

QUALITY IN AUDIO AMPLIFIERS

The author describes below a novel audio amplifier, used in a commercial receiver, which makes use of the new 2B6, described elsewhere in this issue. Two output tubes are used, each feeding into a separate audio channel.

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IT IS an underlying trait in human nature to follow the common herd. Radio manufacturers are today so busily engaged in imitating each other that it is not surprising that the average radio set, instead of being the marvelous musical instrument it should be, has degenerated into a "cigar box," which cannot cover the eight and a half octaves that are possible in the audio spectrum, and that are necessary for the production of good music.

Manufacturers who once took pride in the quality and tone of their products hang their heads in shame as they look at the red figures on their books after a year in competition with "cigar box" manufacturers.

This tendency toward extreme economy and small size has brought about a rapid development in the tube art. Tubes having tremendous amplification at R.F. and I.F. have been developed, but practically little or nothing has been done toward the development of tubes for the audio end of the set. The commonly used pentode is famous for its high distortion, but is used because of its high gain. The distortion is not so noticeable when the frequency range covered by the small speaker and baffle area is only about 25 per cent of that possible; but when used with a large, well designed speaker and baffle, the objectionable harmonics make its use prohibitive.

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Lincoln, like other custom-built sets, has been catering to the appeal of the exclusive who want the best in music and DX. The audio system is the best that the design of present-day tubes makes possible. However, an ever-increasing number of inquiries and requests for something new and better in sound effects and tone led Lincoln engineers to search further for the unusual and exceptional in tonal reproduction. This search extended over the greater part of the last year, and has finally terminated in the development of the new Bin-aural Duo-channel audio system. This is not a trick name designed to arouse your curiosity; rather, it is an exact description of what this system accomplishes: "Bin-aural" means to hear from two directions, and "Duo-channel," as its name implies, means two channels.

However, the outstanding feature of this new system lies in the use of a new super-power output tube, which delivers four watts at less than five per cent distortion. The realization of this new Bin-aural Duo-channel audio system was made possible largely through the use of this new output tube, the 2B6. A study of its characteristics will indicate why this is the case. (See article on this tube elsewhere in this issue.—*Editor*) First of all, at least four watts output was required; second, triode quality was imperative; third, a greater power sensitivity than was possible with any existing triodes

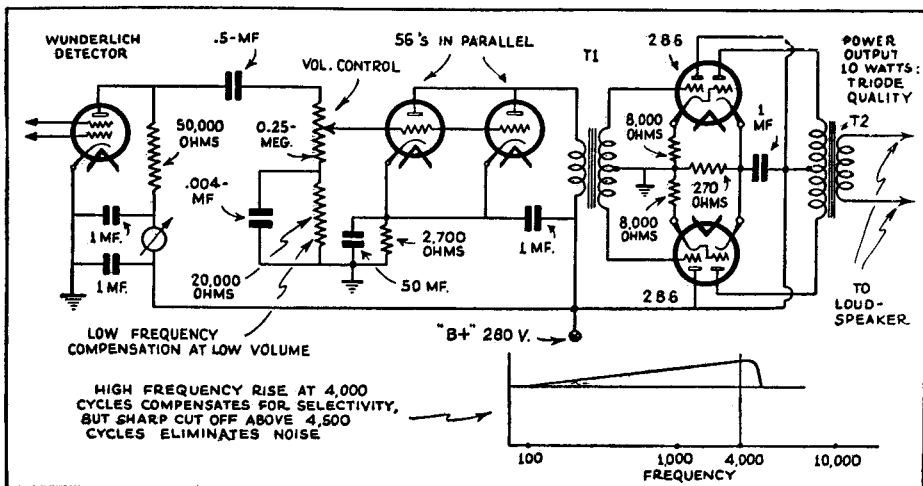
was necessary in order to eliminate additional stages of amplification with their attendant distortion.

A quick summary of the existing tubes will indicate their shortcomings. The type 45 tube in class A delivers only 1.6 watts, and 35 r.m.s. volts must be applied to the grid for this power; it is evident that the power sensitivity is low and additional stages would be required. The type 50 tube, of course, was not considered because of the high plate voltages necessary for its operation, which would make necessary the use of expensive transformers, condensers, and rectifier tubes, so that the list price would become almost prohibitive; then, too, the power sensitivity is low, requiring 60 r.m.s. volts applied to the grid to secure the rated power output. The new 2A3 was also tried out and discarded because of its internal construction, having a multiple filament; furthermore, it requires 42 r.m.s. volts for rated output, and has a very high plate current—60 ma. This tube is rated at 3.5 watts.

A study of the characteristics of the new 2B6 tube will plainly indicate why it is superior in every way and why it was selected: rated watts output, 4 watts; total plate current, 44 ma.; r.m.s. input volts to the grid to secure rated watts output, 24; plate voltage, 250; plate battery, 274 volts; per cent distortion, less than 5 per cent. *By less than 5 per cent, we mean that at only 4 watts does the distortion become 5 per cent, and that at less than 4 watts, the distortion is less than 3 per cent.*

Using the 2B6

The study of Figs. 1 and 2 will plainly indicate just how this tube is used in two different circuits. In Fig. 1 the two type 56 tubes are connected in parallel to increase their power handling capacity and, also, to reduce their plate impedance which is normally quite high. This latter adds very materially in the transformer design for low frequency response. The push-pull input transformer, T1, is a specially designed transformer having the rising characteristic from 20 to 4,000 cycles, as shown in the figure. It is extremely good at low and high frequencies. The high-frequency rise compensates for the extreme selectivity of the Lincoln receiver. Incorporated



A circuit illustrating one manner in which the 2B6 tubes may be used.

in the volume control is a low-frequency compensator to make up for the deficiency of the ear on low frequencies at low volume. The high frequency cut off at 1,500 cycles eliminates noise, hiss, etc.

This is a big improvement over the standard design, but by no means compares with the new Bin-aural Duo-channel system which is shown in Fig. 2. Reference to Fig. 2 will show how the two channels split at the detector plate circuit into a high and low channel, being roughly divided at a thousand cycles, which is the apex of the average ear-pressure curve. Each of these channels operate directly into its own speaker, and each speaker is designed for the best reproduction of the frequencies above and below a thousand cycles in their respective channels. *It can readily be seen, therefore, that exact adjustment of the bass or treble may be secured for any ear under any conditions, as the entire level above or below a thousand cycles is raised or lowered at the will of the operator.* Many startling and beautiful effects may be secured by the placing of the bass and treble speakers in different locations in a room so that a spread, diffused, or orchestral effect is secured; the sound coming from two different directions and in the two different halves of the frequency spectrum creating a naturalness not heretofore possible. Likewise, it has a wide application in the tuning of short waves, as excessive noise or interference may be diminished by reduction of the high-frequency range.

A strange paradox exists today. Broadcast studio managers bend every effort for the production of the entire audio-frequency spectrum, and their use of the highest type of orchestra and vocalists seems to be an empty gesture when one views the "two by four" boxes now displayed as receivers.

It has long been Lincoln's belief that music is more necessary and lasting

TRIODE CLASS A AUDIO SYSTEMS

Many a good receiver was made obsolete when the pentode and class B tubes were first announced. They were made obsolete simply because new tubes were available, and not because the new tubes made reception any better. During the past few months many reputable manufacturers have returned to the triode, class A systems, and have discarded entirely the pentode and class B output tubes.

The general consensus of opinion among these manufacturers is that pentodes are good where high power/sensitivity is desired; class B systems where economical operation, such as in portable sets, is required; and triode, class A audio systems where high quality is essential.

This article by Mr. Hollister treats the audio system used in his latest receiver, and is self-explanatory.

and fundamental than any other contribution. As one well-known engineer so aptly states: "It is no trick to design a receiver which will receive foreign broadcasts, but how? Of what use is any receiver if the reproduction produced by its operation is not enjoyable?"

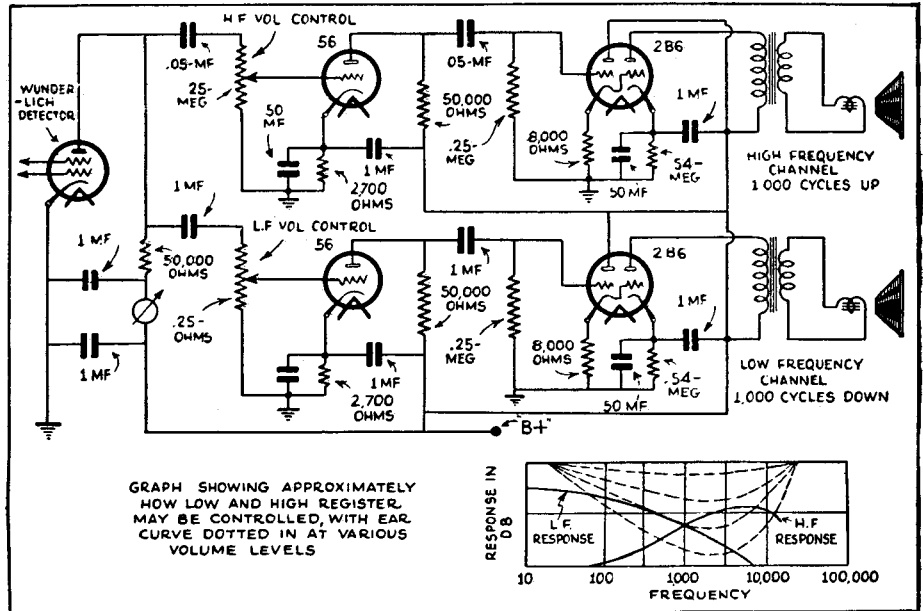


Fig. 2
A circuit superior to that of Fig. 1, and which is adaptable to twin-speaker operation. The response is adjusted to suit the selectivity of the R. F. stages.