Branly / Marconi Coherer Radio Detector from 1896

Thank you for your purchase of a replica Branly / Marconi Coherer Detector radio frequency (RF) detector from 1896. This detector was manufactured to tolerances of .02mm and functions exactly like a 19th century coherer tube. This detector can be used for demonstrations or as the main detector for a primitive radio receiver. In the early 1900s, Marconi is said to have received three Morse code Dits, the letter "S", from across the Atlantic Ocean with a coherer tube receiver on the West, and a spark transmitter on the East.. The distance was 2000+ miles.

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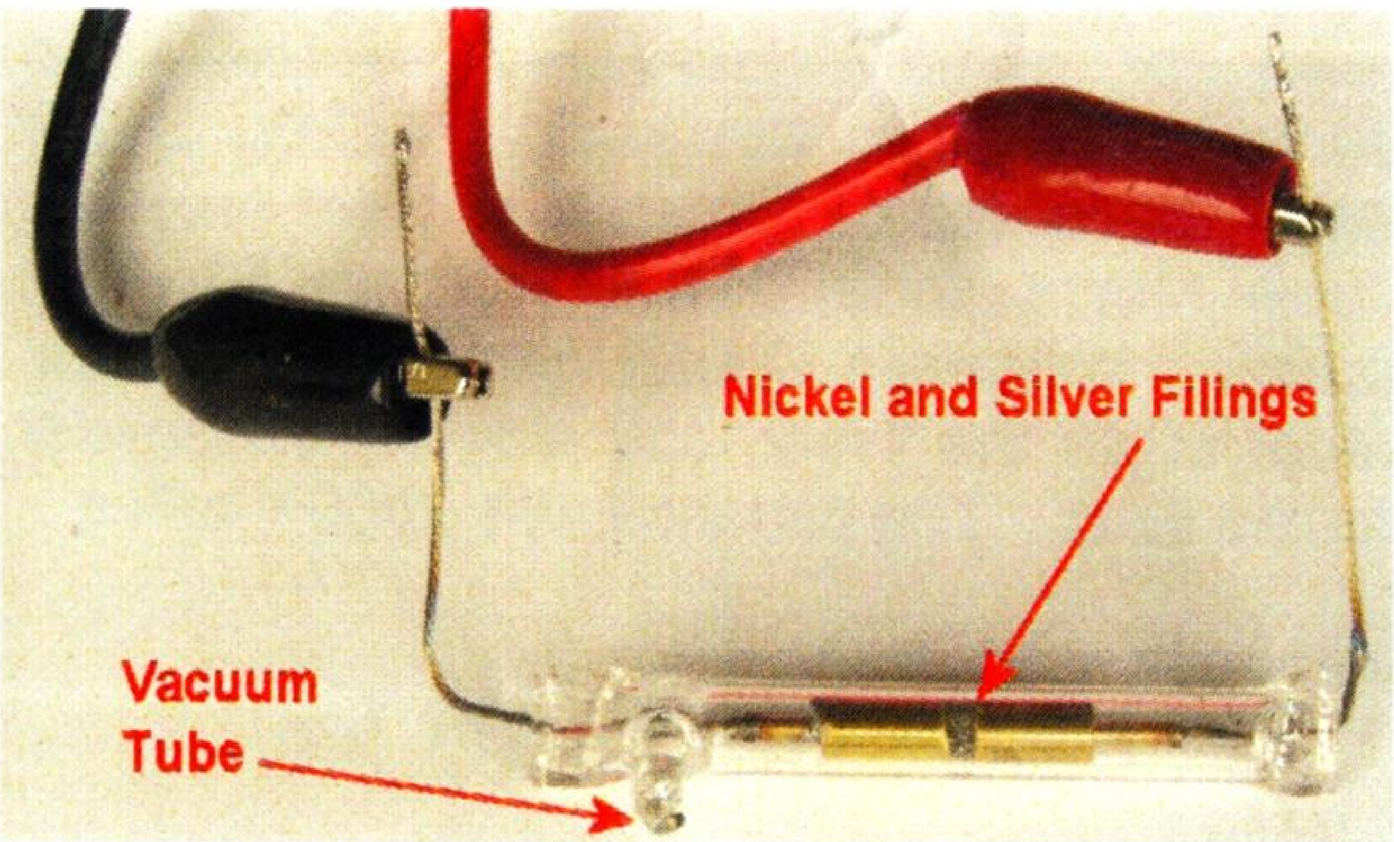
History of the Coherer:

In 1892 French physicist Edouard Branly first passed RF energy through small quantities of metal filings. He noticed that the resistance of the metal filings changed when exposed to RF energy. Branly was one of the first engineers to place the metal filings into a glass tube with closely spaced electrodes for experimenting. Branly also tested various metals for the coherer's gap.

Around 1895 Italian experimenter Guillermo Marconi refined the Branly coherer by optimizing the electrodes, the glass tubing, and the metal filings. Branly was interested in experimenting, but Marconi was interested in long range communications. To this end, Marconi designed a primitive radio receiver based on the coherer. The coherer detector was the first such practical device and they were held in very high regard for 10 to 15 years.



Construction:

The Branly or Marconi Coherer is constructed with two 4mm diameter conductive electrodes (brass) in an evacuated glass tube. Each electrode face is milled to a matching 15 degree angle and the electrodes are then separated with a gap that measures .5mm. The gap between the brass electrodes contains a mixture of fine metal filings consisting of 95% pure Nickel (Ni) and 5% pure Silver (Ag).

The wires connecting the brass electrodes through the glass coherer tube have the same coefficient of expansion as the glass to maintain the vacuum. The connecting wires are solid inside the coherer tube, and braided on the outside. The reason for the braided electrode wires is that the sensitivity of the coherer detector is adjusted by physically rotating the device so as to present more, or less, of the metal filings to the gap in between the electrodes. The more surface area that is exposed to the metal filings, the more sensitive the detector.

When RF energy is presented to the coherer detector, the metal filings instantly "coherer" and become conductive to direct current (DC). The Voltage that can be applied to a coherer tube circuit is very low... somewhere between .5 Volts DC and 3.0 Volts DC. However, this Voltage is sufficient to drive a "Pony" relay when the coherer is activated. The contacts of the Pony relay can be used to drive a buzzer, bell, an LED, or a telegraph "Sounder" such as that used by Marconi.

De-Cohering Your Coherer:

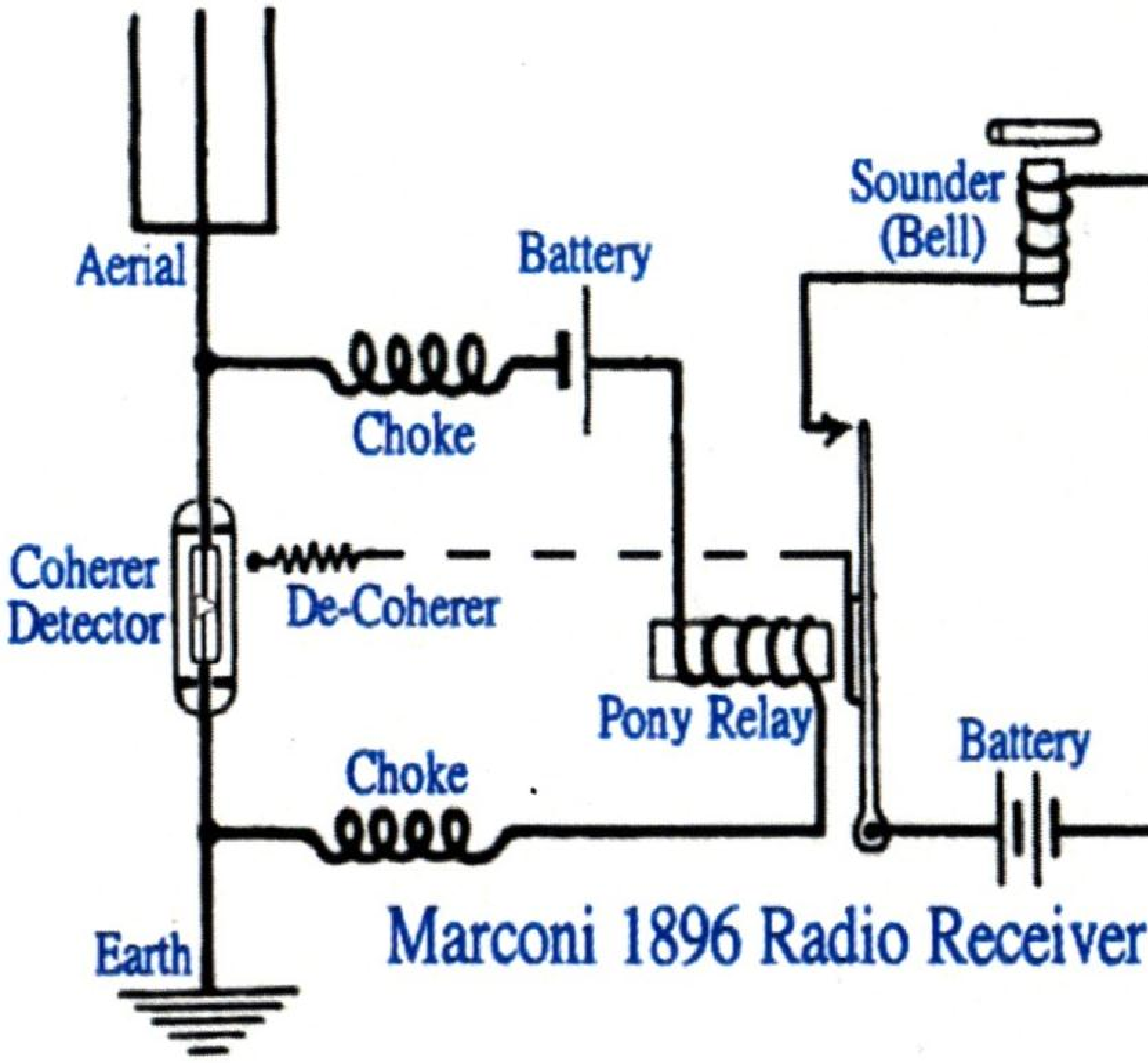
The problem with the Marconi coherer tube is that once activated, the metal filings tend to remain activated in conducting mode until the RF is removed, AND the coherer tube is mechanically tapped. It can be tapped lightly with a pencil, or automatically tapped with a mechanical connection to the buzzer or bell. The de-cohering process was a detriment to the speed that the Morse Code message could be sent.

Testing your Coherer Detector:

To test your Marconi – Branly Coherer detector, simply connect the Red and Black alligator clipped test leads from a Digital Volt Meter (DVM) to the electrode wires from the coherer detector. The coherer will also work with an analog VOM (Volt Ohm Meter) set to the 1000 scale. There is no polarity of the coherer to worry about. Set the meter to the 200 Ohm scale, slide the power switch ON, and gently tap the coherer tube with a pencil to make sure that it is ready for receiving RF. The Ohm reading should be very high, over 20,000 Ohms.

Next, quickly squeeze the ends of the fireplace lighter spark generator or a cigarette lighter very near the coherer detector. You may have to adjust the wire so that a small spark jumps between wire's tip and the metal end of the lighter. Squeeze the spark generator a few times very close to the coherer detector and the meter should drop down to a reading that is below 100 Ohms. A strong spark will drop the meter down to below 20 Ohms. Notice that this low Ohm reading will remain in place after the spark as gone.

Now tap the coherer's glass tube with a pencil.. and the DVM should reset to read a much higher resistance. It is this difference between the low Ohm value when activated, and the relatively high Ohm reading when not activated that can be used for radio communications. Repeat the experiment by gently rotating the coherer tube. Notice that there are more and less sensitive positions. Rotating the coherer tube along the longitudinal axis is of paramount importance in "tuning" the detector. The transmission distance is only a few inches under most conditions.



Marconi 1896 Radio Receiver

Increasing the Tx / Rx Distance:

To increase the Tx/Rx (Transmit / Receive) distance, one end of the spark generator can be connected to a "Ground" wire and the other end of the spark generator can be connected to an "Aerial" wire. Likewise, one end of the coherer detector can be connected to a "Ground" wire and the other end to an "Aerial" wire. The longer the aerial wires, the greater the Tx/Rx distance. Also, the intensity of the spark is directly proportional to Tx/Rx distance. Stronger sparks cause greater RF disturbances leading to longer distances between the Tx and the Rx sites and better radio reception.

Using a 1920s era induction coil from the ignition system of an old car will produce a 1cm or greater spark that can be picked up at a distance of a mile or more with the coherer. Of course such a distance can only be achieved if both the transmitter and the receiver are connected to earth grounds (i.e. a water pipe, or earth grounding rod) and to elevated, long wire aerials.

Marconi eventually added RF chokes to both ends of the coherer detector feeding the Pony relay. The purpose of the RF chokes was to attenuate the back EMF created by the sparks of the electro-mechanical "sounder" or bell. Without the in-line inductors, the back EMF travels to the coherer and causes false triggering. The RF chokes were a great improvement for reception.

By 1905, the coherer was replaced by other forms of detectors that were more sensitive and did not require the de-cohering process after every Morse Code Dit or Dah. By the 1920s, the vacuum tube could detect, as well as amplify, the RF signals and the coherer detector was relegated to history. It is interesting to note that around 1900, a physics professor from India, Sir Jagadish Chandra Bose, spent years investigating the optimal design for the coherer. He experimented, as did Marconi, with all sizes and shapes of electrodes and glass tubes. He tried gold, platinum, brass, iron, stainless steel, and many more metal filings. The best material chosen was typically the 95% Nickel with 5% Silver.

Interesting Coherer 1950s Revival:
In the early 1950s, a Japanese company, marketing to the US under the name Radicon, designed a remote controlled toy robot and a remote controlled toy bus that used a coherer detector in the receiver. The battery operated, remote control transmitter used a 2mm spark which was received by the bus or robot via Tx antenna and a complimentary Rx antenna.