The New B-6 Donle Detector

Radio Enthusiasts Will Be Interested in This New Detector Tube

By H. P. DONLE

THE majority of radio enthusiasts, who have either built a radio receiving set or bought one ready-made, are vitally interested in any method of increasing their radius of reception and the volume of their received signals. The means whereby this can be done, in the majority of cases, are decidedly limited; for this increase must in all cases be secured without loss or sacrifice of signal quality and without the addition of other controls.

To secure an increase in volume-sensitivity of a receiving system usually implies considerable additions and alterations to the circuit, in both radio and audio stages.

There is one way, however, in which these very desirable improvements may be secured, by the simple substitution of a "sensitive detector" for the ordinary "hard" tube; and thus, without any changes in the circuit, the radius of reception and volume of signals secured with the outfit will be greatly increased. Furthermore, a considerable improvement will be secured in tone quality from the set.

There have been several types of "sensitive" detectors used in the last few years, but only two of these have ever been sufficiently satisfactory to become popular. These are: first, the gas detectors such as the UV-200; and, secondly, the alkali-metal detector known as the Sodion: All detectors in which a gas such as argon is used require critical adjustments, and frequently a large filament current. The critical adjustment of this type of detector is a decided disadvantage, because with the average radio set it is not practical to make these adjustments and, furthermore, these gas detectors do not give the quality of signals which can be secured by a properly-designed detector.

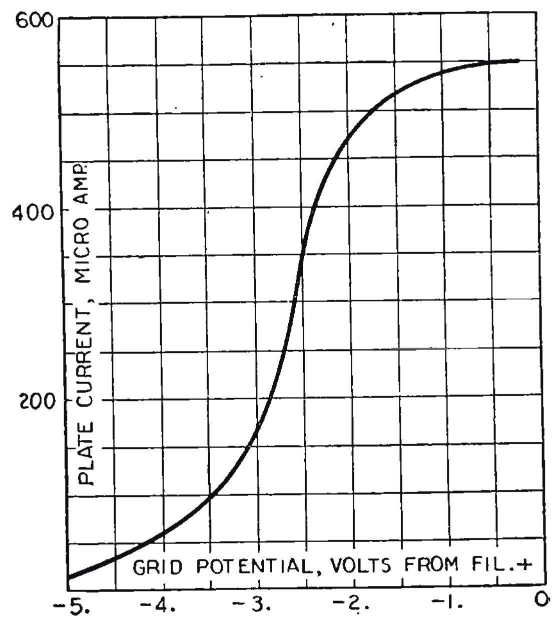


Fig. 2. The static characteristic curve of the Donle B-6 detector tube is reproduced above.

The Sodion detector gave far more satisfactory results than any detector used previously, on account of its simple and broad adjustment and its quality of signal. But for various reasons this detector has been withdrawn from the market.

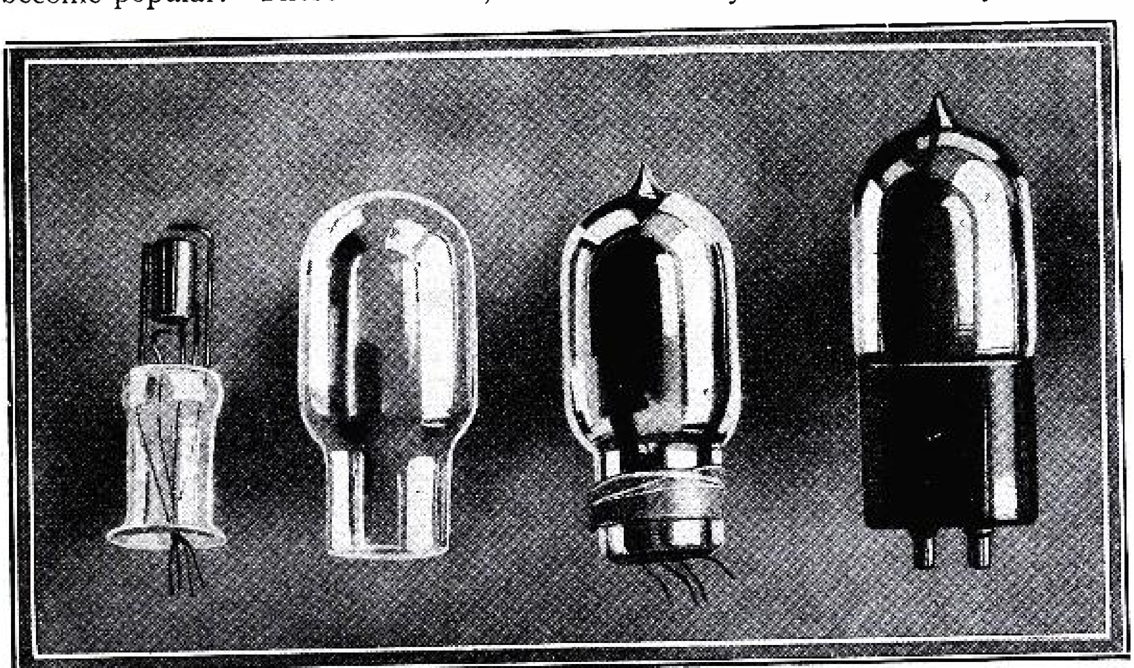


Photo by courtesy of Donle-Bristol Corp.

Fig. 1. The elements of the B-6 tube are shown at the left; the glass tube is next; the resistance that is in series with the filament is then shown wrapped around the glass and last is the finished tube.

Needs No Critical Adjustment

A new detector has been developed by the writer which gives very satisfactory results under all conditions: it is more sensitive than any detector previously used, it does not require critical adjustments, and it gives that round, full quality of tone so desirable in a receiving set. The adjustments of this tube are so broad that it may be inserted in any standard receiving set, which has previously been operating with a hard tube, without even altering the rheostat. In fact, with this new tube, the adjustment of the rheostat is a factor of minor importance and may be eliminated entirely, particularly if the value of "B" potential applied to the tube is properly adjusted.

The structure of this new tube is very simple and much like that of any

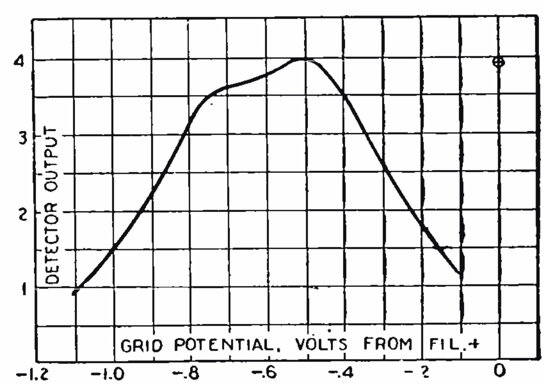
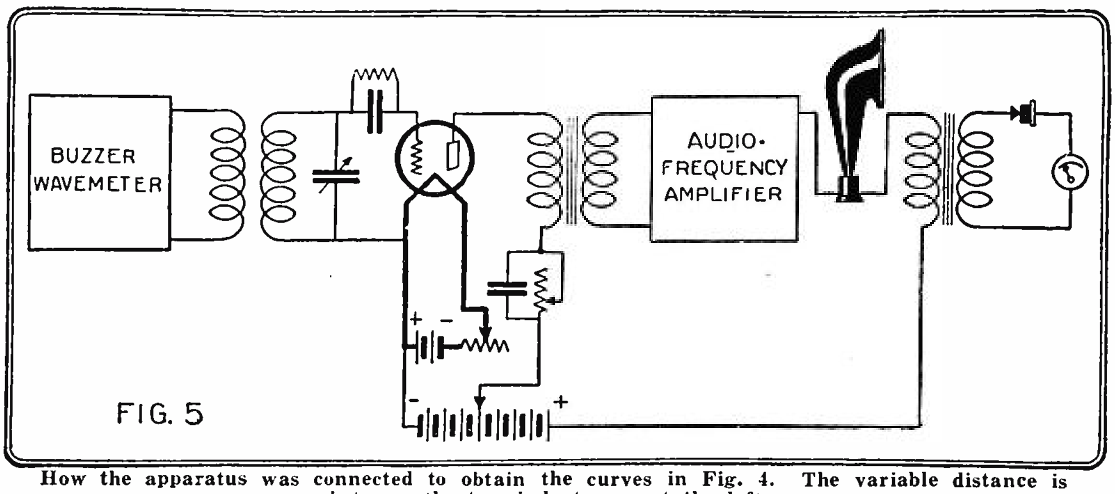


Fig. 3. Here is plotted the intensity of the signal at various values of grid voltage.

ordinary tube, as shown in Fig. 1. The essential parts and their arrangement are as previously stated, quite ordinary. The extreme sensitivity and quality of signals, secured from this tube depend, not so much on the structure, as on the gas contained in the bulb, which for patent reasons may not be completely described at the present time.

Automatic Current Control

In practice the resistance "R" is wrapped around the neck of the tube and is connected in series with the filament. This resistance plays an important part in the tube operation and has a distinct bearing on the blunt filament-current characteristic. The potential across the terminals of the filament in this tube is only 1.1 volts, but the potential across the outer terminals of the tube base is 5 volts. The difference between these two values is taken up in this resistance "R." The resistance consists of a short length of wire having a high temperature-coefficient of resistivity, and tends to maintain the filament current constant with varying battery voltages; thus practically eliminating one of the most disagreeable features connected with the use of a sensitive detector, that of critical filament-current adjustment.



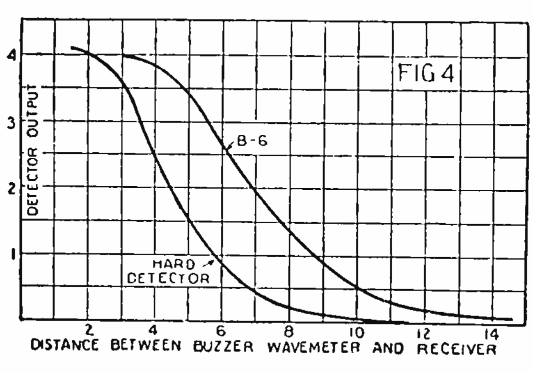
How the apparatus was connected to obtain the curves in Fig. 4. The variable distance is between the two inductances at the left.

The static characteristic of this tube is in many ways similar to that of any other tube, particularly to one in which ionization exists. Its curves are shown in Fig. 2, and were taken under the usual conditions. The particular point of interest in connection with these curves is that contrary to the usual idea, detection does not take place at a sharp kink or bend in the static characteristic.

In Fig. 3 the intensity of the received signal is shown, taken at various values of grid potential with a constant value of applied signal, this latter value being measured from the positive end of the filament. This curve indicates that the maximum response is secured at a point on the static characteristic at which there is no abrupt bend, and detection is due to another factor entirely.

Eliminating Grid-Leak and Condenser

Fig. 3, described above, which shows the intensity of signal at various grid voltages, is quite interesting because it indicates the very large signal which can be secured from this tube without the usual grid-leak and condenser. In order to show the relative magnitude of signal, detected with and without grid-leak and condenser, the signal with

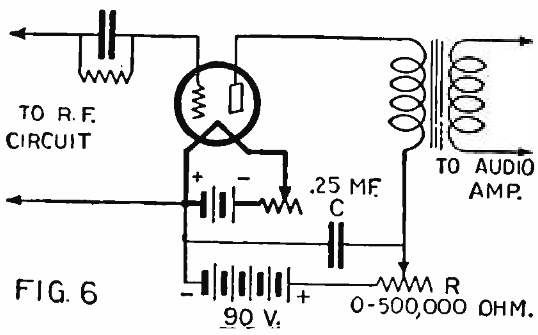


These curves show that the B-6 gives a greater output over most of the range than an ordinary hard detector tube.

the grid-leak and condenser, taken for the same value of applied signal, is shown on this curve by the crossed circle. The comparison of these two methods shows a considerable variation for signals of different intensity; nevertheless, in general equally good results will always be secured with this tube without a grid-leak and condenser, particularly with the use of a potentiometer, which allows the grid potential to be fixed at the most appropriate value.

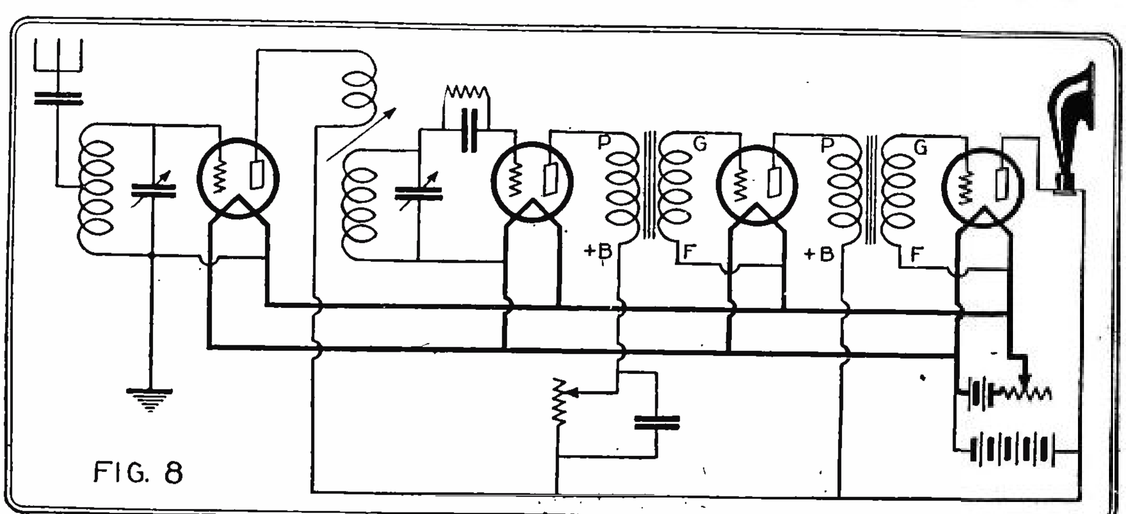
Sensitivity on Weak Signals

The matter of greatest interest in connection with this tube is its per-



This diagram shows the connections necessary for obtaining the correct plate voltage.

formance under actual operating conditions; that is, the output which it will give for applied signals of different



The circuit diagram of a receiver in which is incorporated the Donle B-6 detector tube. Notice the rheostat in the plate circuit to vary the voltage.

intensity, and how it compares under these conditions with the usual detector. The results of such a test are shown in the curves of Fig. 4 which shows the response in telephone current, or current supplied to the audio amplifier system, given in arbitrary units for applied signals of varying intensity both with the new sensitive detector and with a typical "hard" tube. These curves indicate a very great gain on weak signals, decreasing as the signal increases, until both tubes give substantially the same results on the strongest signals. The point, however, where the performance of these tubes becomes nearly equal, is at a signal intensity which has practically saturated each tube; saturation occurring on the "sensitive" detector at a slightly lower signal than on the "hard" detector.

The means whereby these last curves were obtained may be of some interest. The circuit used is shown in Fig. 5, where the signal is secured from a buzzer-excited wavemeter placed at some distance from the detector testing circuit, and arranged so that its relation in regard to the inductance in the latter circuit may be readily altered. The grid circuit of the detector is connected to the usual type of capacity-inductance circuit.

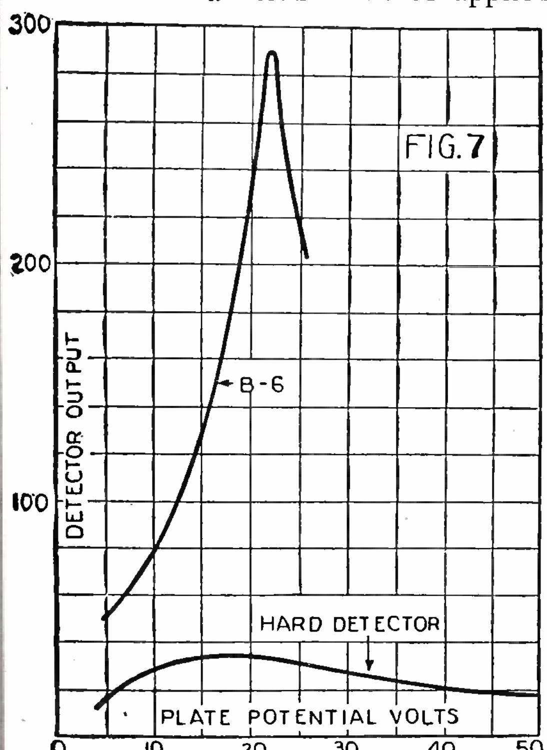
The output of the detector passes into an ordinary two-stage audio amplifier. The output of this audio amplifier is connected to a loud speaker which is in series with the primary of a transformer. The secondary of this transformer is connected to a microammeter through a crystal detector. This transformer is used for the purpose of separating the A.C. and D.C. components in the plate circuit of the audio amplifier, in order that the microammeter may indicate only the alternating component, which is rectified by the crystal detector and indicated as a direct current on the meter.

This circuit is exceedingly simple and allows direct comparisons to be made of various types of detector, the results of which may be read directly upon a meter, thus eliminating the uncertainty and errors accompanying the use of audibility measurements. Furthermore, slight differences in operation which would be difficult and almost impossible to detect by means of audibility measurements are most clearly indicated with this circuit. The horizontal scale of Fig. 4 shows the distance between the coil of the buzzer wavemeter and the coil connected to the detector tube being investigated.

Adjustment of "B" Voltage

The sensitivity of this tube is affected to a considerable degree by the value of plate potential used and it is highly desirable in all cases, in order to secure the best results, that this be carefully adjusted. The method whereby this adjustment can be made most readily, and which simplifies to a certain extent the receiving circuit, is shown in Fig. 6. A rheostat with a high resistance range is connected in series with the plate circuit of the detector tube and is shunted by a fixed condenser and connected to the 90-volt terminal of the "B" battery instead of the usual 22½ volts. This rheostat is adjusted until a signal of maximum volume and quality is obtained and, will not require further readjustment at any time.

The results obtained by the use of this adjustment are shown in Fig. 7, which is a curve showing the output of detector with a fixed value of applied

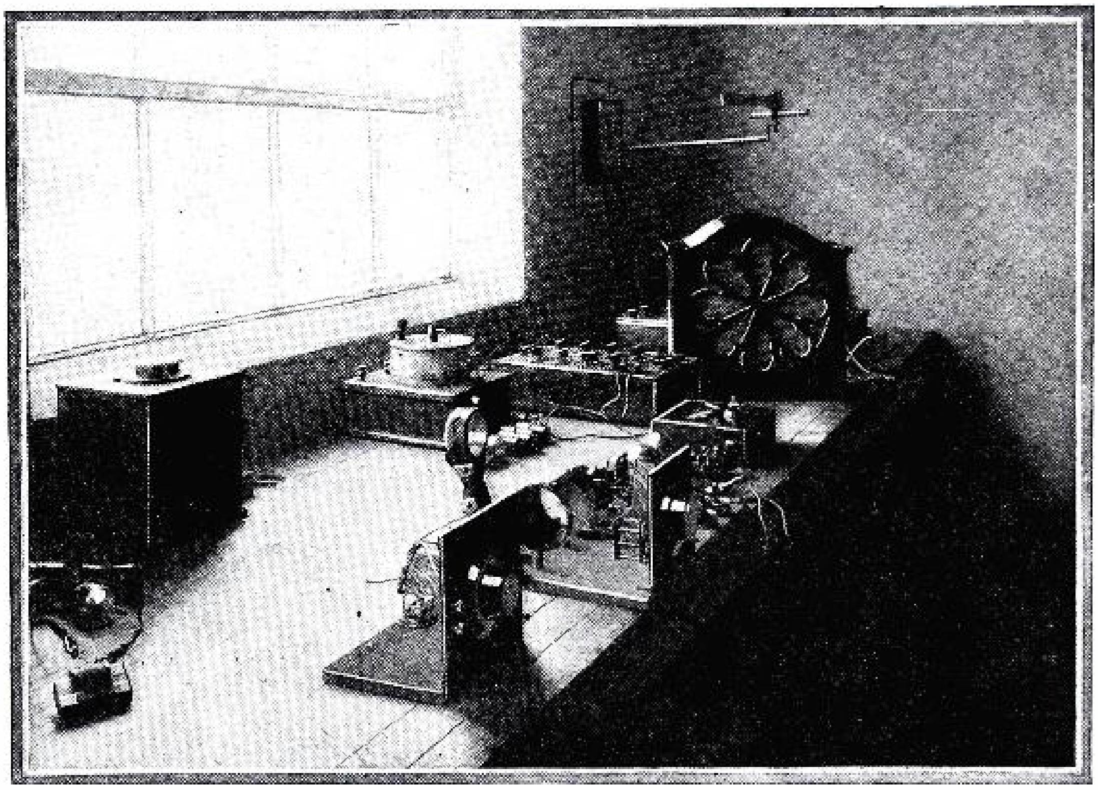


These curves show how critical the plate potential is for the Donle tube, and the opposite for a hard detector.

signals for various values of plate potential. On this same curve is also shown, taken under similar conditions, the performance of a typical "hard" detector. While these curves show that reasonably good results can be secured with the new detector without this adjustment, still there is in practice a substantial gain by its use, particularly as these new detectors vary somewhat in this characteristic.

Rebalancing Sometimes Desirable

When this detector is used in any circuit where one or more stages of radio frequency precede it, the gain due to the more sensitive detector is modified to a greater or less extent by the effect of the detector-input-circuit impedance upon the balance of radio frequency circuits. In other words, a circuit, which has been balanced for a "hard" detector tube having a certain value of input impedance, may not be in proper balance when this new detector is used. Fortunately the difference in the value of this impedance is not sufficiently great to cause any material embarrassment; but it is desirable, if the means are available, to rebalance the radio frequency circuit with the new detector in operation. On a neutrodyne circuit, for example, this can be accomplished quite readily; but in some other types it is rather difficult to rebalance and, therefore, the gain secured by the use of this tube will not be equal to what it should be under most favorable conditions, although it is decidedly worth while.



The apparatus used for obtaining the comparison curves in Fig. 4 in Mr. Donle's laboratory.

This tube is most particularly adapted to a receiving circuit where no regeneration in the detector is employed. A circuit particularly designed for the new detector, incorporating all the desirable features which allow the maximum operation from the detector to be secured is shown in Fig. 8. It is extremely sensitive, gives excellent signal quality and volume and, furthermore, is simple to construct and operate. Various other forms of circuits are being designed for use with this detector, which depend largely upon sensitive detection for their operation, rather than upon the addition of many stages of radio and audio amplification; thus eliminating multiplicity of tubes, noisy operation and distorted signals, common to the usual radio set.

How and When to Use Power Tubes

(Continued from page 117)

to any socket, and to the tubes, proper B and C voltage by means of flexible wires, which protrude from the adaptor. This of course, means that no internal wiring changes are necessary, the adaptor being so designed as to save the set user all this unnecessary trouble.

"What are the best power tube or tubes to employ, there are so many now on the market," is another question often asked. Well, the first consideration is "what sort of a receiver have you," and "does it employ the dry cell or storage battery type of tubes." The only data we have on dry cell power tubes is that of the UX-120 or CX-220. This eliminates any confusion that may exist with owners of the abovementioned type of set. In resistance coupled amplifiers, Mu-20 tubes should be employed and a power tube having the characteristic of Mu-6 (data furnished by the manufacturer of the tube) placed in the last socket or stage.

With receivers operating with the storage battery type of tubes, we have the choice of any of the following types. The UX or CX-112, the UX or CX-171, UX-210 or CX-310. The UX-112 or CX-112 power tube would be the most advisable to employ, and their characteristic data may be found in the chart contained within this article.