THE PHONOPORE
An Early Telephone which operated across a Telegraph Line

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INTRODUCTION

It was around 1943 when I first went north of Alice Springs and called in at several watering stops between the Alice and Tennant Creek. It was at either Aileron or Ti Tree (I can't remember which) that I first saw this wall mounted telephone with a Horn projecting from its front. It was quite different to any telephone I had seen before. I was to learn that this was a phonopore, a relic of the original early telegraph which had operated all the way to Darwin.

The old telegraph circuit, some 3000 Km long from Adelaide to Darwin, operated over single galvanised iron wire and earth return. Sections of the line were connected by eleven repeater stations roughly 250 km apart. Each station was manned was by telegraph operators who transferred the telegraph data from one section to the next.

The Phonopore was a telephone which allowed speech to be sent and received over the same circuit as used for the telegraph. Before the balanced lines and the three channel carrier system replaced the early telegraph system, phonopores were used between various locations on the route between Maree and Pine creek. I imagine that when I saw the Phonopore in operation, it was probably connected between the centre of the newer balanced line and earth. In the field of telecommunications, this is referred to as a Cailho circuit.

The phonopore contained elementary filter circuits which reduced the low frequency telegraph impulses from interfering too much with the telephone receiver. It also cut off the low frequency components of speech transmitted so that they did not interfere with the telegraph circuit. With the low frequencies reduced, the speech did sound a bit "thin", but still allowed communication.

The other difference between the phonopore and the common manual magneto telephone was the calling system. The magneto telephone used a generator rotated by a handle to produce about 80 to 90 volts AC signal at a frequency around 20 hertz. This signal operated a bell on any other telephone connected across the line or a drop indicator on the remote manual telephone exchange. However this could not be used across the telegraph line as it would interfere with the telegraph signals. Instead the phonopore generated a high pitched call signal across the line from a mechanical vibrator or buzzer operated by a push button. The sawtooth waveform generated was around 135 Hertz and was probably rich in higher order harmonics. This would have accounted for the rather harsh high pitched sound.

For an incoming call, the signal actuated a very efficient electromagnetic receiver invented by A. T. Collier of Sydney in the 1880s. Coupled to the Horn, this produced a loud audio note to attract the operator to the phone.

The electromagnetic receiver was manufactured by the Collier-Marr Company in Manchester, England. It owed its high output to the double diaphragm and massive coil assembly. An external horseshoe magnet was used to polarize the iron core of the coil. A diaphragm was set at each end of the iron core, between the core and the magnet's pole pieces. The Phonopore used a metal trumpet or horn to further amplify the sound .

The Collier-Marr calling receiver is shown in figure 1. It is also shown fitted near the top of the early Phonopore of figure 3.

Figure 1
The Collier-Marr magnetic Receiver & Horn

Phonopore in the Railways

At this point, I will diverge a little. My father spent a large part of his working life as a Signalman in the South Australian Railways Signal Cabin at Murray Bridge. As a boy, I was always fascinated with his cabin with its long row of massive levers which mechanically coupled to remote railway line switch points and remote signals. The back wall of the cabin was also covered with various electro-magnetic devices and numerous telephones from which he communicated with other operational places in the railway system. At least one of these telephones had an unusual horn.

After my return from the Northern Territory, I visited my father in his cabin and I then realised that part of the cabin operational communication system included a Phonopore. I guess I didn't attempt to find out what sort of line circuit supported the Phonopore. However it was probably was another cailho circuit derived from one of the balanced telephone lines feeding other telephones the Cabin..

Within our South Australian region of the PMG's Department, I asked a lot of questions about the Phonopore but generally drew a blank. I guess it was never a common item in the Department in SA. However it is clear from my own observations that it was certainly used by the South Australian Railways.

Early History

It is around 68 years since I first encountered the Phonopore in the Northern Territory and learned a little about how it operated. The fact that its existance seemed to be forgotten history encouraged me to look further. Some 68 years later, with the help of the references listed at the end of this article, I have been able to document more about its operation and early history.

The principles used in the Phonopore were devised by Francois Van Rysselberghe who was a Professor of Physics at the Industrial School of the Ostend School of Navigation. He patented his system in 1882, and provided details of a number of circuits to handle different configurations of lines, both single-wire and full metallic (two wire).

The circuit of the Van Rysselberghe system as taken from "The Practical Telephone Handbook ,1912, by J. Poole" is shown in figure 2.

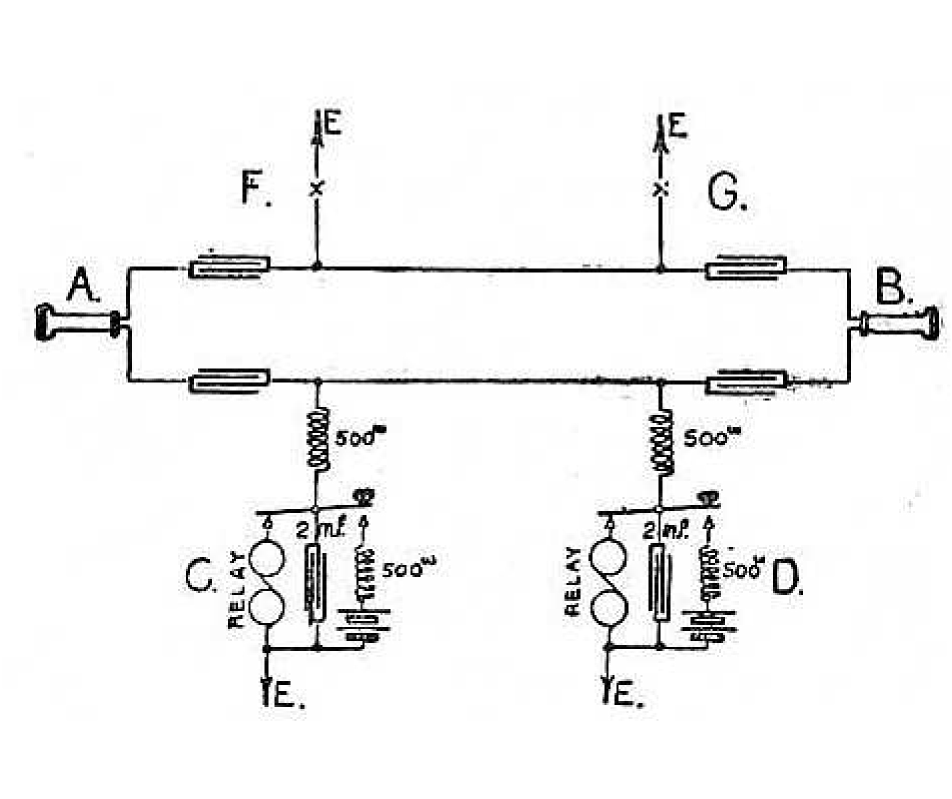

Figure 2 The Van Rysselberghe Circuit
(Note: C and D circuit is duplicated at F and G)

Figure 3
Early Phonopore of the 1890s

A description of operation, concerning the diagram (figure 2), has been reassembled from the original text in the Poole handbook. The name "Phonopore" as a special type of telephone is not mentioned in the handbook and it simply refers to the telephony instrument as the "telephone". For the purposes of describing just the Van Rysselberghe Circuit, my version of the text which follows will also use "telephone":

Two telegraph terminals are shown on the diagram in an abbreviated form at C and D. Symbols at A and B represent the two complete telephone terminals.

Inclusion of high inductance coils in series with the battery and the telegraph line provided sufficient reactance to impede components within the voice frequency range and reduce their presence in the telephone circuit, The level of the voice frequency components generated by the telephone were also insufficient to affect the operation of the telegraph instruments as telegraph circuits work at quite high voltage. Whilst not mentioned in Poole, I assume that the capacitance shown in series with the telephone circuits was also limited in value so that the low frequency telegraph components into those circuits were attenuated. With this arrangement, simultaneous operation of both the telegraphy and telephony was achieved.

By making the telephone circuits return through a second telegraph line fitted in a similar manner, a balanced telephone circuit was achieved. The second telegraph circuit is shown at the top of figure 2 with telegraph terminals F and G, identical to C and D, but for

simplicity not fully redrawn. In its balanced form, the telephone derived line operated free of induction from the two telegraph lines.

Poole reports that the Van Rysselberghe system has been extensively used on the State telegraph lines in Belgium, and on a number of railway lines in other countries, It has also been used for trunk line call-wire circuits by the British Post Office.

With each telephone (or Phonopore) connected between the two telegraph lines, one could describe the arrangement of figure 2 as a form of phantom circuit. (A telephone balanced circuit derived by connecting between two cailho circuits is often referred to in telecommunications as a phantom circuit). The Van Rysselberghe balanced circuit is a bit different to that used on the early Adelaide-Darwin telegraph, as in the latter, there was only one telegraph wire operating against a ground return. Hence the Phonopores on the early Adelaide-Darwin line also had to operate unbalanced against ground.

The Phonopore found application in different forms throughout the world in the late 1880s and the early 1900s. They were used by many railways to provide voice communication over their telegraph circuits without the need for additional telephone lines.

One interesting feature of many instruments, such as the one shown in figure 3, was the inclusion of two telephone earpiece receivers. It has been explained that this reduced interference from the telegraph signal. This puzzled me a bit but I figured that this interference was possibly residual acoustic noise coming via the horn. Perhaps one reduced this interference by clamping an earpiece on each ear to attenuate the external interference. (However, this operation might have been difficult if one of the two hands holding the earpieces was needed to write down a message).

Inside the Phonopore

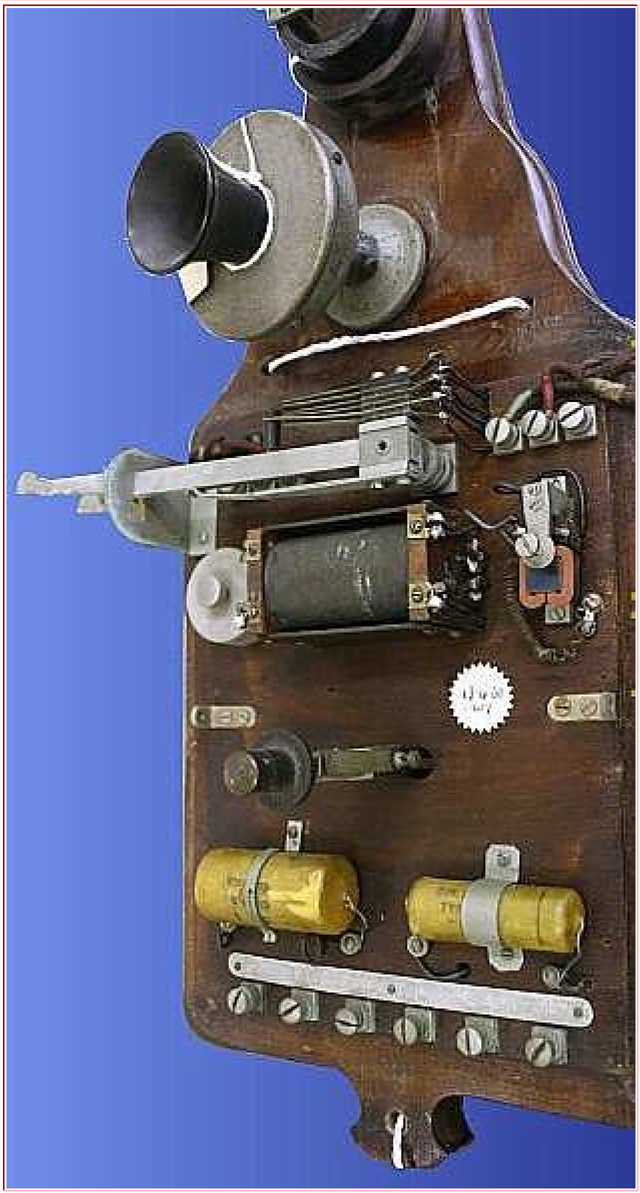

Figure 4
Phonopore with front cover removed

Figure 4 is a photo of a typical Phonopore with the front cover removed. The push button which operates the buzzer for calling is shown at the centre of the photograph and the call generating buzzer is at the upper right.

The transformer (or induction coil) and typical solid back carbon granule transmitter are clearly shown. However the Collier-Marr magnetic receiver with horn is unfortunately cut off by the top of the photograph.

The transformer is a requirement of all telephones using a carbon granule transmitter to match the transmitter circuit low impedance (around 60 ohms) to the nominal line impedance at voice frequencies of 600 ohms. The transformer also isolates the low resistance transmitter circuit from the higher resistance magnetic earpiece receiver and the line resistance.

As with similar carbon granule transmitters on Magneto type telephones, the transmitter circuit would have been supplied with 3 volts from two 1.5 volt cells in series. Two of the terminals at the bottom of the photograph provide for battery connection. The other terminals are assumed to be there for line and earth.

Both capacitance and inductance are normally needed to form effective passive band separation filters. Whilst there are capacitors shown in the photograph, I am not clear on how the inductance was derived to separate the telephone and telegraph circuits for this particular Phonopore sample. Perhaps this was somehow provided by inductance within the transformer assembly.

Phonopore manufacturers and the BI&H Pantophone

During the late 1800s and the early 1900s, there were a number of companies which manufactured a model of the Phonopore. An early maker of the Phonopore was Mr C. Langdon-Davies who distributed his units through his British company the Phonopore Construction Co. Ltd. There were other company names such as Ericssons, Medhurst and Siemens and also the Australian Post Office.

British Insulated & Helsby Ltd (BI&H) made various telephone units including a type of Phonopore that they called the Pantophone (shown in Figure 5). At least one reference called this the Phantophone. I wondered whether this was an original name based on the idea that the telephone system was a phantom circuit superimposed on the telegraph line.

From the Pantophone photograph, it is clear that the Collier-Marr type of calling signal receiver has been replaced by a different unit of some kind. Also the earlier solid back transmitter has been replaced with an Ericsson inset transmitter following a trend in later telephones. (The removable inset module in the Ericcson transmitter allowed easy repair in the event the transmitter becoming noisy or inoperative.)

The two hand held earpiece receivers followed the arrangement used in other Phonopore units to reduce telegraph interference. It is strange that in this unit, two different models of earpiece were fitted.

Figure 5
The British Insulated & Helsby Ltd Pantophone

The Australian Tele 41 Phonopore

Prior to year 1914, the Australian Post Office produced their own model of the Phonopore (the Tele 41) in the Post Office Workshops Melbourne. A photograph of the Tele 41 is shown as figure 6.

In this model, they replaced the Collier-Marr receiver with an Ericsson type of electromagnetic receiver for reception of the calling signal.

Also a send and receive handset replaced the fixed solid back carbon granule transmitter and the floating earpiece type receiver. It is interesting that they apparently no longer needed two earpiece receivers to reduce interference from the telegraph signals.

One reference indicates that the Post Office stopped manufacture of the Tele 41 by around 1920. Telegraphs were in common use by many of the railways in Australia. At one stage, the Australian Post Office leased space on Railway Telegraph Lines to run Phonopore circuits to local Post Offices. These were eventually replaced by more convenient telephone networks.

Phonopores of various types were in use in many of the Railways. In New South Wales, the Phonopores were largely replaced by telephones in the 1930s but the last two were only taken out of service in 1962.

I now have to wonder whether the Phonopore I saw in the Northern Territory around 1943 was an Australian made model or otherwise. The same question arises concerning the Phonopore in my father's railway signal cabin.

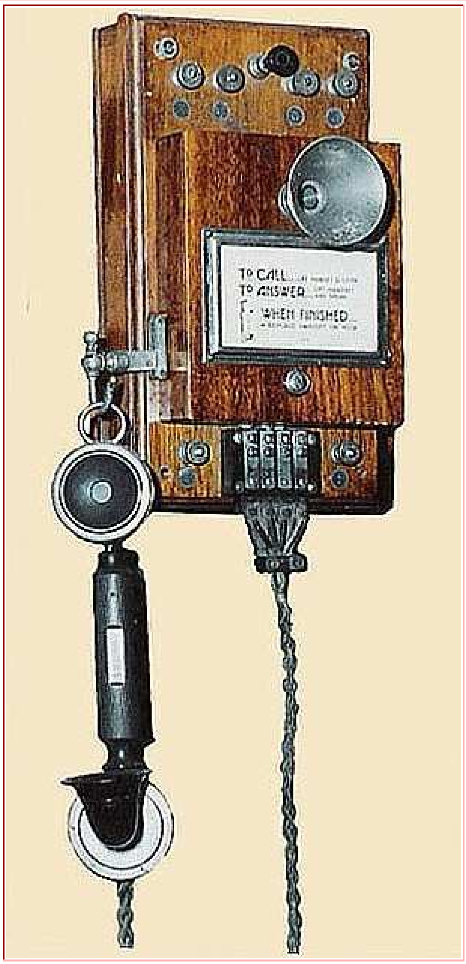

Figure 6
The Australian Post Office
Tele 41 Phonopore

The early Phonopore is indeed a rare Collector's item. There is reference on the Internet to one being held by the Powerhouse Museum in Sydney. I wonder where other remaining relics might be found.

References

(1) The Practical Telephone Handbook 1912 by J Poole

(2) http://www.bobsoldphones.net/Pages/Phonopore/Phonopore.htm

(3) Sam Hallas Web Site http://www.samhallas.co.uk/railway/phonopore.htm

(4) The Strange Appearance of the Collier Marr by Jim Bateman
http://www.telephonecollecting.org/collier.htm

(5) http://www.bobsoldphones.net/images/AustPostOffice/No41.jpg

(6)The Overland Telegraph (Flinders Ranges Research)
http://www.southaustralianhistory.com.au/overland.htm

(7) Telecom Journal of Australia - Vol 60, No3, 2010 - Wartime Telecommunications by G.O.Newton.