

The Electron Relay

By O. B. Moorhead

During the month of April in the year 1915, two local men, one a glassblower, the other an ardent follower of the radio art, prepared a rival for the Audion, with its attending gaseous medium and all the idiosyncrasy that went with it.

It was in the latter part of March of the above mentioned year that the humble writer of this article had a vision of a device more sensitive than the Audion and which could be sold without having the usual strings attached commonly known as R. J. 4 sets. A mental conception of a device which could be shipped unsealed and guaranteed to operate at least five dollars' worth and his responsibility not cease when he dropped it into the nearest mail box, a dream of a device within the reach of all, even the poorest amateur, was this vision. The writer took this vision in the form of a model of excellence to the aforementioned glassblower and after several weeks of their combined efforts the Electron Relay type of tube resulted.

This tube was successful in bringing the sacred Audion to terms as even that exalted device can now be obtained without the purchase of the "little red box". We are to be everlastingly thanked by the appreciative amateur and even some commercial companies for this service, for we even were successful in perfecting a device that exceeded the Audion in sensitiveness and condemned the gaseous medium and Hudson filament bulb to the happy hunting grounds of good but obsolete wireless instruments.

De Forest with great foresight perceived the handwriting on the wall and a few months after the appearance of the Electron Relay brought suit against us, claiming infringement of

numerous patents and claims. In his complaint he included several people that had never heard of an Audion. He then proceeded to bring out a longer tube, an Electron Relay, under the name of Tubular Audion using our familiar aluminum plate, copper grid and stream line filament. And lastly, De Forest has applied for a patent, claiming the cylindrical plate, helical grid and stream line filament as his own invention!

This, dear reader, is overstepping the bounds of legerdemain that even the lax radio patent situation permits, and I protest. Could two people evolve the idea of using aluminum plates and copper helical grids when no theory exists that explains their peculiar suitability except the rather unknown and unapplied theory of photo electric phenomena? I would say that it is highly improbable. We selected these metals from the electro-chemical series because they were eighteen metals apart and in line from the tungsten filament and also because we could procure these metals with ease on the Pacific Coast. Again, the advent of the Tubular Audion was several months behind the first appearance of the Electron Relay. Even if the Electron Relay did infringe on the De Forest gaseous medium patents, we should have been at least credited with an improvement on the old Audion. This improvement is so great that one is inclined to think that the mode of operation is entirely different.

I do not claim that the Audion that De Forest manufactures at the present time differs greatly from the Electron Relay. It does not, because, since the appearance of the Electron Relay De Forest has increased the vacuua in his bulbs to a point where the gaseous medium plays no essential part in the opera-

tion of the detector but is rather a drawback. If De Forest built the type of bulb protected by his patents and exhausted to one thousandth part of an atmosphere the average life of the device would be forty hours. But he does not do this, he exhausts his bulbs to one-twenty-fifth of a millimeter and the gaseous medium, which he sets forth at great length in his patents, is no longer essential but on the contrary is detrimental to the action of the bulb. The evacuation of the Electron Relay is carried on to an even higher point and we strive to remove the residual gases completely and depend upon the electronic emission from the tungsten filament modified by a variation of the grid potential for the operation of the tube. In the De Forest Bulb the modification of the internal action by ionization of the intervening gas atoms is depended on for the successful operation.

From the above you may see that the word "Audion" when applied to the vacuum detectors now being manufactured is a misleading one, for when we eliminate the gaseous medium we have also left the phenomena of audible ions thereby making the word "Audion" a name of a device manufactured in the past. As soon as the gaseous medium is deserted we separate ourselves from all the troubles of producing the desired result.

We can, with a fair degree of certainty, reproduce Electron Relays in any number that will all possess the same operating characteristics. This cannot be done with the nickel element Audion as any user can testify. A very simple test may be made as follows to show the decided difference in the two devices. Take a real De Forest Audion that actually contains a sensitive gaseous medium and hold a terminal of the grid or plate to one terminal of a spark coil. Notice the beautiful luminous glow inside the bulb due to the presence of

the gas. This glow varies in color with different bulbs even as does the sensitiveness of the device. Now take an Electron Relay and hold the terminal of the grid to the coil and you will not perceive the glow; that is because there is no gas present. When a tube does show even the slightest trace of color the tube is invariably very insensitive. Furthermore test an Electron Relay against a sensitive gaseous medium Audion and note the difference in sensitiveness and the wide range of "B" battery over which the Electron Relay will operate. This is due to an entirely different mode of operation which is basic in its action.

At the present time De Forest manufactures the Electron Relay under the name of Tubular Audion and evacuates the bulbs to a high degree for power generation on small telephone sets. We did this some time ago and De Forest certainly cannot claim that there is a gaseous medium in this purely Electron operated device, yet he asserts that we infringe his Bunsen burner and gaseous medium patents.

De Forest now claims that the degree of vacuua in his bulbs is comparable to one twenty-fifth of a millimeter but that does not disclose any important facts as the vacuua may fall after the bulb is removed from the pumps and used for a certain length of time and this is bound to happen unless efforts are made to remove the gases occluded in the metals during exhaustion. In the manufacture of the Electron Relay exhaustion is carried on to one millionth of a millimeter and every precaution is taken to remove the slightest traces of residual gas. We have perfected a device that employs the electronic emission and it would be no more than just that De Forest cohere to his original mode of manufacture, using a vacuua not high enough to remove

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all gases from within the bulb, thus conforming to the claims set forth in his patents of an Audion using a gaseous medium.

In a recent article by Dr. Lee De Forest in a certain publication he claims to have discovered the external grid type of device several years ago and he remarks that if the grid works outside the bulb it would naturally work better inside between the plate and filament. But Dr. De Forest does not seem to be aware that the ideal type of bulb would be one with a zero grid current; and what is better than a purely electro static control? The General Electric Company in the Pliotron specifies that the wires which constitute the grid should be of as small a cross-section as possible so that the current which flows to the grid may be extremely small.

De Forest may have discovered the outside grid years ago and his assumption that the grid must be intervening between the plate and filament may have been correct for the sensitive gaseous medium, but this does not apply to a device using the electronic emission. It is certain that the controlling member should intervene between the anode and cathode to exert maximum control of the emission, but it is also certain that the grid should control the stream by a purely electrostatic potential.

When a device is developed that is arranged geometrically so that the grid is outside the tube and yet is in a position to exert full control upon the electron stream, we will have a perfect vacuum tube, as then the grid current will be nil.

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