The Radioson[^1] Detector

The Electrical Experimenter, vol. 1 no. 10

February 1914

Figure 1: The Radioson Detector as advertised in the November 1914 issue of *Popular Electricity and Modern Mechanics*

IT is a well-known fact that the Electrolytic Detector has always been one of the most sensitive detectors invented since detectors first came into general use. The reason why it has not been adopted as the universal detector is partly due to the fact that the ordinary Electrolytic Detector, as it has been known in the past, was not a really commercial article, for it cannot be denied that even the best Electrolytic Detectors, as manufactured heretofore, had some serious defects. One of the reasons, and perhaps the main reason why it was not used universally, is that in all such detectors manufactured heretofore it was always necessary that a certain amount of acid was handled; this naturally is a serious objection, as not everybody likes to have acid around the instrument table, and for the reason, also, that the acid in the Electrolyte (or rather the water in it) evaporates quite readily, and therefore makes continuous adjustment necessary.

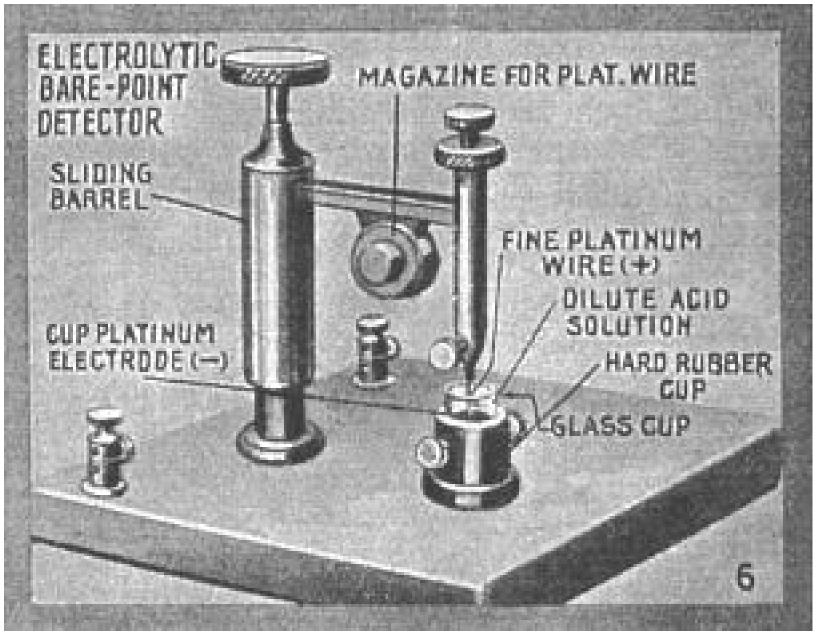
Figure 2: The "Radioson" Detector

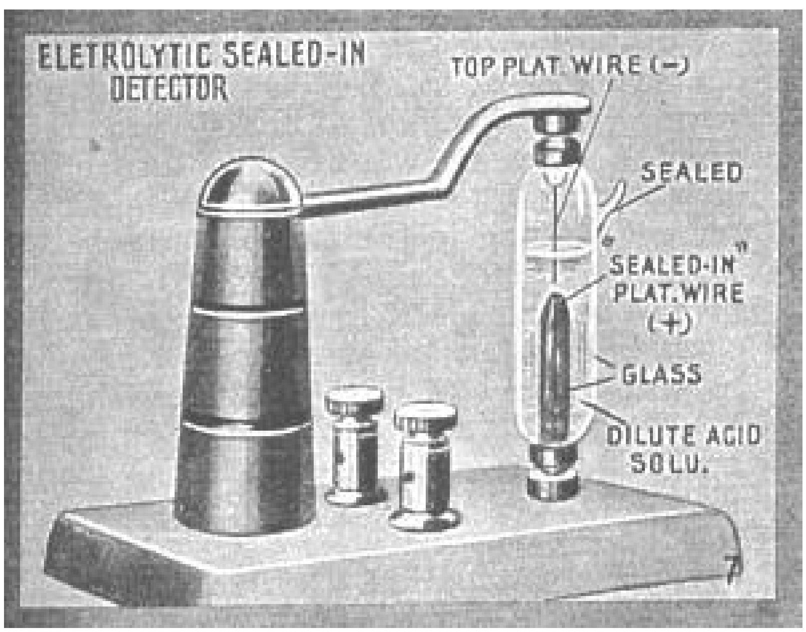
The Bare-point detector, while excellent in many respects, is subject to every draft of air, as the exceedingly fine platinum wire, which can hardly be seen by the naked eye, is usually subject to drafts, and, as a matter of fact, even the operator's breathing against the detector will readily throw it out of adjustment. Of course, this is not the case if the detector should be encased by a glass bell or other cover. However, it cannot be denied that the Electrolytic Detector as a whole is the most sensitive detector if it is put together in its correct fashion.

Many inventors have busied themselves in constructing an Electrolytic Detector that would have only the good features of same and none of its bad ones, but not since the advent of the Radioson has it been possible to produce a really satisfactory article.[1] Even the Bare-point detector, which heretofore has always been considered as the most sensitive detector of this class, is only really sensitive in the hands of an operator who is very familiar with its working and knows exactly all its functions. The writer might state that there are mighty few operators who are fully conversant with the theoretical as well as the practical side of such a detector, and that is the reason why the Electrolytic Detector, as

[1]Gernsback's "radioson" was apparently an improvement on Canadian researcher Reginald Fessenden's bare-point electrolytic detector, the benefit being that the necessary acid solution was protected and sealed in. "Another form of electrolytic detector which will stand considerable rough usage is that known as the Sealed-Point Electrolytic Detector. The commercial form of this instrument, as here illustrated, is known as the Radioson. The operation is the same as in the bare-point electrolytic type of detector and a battery of two dry cells is used with it, together with a pair of high resistance telephone receivers and having the battery potential preferably regulated by means of a high resistance potentiometer. The advantage of this type of electrolytic detector is that the acid is sealed in, consequently does not spill or evaporate." H. Winfield Secor, "Radio Detector Development," *The Electrical Experimenter,* January 1917, p. 652.

it has been known heretofore, was not as successful as it deserved to be.[2]





[2]A possible defense of G's first ever article published on an electrolytic interrupter? Is this simply a retread/update of his initial design?

The Radioson Detector has been the outcome of years of experimenting and it is interesting to note that only a platinum wire of a certain size, which has been fond by experiment, will produce the best results. A few hundred thousandths of an inch variation in thickness will make an enormous difference in the sensitiveness of the Radioson Detector. It might be stated that only one in about four manufactured will come out fit to pass inspection, and the other three must be discarded as useless; this, perhaps, is the reason that this detector costs more to manufacture, and therefore is more expensive than the regular detector.

Why is the Radioson more sensitive than the ordinary Electrolytic Detector? Consider the following:

Fig. 1, greatly exaggerated, shows the elements of the ordinary bare-point "Electrolytic," using the finest wire. By observing the extremely fine (0.0001 inch) Wollaston wire under the lens, it will be seen that the contact between the fine wire, "A", and the surface of the acid is never a mere point-contact, but as the fine wire is so very light it curves around and a considerable portion—about 1/8 inch—usually floats or lays on top of the acid, see sketch.[3] This give a contact of 0.0001" x 0.125" = 0.00003927 sq. inches, which is far too much for high sensitivity. For this reason some makers tried to seal in the Wollaston wire into a class tube and then grinding the point so that only a point of the wire is exposed. However, this was not an improvement. Consider Fig. 2. If the Wollaston wire is sealed in, the silver coating, as well as the platinum wire, comes to the surface. What happens? The acid eats away the silver, and a space, "B", "C" remains between the glass and the sides of the fine platinum wire. The acid by capillary action fills up this space and consequently the contact on such a detector is as large as the one obtained with the bare-point detector. This "sealed-in" detector, therefore, shows no improvement whatever. Now, consider Fig. 3—the Radioson way. By an absolutely new process we succeeded in melting a 0.0002" platinum wire (without silver coating) into a tube made of a specially prepared glass.[4] The acid does not attack platinum, as is well

[3]Wikipedia: "Wollaston wire is a very fine (less than .01 mm thick) platinum wire clad in silver and used in electrical instruments. For most uses, the silver cladding is etched away by acid to expose the platinum core. The wire is named after its inventor, William Hyde Wollaston, who first produced it in England in the early 19th century. Platinum wire is drawn through successively smaller dies until it is about .003 inches (0.076 mm, 40 AWG) in diameter. It is then embedded in the middle of a silver wire having a diameter of about 0.1 inches (2.5 mm, 10 AWG). This composite wire is then drawn until the silver wire has a diameter of about .002 inches (0.051 mm, 44 AWG), causing the embedded platinum wire to be reduced by the same 50:1 ratio to a final diameter of .00006 inches (1.5 µm, 74 AWG). Removal of the silver coating with an acid bath leaves the fine platinum wire as a product of the process."Wollaston wire was used in early radio detectors known as electrolytic detectors and the hot wire barretter. Other uses include suspension of delicate devices, sensing of temperature, and sensitive electrical power measurements. It continues to be used for the fastest-responding hot-wire anemometers." On history of using Wollaston in electrolytic detectors, see **Thomas H. Lee**, The design of CMOS radio-frequency integrated circuits, 2nd edition, Cambridge University Press, 2004, p8, especially the chapter "A Nonlinear History of Radio" and "Overview of Wireless Principles".

[4]On minerals and media, Parikka's book on geology, and current stuff on e-waste and rare earths. Does Bill McKibben (who writes on a return to stationary state economics, "The Coming of the Stationary State") write on e-waste? Our inability to conceive of an

known. Consequently the contact of the Radioson can under no circumstances ever be more than the area of 0.0002" diameter, or 0.0000000314 square inches. Consider this figure with the former one! The Radioson is, therefore, 1246 times smaller than the contact of the best bare-point Electrolytic.

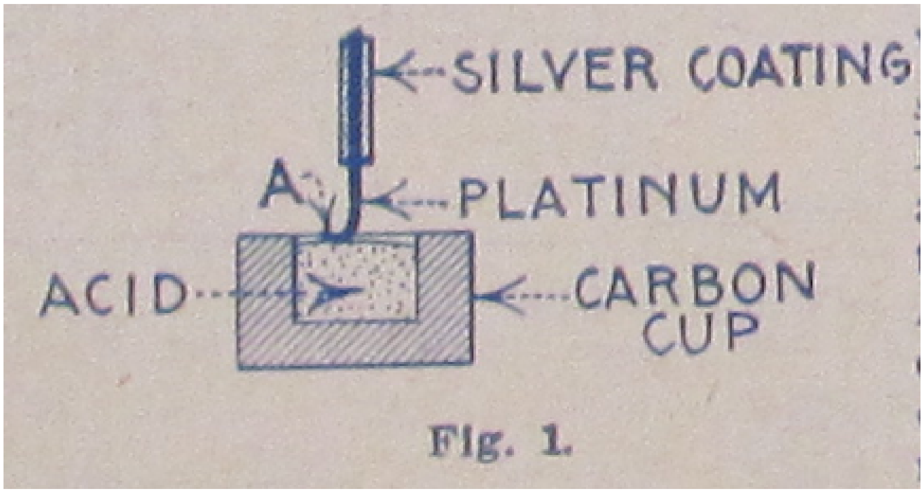


Figure 3: Fig. 1

It is, therefore, not surprising that the Radioson Detector is so marvelously sensitive.[5]

The writer has found, and his opinion has been shared by several Radio experts, that the Radioson to-day is unquestionably the most sensitive detector, even far surpassing the Audion, which heretofore was considered the most sensitive detector manufactured.[6] It is a matter of record that by connecting a double-pole, double-throw switch on one side of the Radioson and connecting on the

intergenerational ethics (phrase from Fredrik Johnson's "Victorian Anthropocene" talk). "We can't articulate binding commitments to people not yet born."

[5]Robert P. Murray, editor of the *Antique Wireless Association Review,* reports attempting to reconstruct this "radioson" detector: Robert Murray, "Reginald Fessenden's Liquid Barretter," in *The Early Development of Radio in Canada, 1901-1930: An Illustrated History of Canada's Radio Pioneers, Broadcast Receiver Manufacturers, and Their Products* (Sonoran Publishing, 2005). "I fashioned one [a detector more simple than Fessenden's original design] after that shown in the 1914 E.I. Co. catalog. This had a similar arrangment of electrodes in a glass cup, but in this case the cathode was a coil of about 3 inches of the same platinum wire. The anode was about 1/4 inch of platinum wire soldered into the advancing screw. This detector worked, but very faintly. I found that it worked best when the wire was just about drawn up out of the acid, and possibly pulling on the surface tension. I do not know why the device worked this way. I mention this only as a speculation. I can hardly see 0.001 inch platinum wire without a magnifying glass. I can certainly not see when it dips into the acid, but can hear the result in the headphones. When I hold the wire between my fingers I can not feel it." (3)

[6]This is a *huge* claim that is undoubtedly false. Basically saying that vacuum tubes aren't as powerful as his electrolytic design. Could this media archaeological path not taken (De Forest's audion tube obviously won out) truly be a possibility for the history of radio? Gernsback

other side of the switch to an Audion, it will be found that the Radioson is far more sensitive than the Audion. In some cases signals that can not be heard at all with the Audion come in fairly loud with the Radioson.

The Radioson is, to-day, the only detector known that needs no adjusting whatsoever. An important point is that messages come in clearly and distinct even while the detector is shaken, and for this reason it is, of course, never subject to shocks and it is, therefore, indispensable for portable sets, in automobiles, railroad trains, ships, aeroplanes, etc. The acid as well as other sensitive parts are sealed into the detector cartridge. For this reason there is never any spilling of the acid nor any danger of the acid coming into contact with the hands of the operator. The Radioson is adjusted to its highest sensitiveness at the factory, and for that reason it is quite impossible to put it out of adjustment except if the cartridge is broken or unless a high tension discharge is put through the detector.

The Radioson practically requires no attention, it is always ready for use and the operator never loses part of a message on account of bothersome as well as

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hitched his star to the electrolytic interrupter design from his very first publication. Doubling down here.

In a later editorial, Gernsback dials down his claims about the superiority of the coherer: "Dr Branley of Paris was perhaps the first one to work extensively in this branch of radio and as far back as 1906 this investigator fired guns closed doors started and stopt motors by means of distant radio control This was in the age of the coherer and probably due to its inherent shortcomings the art of radio kinetics was not much advanced until very recently The coherer is a very unsatisfactory scientific instrument insofar that even if constructed by precision mechanics it has the great inherent fault of being susceptible to shocks as well as to most extraneous impulses Thus for instance a very sensitive coherer will usually operate on strays or static as well as inductive effects and stray waves In other words this instrument even the most balanced one is not reliable It will go Off when least expected A coherer heretofore was thought to be the prime necessity for radio kinetics because it was practically the only instrument known that could close the contacts of a relay Ordinary detectors such as the crystal type and others could not be used until about three or four years ago at which time very sensitive galvanometer relays were introduced which actually could be used to close a contact by means of a carborundum or silicon detector." "Radio Kinetics," *Radio Amateur News*, vol. 1 no. 12, June 1920

The idea is that the audion was too complex (and too expensive) still by 1919/1920 for practical use if the radiophone / wireless telephone was to become a reality for amateurs: "Using the audion as a generator for undampt waves and as a RT transmitter is of course a great accomplishment in itself And the device works well better than anything else so far But it is not the ultimate goal Vacuum tubes of the audion type are tricky as yet and not too practical Unless you use special tubes and you can t just now due to a complicated patent situation the speech is not always clear and far from satisfactory At the critical period the tubes often go bluey and refuse to talk Amateurs therefore should look for substitutes of vacuum tubes or devise other tubes employing entirely different principles The writer years ago experimented." "Developing the Radiohpone," *Radio Amateur News*, vol. 1 no. 6, December 1919

Later, in *Radio for All,* Gernsback admits the inherent technical limitations of the device: "Unfortunately the Radioson, once subjected to strong signals or even too strong static currents, would burn out the exceedingly fine Wollaston wire, after which the instrument became inoperative. Although the Radioson was perhaps one of the best electrolytic detectors ever designed, no means could be found to keep it from burning out and the manufacture of it was given up by the makers. Soon after the invention of the electrolytic detector, crystal detectors came into vogue." (58)

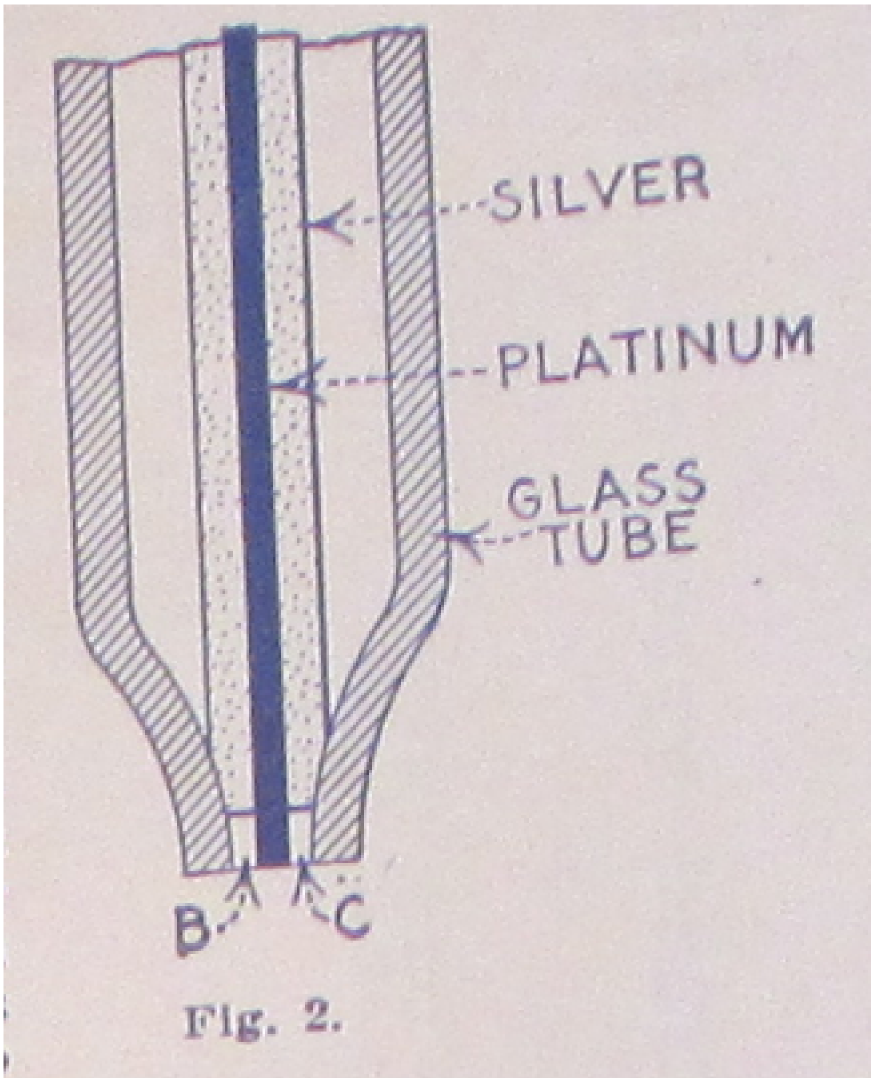


Figure 4: Fig. 2

annoying adjustments common to EVERY OTHER detector.

The Radioson is clean as well as very compact. It works on a shaky table as well as on a steady foundation.[7] An interesting fact is that the Radioson does not require the use of a Potentiometer, but it is necessary to use two dry cells (three volts) in connection with the detector. These cells may be of very small size, such as a flashlight battery.

In order to get the best results with the Radioson it is necessary to use it in connection with at least a 200 ohm head set, or a higher resistance set up to 8000 ohms: either set may be used, but nothing less than 2000 ohm must be used, as too much current would flow, which, in time, would destroy the very fine platinum wire; this naturally would make the detector useless.

The writer, who designed this detector, found that by placing the anode, that is, the member carrying the fine platinum wire (contrary to other sealed-in electrolytic detectors), upside down, better results obtained. This is done for the reason that it allows the microscopic gas bubbles to disengage themselves more readily from the anode point than if the sealed-in anode was placed in the usual position, namely, point down. In the latter case, the gas bubbles sometimes adhere to the point, which, of course, decreases the sensitiveness of the detector, as has been often found by many experimenters.

A very interesting fact about the Radioson is, that when it has been used for several months, it is sometimes found that it is not quite as sensitive as it was originally. All that is necessary to do then is to take out the cartridge and shaking it violently by holding it between two fingers and shaking it in the direction of its axis. This immediately restores its full former sensitiveness for the following reasons: Although the acid, as well as the other ingredients used in making the electrolyte are chemically pure, there is always a chance that some

[7] Who is Gernsback pitching this device to right now, and why? If this is such a valuable advance in radio technology, and if Gernsback was truly the obsessive profit-seeker SF historians like to claim he is, why would he share blueprints for his design? Why make this public and allow any experimenter to reproduce the results he's achieved? Did he already try to pitch this to companies and they turned it down because, obviously, a radioson detector can't be more powerful than the Audion? Or is it the best possible version – that Gernsback was on to something, and he thought the best way for ideas travel is to share them, make them public, allow others to "fork" or "version" his hardware so that the idea grows faster that way? Was this a possible model of collective tinkering before corporatized R&D and professional engineering? Can I make such a historical claim? Knowing more about the technical specificities of this radioson would help me answer that question. **As we see by the end,** however, this is all advertising rhetoric. A huge technical article about a new advance is really an advertisement for a new product sold.

"Detectors and detector theory did not develop in smooth and rational progres- sion, but in the usual fascinatingly wayward manner associated with most human activities. Only on rare occasions did research- ers describe their technology with clarity. Moreover, commercial competition meant that there often was a great deal of secrecy about technical details." D.P.C. Thackeray, "When Tubes Beat Crystals: Early Radio Detectors," *IEEE Spectrum*, 20, no. 3, (March 1983): 64–69, doi:10.1109/MSPEC.1983.6369844 –This is what makes Hugo's announcement of the Radioson so unique. Not just an immediate product announcement, but a detailed discussion of how the part is made and why.–

microscopic particle of material might partly cover the anode, but by shaking the electrolyte, this particle will readily come off, and, besides, the shaking has the effect of also cleaning the glass as well as the anode point in a very efficient manner. For this reason the Radioson has a very long life, and if it is handled carefully it will last for years; furthermore, the electrolyte used does not affect the platinum wire in any manner whatsoever, even if the detector is used continuously.

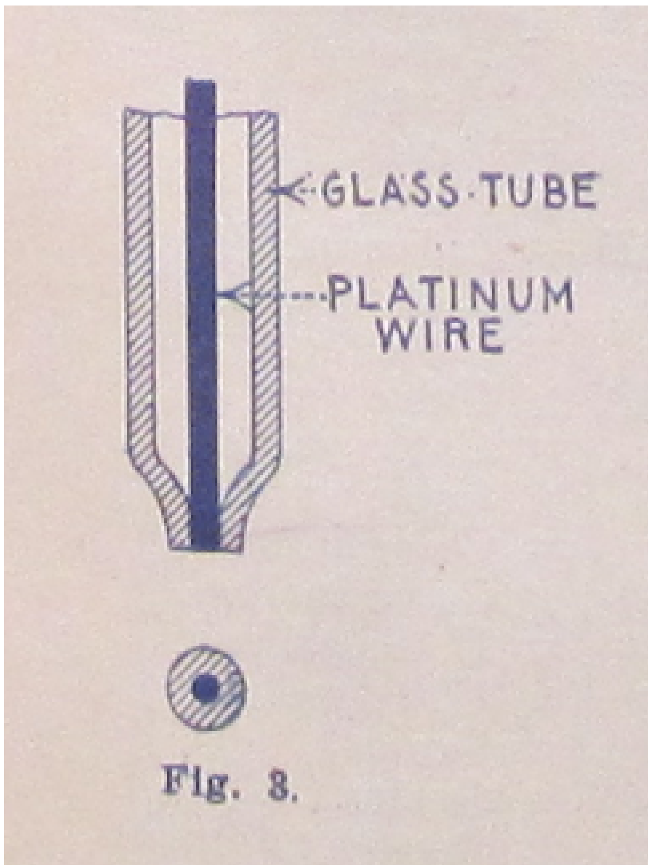


Figure 5: Fig. 3

Persons familiar with the Electrolytic Detector might be of the opinion that as the acid as well as the anode is sealed in airtight, sooner or later the working of the Radioson might be affected, on account of accumulation of gas. However, this is not the case, as the gas bubbles on account of the extraordinary small dimension of the anode are microscopically small. By looking at the figures above, giving the amount of anode area exposed, this will be readily understood, and, while it is not to be denied that there must be a certain amount of gassing, the same is so very slight that, for practical use, it does not come into consideration at all.

Another interesting point in connection with this detector is, that, by placing several Radiosons in parallel, this will increase the volume of the sound, and, although the increase is not more than 10 or 15 per cent., it is quite noticeable. Placing the detectors in series cuts down the efficiency.

Another very important fact is that heating the Radioson cartridge increases its sensitiveness enormously. Placing it very near to a steam radiator or letting the sun shine upon it, will bring in the signals sometiems fully 200 per cent. louder. This phenomenon was discovered by Dr. Branley [sic] of Paris some years ago.[8]

All in all it may be said that without exaggeration the Radioson Detector is, to-day, the most sensitive detector that has been devised as yet. The Electro Importing Co., the manufacturers of this detector, guarantees each and every detector in all respects, and the Company furthermore guarantees that every Radioson is absolutely uniform, and it will be observed that all of them, when compared, will be equally sensitive. This is a very important feature, especially if comparative tests in the intensity of received signals are required.

The author will be glad to answer any questions concerning the Radioson, and he shall be glad to furnish such information as is consistent to give in connection with this detector.

[8] Not only did the physicist and inventor Édouard Branly (1844 – 1940) discover the effect of heat on a coherer (later known as a detector), he was the first to describe and publish on the potential of the effect of electrical oscillations on metal filings. In the words of Lee De Forest: "The form and nature of the ordinary filings-tube coherer, as applied to-day in wireless telegraphy, is fairly familiar. Branley [sic] discovered, in 1891, that the effect of electrical oscillations upon a body of metal fillings was to produce a marked increase in the conductivity of the mass, a conductivity which persisted until the particles were broken apart again by mechanical jar. Although Varley, Hughes, Onesti and others had previously noted this phenomenon, none of these investigators had fully appreciated the causes involved, or given to the world of science the benefit of their researches in thorough published reports." Lee De Forest, "Electrolytic Receivers: Wireless Telegraphy," *Telephony* vol. 8 no. 5 (November 1904), p. 424.

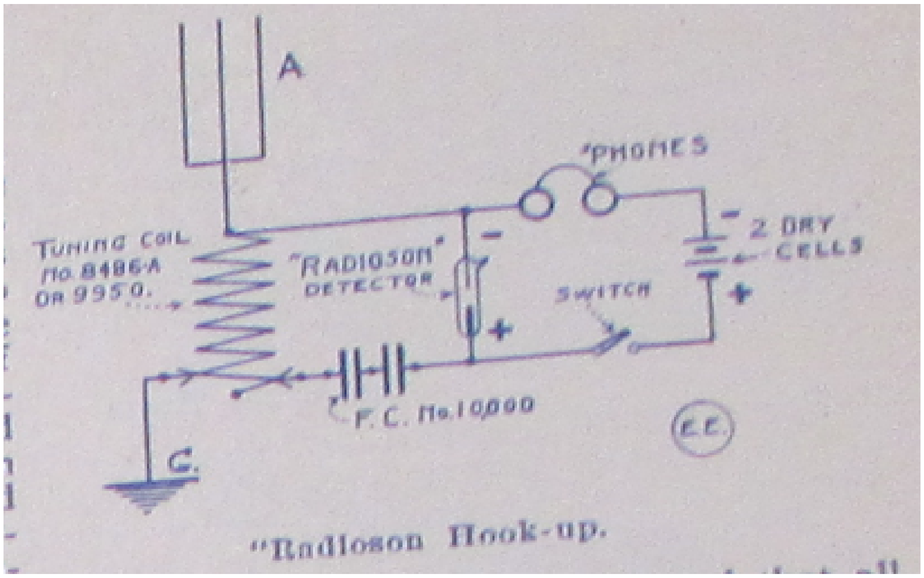
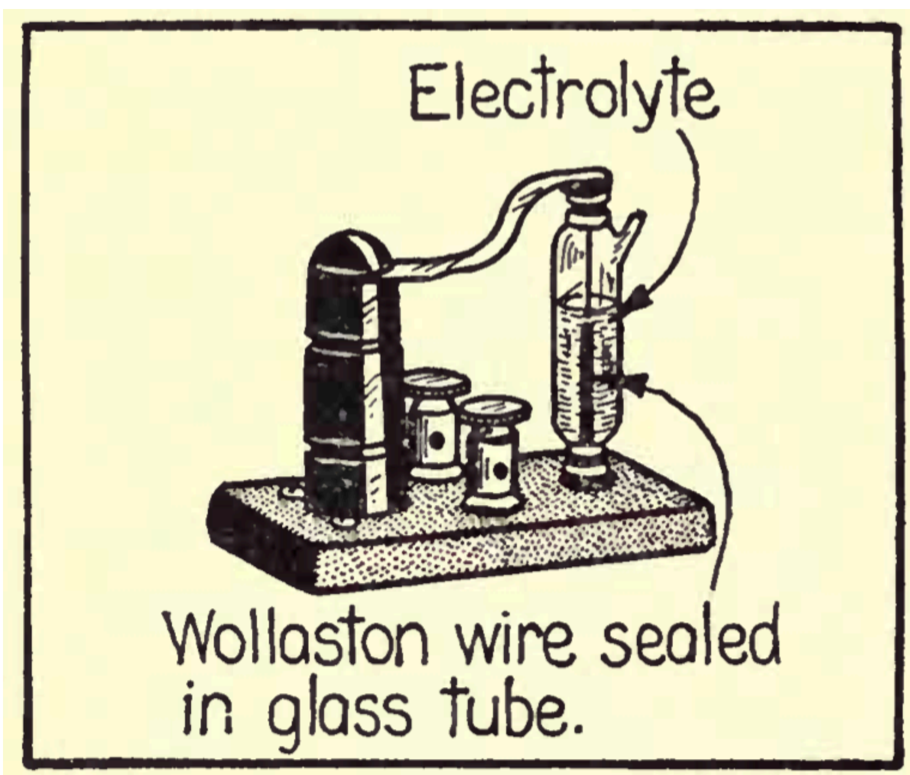
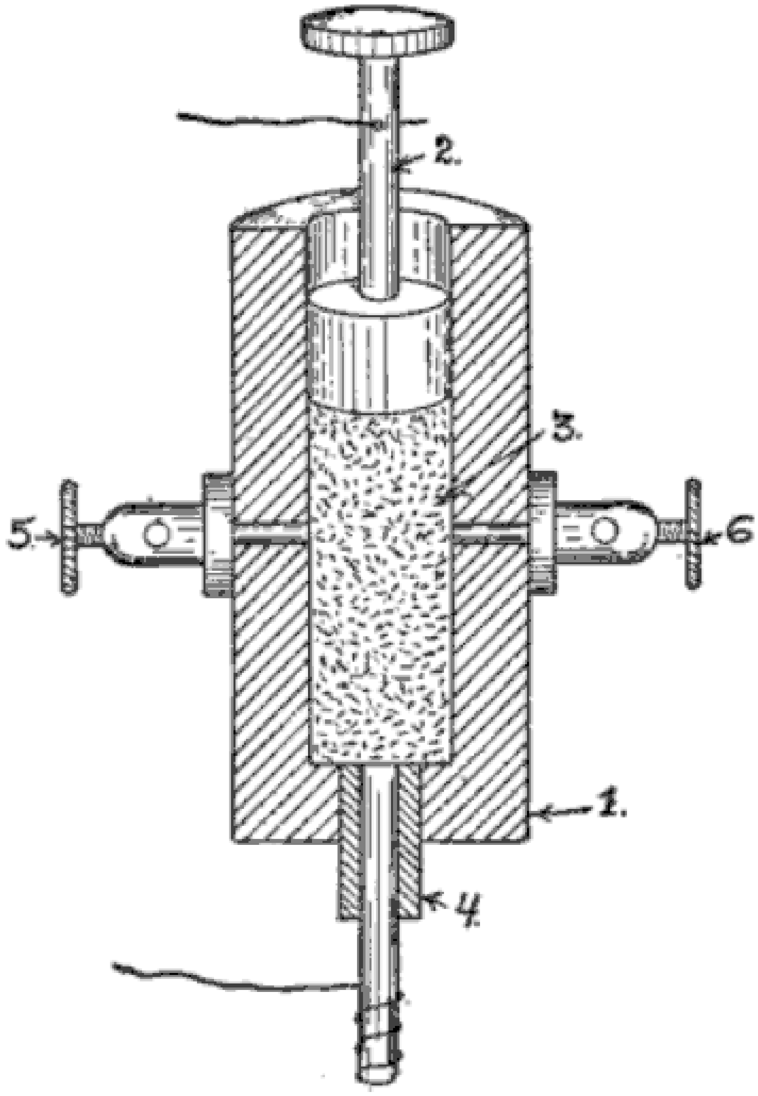


Figure 6: “Radioson” Hook-up.

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