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 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?"

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 censensus 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.

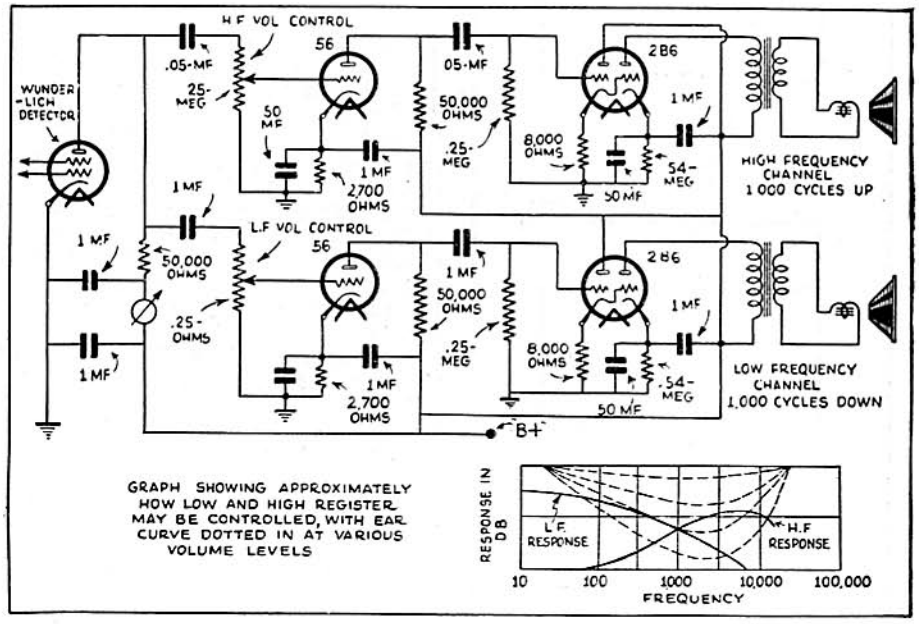

Fig. 2
A circuit superior to that of Fig. 1, and which is adaptable to twin-speaker operation. The response is adjusted to suit the selectivity of the R. F. stages.

FEATURES OF A MODERN 50 KW. STATION

THE General Electric Company is installing at South Schenectady, N. Y., one of the most modern 50 kw. broadcast transmitters in the United States. This transmitter is designed for improved operating characteristics particularly as regards frequency stability, quality of transmission and continuity of operation. Many of these improvements are being incorporated as a result of the company's experience in operating and maintaining broadcast transmitters for the past ten years. The company also has wide experience in the commercial field. This experience has been continually used as a basis for continued improvements up to the present time. It has been the company's policy to incorporate new design features at WGY for thorough operating tests under actual service conditions before such features are included in commercial transmitters. This policy has been applied to the new transmitter and it is confidently expected that many important improvements will result.

It may be interesting to follow the audio signals which are sent out from the studio for transmission to the radio audience.

These signals consist of electric currents similar to those transmitted by the service telephone excepting that the frequencies present include those in the approximate range from 30 to 10,000 cycles. The signals arrive at the transmitter building via a telephone wire line which is specially adjusted and balanced to permit the transmission of all these frequencies without discrimination. This is necessary to insure that the full range of essential frequencies is made available to the radio audience.

At the transmitter building the signals are sent to the transmitter control room where audio control, metering and amplifying apparatus is located. Here the signal is amplified to compensate for the losses sustained in the telephone line and sent on to the transmitter proper.

The signals next pass through a power amplifier to first stage of which employs a 50 watt tube. The second stage consists of two 250 watt tubes operating in push-pull. After passing through this stage, the audio signals attain a voltage level equivalent to ten times the voltage of the ordinary lighting circuit. The power developed is greater than that required to operate three ordinary radio receivers. In the above audio

(Continued on page 174)

A 50-WATT TRANSMITTER

(Continued from page 151)

power amplifier circuits, improved operation has been effected so that the correct phase relationship of the various frequencies is maintained. It is even more important that the amplification be essentially linear so that harmonic frequencies are not generated to an appreciable extent. This is accomplished by the use of improved transformers, balanced push-pull circuit and over conservative use of tubes which are only called upon to deliver a fractional part of their maximum output power.

The radio frequency (carrier) for the transmitter is obtained from one of two crystal-controlled oscillators. The frequency is determined by a specially ground quartz crystal which is mounted in a compensating holder. This device is mounted in a thermally insulated compartment in which the temperature is maintained relatively constant at a predetermined value. Both crystal oscillators are operated continuously day and night so that they are instantly available for use. The highest degree of frequency stability is thereby attained. This is important from the listeners' standpoint, since it provides the maximum assurance that interference with other high class stations will not be experienced.

The radio frequency carrier is further amplified by screen grid tubes until it is at an approximately similar voltage level to the output of the push-pull audio power amplifier. These currents are then combined or modulated at a comparatively low power level, in a radio amplifier unit rated at 250 watts output. Here, again, design improvements have been made to assure that the carrier will be properly moulded and controlled by the audio signal current so that the fidelity and phase relationship will not be changed.

The combined radio and audio currents are further amplified by two push-pull radio frequency stages rated 5 kw and 50 kw output respectively. Each of these stages requires the use of tubes whose maximum power output is more than four times the rating given above, in order that the combined currents may be amplified with a minimum of distortion.

From the 50 kw. (maximum rating over 200 kw.) stage the combined currents are sent to the antenna over a new type three wire transmission line. The combined currents are then radiated or "broadcast" so that they become available to the Radio audience.

In order that the operators may have proper control of this entire process, it is essential that means be made available whereby the functioning of the various parts of the transmitting equipment may be readily checked. The remote control room is equipped with special monitoring loud speakers which may be connected at various points in the circuit for direct quality checking by ear. Volume controls are used for maintaining the audio currents within predetermined limits. Two different types of modulation indicating devices are supplied for checking the modulating or combining process. One of these is an oscillograph of special design by means of which either visual observation or permanent recording of the combined currents may be made. A careful log is kept of the visual indications of this device at regular intervals. The second device is called a modulation alarm indicator. This device indicates the degree of modulation by means of a conventional meter. It is also equipped with an automatic alarm mechanism so that when a predetermined degree of modulation is exceeded it is immediately called to the operator's attention by an alarm buzzer. Such elaborate precautions may seem superfluous, but recent tests have shown that excessive distortion of signals results if the modulation is allowed to exceed 100%. Under such conditions an additional range of audio frequencies is produced which not only cause a loss of efficiency but which may cause interference in adjacent channels due to the increased width of sidebands.

Frequency monitoring is accomplished at the transmitter by means of a visual indicating meter which is designed to maintain an accuracy of plus or minus 10 cycles. Thus frequent checks may be obtained on the operating frequency and such checks may be entered on the operating log sheet.

The antenna current will be measured at the transmitter by means of a special rectifying circuit. This gives the operator a final check on the power in the antenna. An automatic signalling device is included which sounds an alarm in case the antenna current drops below a predetermined value.

OPERATING NOTES

(Continued from page 172)

A puzzling phenomenon was that of an Apex 28A, series 31. The set would play for about ten or fifteen minutes, and then stop. Turning the switch off and on would produce reception for perhaps another ten or fifteen minutes until it stopped again. Visual inspection of the set disclosed the fact that each time this thing happened, the brightness of the filaments in all tubes would grow dimmer, and then would go out entirely. The A.C. cord, the off and on switch, and the primary of the power transformer were all given a careful continuity test; but all appeared normal.

After going over the chassis and pulling wires for possible shorts or loose connections, nothing was disclosed. The A.C. toggle switch was strongly suspected, and it was decided to remove it for closer inspection. When inspecting this switch, it was discovered that the brown bakelite housing, which covers the lever and spring contacts, was cracked in several places. This condition evidently partly released the hold on the spring contacts which, in turn, made it possible for them to gradually slip down until they became disengaged from the lever. Moving the toggle switch up and down evidently brought them back temporarily, only to drop down again after a short interval of time. A new switch solved this problem.

Low record reproduction in some models, particularly in the General Motors radio and phonograph combinations, can often be traced to broken connections between the tone compensator and the volume control. This tone compensator is hard to get at for testing purposes, as it is located underneath the motor board, close to the volume control. It is wound with very fine wire and the ends are soldered directly to the terminals on the volume control. In almost every case the reason for the broken leads is that the volume control worked loose, and one little turn of the volume control knob would be sufficient to break off the wires. It is advisable, therefore, when confronted with trouble of this nature, to always inspect these leads, even though you may find that the volume control is tight.

It is obvious, of course, that when the leads are found broken, it is only necessary to unwind a few turns and then resolder them to the proper terminals on the volume control. When repair work of this nature happens, it is desirable to replace the ring nut on the volume control with a thin hexagon nut and spring washer, so as to preclude the possibility of a non-remunerative call-back in the near future.

READERS' PAGE

(Continued from page 169)

ZENITH 460—(A correction)

Editor, RADIO-CRAFT:

In the June, 1933, "automotive issue" of RADIO-CRAFT there appears a slight error in the sensitivity rating of the Zenith model 460 automobile receiver. The sensitivity rating is 1.5 microvolts (R.M.A. standard input required to give an output of 50 milliwatts) or 0.4-microvolt-per-meter, instead of 1.5 microvolts-per-meter as you have listed. We will appreciate the publication of this correction.

We feel that the publication of automobile receiver data and schematic diagrams is a real boon to the Service Man. We also believe that every manufacturer of automobile receivers should give the Service Man special consideration in the layout and design of his set. The compact construction of modern receivers makes this feature doubly important.

MARVIN HOBBS, Engineer,
Automotive Receiver Section,
Zenith Radio Corp.