# The New Sodion D-21 Detector

THE sodion tubes are intended for detection only. Both the S-13 of last year and the D-21 of this year depend on the presence of sodium for their sensitivity. Other metals, such as potassium, caesium or rubidium can be made to serve the same purpose, but sodium is comparatively cheap and easy to secure.

This scheme serves the same purpose as the small amount of gas which is left in the usual "soft detector" tube. However the action is said to be quite different and the tube curves do not have the "kinks" which provide the sensitivity of the gas tube.

In other ways the two tubes are not at all alike. The S-13 was a non-oscillating tube, with a non-standard base, also it was so designed that it required slight changes in the wiring standard receiving sets.

The new D-21 has a standard base, can be made to oscillate smoothly and easily,

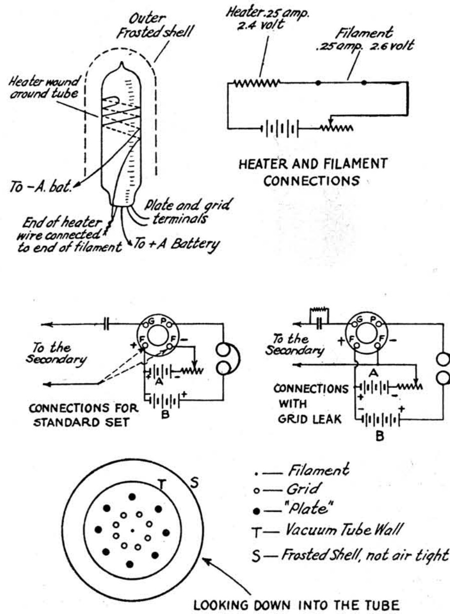

**THE NEW D-21 TUBE COMPARED WITH THE OLD S-13 TUBE**

**The base of the D-21 is of standard size. The frosted shell of the D-21 has been made larger than that of the old tube so as to provide a better grip when putting the tube into the socket. The actual vacuum tube inside is of about the same size as that of the old S-13.**

and is so designed that no wiring changes are needed—it can be substituted for a "gas tube" or "hard tube" without any ceremony.

### Construction

The photographs show the internal "machinery" of the D-21. The tube itself is quite small but is surrounded by a frosted glass shell (not airtight) which shields the tube itself from draughts, steady temperature being important. The inner glass shell is the vacuum tube proper—it is sealed in the usual fashion and contains the grid, filament and plate. Also the "heater" is wrapped around it. All four of these things are different from the devices found in the more common varieties of tubes. The filament is of tantalum instead of the usual




CONSTRUCTION AND CONNECTION OF D-21 TUBE

tungsten, although tungsten will work equally well. The heater is connected in series with the filament and serves to warm up the tube so as to keep up the best temperature for tube operation. This is necessary because the tube contains sodium vapor, as previously stated. When the tube is turned on the filament at once glows bright yellow, the heater warms up more gradually and after a minute or so the tube is in operating condition. The frosted glass outer shell then prevents sudden changes of temperature. The grid is made of wires spot-welded together into a tiny "squirrel cage". The "plate" is not a plate at all, but a larger squirrel cage of the same sort, located so that its wires come between those of the grid. This is shown in one of the diagrams.

By changing the size and number of wires in the squirrel cages, also by changing the diameters of these cases, it is possible to get almost any desired grid and plate impedence. The present dimensions are chosen so as to agree with standard practice.

### Operation

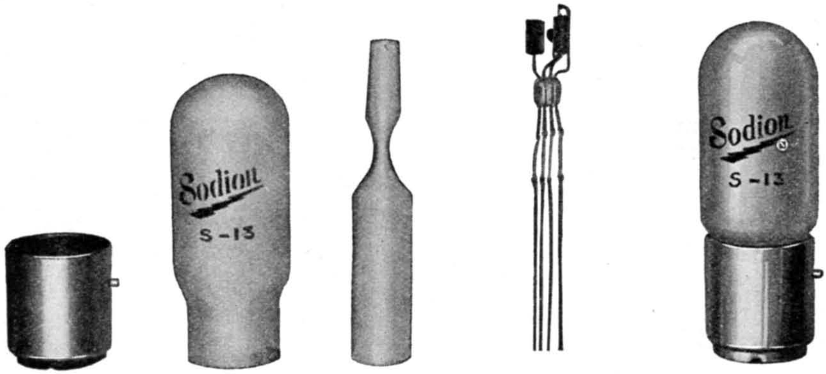
The D-21 tube can be used as a non-regenerative detector, as a regenerative detector and as an oscillating detector. Since the tube is pumped to a "hard" vacuum there is no need for critical adjustment of the plate and filament voltages.

Three tubes were secured at the factory and given some rough tests in different receiving sets. Of course these tests were pretty crude—they consisted of listening and making notes. However it is interesting to find that tests made at different places by four different men check up very well indeed.

Two of the tubes worked best without a grid leak, the third one worked just a trifle better with a 2.5 megohm leak. The difference between the tubes was surprisingly small and one report will answer for all three.

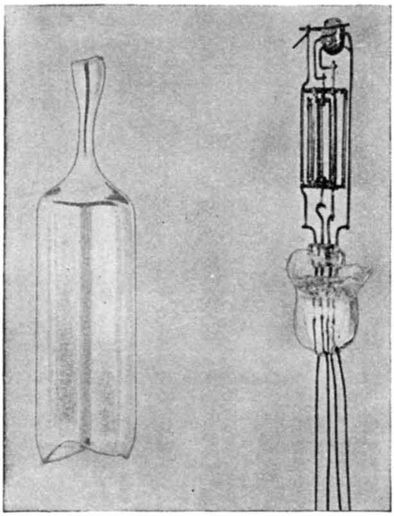
### In a Superheterodyne

When used in the first detector socket of a superheterodyne receiver for telephone work they showed very fine sensitivity. On very weak signals they proved very much better than any one of six UV-199 tubes and a trifle better than any one of three UV-201-A tubes. A "soft" tube was not handy for comparison, therefore this test was not particularly complete. When strong signals were being received the UV-201-A tubes seemed to have the advantage, the UV-199 choking up entirely while the D-21 stayed clear but did not give as strong signals as the UV-201-A. On the whole the honors were with the D-21, it was most sensitive where sensitivity was most needed—one on weak signals, also the adjustments were entirely uncritical.




**THE S-13 TUBE OF LAST YEAR**

**1—The small base 2—The frosted outer shell, not airtight but merely cemented to the base and acting as a protective covering for the tube itself. 3—The tube itself before the "works" are put inside. 4—The metal parts of the tube. These are sealed into the tube (3) after which the tube is evacuated and sealed. The "heater" wire is then wrapped around the tube and connected in series with the filament. Next the tube is fitted into the base, the 4 wires connected to the terminal pins and the frosted outer shell put into place. 5—The finished S-13 tube after assembly.**

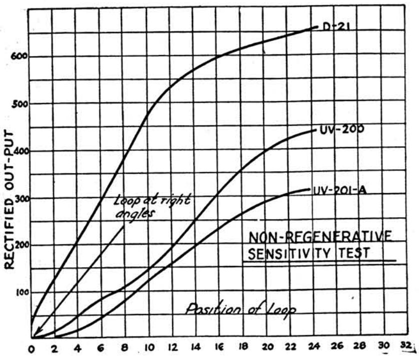


**THE METAL PARTS OF THE D-21 TUBE**

**The straight tantalum filament runs thru the centre of the assembly. Around this is the grid, made in squirrel-cage shape of fine wires spot-welded together electrically. These two elements are surrounded by a larger squirrel-cage with its bars opposite the gaps in the grid; this larger squirrel-cage takes the place of the plate in the standard types of tubes.**

### In a Tuned R.F. Set

The tube was next tried in a set using two stages of tuned R.F. amplification




**SENSITIVITY TEST OF THE D-21 TUBE IN A NON-REGENERATIVE LOOP SET**

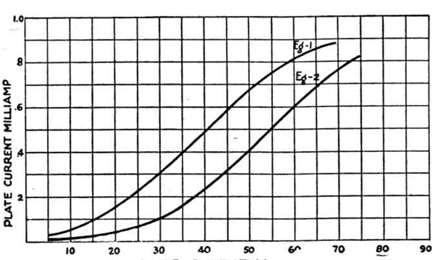
**The method is described in the article. Referring to the lower (horizontal) scale of the curve, when the loop is in the position "O", it is at right angles to the line of transmission; therefore it is collecting only a very little energy from the passing ether wave and this very little is due only to accidental antenna effect. For practical purposes we can say that in this position the loop collects no energy. Going to the right along the scale the larger figures indicate that the loop has been turned thru a greater and greater angle, approaching the line of transmission. Unfortunately the scale on the loop was an arbitrary one and did not indicate angles directly. However the divisions were even.**

ahead of the detector. The report on this test is quoted:

"Slightly better than a UV-200 as a detector, with either 22.5 or 45 volts on plate. Seemed fairly non-critical as to both A and B voltages.

"On weak signals very little difference between the Sodion and a 200 was noted. On moderate signals, using loud speaker, the Sodion gave roughly an aural increase of 15 or 20%. On loud signals the Sodion still held the lead.

"Quite a difference in the tone reproduction was noted. The Sodion gave a deeper



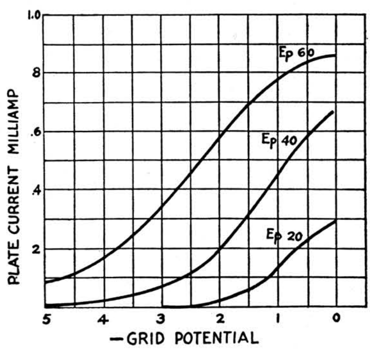

tone or timbre than the UV-200. Of the two the Sodion gave much the better tone.

"Another peculiarity was noticed. On tuning KDKA exactly to resonance, the 200 was almost as good as the Sodion; on throwing one circuit (primary or secondary) slightly out of resonance, the Sodion was greatly superior to the 200. Did not have chance to test on higher waves to see if this still held good. (Note—all these tests made on radiophone broadcasts at usual wavelengths.—Tech. Ed.)

"In comparison with a uniform UV-201-A, used as a *detector* the Sodion was superior at all points. The sodion was tried in both radio and audio frequency circuits (i. e., it was tried in the amplifier sockets of the same set, both before and behind the detector.—Tech. Ed.) but was no good.

"Also tried it in short wave set as an oscillating detector but couldn't make it oscillate even with urgent persuasion."

The D-21 was next tried in the detector socket of an ordinary regenerative receiver. When working non-oscillating it gave results similar to those in superheterodyne. Weak signals could be heard very nicely,




although three specially picked UV-201-A tubes ignored them entirely. When strong phone signals were received the D-21 dropped behind the UV-201-A.

As an audio amplifier the D-21 was a failure.

When an attempt was made to receive C.W. signals with the D-21 acting as an oscillating detector the results were most disappointing. Few signals were heard and these were weak. The UV-201-A and the UV-199 "had all the delegates" in this field.

Summary of unofficial tests:

It will be seen from these tests that the general effect was to make the D-21 seem an excellent device for use as a *detector* in non-oscillating radiophone reception, giving the best performance on weak signals but acting very well indeed on strong signals. As an amplifier (R.F. or A.F.) it was not a success, nor was it particularly encouraging as a C.W. detector.

### Laboratory Tests

Some laboratory tests at the factory gave the following interesting results: An oscillator was set up so as to transmit a weak modulated signal. This signal was received some distance away on a loop receiver equipped with a tube detector (non-regenerative circuit), two stage audio amplifier and tube rectifier. The output of the rectifier was measured as an indication of the output of the detector. This performance was repeated with the loop set at different angles to the line of transmission, thus changing the *input* to the detector and giving an idea of the change in sensitivity when different signal strengths are being dealt with. The results for various tubes are given.

### Miscellaneous Notes

The grid return should be made to the "-F" terminal of the socket if a grid leak is being used. This means that the return is really being made to the negative terminal of the heater.

In many receiving sets the return is not made to the "F" of the detector socket, but to the "+F" instead. The change in the wiring is simple, but it can be avoided by taking out the grid leak and operating with the grid condenser only. The return can then be made to *any* point on the filament circuit.

The tests above were made on three tubes which came direct from the factory. We do not know where the tubes may be bought on the general market, hence were unable to make the test otherwise. However, the tubes were not "hand picked", they were simply taken from the regular production. The curves shown in this article were also made at the factory on regular production tubes with the bases in place and the heater connected. Therefore the drop through the heater should be added to the grid biases which are indicated.

The measured value of the mutual conductance was 260 micromhos, the plate impedence 51,000 ohms, and the voltage amplification 22.36. For the sake of comparison, a typical UV-201-A will measure as follows: Mutual conductance varying from 200 to 750 micromhos with a plate voltage range of 80 to 20, plate impedence 10,000 to 30,000 ohms, with same plate voltage change. The voltage amplification will be fairly steady at 8.

# A Quick Coil Test

THE main excuse for this story is to show how easily one can get an idea of the goodness of a coil, and how entirely unnecessary it is to have any elaborate equipment for doing it.

We began by wondering how important it was to use the proper material for a coil form, assuming that there was going to be something in the way of a tube to wind on.

This was after supper and we didn't have time to think of making real resistance measurements. Therefore, we connected up the apparatus shown in Figure 1; the driver being nothing but the usual transmitting set run at low power, and working on 180 meters. The reason for sticking on 180 meters, was that we were curious about coils that tuned from 125 to 270 meters when we used a condenser with a maximum capacity of 500 μμfds. 180 meters would give a fair idea of the action of the coils clear through the range.

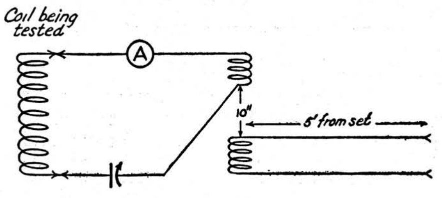



FIG. 1 *All wiring to be left alone during tests. Make no changes except connecting different coils and turning variable condenser by means of long wooden handle.*

The first candidate was a coil having 24 turns of No. 18 D.C.C. wire wound on a tube 3⅛ inches in diameter. This tube was of bakelite (or perhaps it was formica) and was about 1/16-inch thick. The wire was spaced by its own width, which made the coil 2½ inches long. With very careful tuning, we were not able to get a secondary current of over .26 ampere.

A glass tube was next tried and turned out to be just a shade poorer, as the best current was only .25 ampere. The tuning was exactly the same, resonance being secured with the condenser at 43 on a scale of 100 divisions.

Next, the winding was taken off the bakelite tube and a layer of corrugated paper from a vacuum tube package wrapped on before replacing the wire. Since this made the coil somewhat larger in diameter, the number of turns was slightly reduced to get the same tuning as before. The length of wire was almost exactly the same. The current was .3 ampere.

Finally a self-supporting coil was tried and a current of .33 ampere obtained.

*(Concluded on page 65)*