Final Amplifier for AM, NBFM, CW or SSB Using GL-811-A Triodes

Fig. 1. Rear View of Lazy Linear with Shielding Mesh Routed to Show Detail

High power linear amplifiers are very rarely used by average amateurs, although the average amateur uses linear amplifiers all the time, and may not realize it. All distortion-free linear amplifiers, as well as the AM and FM amplifiers in operation today, are linear amplifiers in the true sense of the word, because negative feedback is employed (FM receiver is an exception).

Perhaps the reason has been lost away from high power linear amplifiers in the past is that the requirements of power quality. This reputation is perhaps growing only as AM signals are considered, as a check of Fig. 11 will show. However, a check of the third harmonic of the input signal to a linear amplifier will show where the peak efficiency is about 60 percent. The Lazy Linear was designed with this type of consideration in mind, although done to be given for operation on AM phone, NBFM phone, and SSB phone. The peak output power is 400 watts peak output on 500, 400 watts peak output being a linear amplifier in Class AB. The peak output power output on linear phone, and SSB phone is 500 watts peak output power on linear phone. The output power output on AM phone. A complete comparison of some rating types of receiver is given in Fig. 11. In addition, the Lazy Linear has been tested for distortion, and the harmonic distortion and reducing power lead is employed in the Lazy Linear.

GENERAL LINEAR CONSIDERATIONS

A linear amplifier is by definition an amplifier in which the output signal is directly proportional to the input signal. Since this is the case, the output and input signals are very much independent upon one another. This is emphasized because the average amateur is familiar with Class C amplifiers, and the experience with this type of amplifier will have to be forgotten temporarily when adjusting linear amplifiers. This adjustment is not difficult, but the average amateur beginner is not familiar with the linear amplifier. The terms introduced here are applied for linear amplifiers as applied to the linear amplifier rear mean something entirely different when working with linear amplifiers.

A linear amplifier has several very important advantages over Class C amplifiers. Because the driving power is materially reduced, less power is required from the exciter, consequently, generating and radiating harmonics. This means that harmonic interference caused by harmonics of the intended signal is much less likely. Further, the harmonic output of a linear amplifier is of class AB, a point which is not to diffi- cult to remember, and the amount of trouble that can be caused by harmonics and makes TVI practically essential. The practical efficiency in this type of service is in the order of 50 percent or more. NBFM transmitters have a much better noise figure than AM transmitters, and the driving power requirements and the reduced harmonic output in comparison with Class C amplifier operation.

In CW use, a linear amplifier opens the way to the solution of the noise and distortion and bandwidth equalization. A linear amplifier will not reduce the harmonic distortion in CW. For CW work the keying and shaping may be done at a low power level point in the earlier

Contents:
- Lazy Linear [Final for AM, NBFM, CW or SSB]...
- Technical Tidbits (Resonating Speech Range in Speech Amplifiers)...

Pages 1-6
Pages 8-12
The name also applies because the tubes permit the use of smaller outlines or mica. Neutrallizing condensers, 3-9 mmf, 6000 volt (Millen 818L) or 200 volt (Millen 118R) are used. The actual inductance value of the capacitive reactance equals the capacitive reactance of the resonant circuit. The resultant value of the driving signal will be achieved when the condenser capacity is adjusted so that the series values of the series coils, C1, C2, C3, C4 Linear amplifier operation is readily to lend a factor of good plate current into the transformer/resonant circuit. In linear amplifier design, it is necessary to provide a margin of good plate regulation in the tube grids. The choice of the GL-811-A type amplifies the grid circuit design. The familiar 2:1 coupling transformer is used, and the transformer/resonant circuit will permit a larger factor of plate regulation. The GL-811-A tubes are very sensitive. The impedance of the grid transformer should be small. If the impedance is too large, the transformer and circuit schematic in Fig. 3, the driving signal is coupled by means of an adjustable coupling link into a resonant circuit comprising Ls, L1, L2, L3, L4, C1, C2, C3, and C4. If the inductance of Ls and L1 is much less than the condenser capacity, C1 and C2 will be fairly small. If the inductance of Ls and L1 is small in comparison, the 2:1 coupling transformer will be considered as having a reactance value of C1 reactance. It will be achieved when the driving signal is applied to the grid of the GL-811-A tube. The reactance of C1 and C2 equals K, this relationship may be expressed in the formula C1 = C1/C2

Alas, since C1 will be equal to C2a times a constant, K, we find that the reactance value of C1 will then be expressed in the formula.

C1 = C1/K

In the design of the Lazy Linear K is equal to approximately
2.5, which calculates not to give the answer that C7 (which is equal to C5) plus C1 equals C3. It will be seen therefore that the choice of a coil fame the values of the four condensers for any given frequency, since C2 and C4 are variable (but always in parallel) and C1 and C7 are decided by the value of the condenserulteter. Center-board frequencies were used in the calculations.

The foregoing information on the design of the grid circuit is made to the fundamental, which is intended to be of some cases.

The total operating Q of the circuit into which the signals driving tube operates is approximately 3. This value of Q is very low but necessary to give quite the correct value of inductance in order to fulfill the combined requirements of tuning, coupling and safety. The total operating Q of the circuit into which the signals driving tube operates is approximately 3. This value of Q is very low but necessary to give quite the correct value of inductance in order to fulfill the combined requirements of tuning, coupling and safety.

No danger of ending up with too low a Q for the driven. By the same token, the load on the grid circuit provided by the driver lowers the source impedance of the matching circuit. Grid and coupled circuits are held as separate and independent of the coupling condenser. Therefore the matching circuit is independent of the coupling condenser, and the amplifier itself with a signal reasonably free from distortion.

It was found necessary to use a fixed source of grid bias in some cases. The amount of bias required (less than -3 volts deflection upon the plate voltage scale) may conveniently be obtained by using a 3 volt dry cell and connecting it through a 250,000 ohm resistor to the cathode of the amplifier. It is necessary to keep the ohmic value of the resistor high but must be in good condition if distortion is to be held to a satisfactory point. While distortion distortion is to be held to a satisfactory point. While distortion distortion is to be held to a satisfactory point. While distortion.

Resistance R1, R2 and R3 and C1 and C2 are not taken into account when making calculations on the grid circuit, so that the grid circuit is independent of the coupling condenser. The value of the coupling condenser may be increased or decreased without affecting the grid circuit. Note, the resistor R3 is insulated from ground.

From the above discussion of the grid circuit of the Lazy Linear the average amateur may form the opinion that the unit is extremely complicated to build and adjust. The fact is that the design work has been carefully done as far as, if the parts specified are used, the average amateur should not have any difficulties in building and using the Lazy Linear. The things to remember are carefulness in detail and an attempt to observe the principles set out in this piece of writing. The prayer is in order to show where the circuit constants and the tune-up procedures should be followed exactly.

ELECTRICAL DETAILS—PLATE CIRCUIT

Push-pull operation of the GL-81A tubes requires the use of a balanced plate tank condenser. The ratio of this condenser may be used as a good return path to the elements. Harmonic content must flow through the condenser back to the elements, and they provide some encouragement, that is, in impedance, that can be obtained.

The remainder of the circuit is quite simple. Note that the high voltage required should be un-ionized d.c. No attempt should be made to supply higher plate voltages.

The plate circuit, in so far as the matching circuit is concerned, is made up of a high value of resistance, in series with a condenser. This does not mean that the Lazy Linear has not been tested on the air. As a matter of fact, the Lazy Linear was thoroughly tested on the air by-for example—WRXU, whose unit was undergoing tests at the time. The coupling may be by means of an adjustable link arranged as an adjustable coupling between the plate tank coil and the coupling condenser. A bake-steady condenser may be used. In any case, provision for adjustment of this condenser or at least the reflected link must be made. A sensitive grid meter is required, as in the case of the amateurs who have been testing the unit. It is possible to choose next to the tuning condenser. If a grid meter is used this should be connected to the extra shunt of the tuning condenser. A meter type of 6.800 ohm or 2000 watts working should be suitable. Approximately 6000 square plate-to-plate loading is correct, although the exact value depends upon the plate voltage used. It is necessary for the unit to be in a to a two-ampere range. A condenser of 6,000 ohm per volt should be used in order to provide suitable L-C values on each band. Plate coil specifications are as follows: The initials, volt and volt may be used. For example, 450 volts coil, 2400 is the 24.
newly made, the desired length with soldered on center wire, respectively, in 0.02, 0.03, and 0.04 inches.

MECHANICAL DETAILS

The Linear Grids are constructed on a 13 by 17 by 3 inch panel of alpha and a 2 by 14 inch front face. The rear panel is made of 43 Organic plate. This plate is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The rear panel is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.

The entire unit is made of 43 Organic plate. It is bonded to cast iron from the back face at the proper edges.
The front panel and the rack end plates, between shield and stator, are mounted on each other parallel with standoff posts to prevent breakdown of the grid coil. Edge padding must be used.
SIGNAL TO that frequency band you intend to transalting plate tank condenser grid supply position exciter to the grid re means of achieving this design to avoid power densers. The resistance for an external meter The next step Neutralize the final in current the plate grid disconnected from the rear high-voltage bushing. Reque's article attempting to get the desired plant current. Drive by approximately 15 volts, and then push the exciter to the grid circuit. The objective here is to prevent the high load to the exciter so that the exciter works properly. In other words, you are familiar with the operation of your exciter, the various power leakage, the line input, the plate load, or the dummy load, or the plate drive the exciter. An adjustable C, until the exciter is working as it should. The ability of the Oscoop to support output current. Tune the circuit, making sure all the necessary adjustments to match the exciter to the grid Condenser. The Table 2 gives the power required.) While making these adjusting adjustments by adjusting the plate tank condenser, the envelope coupling. While making these adjusting adjustments by adjusting the plate tank condenser, the envelope coupling. If the envelope coupling is too coarse a factor of perhaps five to one, depending on the plate loading, which has not yet been adjusted. However, we do not exceed the maximum plate current several of the exciter. The amplifier has now been adjusted in a preliminary sort of way, and we are ready to proceed with the two-tone test method. Turn the amplifier on and adjust the first test signal to be approximately 10 volts on the output, as shown by the plate rail circuit of the Linear Amplifiers. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils. The amplifier is now ready to be coupled to the Linear Amplifier plate circuit at this time. The coupling between the signal generator and the Linear Amplifier is 25 mils.
There is the reason that switch B, was incorporated in the Layey Linear. In parallel 1 the grid low was where the output voltage never varied. In parallel 2 the grid low was where the output varied, and the lower the plate voltage the higher the grid voltage. There is the reason that switch B, was incorporated in the Layey Linear. In parallel 1 the grid low was where the output voltage never varied. In parallel 2 the grid low was where the output varied, and the lower the plate voltage the higher the grid voltage.

First, the three-tone test signal was chosen as the best form of test signal for measuring the grid low to the plate characteristic 

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

The third test signal is a d.c. signal that is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

The third test signal is a d.c. signal that is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

The third test signal is a d.c. signal that is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

The third test signal is a d.c. signal that is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

The third test signal is a d.c. signal that is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

The third test signal is a d.c. signal that is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.

When the grid low is driven by a d.c. source the signal will be undistorted, unless there is some 

Audio amplifiers are built for mixing electronic waves (as audio frequencies) into one another. This mixing of waves of audio frequencies is what gives the amplifier its power. When an audio amplifier is used as a speaker, it is possible to drive the amplifier with a voltage that is lower than the amplifier's rated output voltage. This is because the amplifier is not used as a speaker, but as a power supply for driving an audio system.

The second test signal for measuring the grid low to the plate characteristic is a d.c. signal that is used only when the grid is driven by an a.c. voltage that is not high enough to drive the amplifier. This d.c. signal is used to drive the amplifier into a d.c. mode, and the output voltage is used to measure the grid low to the plate characteristic.
speech amplifier, equipment until it transmits the narrowest possible audio range, having only enough audio range for complete understandability. A more rabid group goes even further, by partially eliminating the carrier and then transmitting only one sideband. These amateurs deserve a lot of applause, but we needn't bother to applaud them, because they did this not for applause but because they want their money's worth out of their equipment.

Which brings us to the third group, which most certainly include the majority of the world's phone men. This group is made up almost entirely of Average Phone Man and others of his ilk. Mr. Average Phone Man has a speech amplifier and a modulation which he copied faithfuly from some handbook or some radio magazine. When he finished the audio end, he connected it to his c.w rig, got on the air, and asked the first ham he contacted the age-old question "How's my modulation?" Aside from the fact that Mr. Average Phone Man should have checked his modulation with a scope, while transmitting a steady load, instead of depending on the advice of another Mr. A. P. M., this situation is quite normal and is to be expected.

All right, you say, this is old stuff, so where's the pitch? Here it is. Why continue to waste power by transmitting certain audio frequencies if these audio frequencies are unable to help the other fellow hear you, especially when you can almost get rid of these unwanted high and low frequencies practically no cost? To be specific about cost, the change can be made by the use of 600 volt paper or mica condensers.

Before explaining how and where to put which condensers, let's make certain that another point is clear. This article has nothing to do with speech compressors, speech clippers, or sharp cutoff low-pass filters. The latter will do an excellent job of tailoring the speech range, but these filters may be rather elaborate. Speech compressors and speech clippers, on the other hand, do not affect in any way the bandwidth characteristics of an amplifier unit. They may, however, affect the fidelity from a distortion standpoint. This is especially true of speech clippers.

One other point might also be explained here. The changing of bandwidth is a suitable way to change the type of speech amplifier. However, a restricted bandwidth will allow more changes to be made in an amplifier which is used for HFPA. If the swing is not great enough, the bandwidth may become excessive. In other words, it is worthwhile to make these changes in HFPA speech amplifier work, but the effect will be nullified if the signal is permitted a too free frequency range, due to an improper adjustment of the condenser.

Here, then, is what you may do to restrict the audio range or bandwidth of the amplifier in an economical way that will attenuate the low audio frequencies by 30 to 50 db. First of all, the proper value of condenser is the same, whether it is for the second and third stages, or for the stage in the grid circuit of the third tube. If the third tube is a phase inverter, it is best not to attempt to change the coupling condenser between the second and third stages, as you would be beyond the scope of this article but it might be necessary to change the grid circuit of the phase inverter in order to get the proper effect from the changed coupling condenser. In this case, the coupling condenser can be changed between the microphone and the input tube. This is completely satisfactory if a dynamic microphone is used. If a crystal microphone is used, a different approach is necessary. Again this is not within the scope of this article, so that you will have to be satisfied with changes on only one tube, instead of two.

The final step before starting the calculations is to check the value of the grid resistor to which the new coupling condenser will connect. This will be the grid resistor for the second and third tubes unless, as stated above, it is necessary to put one coupling condenser between microphone and grid, in which case examine the grid resistors for the first and second tubes. These resistors should be no greater than 250,000 ohms. If they are of a greater value, decrease them so they are 250,000 ohms or less. Incidentally, the grid resistor for the second tube is usually the gain control.

The proper value of coupling condenser will now be one whose capacitive resistance, at 300 cycles, is equal to the grid resistance in the grid circuit of the stage to which it connects. These words mean, simply, that the condenser value in microfarads is:

\[
\text{value} = \frac{1,000,000}{\text{resistance}}
\]

where \( \text{resistance} \) is the value of the grid resistor in ohms. This assumes that the low frequency point selected was 300 cycles. The figure of 1886 is 300 times 2 times \( r_2 \). As an example, if you are using a grid commutator condenser for your grid, so that \( r_2 \) is 0.0026 mf condenser, make the calculations for the second stage, and replace your grid resistance by your calculated value of grid resistor if it is not already that value. The low frequencies of the microphone are dropped out at this point.

Before starting the calculation of the plate to grid resistance, let's take a look at the plate circuit of the second stage and get the value of the plate load resistor which you are using. This is the resistor which connects directly to the plate at one end and is bypassed to ground (and connects to grid network) at the other end. Next, get the value of grid resistor on the tube which follows the plate you wish to consider. Now look up this value of grid resistance in a radio magazine. When you have decided upon the value of the grid resistor you just looked up, now, calculate the effective parallel resistance of these three factors that is, of \( r_p \), the plate resistance, of \( R_a \), the plate load resistance, and \( R_g \), the grid resistance, by this relation:

\[
\frac{1}{r_{eq}} = \frac{1}{r_p} + \frac{1}{R_a} + \frac{1}{R_g}
\]

For example, if you wish to use a 6J7 tube a plate load resistor of 20,000 ohms. The plate resistance of a 6J7 is 40,000 ohms. Assume that the plate load resistance of 20,000 ohms and the grid resistance of the next stage is 250,000 ohms. Now calculate the effective parallel resistance in 1999 ohms. Call this \( R_{eq} \) for the 6J7 stage. Incidentally, \( R_{eq} \) for tubes of low, as shown above. For periods, \( R_{eq} \) will be very high. 7
The proper value of shunt condenser to connect from plate to ground is one whose capacitive reactance, at 3500 cycles, is equal to 8T. Stated again simply, the value in micro-farads is:

\[ \frac{22,000}{16,000,000} = 1,080,000 \] (22,000 \ 2N7)

This assumes that the high frequency point selected was 3500 cycles. The figure of 22,000 is 3500 times 2 times \( e \). As an example, if 2N7 is 5900 ohms, then the plate to ground condenser calculates out to be 0.0016 mfd so use a 0.0015 mfd condenser. Connect it to the plate of the tube and to a convenient ground point. Make this calculation for both stages. This takes care of the higher frequency audio tones.

Let us now examine the change we have brought about in the speech amplifier and also examine what we have gained from this change. To do this, we shall have to assume that the response of the speech amplifier, before the change, was fairly uniform from 150 to 6000 cycles. This is the sort of response which might be expected from a speech amplifier used in general circuit practice. In addition, the response was probably only five or six db down at 100 and 10,000 cycles.

When you used your speech amplifier, before the change, you were modulating your carrier with all the complex audio tones that exist in the microphone output; over the 100 to 10,000 cycle range. From that same microphone output, the pure tone to which you are using to hear your signal, was therefore spread over a wide frequency range. It so happens that it takes a fair amount of modulator power to transmit the lower and higher frequency audio components which are not necessary for intelligibility.

By making the change to your speech amplifier, you now still have the same power in your sidebands, assuming that the percentage of modulation is the same, but you now have a great deal more power available to transmit the range of frequencies that really count, those between 300 and 3500 cycles. Effectively, therefore, you have a "softer" signal, because you have increased power at the audio frequencies to which the other ham listens. In round numbers, the increase in signal strength is about 6 db, which is the same as a 0.04 to one increase in carrier power, or the same as putting up an antenna with a 0 db gain over the one you were using.

To get an idea of the response curve which is obtainable, let us look at a speech amplifier which uses, for example, a 6SL7 dual triode for the first two stages, driving a third stage which has a 250,000 ohm grid leak. Assume that the aforementioned changes have been made. Now let us apply a pure tone at 1000 cycles to this amplifier. The output of the speech amplifier, next, apply a pure tone of 300 cycles. The output will be down 6 db, or four to one in power. The same thing is true for a 3500 cycle tone. A pure tone at 150 cycles (and at 7000 cycles) will be down 14 db, or twenty-five to one in power.

Thus, while the curve obtained is not of the sharp cutoff variety, it will give essentially the same results, and will certainly sound the same to the ear. Further, it was obtained at practically no cost. —Lighthouse Larry.