A Discussion of Condenser Plate Shapes

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Variable air condensers are made with three general types of plate shapes, although there are many modifications of each type.

The first rotary variable condensers were made with "straight line capacity" plates. These plates were semi-circular in shape and are called straight line capacity because the curve of capacity plotted against dial divisions (angle of rotation) is a straight line. The relation between capacity, wavelength, and frequency are such that this plate shape tends to result in crowding of stations at the lower end of the capacity range. That is, there are more transmitting channels for each dial division at the lower end of the scale than the upper. This objectionable feature has led to a widespread use of other plate shapes.

The straight line capacity plates have, however, one distinct advantage when used in single-control set-ups. Where it is desired to tune several circuits with one control, some form of capacity adjustment is nearly always necessary to compensate for different zero capacitances in the several circuits. If semi-circular, (straight line capacity) units are used, this adjustment can be made by slightly advancing one or more of the units. If this be done with condensers having other plate shapes, the capacities will become unbalanced as the control dial is advanced. This is due to the fact that if the plate shape is not "straight line capacity," the capacity variation per dial division increases as the condenser is turned toward maximum capacity, and the unit which was advanced gains capacity more rapidly than the others. This feature has caused at least one important manufacturer of uni-control receivers to return to the semi-circular plate shape.

It may be noted that the effect of "straight line wavelength" and "straight line frequency" condensers is strictly a slow motion action, having a variable reduction, gradually lessening as the condenser is advanced. The same result can be and, in fact, has been accomplished by a slow motion dial so constructed as to automatically vary its reduction ratio to give the effect of a "straight line frequency" plate when used with a "straight line capacity" condenser.

The disadvantage of the semi-circular plate shape was first realized in connection with the construction of wavemeters. This was long before there were enough broadcast stations for the problem of station separation to be serious. As the relation between capacity and wavelength is not a direct proportion, a dial calibrated in wavelengths will not have equal divisions over its scale if a semi-circular plate shape is used. This not only makes the instrument more difficult to read, particularly as to the estimation of readings which fall between divisions, but involves difficulty in calibration, as the space between two points ten meters apart for instance, could not be divided into ten equal one-meter divisions. A plate shape which would give equal divisions for equal wavelengths, i.e., "straight line wavelengths," was highly desirable, and a condenser with such a plate shape was first used commercially in the General Radio 124 wavemeter, introduced in 1916. When the multiplication of broadcast stations began, the straight line wavelength plate was introduced for condensers used in receivers, and became very popular, due to the better separation of stations resulting from its use.
The General Radio Experimenter

It is necessary to give the high powered stations channels in the upper portion of the wave band, and the crowding together of these stations, generally having the better programs, proved disadvantageous.

Voltage Regulation of Plate Supply Units

Broadcast stations continued to multiply, however, until all channels in the wavelength range allotted to broadcasting were filled. The transmission channels were assigned on the basis of uniform frequency rather than uniform wavelength separation, and, as they all became occupied, the difficulty of crowding a great many more than half the stations into the lower half of the dial again rose. The obvious step was, of course, the "straight line frequency plate" shaped to give equal frequency divisions over the dial. This plate shape not only improves the distribution of stations over the dial, but is the only type of condenser which can be used in a single-control heterodyne, where there is a contribution of stations over the dial, but stray or "zero" capacity of most receivers is so large as to defeat this type of condenser. In the first place, it added a rotation of several controls to those already on the receiver, a distinct disadvantage at a time when the trend is toward simplification and elimination of adjustments. A further objection was that very few users of the power units had a suitable voltmeter for adjusting the voltage. A very high resistance voltmeter is required for this purpose, as the ordinary voltmeter used for checking "B" battery voltages, draws sufficient current to change the voltage of the plate supply greatly. As a result, the voltage of these instruments having adjustments was in most cases set at the wrong value. This is not so serious of itself, as present day tubes do not usually require a particularly critical adjustment of plate current. There was a strong temptation, however, to make excessive use of the voltage control in an effort to clear up trouble having its source elsewhere. It proved, unfortunately, that many of the variable resistances offered for this work were not equal to the strain of almost continual adjustment, and trouble developed due to the noisy action of these devices.

These considerations made the elimination of the variable resistance highly desirable. While this arrangement does not permit an exact adjustment of voltage, if the resistances are properly proportioned, it is possible to hold the voltage at any terminal within fairly narrow limits over the range of current likely to be drawn from it.

In a plate supply designed for this purpose, the resistance across the output circuit is relatively low, so that a considerable current is drawn from the rectifier when no tubes are connected. When tubes are connected to the plate supply, the series-parallel circuit resulting, consisting of tubes and the output resistance of the filter is very complicated. Briefly, however, as tubes are inserted into the circuit the "bled" current through the low tap resistance decreases, and part of it flows through the tubes. Thus the drain on the rectifier and its output voltage does not change as much as it would have been the variable high resistance system used. The result is greatly improved regulation. In fact, it is possible to have a lower voltage drop per mill at the lowest tap than occurs in the overall voltage, despite the greater resistance of the circuit from which it is drawn.

A plate supply designed along this line will fit the needs of a great number of cases without adjustments of any kind. In the few cases which it does not fit, the adjustable factor may easily be added.

Another advantage of the low output resistance is that it limits the rise in voltage when the load is turned off, lessening the possibility of damage to filter condensers. This design, combined with a judicious choice of condensers, has practically eliminated the problem of condenser puncture.
How Good Is "GOOD"?

The Type 415 Laboratory Amplifier

How good is "good"? What are the requirements of a good amplifier?

It will be readily conceded by all that a perfect amplifier is one which will cause a reproducer to set up in a room exactly the same combination of sound waves as existed in the room where the transmitter microphone was placed. The reproduced sounds depend on a great many factors beside the amplifier, and the original sound may be changed either before it enters or after it leaves the amplifier. Before reaching the receiving audio amplifier, the sound passes through a microphone, several amplifiers, often several hundred miles of telephone line, a few or hundreds of miles of space, the radio frequency amplifier and detector. Each successive element of the system has an opportunity to alter the characteristic of the original sound, and most of them take advantage of it to a greater or lesser degree. The composite effect of these elements in the system includes both addition and subtraction.

In considering the amplifier, we are then confronted by the fact that the product delivered at the amplifier input terminals is no longer capable of reproducing the sound waves existing at the microphone. Even a "perfect" amplifier per se, then, can not deliver a perfect output. The amplifier cannot replace that which has been lost. Possibly, however, it can partially remove the sounds which have been added, without removing any of the original sound. Many of the noises added to the signal as it traverses the transmitting and receiving systems occur at relatively high frequencies, above 5,000 cycles. The experiments of Dr. Har­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­­…
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For those who are building a continuous line of the General Radio Experimenters, the above prices are a part of the General Radio Experimenter's tool kit. For further information, please contact us at the address below.

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