OCTOBER, 1954

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# AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

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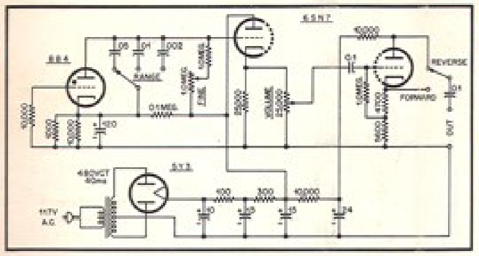


*The advantages of square-wave testing have been described by many authors, but the use of sawtooth waves is less known. A simple generator, such as the one above, will provide a signal source which can be fed to an amplifier and the output can be viewed on an oscilloscope. This author tells how the sawtooth signal can be interpreted to give reliable data on both high- and low-frequency performance.* See Testing with White Sound, *page 41*




# A Laboratory Reference Standard Loudspeaker System

DANIEL J. PLACH* and PHILIP B. WILLIAMS**

**Design considerations for a loudspeaker suitable for high-quality monitoring applications in broadcast and recording studios, as well as for the discriminating listener who demands the optimum in performance and aural realism.**

THE EAR IS A MECHANISM of relatively short "memory." It cannot record impressions accurately enough for close comparisons of audio reproducing systems if much time elapses between auditions. The most thorough and time-saving method of contrasting the sound qualities is to switch frequently between systems during the test.

A need was felt at our laboratory for a complete reproducing system which would constitute a standard of comparison for evaluation of speakers during design and development. In addition to the more ordinary requirements for response, distortion, smoothness, and so on, these performance factors were assigned paramount importance:

(1) Pure bass output to 35 cps, even at high operating levels, and at such efficiency as to require *no bass boost* in the amplifier.

(2) Elimination of colorations or spurious sounds.

(3) Uniformity and smoothness of output over the entire range, in such degree that with high-quality source material, no external electrical equalization would be required.

No restrictions were placed upon cost or on the components to be used. The number of channels incorporated in the complete unit was to be determined from extensive theoretical considerations and aural analysis of the practical results.

The evolution of this new speaker system has been accompanied by a growing realization of the uses for which it is eminently suitable. An intrinsically uniform sound reproducer can be of primary importance in analyzing recorded or reproduced sound in many phases of audio and associated industries.

### Design Considerations

It is generally realized that the extreme ends of the audible sp-ctrum are most difficult to reproduce. Furthermore, the requirements for high- and low-frequency speakers are incompatible. At low frequencies the excursions of a diaphragm are large and require large cones. These large amplitudes involve special designs to reduce distortion that may arise from nonlinearities in the suspension system or flux field surrounding the voice coil. Generally, a low resonant frequency is desirable to place distortion products at low frequencies where they are less objectionable to the ear. This last factor necessitates the use of compliant suspension and heavy moving-system mass.

While some similar problems occur in high-frequency units, they are not so pronounced, since amplitudes are small. The problem in maintaining good high-end performance is to minimize the effective mass of the moving system, and in the case of horn speakers to maintain small clearances between diaphragm and sound chamber. Additional complicating factors are the need for good spatial distribution and smooth response.

It is generally conceded now, however, that there are few occasions when treble boost is required in a reproducing system with an effective top-end tweeter and with record equalization. On the contrary, an efficient tweeter often must be padded down to avoid over-brilliance or to reduce noises inherent in the program material.

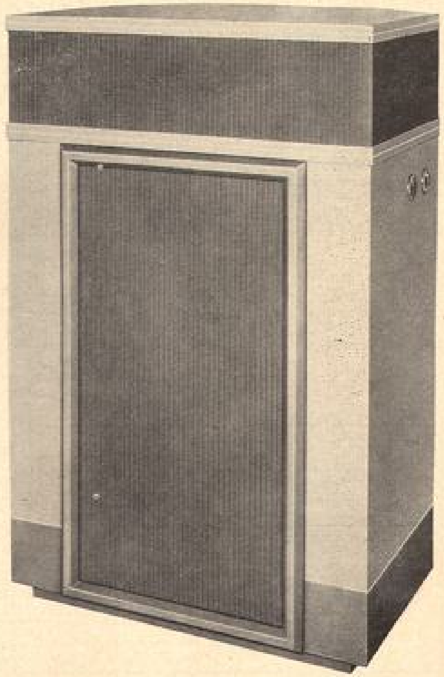

**Fig. 1. The Jensen Laboratory Standard Loudspeaker, Model RS-100.**

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With a flat high-frequency response, experience has shown that high-end boost is rarely necessary, if ever. This can be attributed to the Fletcher-Munson effect, in that the ear is less sensitive to change in response with respect to level variations as compared to effect of such change at low frequencies.

With many speaker systems, liberal use is generally made of the bass boost controls, especially when: listening level is disproportionately low, woofer is inefficient, improperly matched, or not housed so as to get the most from its capabilities, or program material is deficient in bass, due to poor pickup or recording.

A common misconception about speakers is that a big efficient speaker in an infinite baffle, driven by an amplifier with high damping factor is the ideal combination. Severe over-damping of the speaker can give as much as 10 to 12 db loss at the speaker resonant frequency. There is no advantage in exceeding critical damping by using too low an amplifier internal impedance. To the contrary, there is some preference for slight under-damping in the interest of better attack time. Under high damping conditions, a bass-reflex enclosure gives considerable improvement over a total enclosure even when the latter is large enough to be considered infinite in size for all practical purposes. Properly designed horn loading, of course, gives the best low end output and performance.[1]

Boosting bass in the amplifier to compensate for insufficient speaker output has several drawbacks. The woofer cone has to move further, and may reach a condition of overloading. Harmonic and intermodulation distortion to a serious degree may be found when 10 to 12 db of bass boost is used. Under conditions of high bass boost, an amplifier is severely limited in average power output before it becomes overloaded—and the overload is maximum at the low frequencies where amplifier performance is necessarily the poorest. When the happy combination of reducing both the power output of the amplifier and woofer cone movement can be achieved, important gains in sound quality are found. The closest approach to the ideal condition at this stage of the art comes with use of a well-designed woofer-horn system in which these elements are optimally matched together to take advantage of complementation of physical and acoustical factors.

Highly damped speakers in closed boxes or infinite baffles do not emit bass sound equivalent to that of the original pickup unless some amplifier bass boost is used. There are already too many losses in the recording-playback system to allow much additional loss in the speaker. The pickup microphone may have a drooping low end, especially where tailored to favor speech. Records have definite groove limitations, although equalization is intended to compensate by a boost in the preamplifier. Pickup cartridges usually have some loss at extreme low frequencies. If these other transducers are not perfect—as they are not at this stage of the art—it is doubly important to gain low end efficiency where it is still possible—in the loudspeaker system.

[1] D. J. Plach and P. B. Williams, "Horn loaded loudspeakers." *Radio and Television News*, May, 1952.

### The New Model

In this unit, the utmost planning, designing and auditioning of various combinations and designs have given a reproducing system which comes close to the ultimate goal of speaker designers—to reproduce sound exactly equivalent in proportion and timing to the original sound-produced electrical energy. Final testing has been done over a considerable period of time both in the laboratory listening and measuring rooms and in living rooms of well known audio experts before large and varied audiences. This extensive auditioning with microgroove records, tape recordings, FM and AM programs, has shown that bass boost has been called for only on rare occasions—no more, actually, than the instances in which some bass drop would be acceptable, or even desirable for optimum balance as judged by the ear. The new Laboratory Reference Standard loudspeaker, RS-100, is an integrated system based upon the solid foundation of optimized and intermatched elements and components selected, and modified where necessary, to deliver as close to flat total sound output as the state of the art permits. Painstaking attention to sound character and cleanness of quality has resulted in a unit which can be listened to for long periods of time without aural fatigue or consciousness of distracting self-generated sounds. This loudspeaker is pictured in *Fig. 1*.

This superb performance has been achieved with an articulated triple-channel system completely horn loaded. Choices of the midchannel, and to a lesser extent the high-channel units, were dependent upon the highest frequency at which the woofer could operate without noticeable breakup or intermodulation.

Actually, for the best arrangement, this top frequency is not high, varying from 400 to 800 cps for a 15-in. woofer, dependent upon its construction and the lowest frequency of operation needed. Any woofer has a limited range of frequencies over which its cone operates as a piston, moving as a unit without the segment vibration sometimes used in speakers to raise the normal high-frequency cutoff. When something can be done to extend one end of the woofer range without affecting operation at the other end, the job of the midchannel unit can be made easier, and sound quality of the system thereby improved.

What can be done to stretch out the woofer passband and still keep it clean? The high end can be extended by lightening the cone, making it stiffer, or lightening the voice coil. But all of these things tend to degrade the low-end performance. But something can be done with the low end—a trick which is entirely practical and gains extra lows. Based on sound design principles,[2] "reactance annulling" is used to mutually cancel out limiting factors in the speaker and in its loading horn by designing these elements to complement each other.

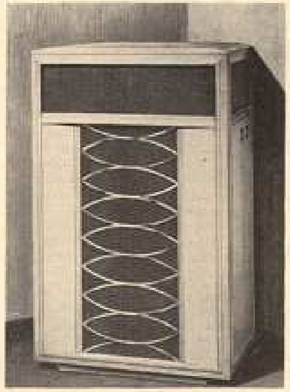


Fig. 2. The Laboratory Standard speaker in furniture-type styling suitable for the home.

Below its resonant frequency as operated in free space, or in a box, a speaker is stiffness-controlled, meaning that the suspension primarily determines the cone velocity. Under this type of operation, acoustic output drops off, while distortion rises rapidly. In this range the speaker appears capacitive in nature as viewed from the driving point on the mechanical side.

A horn presents to a loudspeaker a complex load consisting of a useful resistive component accounting for acoustical radiation, and a quadrature component which is mass-like or inductive in nature. In the hypothetical infinite horn, the throat resistance is theoretically zero at the cutoff frequency and the mass reactance generally has its maximum value at this point for most useful horns. For the practically usable finite horn, the throat resistance at cutoff is not zero. It has a small but finite value at this point, and approaches zero below horn cutoff.

### Reactance Annulling

To obtain maximum possible efficiency in the vicinity of cutoff, it is imperative to cancel the positive mass reactance of the horn by counteracting it with the stiffness of the speaker suspension. Since the speaker is stiffness-controlled below resonance, proper choice of system parameters can achieve this required reactance annulling at horn flare cutoff. This condition requires that the speaker resonant frequency be placed *higher* than horn flare cutoff. The resonant frequency, however, cannot be chosen arbitrarily. It must be related to the type of horn, the cutoff frequency and to throat size. This annulling also effectively cancels out the speaker stiffness effect, so that it operates normally *below* its free space resonant frequency and to frequencies somewhat below horn cutoff.

[2] D. J. Plach, "Design factors in horn-type speakers." *J. Aud. Eng. Soc.*, October, 1953.



The choice of horn flare is important. The Jensen hyperbolic-exponential flare family[3] has characteristics markedly better than the well known exponential type. The throat resistance characteristics can be made more constant closer to cutoff by proper flare choice. In fact almost any desired reactance or resistance characteristic near cutoff frequency can be obtained by appropriate choice of the flare parameter *T*.

The RS-100 employs the principle of reactance annulling in the woofer and midchannels. The effect is most striking in the woofer channel, where solid, clean bass is available as low as 32 to 35 cps, and at relatively high power.

In general, distortion in a woofer rises as the frequency is lowered, because of the greater cone movement as frequency decreases. *Figure 3* shows an unretouched photograph of an oscilloscope tracing of the output of the "furniture" model of the speaker, PR-100 (shown in *Fig. 2*), at low frequencies at high power levels. These powers are considerably more than to be expected in ordinary use. The close conformance to the original sine wave pattern shows negligible distortion at frequencies and powers commonly expected to give considerable harmonics instead of pure tones. In a typical medium or large listening room, 50 milliwatts (1/20 watt) average power as indicated by a VU meter gives sufficient power to this speaker system to provide louder than normal listening level. At this average power, assuming 20 db increase for peaks to be expected in orchestra music, 5 watt peaks will drive the speaker system. This means that speaker distortion will be so small as to be negligible and probably not even detectable. Extensive listening tests have not shown up any instances of recognizable distortion at these low frequencies.

The enclosure consists essentially of low frequency horn, with the necessary trimmings, mountings, hardware, controls, and space for smaller reproducers and networks. The *T* of the flare is 0.70, with theoretical 40-cps cutoff. The trilateral-mouth area of 576 square inches has an effective area of 4000 square inches in a corner. The woofer is mounted at the bottom of the front panel, radiating backward and upward. In a manner of speaking, it is a restricted-range two-channel system by itself. The special 15-in. cone type driver is designed with a heavy, high-inductance, low-resistance voice coil and heavy-body cone. Speaker loading, a sign of efficiency, is quite heavy, so that cone movement is relatively small even at the bottom frequencies.

As a direct result of extending the operation of the woofer below its otherwise normal cutoff frequency, a 600-cps top frequency is attainable. At this point, horn loading a compression driver is perfectly practical, and in fact desirable. It is not generally realized, but the musically important region from 300 to 600 cps is difficult to reproduce in a completely horn-loaded speaker system of reasonable dimensions. Even a properly designed 2-in. compression driver diaphragm when properly loaded must move an excessive amount at 380 cps, where power peaks in orchestral music are at a maximum. With a system rated at 35 watts input, as is the RS-100, twenty-two thousandths of an inch movement would occur occasionally for typical peaks in orchestral program material. While this movement is not great for a cone speaker, it puts a severe strain on compression drivers intended for the most linear sound output. At a frequency of, say, 600 cps, this movement for the 2-in. voice-coil compression diaphragm is reduced to about six thousandths of an inch, well within its capability.

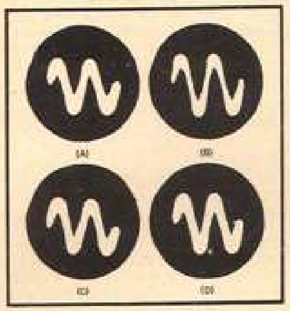


Fig. 3. Unretouched oscillograph photos showing sine-wave response at various outputs and frequencies: (A) 35 cps at 16 watts; (B) 40 cps at 16 watts; (C) 40 cps at 30 watts; (D) 60 cps at 30 watts.

The back-radiation from a woofer cone cannot be depended upon to produce much output above about 300 cps, because of the many reversals of direction of the air path and absorption in surfaces and irregularities of structural members of the enclosure. While a separate woofer can be used to fill in this response region, the extra space required is rather large if complete horn loading is an objective for a system.

The simplest method is to use the front of the woofer cone for direct radiation to the outside. This operation does not detract from back loading performance, and indeed simplifies it in some ways. So in effect, the 15-in. unit is operating in a modified two-channel arrangement of its own, with an acoustic crossover at about 300 cps.

The range from 600 to 4000 cps is reproduced by a type RP-201 midchannel speaker. While this unit operates quite well to 7000 cps, an advantage in spatial distribution is effected by utilizing a smaller unit above 4000 cycles. The RP-201 uses a 2-in., voice-coil, reentrant, fabric-filled, phenolic diaphragm and a cast hyperbolic-exponential horn with flare of $T = 0.7$. A multiple take-off passage eliminates sound-chamber interference effects in the passband of this driver. An intra-range equalizer is installed in this channel to give the complete system response balance considered by listeners as most nearly ideal.

Any desired reduction in output from these channels is provided by continuously variable pads at the side of the enclosure. These adjustments are independent of each other, for maximum flexibility and accommodation to different program material. This considerable latitude of adjustment in balance of the whole system will adapt the RS-100 for use in rooms of any size and degree of liveness. In a large room with many drapes and other absorbing material, the two pads should be adjusted for high output to compensate for frequency selection absorption. A small living room position usually calls for about 2 db padding in the midchannel and 6 db in the tweeter. These attenuations occur with both control knobs vertical. This vertical position is considered the "normal" position for flat response.

From 4000 cycles up, the ultra-high-frequency RP-302 Super-Tweeter reproduces all the tinkles, swishes, and "musical instrument separation" possible at this stage of the art. This tiny unit, self-contained with its own horn of $T = 0.7$, is mounted "piggy-back" on the midchannel horn to minimize baffle-type reflections.

The lightweight, phenolic-resin-impregnated tweeter diaphragm has an inherent "damping factor" as a physical characteristic. Unlike metallic radiating surfaces, this phenolic material can be moved by its motor system without the excessive breakups and resulting harsh noises and intermodulation frequently apparent in metal diaphragms. This damping feature is especially important in the presence of interfering scratches, pops and other noises which always occur to some degree in record surfaces. At best, any sudden impulse such as record groove imperfections may create has an annoyance factor of its own, and the annoyance is multiplied many times if the speaker unit moving system is free to oscillate as one piece or in segments, following a burst of noise.

At very high frequencies, where the voice coil has an increasing tendency to become decoupled from the diaphragm, internal damping is extremely important, as internal dissipation in the diaphragm is the controlling factor in transient performance.

For this reason, the phenolic diaphragm, with its high internal damping, is preferred to the aluminum or magnesium type diaphragms, with their inherently high-Q characteristic. Phenolic plastic material is preferred from the standpoint of transient performance in high-quality reproducing systems.

(*Continued on page 84*)

[3] U. S. Patent 2,338,262.

# LABORATORY REFERENCE LOUDSPEAKER

(from page 36)

Frequency division is accomplished electrically as shown in *Fig. 4*. Networks are of the constant resistance type. Inductors are generous size air-core coils to provide linear low-loss operation. Attenuation is 12 db per octave outside the network pass bands.

*Figure 5* shows a phantom view of the operating elements of the RS-100. The woofer is placed in an acoustically adjusted chamber at the bottom of the enclosure, radiating through a slot throat along the bottom. Sound from this back-radiation emerges at the top front and at the top sides. Also radiating from the top front is sound from the midchannel and tweeter units. The middles and highs emanate at about ear level, for most realistic space positioning and phasing effect. All networks are clear of the sound paths, being placed on a demountable panel in the frontal cavity below the main horn mouth. Access to the woofer is by means of a removable panel just behind the speaker, and access to the whole system is by means of a removable back to the enclosure. The over-all dimensions of the RS-100 are 52⅜ in. high, 32⅞ in. wide, and 24-11/16 in. deep.

Construction is of heavy (¾ in.) plywood, each joint being glued and reinforced with wood screws; bracing is used where there is any tendency toward panel resonances of vibration during operation. The RS-100 is finished in two-tone enamel, with contrast similar to that styled into much professional equipment. The power rating is 35 watts input, and the impedance is 16 ohms. The same performance may be had from the Imperial, model PR-100, which is designed in Suburban Modern furniture styling in blonde or mahogany.

### Construction details

*Figure 6* is an exploded view of the construction employed in the RS-100 cabinet, and shows clearly the various panels in relation to each other, as well as showing the bracing. *Figure 7* is a complete constructional drawing, but details of dimensioning are not shown in order to simplify the drawing. However, for closer study of the construction, it should be pointed out that the drawing is accurately scaled, with 1/16 in. representing 1 inch, and dimensions of the horn structure can be determined by measurement.

Before leaving the factory, each individual RS-100 or PR-100 is tested by instruments and by ear, and each is accompanied by a certificate guaranteeing its performance.

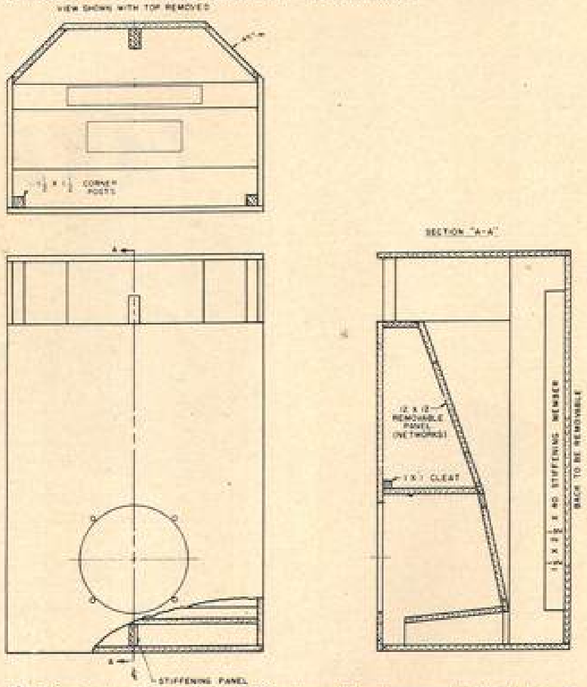



Fig. 7. Constructional drawing of the RS-100 enclosure. Dimensions are omitted in the interests of simplification, but the drawing is to scale—1/16 in. = 1 in.



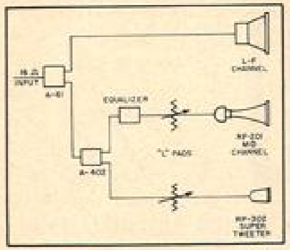



Fig. 4. Block diagram of components of the reference loudspeaker.

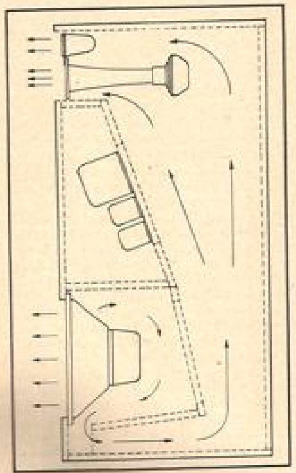


Fig. 5. Cross-section through center of enclosure to show placement of loudspeaker units and dividing network.

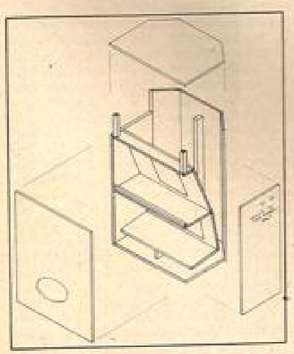


Fig. 6. Exploded view of the enclosure.


**P15-LL L-F UNIT** [illegible] 15-in. "woofer" [illegible] up to 600 [illegible] cycles in 2-way [illegible]. Edge damping. [illegible] 37 cycles. Power [illegible] 35 watts. Impedance 16 ohms. Shipping Weight, 16 lbs. [illegible] Net Ea. $56^80

**RP-201 H-F UNIT**
[illegible] the range from 600 to 4000 cycles as the mid-channel in a 3-way system. Driver unit loaded by cast aluminum Hypex horn. Coverage angle, 115° Impedance, 16 ohms. Power rating with A-61 network, 35 watts speech and music signal input to [illegible]. Shipping Weight, 8 lbs. ST-897. Net Each .......... $42^60

**RP-302 ULTRA H-F UNIT**
[illegible] the top of the range from 4000 cycles to the highest audible [illegible] with unexcelled smoothness and freedom from distortion. Coverage angle, 120°. Impedance, 16 ohms. Power rating with A-402 network, 35 watts speech and music signal input to [illegible]. Mounts in 1⅛" hole in baffle or on bracket. Satin finish. Shipping Weight, 3 lbs. ST-899. Net Each .......... $33^60

**A-402 CROSSOVER NETWORK**
Two-channel type; high pass transmits everything above 4000 [illegible], low-pass everything below this frequency. 180° constant-[illegible] type. 4½" high, 3½" wide, 3¼" deep. Shipping Weight, 3 lbs. ST-898. Net Each .......... $8^20

**A-61 600 CYCLE NETWORK**
[illegible] frequencies above 600 cycles to A-402 for further division; [illegible] 600 cycles to the P15-LL unit. Two-channel, 180° constant-[illegible] type, with 12 db/octave attenuation outside pass band. [illegible] 7" wide, 4½" deep. Shipping Weight, 5¼ lbs. [illegible] Net Each .......... $17^50


**P12-NL LOW FREQUENCY UNIT**
[illegible] 12" "woofer" especially designed for 2-way systems. [illegible] up to 2000 cycle crossover. Impedance, 16 ohms. [illegible] 25 watts. Shpg. weight, 10 lbs. ST-912. Net Each .......... $36^50

**RP-102 HIGH FREQUENCY UNIT**
A new advanced design "tweeter" for use in 2-way systems crossing over at 2000 cycles. Reproduces an unusually wide range from [illegible] cycles to extremely high frequencies with smooth response, [illegible] balance and very low distortion. Impedance, 16 ohms. Power rating, 35 watts speech and music signal to input of 2-way [illegible] when used with A-204 network. Shipping Weight, 6¼ lbs. ST-895. Net Each .......... $28^35

**A-204 CROSSOVER NETWORK**
Two-channel type. High-pass section transmits everything above [illegible] cycles, low-pass, everything below this frequency. 180° [illegible]-resistance type. 4½" high, 3¼" wide, 3¼" deep. Shipping Weight, 3¼ lbs. ST-894. Net Each .......... $13^00

**H-F & LEVEL CONTROLS**
[illegible] brass cup escutcheon, appropriately marked, [illegible] in 1⅛" holes, and [illegible] bar knobs. 25" leads [illegible]

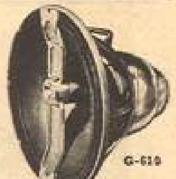
**H-F Balanced Control.** For adjusting balance of H-F Units. [illegible] ST-[illegible]. Net Each .......... $4^15

**Level Control.** Input control to [illegible], 16 ohms. ST-[illegible]. Net Each .......... $4^30

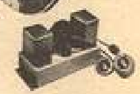
**"L" PAD CONTROLS**
L-pad type, complete with pointer knob and escutcheon.
**Level Control ST-276** 6-8 ohms, 5-watts. Net .... $1.80
**Level Control ST-760** 3-4 ohms, 5-watts. Net .... $2.01
**Level Control ST-761** 500-600 ohms, 15 watts. Net Ea. $3.72
**Level Control ST-411** 6-8 ohms, 15-watts. Net .... $2.82

[illegible] **Autotransformer.** For matching any two of 16/8/4 ohm impedances. Net Each .......... $5.15

**G-610 TRIAXIAL**
The G-610 consists of 3 independently driven elements each covering a portion of the range and a Crossover and Control Network. Crossovers are at 600 and 4000 cycles. Low frequencies reproduced by a heavy duty curvilinear diaphragm unit. Mid frequency section has compression driver unit, flared cone of l-f unit acting as final section of horn. Special small h-f tweeter at front covers high end to limits of audibility. Combination smoothly covers the widest range available today! Power rating 35 watts. Impedance 16 ohms. Mounts in any cabinet for 15" speaker; BL-151 cabinet recommended for outstanding results. Baffle opening 13⅞"; OD 15⅝"; depth 10⅝". Shipping Wt., 50 lbs. ST-900. Net Each .......... $252^75




**TRANSFORMERS FOR G-610**
These transformers are high fidelity units, mounting directly on network chassis, with plug-in connections, to give alternate input impedances.
**Model T-201**—ST-846. 4 and 8 ohms. Net Each .......... $12.35
**Model T-202**—ST-847. 500-600 ohms. Net Each .......... $12.35



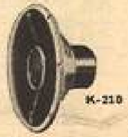
**H-530 COAXIAL**
In wide range extension, in the unusual degree of smoothness and the fine balance of response, this new coaxial has been acclaimed as a new milestone in speaker engineering. Low frequencies are reproduced by a highly efficient 15" L-F unit designed especially for a smooth transition in the crossover region. Upper channel is a new compression driver perfectly matched to a special H-F divided cellular Hypex horn to reproduce a wide frequency range above 2000 cycles. Impedance, 16 ohms. Power rating, 30 watts speech and music signal input. Complete with network and H-F control. Baffle opening, 13⅞"; O.D., 15⅝"; depth, 10¼". Shpg. Wt. 25 lbs. ST-893. Net Ea. $129^50


**H-520 COAXIAL**
A new coaxial loudspeaker with the smoothness, fine balance and wide range response you expect in a truly advanced-design 2-way system. A compression driver unit loaded by a 6-cell Hypex horn reproduces frequencies above 2000 cycles. An efficient 15" L-F unit handles the lower frequencies. Impedance, 16 ohms. Power rating, 25 watts speech and music signal input. Baffle opening, 13⅞"; O.D., 15⅝"; depth, 9⅜". Shipping Weight, 16 lbs. ST-892. Net Each .......... $79^50


**MODEL H-222 COAXIAL**
Outstanding, efficient, new wide-range 12" coaxial with compression driver tweeter and 6-cell h-f horn brings a new meaning to high fidelity in a small speaker. Integral frequency division. Power rating 25 watts. Impedance 16 ohms. Baffle opening 10½"; OD 12½"; depth 8¾". Has h-f balance control on 36" cord. Shipping Weight, 12 lbs ST-875. Net Each .... $54^50


**MODEL K-310A COAXIAL**
A fine, low cost true two-way 15" high fidelity speaker that will outperform many at higher prices. Integral frequency division system. Power rating 16 watts. Impedance 16 ohms. Shipping Weight, 18 lbs. ST-891. Net Each .......... $37^60

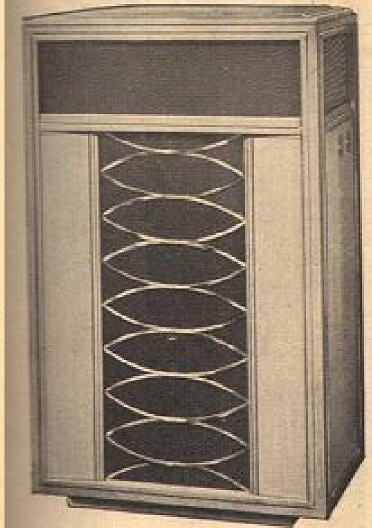

**MODEL K-210 COAXIAL**
A 12" high fidelity speaker at extremely low cost. Integral frequency division system. Power rating 12 watts. Impedance 8 ohms. Shipping Weight, 7 lbs. ST-831. Net Each .......... $24^85











# Imperial

## The Ultimate in High Fidelity

In the search for pure high fidelity, completely authentic, with smooth coverage of the complete frequency range from lowest bass to upper limits of audibility, Jensen designed the RS-100 Laboratory Reference Standard Reproducer (see below) for use as a standard of comparison in high fidelity. For those who pursue the ultimate, the very same reproducer is offered here as the Imperial PR-100 in cabinetry that bespeaks a place of honor in the distinguished home. There's a totally new, smooth sound, utterly real—undoubtedly the finest sound you've ever heard. Voices come to life and there's a new almost geometrical separation of instruments. A three-way system (we'd have used **six** channels if necessary, but three were far and away the best), with l-f unit loaded by a new-design reactance-annuling trilateral-mouth horn for bass; selected compression-driver horn-loaded mid-channel with intrarange equalizer for a final touch to precise balance and coloration elimination; and superlatively smooth, space-blended supertweeter top. Expensive to be sure . . . but priceless in performance. Place it on a sidewall or in a corner as you choose. Individually serially numbered, laboratory tested with signed certificate and guarantee of performance, accompanied by handsome descriptive presentation brochure. Impedance 16 ohms, power rating 35 watts. 53¾" H.; 32½" W.; 24¾" D. Shipping Weight 222 lbs.

**PR-100 "IMPERIAL" REPRODUCER**
**ST-919**—Selected Mahogany. Net Price .......... $525.00
**ST-918**—Satin Korina. Net Price .......... 535.00

# Laboratory Standard RS-100

## Designed Especially for Ultra-Critical Applications

Intended especially for ultra-critical applications. Designed by the Jensen engineering staff as a reference standard for comparison of high fidelity reproduction, the RS-100 is a new and important tool for sound engineers and psycho-acoustic laboratory specialists. It also will find extremely wide application in broadcast and TV station monitoring, recording studios and other installations requiring exacting sound reproduction. Music lovers and audiophiles, too, will find ready usage for the RS-100 in experimental or permanent home tuner-amplifier-record player and tape-recorder set-ups. It embodies the same electrical and acoustical characteristics as the PR-100.

The cabinet is made of plywood—modern—artistically styled and finished in two-tone, blue gray. Each RS-100 is individually, laboratory tested and accompanied by a signed certificate and guarantee of performance, and a descriptive brochure. 52⅜" H. x 32⅜" W. x 24 [illegible]" D. Shipping Weight: 222 lbs.

**ST-920**—Net Price .......... $468.00