITRAN

Complete Listing — 19

VARIACTORS

Complete Listing — 20

CHARTS

Watts/DB — 21
L/C/X/F Chart — 22-23
Voltage Ratio and Power Ratio/DB — 24
Voltage, Current and Impedance/DB — 25
Acoustic Levels — 26
Attenuation Network Data — 27
Voltage % of Fundamental/DB — 28

AMPLIFIER CIRCUITS

AC Pre-Mixer — A
Microphone Pre-Amplifier — A
Program Amplifier — B
Monitoring Amplifier — B
Audition-Driver Amplifier — C
100 Watt Amplifier — C
250 Watt Modulator — D
1000 Watt Modulator — D

EQUALIZERS

Simple Equalizers — 31
Resonant Equalizers — 32
Recording Filters and Equalizers — 33
High Q Equalizer Coils — 34-35
Universal Equalizer — 36-37
Universal Attenuator — 37
Wave Filters — 39
Low Pass and High Pass Filters — 40
Band Pass Filters — 41
Aircraft Filters — 41
Simple Independent Equalizers — 42
Sound Effects Filters — 43

AMPLIFIERS

Remote Amplifier — 44
Studio Preamplifier — 45
Main Amplifier — 45

UTC's leadership in the transformer field is readily indicated by the great number of commercial organizations who are satisfied users of UTC products. Among these are such organizations as RCA, Western Electric, General Electric, Western Union, Columbia Broadcasting System, U. S. Army, U. S. Navy, U. S. Department of Commerce, etc. Due to the specialized nature of high fidelity audio equipment, a large number of requirements are encountered where stock units are not suitable. If you have a problem along these lines write to the UTC Engineering Staff.

UNITED TRANSFORMER CORP.

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