What Father Landell de Moura Used to Do in His Spare Time

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Abstract—**Father Roberto Landell de Moura, born in 1861, in Porto Alegre, Brazil, built the first wireless transmitter for message transmission in 1892, even before Marconi's experiments. In 1894, he made the first public transmission through Hertz waves, with a broadcasting range of eight kilometers, from the top of a hill on Av. Paulista to the top of Santánna hill, in São Paulo. Between 1903 and 1904, father Landell de Moura managed to patent three inventions in the United States: the "Hertzian or Landellian" wave transmitter, the wireless telephone and the wireless telegraph. The Brazilian patent of Father Landell's device received the number 3279, in 1900. This paper tells a little bit about his history and inventions, including the facsimiles of his American patents, in order to pay tribute to one of the great inventors of all times in the field of electrical communications.**

Keywords—**Landell de Moura. Wireless telegraphy. Wireless telephony.**

I. Introduction

Father Landell, born in 1861, in Porto Alegre, built the first wireless transmitter for message transmission in 1892 (Carneiro, 1999). In 1894, he made the first transmission through Hertz waves, with a broadcasting range of eight kilometers, from the top of a hill on Av. Paulista to the top of Sant'anna hill, in São Paulo (Oakenfull, 1912).

Between 1903 and 1904, father Landell de Moura managed to patent three inventions in the United States: the "hertzian or landellian" wave transmitter, the wireless telephone and the wireless telegraph. The Brazilian patent of Father Landell's device received the number 3279, in 1900 (Alcides, 1997). This chapter tells a little bit about his history, so as to guaranty that his name shows among the great inventors of all times in the field of communications (Alencar, 2003).

II. The Fantastic Father Landell de Moura

Roberto Landell de Moura was born in January 21st of 1861, in the city of Porto Alegre, Rio Grande do Sul, on the Rua de Bragança, as it was called then, today it is Marechal Floriano, at a house located at the same curb as the old Praça do Mercado, being baptized, along with his sister Rosa, on February 19th 1863, at the Rosario Church, of whose attendants, years later, and until he passed away, would come to be a vicar. He was the fourth of twelve brothers, sons of Inácio Jose Ferreira de Moura and Sara Mariana Landell de Moura, both descendants of traditional families of the state of Rio Grande do Sul (Fornari, 1960).

Landell de Moura attended the Colégio dos Jesuítas, in Sao Leopoldo, a city located next to Porto Alegre, capital of Rio Grande do Sul. He attended the course of humanities, known as Classic at the time, equivalent to High School today. In 1879, Landell de Moura transferred to Rio de Janeiro, to attend the Escola Central, previously known as the Academia Real Militar, founded in 1792, by order of Dona Maria I, Queen of Portugal, bearing the name of Real Academia de Artilharia, Fortificação e Desenho, and today goes by the name of Instituto Militar de Engenharia (IME). Apparently, he got a job at a secos e molhados warehouse to pay for his stay at the capital of the Empire.

At Rio de Janeiro, Landell de Moura only stayed a few months. His brother, Guilherme, who intended to follow an ecclesiastical career, stopped by Rio de Janeiro, on his way to Rome, Italy, and convinced him to embrace priesthood. In the Brazil of the 19th century until the beginning of the 20th century it was important that each and every traditional family had a priest, as well as a military officer.

In Rome, Landell de Moura started to attend the Colégio Pio Americano and also the Universidade Gregoriana, as a Physics and Chemistry student, subjects to which he showed a certain inclination since a child. He was made a priest in November 28th 1886. Back to Brazil, he stayed at the house of priests at the Morro do Castelo, Rio de Janeiro, when he had the opportunity of exchanging some ideas with D. Pedro II, Emperor of Brazil, about sound transmission, a subject that fascinated D. Pedro II since 1856 and that led him to finance part of Alexander Graham Bell's work in the United States.

After a short stay at Rio de Janeiro, Father Landell de Moura was designated chaplain and professor of Universal History of the Episcopal Seminary of Porto Alegre. In 1891, he was nominated parochial vicar of Uruguaiana and, in 1892, was transferred to the state of São Paulo where, for seven years, he worked as vicar in Santos, Campinas and Sant'Ana.

III. Landell de Moura's Principles

In 1893, Father Landell de Moura worked in the city of Campinas, in the inlands of the state of São Paulo. It had already been a few years since he arrived from Italy, and the calmness of the city permitted the development of his ideas about wireless transmission, the principles of which were enunciated by him:

"All vibratory movement that until today, as well as in the future, can be transmitted through a conductor, could be transmitted through a beam of light; and, by that same fact, could be transmitted without the aid of that agent".

"All vibratory movement tends to transmit itself in the direct ratio of its intensity, constancy and uniformity of its ondulatory movements, and in the inverse ratio of the obstacles that oppose themselves to its propagation and generation".

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"Give me an ondulatory movement as extensive as the distance that separates us from other worlds that roll above our heads, or under our feet, and I will make my voice get there".

That last principle caused the wrath of many parishioners and some ecclesiastical authorities – in 1893 a Brazilian priest assured the transmission between different planetary systems and, against the centennial teachings of the Church, insinuating the existence of life in other worlds. His laboratory, built at the cost of a lot of sweat and labor, was, more than once destroyed. But Father Landell de Moura, patiently, rebuilt his equipments and continued his scientific work.

Father Landell de Moura used to carry his mysterious packages, which contained the parts of a device invented by him, and said device – he assured – could be used to speak to another person several kilometers away, without the need of wires (Fornari, 1960). Some people that were interested asked him for proof. The priest - with his still rudimentary device, accomplished several wireless voice transmission and reception experiments, and all of them were completely successful. These experiments, some of which were taken in effect with the purpose of getting the authorities interested and gaining sponsors for the perfecting and industrial exploitation of his invention, took place, on the hill of the Avenida Paulista to the hill of Sant'Ana, at an approximated distance of 8 kilometers, in a straight line - therefore more than a year before the first and extremely simple experiment accomplished, by means of hertz waves, by Guglielmo Marconi, in Pontequio, near Bologna, in Spring of 1895, and about six years before his first radiogram.

Despite the persecutions he had to bear with, Father Landell de Moura, declared, at the time (Fornari, 1960):

"I want to show the world that the Catholic Church is not an enemy of Science and human progress. Individuals, from the Church, may have regarding this case or that, opposed to this truth; but they did this out of blindness. The true Catholic faith does not deny it. Although they might have accused me of having something to do with the Devil, and interrupted my studies through the destruction of my devices, I shall always assert: this is as it is and cannot be in any other way... Only now I understand Galileo crying out: E pur se muove!"

IV. The First Patent

In 1900, after being persecuted by all kinds of shame and financial difficulties, he finally obtains a Brazilian Patent, under the register of 3279, especially granted, as described in the document,

"For a device appropriated for the transmission of the word at a distance, with or without wires, through space, earth and water".

It is also worth reproducing the note published in the Jornal do Commercio, of São Paulo, in June 10th 1900, about one of Father Landell's experiments (Alencar, 2000c):

"Last Sunday, on Sant'Ana hill, in the city of São Paulo, Father Landell de Moura did an experiment with several of his inventions, with the objective of demonstrating some laws he discovered while studying the propagation of sound, light and electricity, through space, earth and the aqueous element, which achieved brilliant success.

These eminently practical devices are, like many corollaries, deduced from the above-mentioned laws. Were present at the experiment Mr. P.C. P. Lupton, representative of the British Government, and his family, among others."

Even more interesting is the description given by Father Landell himself, of two of his inventions:

"The Anematophone is a wireless device which has the same effects of regular telephony, but with added clearness and safety, as it works even under wind and bad weather. This device is impressive by the entirely new laws it reveals to us, likewise, what follows:

The Teletition, a kind of wireless phonetic telegraphy, which two people can use to communicate with each other without being heard by anyone else. I believe that with this system of mine we could transmit electric energy, through great distances and with a lot of economy, without the need of wires or conductor cables."

Father Landell reached the point of offering his inventions patent to Mr. Lupton, so that England could industrialize the wireless transmitter. The priest's relatives and old friends, when inquired about this matter, said that Mr. Lupton, who was a formalist man and was not scientifically enlightened, did not even send word to England of Father Landell de Moura's offer, because he did not believe in the practical (and especially commercial) utility of wireless telephony.

Another version asserts that the consul, dazzled by the invention, that promised to completely revolutionize contemporary science, had advised Father Landell to transfer himself to Great Britain, in order to get his inventions patented, and after that necessary formality, donate them directly to Queen Victoria, so that he could get what he wanted from the Ambassador, the credentials that would recommend him to his country's government - an alternative which the priest did not accept because he would have to pay for his transportation and maintenance.

A third version of the episode says that the offer was sent, but as the Angle-Saxon bureaucracy was just as sluggish as the Brazilian, the papers referring to the offer, ten years later were still forgotten on top of someone's desk.

V. The Trip to the United States

Landell de Moura decided to leave for the United States, in 1901, so that he could get his inventions patented, seeing as how hard it was to mass-produce them in Brazil. He gathered some money and left, at the beginning of the year, thinking of returning quickly. A specialized North-American journalist, in a column for the New York Herald of October 12th of 1902, describes Father Landell de Moura as "a gentleman of about forty years old" that reached the pinnacle of his genius.

Father Landell de Moura lived in the United States for a period of three years, and during those years he enraptured the North-American scientific sympathizers with his inventions, among them the three most important to the world: the wireless Telephone, the wireless Telegraph and the wave Transmitter.

There is an explanation as to why he stayed so long in the United States: three months after his arrival, in a document dated October 4th of 1901, Father Landell de Moura filed a petition for the patent of his first invention, the wireless Telephone, believing that, once the phone was patented (what he thought was a matter of weeks), the remaining months would be enough to obtain patents for the other inventions.

The Patent Office in Washington however was not satisfied with the theoretical exposition of his petition. "His theories were so revolutionary - they declared to him at that division, his brothers Pedro and Dr. Joao Landell de Moura, respected well known people at Porto Alegre, said that - the patent could not be granted without the presentation of a model of the device, for practical demonstrations" (Fornari, 1960).

It was through the course of these three toilsome years that he filed a petition, in documents dated of January 16th of 1902 and 9th of February of 1903, respectively for the patenting of two other inventions: the wireless Telegraph and the wave Transmitter.

The Patent Office nevertheless required the respective models of these two last inventions, which was done. Once presented, he was finally granted the three patents, and only after meticulous proofs and second-proofs, which consumed two years. This happened because the responsibility that that republic had towards the world, with the dispatching of the official recognition of such relevant inventions, which would fatally create new and unpredictable perspectives for the entire civilization, and it would not be wise to register them without having absolutely positive proof of the exactness of his theories and the efficiency of his devices.

After these formalities were taken care of, they gave him the patents under the numbers of 771 917 in October 11th of 1904 (Wave Transmitter); 775 337, in November 22nd of 1904 (Wireless Telephone), and 775 846, of the same date (Wireless Telegraph), which are presented in the Appendix.

With a feeling of completing his duty, Father Landell returns to Brazil at the beginning of 1905. Although he came back, it was not for long. Father Landell de Moura thought of staying only three months in Rio de Janeiro, and afterwards returning to New York, as there he had more scientific resources he intended to not only go on with his studies and experiments, but also to get six more of his inventions patented, which are missing until today.

However the future canon was going to stay in Brazil, and would be forced to leave his works of scientific investigation.

VI. Experiments with the Photoelectric Effect

Father Landell de Moura also knew the properties of selenium, relating to its sensibility to blue, violet and ultraviolet rays, and although that did not constitute an essential part of one of his inventions, he was already using it in some of his transmissions. Father Landell de Moura was already utilizing the photoelectric effect, studied by Prof. Ernest Ruhmer, which won Albert Einstein the Nobel Prize in 1905, for the transmission of information using a light beam.

To better clarify the subject, here follows an abridgment of five aerial transmission systems that can be found in the three patents dispatched by the North-American Government (Fornari, 1960):

- Acoustic transmission of the articulated or phonographic voice at a short distance, by means of an air current sent in the same trajectory of the voice with the objective of strengthening it. ? Luminous acoustic transmission, by means of a beam of light. Father Landell de Moura discovered the influence of this beam, and the air current in the first system.
- The electric transmission of the human voice, through a beam of light produced by a voltaic arc, or any other actinium irradiation source. The receptor, which is a selenium capsule, only works under the effect of actinium rays, a property discovered by the priest.
- Electromagnetic transmission of the phonic, harmonic and luminous systems, and of the human voice, by means of the superposition of irradiant electrical vibrations. In this case Father Landell de Moura used his lamp with three electrodes and many other devices that are included within his patents, that combined, generated the effects he had in mind when telegraphing or phoning without a conducting wire.
- The electrical transmission of the phonic system, of the spoken word and of the musical note, by means of scintillations produced by a lamp of his invention, called scintillating, and which figured in his Wave Transmitter.

The description of what would be landellian waves, made by a newspaper in São Paulo, and that in 1900 was occupied with the priest's scientific theories, sounds like what today is denominated soliton (Fornari, 1984).

"Although they might appear to be of the same type as hertz waves, they differ a lot from them, because it is almost possible to reduce the impact of these waves, and they are produced by electrical vibratory movements and possess neither constancy nor uniformity, which decreases little by little, while those ones, - the landellian waves - are not affected by these kinds of transformations, and are produced by electrical vibratory movements which undulatory values are continuous and always the same."

In his theories about the superposition of the vibratory, acoustic, luminous, radiant, and electromagnetic movements, to transmit and receive the phonic, luminous, harmonic and acoustic signals plus the articulated, or phonographic human voice through space, earth, and the aqueous element, those waves have a definite action, because they project themselves in a continuous mode, between the transmitting and receiving stations, forming a permanent and uniform undulatory field. And it was by means of this field that he sent his telegraphic and telephonic messages.

The concept of this "ondulatory field through space" was not only an ingenious idea, but also a scientific reality, and was later made use of for several purposes. Father Landell de Moura expressed in interviews so many times, the possibility of transmitting image through great distances - anticipating television, which would only appear decades later.

Father Landell de Moura, after returning to Rio de Janeiro from the United States, in 1905, requested two ships from the President of the Republic, Dr. Rodrigues Alves, to demonstrate his inventions.

One of the President's deputy officers was so astonished to know that the priest talked about transmission at any distance that he advised the President not to permit the experiment, thinking that the priest was crazy. With the cloaked denial of the President's Secretary's office and the doubt that was launched against the legitimacy of his inventions, Father Landell de Moura, completely disillusioned, and deeply shaken, on an impetus of irritation, destroyed his devices and boxed his books, notebooks and documents, and finally decided to go back to priesthood exclusively, where he would surely find consolation for his misfortune and disappointments (Fornari, 1984).

VII. Epilogue

The Monsignor Roberto Landell de Moura, the forgotten pioneer, precursor of the wireless transmission, the forgotten Brazilian inventor, died anonymously, at 67 years of age, on July 30th of 1928, in a modest room in the Beneficência Portuguesa, of Porto Alegre, surrounded only by his relatives and half a dozen faithful and devoted friends.

Four years before his death, on November 3rd of 1924, at the time he was already the Penitentiary Canon Landell de Moura, he declared to an editor of the extinct porto-alegrense channel Última Hora, which interviewed him because of the announcement of the deployment of a broadcasting station of great potency in Curitiba, by the Rádio Clube Paranaense (Fornari, 1960):

"God used my humble person to raise the veil that covers the secrets of nature, although the radiotelephony system, in use at present, is based on the principle of the superposition of the electric undulatory movements and the application of a light bulb similar to the Crookes light bulb, with three electrodes, a bit modified, and which serves the purpose of transmitting and receiving telephonic and telegraphic messages alike, without the need of a conducting wire."

Indeed, the discovering of this principle and the invention and application of this light bulb (valve), we owe to Father Landell de Moura, and not only for those means, but also for others, all of which possessing great scientific reach. No one before him had utilized electromagnetic waves (landellian waves, as it was said at the time) generated by the above-mentioned light bulb for the transmission of information. This extraordinary conquest is due solely to him, for only in 1907 would Lee De Forest present to the World his famous "Three electrode light bulb" utilized by Howard Armstrong to develop the homodyne radio in the United States.

Brazil, which had forgotten it's greatest inventor in the area of telecommunications, was starting its Republic as a member of the International Postal Union and taking part in all the international deals that regulated telegraphy, submarine cables and marine signalization (Oakenfull, 1912).

VIII. Acknowlegments

The authors express their gratitude to the IEEE Foundation, CNPq and CAPES, for the financial support to the research.

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IX. Appendix – Patents Awarded to Father Landell de Moura in the United States

This appendix presents the three patents awarded to father Roberto Landell de Moura by the Patent Office of the United States of America. This material complements the text and provides a glimpse of the kind of pioneer father Landell de Moura was. He decided to file for a patent in the USA to offer his inventions to international entrepreneurs and to guarantee that sooner or later he would receive the honor and glory he deserved.

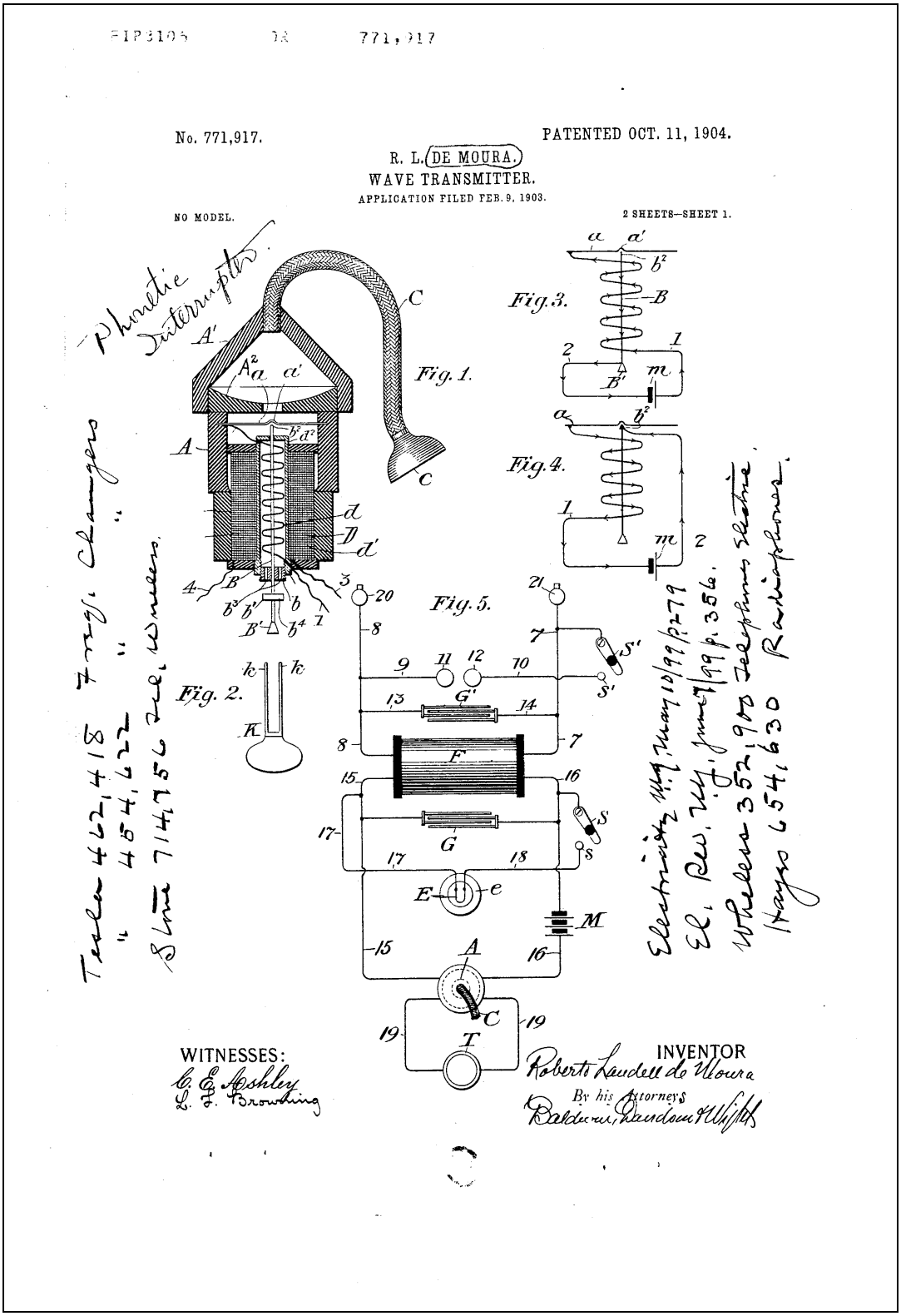

Fig. 1. Patent 771 917. Page 1/6. Source: http://www.uspto.gov.

No. 771,917. PATENTED OCT. 11, 1904.

R. L. DE MOURA.

WAVE TRANSMITTER.

APPLICATION FILED FEB. 9, 1903.

NO MODEL. 2 SHEETS—SHEET 2.

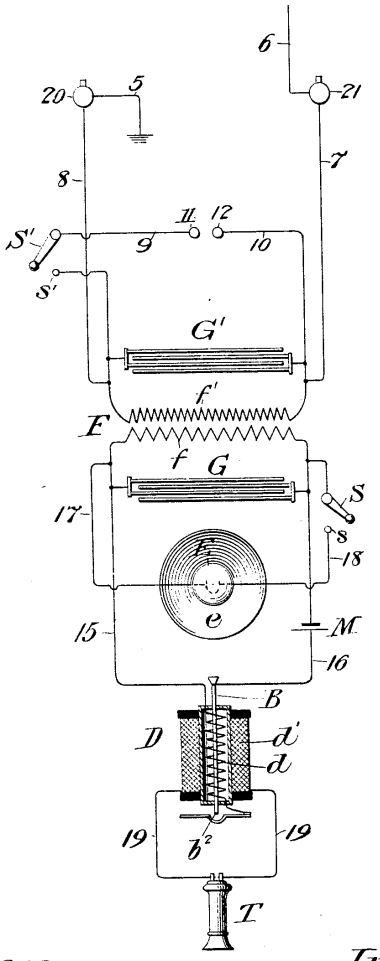

Fig. 6.

Witnesses:
Edward C. Clement
M. L. Adams

Inventor:
Roberto Landell de Moura.
By his Attys
Baldwin Davidson & Wight

Fig. 2. Patent 771 917. Page 2/6. Source: http://www.uspto.gov.

No. 771,917. Patented October 11, 1904.

UNITED STATES PATENT OFFICE.

ROBERTO LANDELL DE MOURA, OF NEW YORK, N. Y.

WAVE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 771,917, dated October 11, 1904.

Application filed February 9, 1903. Serial No. 142,440. (No model.)

To all whom it may concern:

Be it known that I, ROBERTO LANDELL DE MOURA, a citizen of the Republic of Brazil, and a resident of the borough of Manhattan, city of New York, county and State of New York, have invented a new Wave-Transmitter, of which the following is a specification.

My invention relates to the transmission of intelligence from one point to another without the intermediation of wires, or, in brief, to signaling through space.

It has for its object the production of improved results with simplified apparatus, utilizing certain principles of my own discovery.

Heretofore when signals were to be transmitted the transmission has been accomplished by means of manually-operated apparatus. In some cases this has been replaced by automatic mechanism; but the management of such mechanism or the manipulation of a key requires a certain amount of skill and experience in the operator. According to my invention, I primarily produce electrical oscillations and flickerings of light by means of sonorous vibrations, which may be those of the human voice or of other sounds. I then employ these electrical or light oscillations so produced for telegraphing or telephoning through space. In such transmission, and particularly in telephoning, I may use devices similar to those described in my prior application, filed October 4, 1901, Serial No. 77,576. In order to produce the two kinds of oscillations mentioned, I have devised an arrangement of circuits and certain apparatus which I denominate a "phonetic interrupter."

My phonetic interrupter consists, essentially, of a pair of contacts responsive to the tones of the voice or to vibrations communicated from any source controlling the primary circuit of a high-wound induction-coil whose said primary is connected to the primary of a Ruhmkorff coil for transmitting. The sonorous vibrations at the interrupter are transformed into electric or light waves, which upon passing to the receiving-station are there received and caused to affect suitable apparatus whereby they may render themselves apparent through the medium of a telephone-receiver, a lamp, a Morse register, or the like.

My invention is fully described in the following specification and illustrated in the accompanying drawings, in which—

Figure 1 is a sectional view of my phonetic interrupter with the parts shown in full. Fig. 2 is an adjusting-key for the core of the induction-coil. Figs. 3 and 4 are diagrams showing the connections of the primary circuit of the interrupter. Fig. 5 is a diagram of the transmitting-circuits, with the apparatus shown in place. Fig. 6 is a similar diagram showing the connections of the apparatus more in detail.

Referring to Fig. 1, A is a non-conducting case or shell, and A′ is a cap therefor. This cap is formed so as to inclose a resonating-chamber, at the bottom of which lies a perforated disk A^2, corresponding to the mouthpiece of the ordinary telephone and fulfilling the same function when the cap A′ is removed. Lying beneath the disk A^2 and supported by the shell is a diaphragm *a*, having at its central point a slight depression *a*′.

Arranged within the shell and supported between suitable heads is an induction-coil D, having the primary winding *d* and the secondary winding *d*′, with a core of soft iron d^2. This core is made hollow, and within it lies a central spindle B, supported at its upper end by the perforated end of the core and at its lower end adjustably held therein by means of the nut *b*, threaded into the lower end of the core, and the guide b^4. The spindle has a head B′, by which it may be manipulated, the function of the adjustment being to permit the air-gap between the tip of the spindle at b^2 and the diaphragm *a* at *a*′ to be arranged so that the vibrations of articulate speech will cause a regular, rapid, and continuous moving and breaking of the circuit. By means of the key K (shown in Fig. 2) the nut *b* may be screwed home when the spindle is adjusted, the prongs *k* and *k*′ of the key finding registering openings in the nut at b^3.

Fitted to the apex of the cap A′ is a flexible

Fig. 3. Patent 771 917. Page 3/6. Source: http://www.uspto.gov.

tube C, with a mouthpiece *c*. When the apparatus is to be used, the user speaks according to a predetermined code or in such other manner as may be agreed upon into the mouthpiece *c*. The sonorous waves propagated through the tube and passing through the central aperture of the cap A^2 impinge upon the diaphragm *a*, producing a corresponding vibration thereof, whereby if the adjustments have been correctly made a very rapid series of makes and breaks or successive contacts will take place between the diaphragm and the tip b^3, corresponding in frequency to the waves originating them. These makes and breaks produce impulses or variations of current in the primary circuit 1 2, the connections of the circuit being clearly shown in Figs. 3 and 4. In Fig. 3 the terminal wire 2 from the local battery *m* is connected to the spindle B at its lower end or head, while the primary wire 1 passes direct to the winding and thence to a connection with the diaphragm. In Fig. 4 the primary wire 1 passes through the coil to the diaphragm, and wire 2 is connected to the tip b^3 of the spindle. Obviously in either case the effect of makes and breaks will be to cause pulsations of current in the primary winding corresponding very closely to the tones of the speech or sounds which caused them. It is of course impossible to get any adjustment short of a perfect contact that will give all of the overtones and will render the articulation perfect; but, on the other hand, in order to obtain the discharge effects, to which I shall presently allude, I find it is better to have positive breaks than mere changes in resistance in the circuit. It goes without saying that I can adjust the contacts so as to produce constant contacts and variable pressure, which are the requisites for perfect microphonic working; but for practical purposes I find it is better to produce the impulses in the manner I have described.

Referring now to Fig. 5, I will describe the connections of my apparatus to produce an operative system. As Fig. 6 shows the same parts in more detail reference may also be had thereto from the detail connections. In these figures F is a Ruhmkorff or other high-power induction-coil adjusted to produce a spark of some length—say from one-quarter inch upward. The primary winding *f* of this coil is connected in a circuit 15 16, containing the main battery M and the phonetic interrupter A. The secondary winding of the coil F, which is marked *f''*, is connected by wires 7 and 8 to the terminals 21 and 20 for the radiating bodies or wires, which may be the usual or any special desired form of aerial conductor, with or without earth on one side. Adapted to be bridged across this circuit 7 8 by the closing of the switch S' on its contact *s'* is a pair of sparking terminals 11 12, the bridge-wires being marked 9 10. A condenser G' of suitable capacity is also connected across the secondary circuit by means of wires 13 and 14. The primary circuit 15 16 passes from the Ruhmkorff coil to the primary terminals of the induction-coil D in the phonetic interrupter. The secondary winding *d'* is connected in a local circuit 19, which contains a telephone-receiver T, and the primary circuit contains a lamp E, which may serve for both sending and receiving messages. A condenser G of suitable capacity is also bridged across the primary circuit.

The operation of the system thus described is as follows: For transmitting Hertz waves corresponding to sonorous vibrations the switch S' is closed, the switch S is opened, and the operator proceeds to produce sounds in the desired manner into the mouthpiece *c* of the phonetic interrupter. A succession of impulses is thus produced in the primary circuit of the coil F, whose effect is increased by the presence of the condenser G, which takes up the extra current, assists in the rapid demagnetization of the core of the induction-coil, and also prevents sparking between the diaphragm and the tip-terminal. These impulses in the primary, which are very rapid, with proper adjustment reaching between five hundred and nine hundred per second, produce very high potential impulses in the secondary. To produce oscillations of light by means of the interrupter in the sending-station, I use the natural human voice, preferably because the flickerings produced corresponding in form and frequency to the initial sounds and being properly retranslated through the agency of suitable apparatus at the receiving-station enable the original sounds to be recognized more or less perfectly, and while many words or tones can be recognized for their own intrinsic value, as well as for any arbitrary code value that may be assigned to them apart from this, a sufficient number of distinctive words can be selected to make a complete and very efficient code.

Obviously as a substitute for the human voice other sources of sonorous vibrations may be employed. Thus to produce electrical oscillations by means of the same interrupter I may use at the sending-station a source of sound consisting of a musical instrument similar to a small organ, having a set of reeds or pipes with controlling devices and one or more acoustic tubes connected to the mouthpiece of the interrupter-tube. The diaphragm of the interrupter being thus strongly vibrated causes oscillations of light or electricity which may be received after transmission by means of any suitable sensitive device. In addition to this method of transmitting by means of electric or luminous waves, as I have said, certain of the features

Fig. 4. Patent 771 917. Page 4/6. Source: http://www.uspto.gov.

herein may be utilized in connection with my other systems. In one of those systems I employ waves or flickerings of light for the purpose of transmitting code-signals. In the present case I may employ the lamp E in a similar manner, producing the initial changes in current by the phonetic interrupter. Should the pulsations of light be too rapid, the adjustment of the fixed terminal and the diaphragm may be changed until the amplitude of vibration is great enough to eliminate all but the fundamental tones. In fact, the diaphragm may be weighted, if desired, or its pulsations may be otherwise retarded. In case of transmitting by light-waves I use the reflector and may also use screens of various materials, such as slides of colored glass, and, if desired, I may substitute for the lamp shown a cathodic lamp of the kind described in my other application or other kind of light.

It will be observed that the most important and, in fact, the essential feature of my invention consists in the employment of a make-and-break transmitter worked by sonorous vibrations, causing the transmitted electromagnetic or light waves to correspond closely to the sound-waves by which they are produced.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a system of signaling without connecting-wires, an induction-coil, a discharge-circuit connected to the secondary of said coil, with a circuit-interrupter and a source of current connected to the primary of said coil and means to actuate said circuit-interrupter to make and break the primary circuit in accordance with sonorous vibrations, whereby current-pulsations may be produced in the primary corresponding or approximating to the sounds by which they are produced, substantially as described.

2. In a system of electric signaling without connecting-wires, an induction-coil, a discharge-circuit having a terminal radiating-wire connected to the secondary of said coil, a suitable source of current, connected to the primary of the coil; and means for making and breaking the primary circuit adapted to be actuated by sonorous vibrations, substantially as described.

3. In a system of electric signaling, without connecting-wires, a primary energizing-circuit, a secondary discharge-circuit, means for rapidly and repeatedly making and breaking the primary circuit, said means arranged and adapted to be brought into operation by sonorous vibrations, substantially as described.

4. In a system of electric signaling without wires, an induction-coil, a secondary discharge-circuit therefor, a primary circuit and a source of current, a phonetic device having contacts included in said primary circuit, and means to periodically open and close said contacts, and thereby to produce corresponding current-pulsations in the primary and secondary circuits, substantially as described.

5. In a system of electric signaling without wires, an induction-coil and a sceondary discharge-circuit therefor, a primary circuit therefor with a source of current and a periodic circuit-interrupter therein, together with means connected to said primary circuit for producing light-rays of variable intensity corresponding to the current-pulsations in the primary and secondary circuit, substantially as described.

6. A phonetic interrupter or make-and-break transmitter for signaling-circuits, comprising a casing or shell, an induction-coil therein, a pair of contacts mounted thereon, circuit connections to the secondary circuit and other circuit connections through the primary to the pair of contacts, substantially as described.

7. In a system of electric signaling without wires, the combination of the following instrumentalities; an induction-coil, a secondary discharge-circuit for said coil, adjustable discharge-terminals and a condenser bridged across said circuit, a primary circuit and a source of current therein, a periodic circuit-interrupter in said primary circuit, an electric lamp bridged across said primary circuit and a condenser also bridged across the primary circuit, substantially as described.

8. A phonetic interrupter for wireless telegraphy comprising a shell or casing, a diaphragm, a perforated cap covering the diaphragm, a sound-chamber formed within a second cap, with a conducting-tube and mouthpiece therefor; an adjustable contact-spindle extending into close proximity to the diaphragm and forming therewith the terminals of a primary circuit, together with means to lock said spindle to the core when adjusted, substantially as described.

9. In a system of electric signaling without wires, an electric lamp, a circuit and a source of current therefor, and a periodic circuit-interrupter in said circuit adapted when actuated to make and break the same, with means to actuate said interrupter by sonorous vibrations or musical tones, whereby variations in the radiation from said lamp may be produced, corresponding to the said vibrations or tones, substantially as described.

10. In a system of electric signaling without wires, an electric lamp, a circuit and a source of current therefor, a periodic interrupter in said circuit adapted when actuated to make and break the same, a condenser bridged across the circuit, and means to actuate the interrupter by sonorous vibrations or musical tones, whereby a series of current-pulsations

Fig. 5. Patent 771 917. Page 5/6. Source: http://www.uspto.gov.

may be produced with corresponding variations in the radiation from the lamp, substantially as described.

11. In a transmitting apparatus for wireless signaling systems, a primary circuit, a periodic interrupter and an electric lamp therein, a secondary circuit having discharge-terminals adapted to produce electromagnetic waves, an induction-coil having its windings in the primary and secondary circuits respectively, and means to actuate said circuit-interrupter by sonorous vibrations, substantially as described.

In testimony whereof I have hereunto subscribed my name.

ROBERTO LANDELL DE MOURA.

Witnesses:

DANIEL B. TAMAGNO,

EUGENE M. BERARD.

Fig. 6. Patent 771 917. Page 6/6. Source: http://www.uspto.gov.

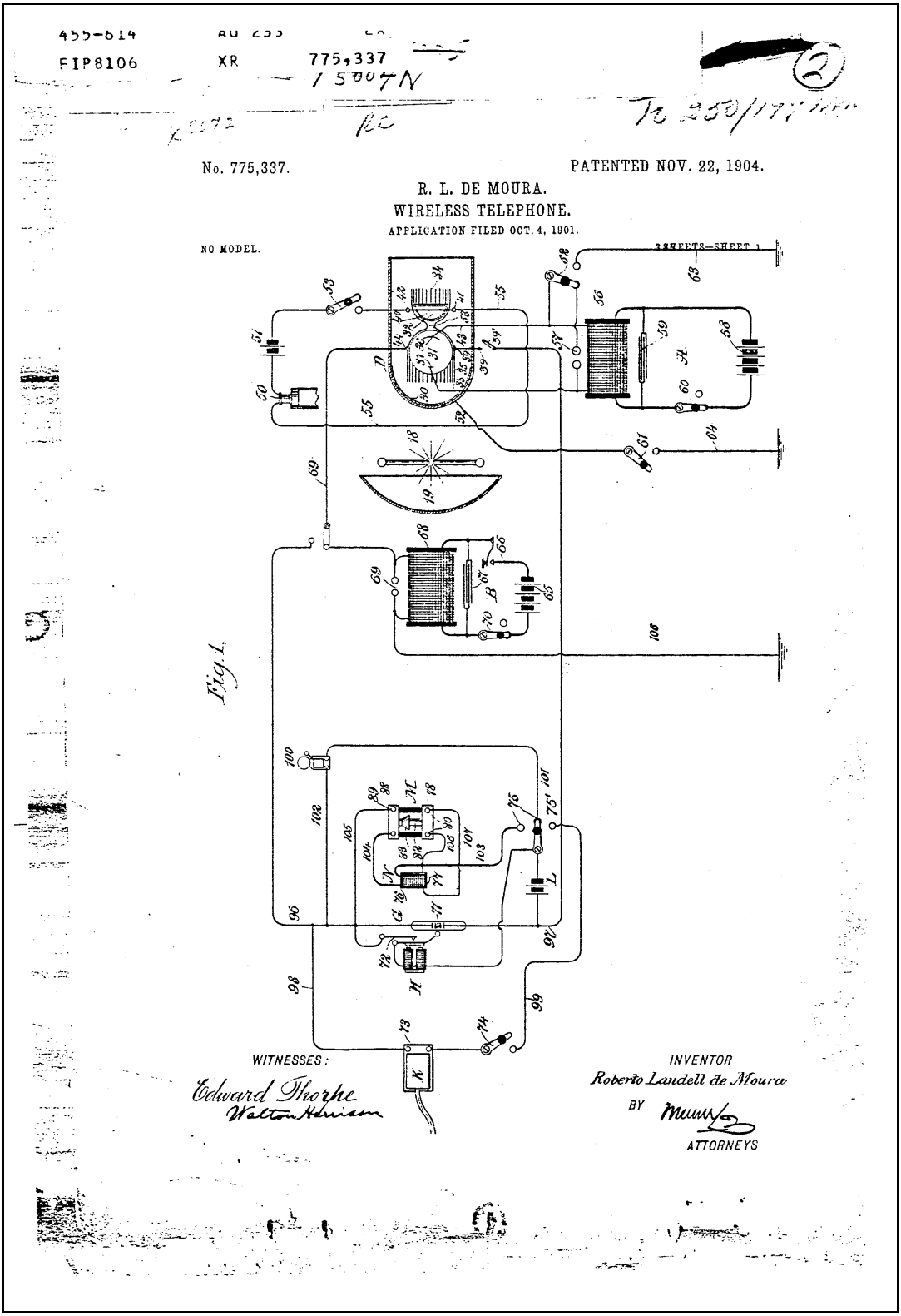

Fig. 7. Patent 775 337. Page 1/7. Source: http://www.uspto.gov.

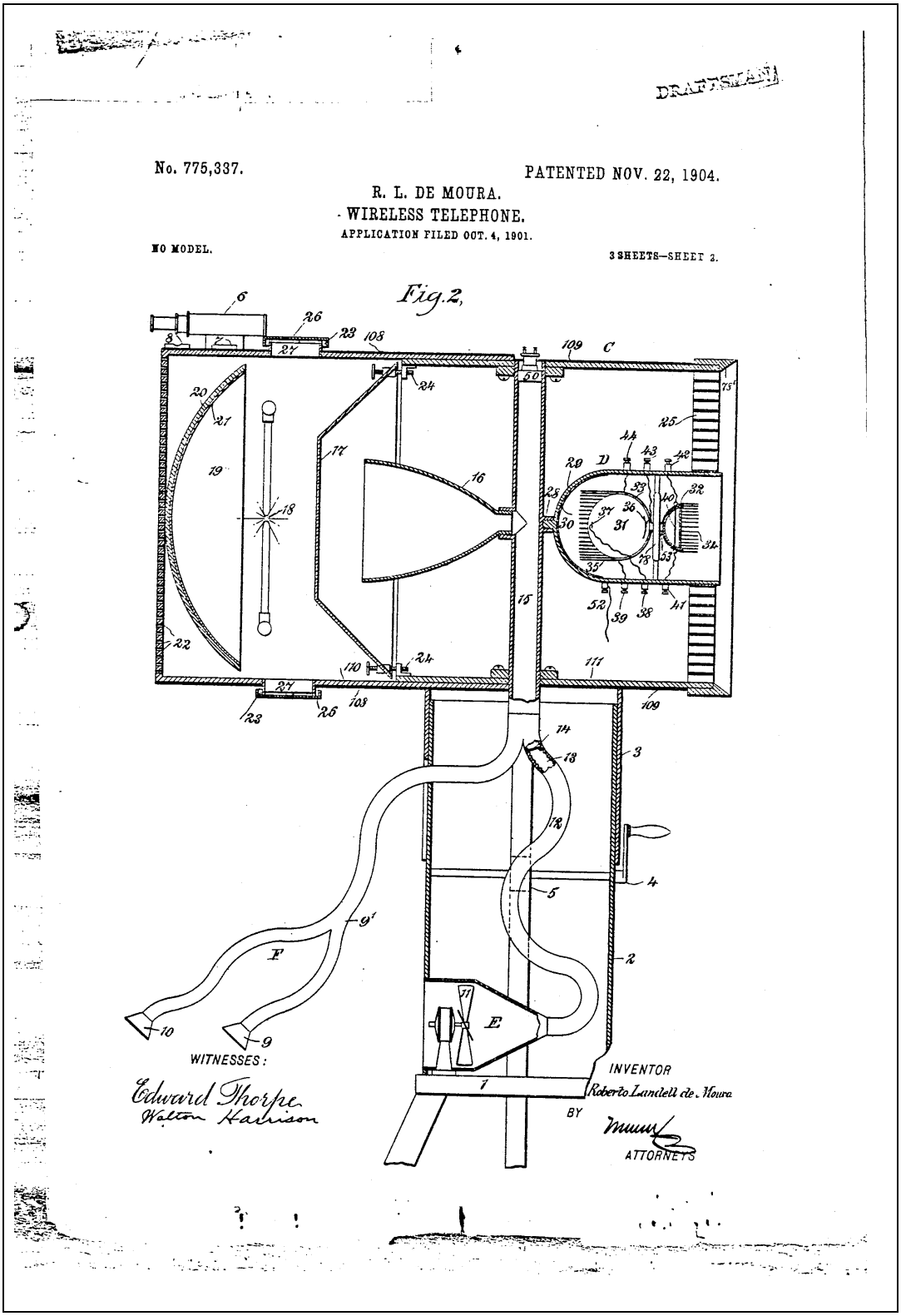

Fig. 8. Patent 775 337. Page 2/7. Source: http://www.uspto.gov.

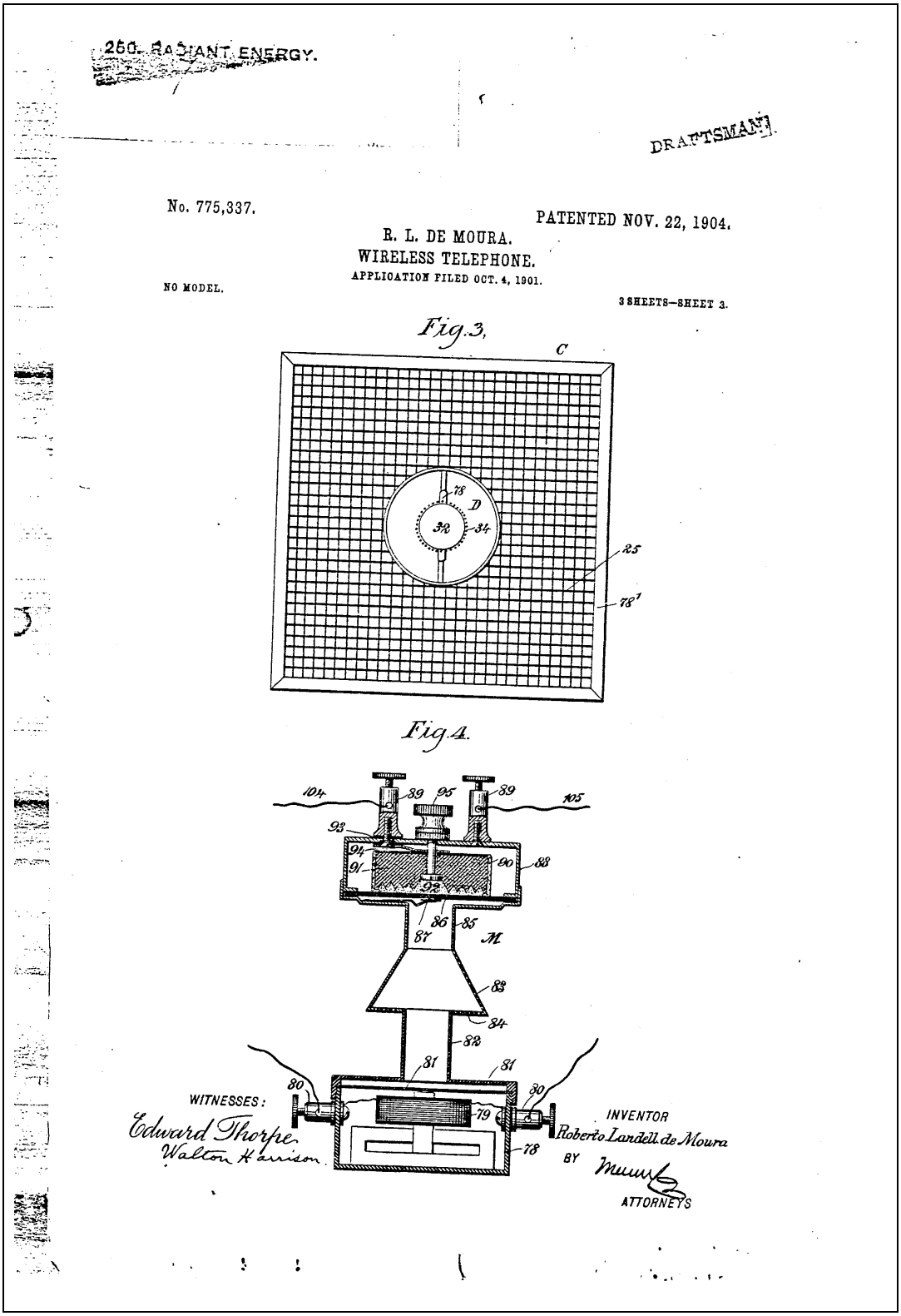

Fig. 9. Patent 775 337. Page 3/7. Source: http://www.uspto.gov.

No. 775,337. Patented November 22, 1904.

UNITED STATES PATENT OFFICE.

ROBERTO LANDELL DE MOURA, OF NEW YORK, N. Y.

WIRELESS TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 775,337, dated November 22, 1904.

Application filed October 4, 1901. Serial No. 77,576. (No model.)

To all whom it may concern:

Be it known that I, ROBERTO LANDELL DE MOURA, a citizen of the Republic of Brazil, and a resident of the city of New York, borough of Manhattan, county and State of New York, have invented a new and Improved Wireless Telephone, of which the following is a full, clear, and exact specification.

The object of my invention is to transmit and receive intelligence at a distance by means of sound and electrical waves, corresponding to articulate speech, without the aid of wires.

In the accompanying drawings like characters indicate like parts in all the figures.

Figure 1 is a diagram showing the apparatus at one of the stations, both for transmission and receiving. Fig. 2 is a sectional view of certain parts of the apparatus. Fig. 3 is a partial elevation thereof viewed from the front. Fig. 4 is a sectional view of a device for augmenting the sound-waves in receiving signals.

This apparatus consists generally in a device for transmitting and receiving vocal sounds and speech and includes a signaling device for attracting the attention of an operator. This signaling device is herein shown merely to exhibit the connection of the same with the telephone proper.

A divisional application claiming this signaling apparatus has been filed January 16, 1902, Serial No. 89,976.

Taking up first the telephonic transmission and receiving and referring particularly to Fig. 2, the frame 1 is provided with an upright tubular member 2, upon which telescopes another tubular member, 3, adjusted by means of a crank 4 and rack and pinion 5, to be elevated and lowered at will. Upon the member 3 is mounted a transmitter C. A telescope 6, compass 7, and level 8 are mounted on the transmitter for the purpose of pointing the same in alinement with a distant station. A tube 9′ has branched ends provided with terminal mouthpiece 9 and earpiece 10, and is united to another tube, 12, the two tubes being connected to the lower insulated end of a tube 15.

The tube 12 is provided with an upwardly-opening check-valve 14 and has at its lower end means for producing an air-blast comprising a chamber E, containing a fan 11. When one uses the fan and it is in action rotated by suitable power and a person talks into the mouthpiece 9 or 10, a blast of air opens valve 14 and passes up with the sounds from 9 through the tube 15, and the sound-waves with the blast of air are projected by the member 16 against the deflector 17 and by this are sent forth through the interior of the barrel C, which is also traversed inside by the pencil or ray of composite light from 18.

At 17 I show a plate of quartz-glass suitably framed and adjustable by means of the screws 24.

18 is a source of light, preferably an electric-arc lamp, whose light is rich in violet rays.

At 19 is a mirror, consisting of a back 20, which may be of polished metal or glass and of parabolic shape to reflect only actinic or violet rays. I do not confine myself to this form of light or the means shown for rendering its rays parallel or to the particular means for sifting out all but the violet or actinic ultra-violet rays, as any means may be employed that will produce violet or actinic rays or augment their intensity.

Back of the mirror and at intervals around the barrel of the transmitter are ventilating-openings 22 and 23, the latter provided with hoods 26 to keep out light. The barrel comprises two members 110 111 and 108 109, these telescoping together.

The quartz-glass 17 may be replaced by other substances which will deflect sound-waves and which may be resonant thereto, but will pass the violet or actinic rays of light. Sound-waves carried on the incoming air-blast are brought against this deflector 17 through the funnel 16.

A grating 25, of thin metallic slats covered with lampblack and crossing each other, splits up the light into a number of parallel beams, which I find adds to the efficiency of the apparatus. The member 25, Fig. 2, at its extremities is insulated and also its last central metallic plate, in which the member D is adjusted. The member 25, Fig. 1, is electrically connected with the wires 44 and 39 by means of two insulated wires, which pass through

Fig. 10. Patent 775 337. Page 4/7. Source: http://www.uspto.gov.

the center of the insulating-jacket existing between the two metallic walls, which telescoping one in the other form the member D. The two connecting-wires, as well as the member 25, have no communication with the interior or the exterior walls of the member D. The plate 17, as stated, is in every case so constructed as to offer no obstruction to these violet rays. This is important, as my discovery has been that by means of these actinic rays of light the sound-waves impressed thereon can be carried to considerable distances.

Located centrally in the barrel of the transmitter is a smaller receiver-barrel 29, provided with a closed rounded interior end containing a reflector 30, preferably of metal. This barrel is carried on the upright tube 15, being screwed on a socket-support 28.

In the focus of mirror 30 is a hermetically-sealed and exhausted hollow semispherical member 32, covered with quartz-glass or other substance pervious to the violet rays and containing a selenium plate or grid 40, the general plane of which is vertical. Terminals 41 and 42 are provided for the selenium-cell, and a third, 52, is used sometimes with a ground-wire, by which undesirable static charges are dispersed. The selenium-cell and all attachments are carried on the insulated stem 53 on the post 78.

Two apparatuses like that of Fig. 2 adjusted one in front of the other and at a distance relatively short may be used for sending and receiving acoustically—that is, without the telephone 50 and also without the coöperation of the selenium plate 40. Then for sending the operator after having put in action the fan 11 and the light from 18, Fig. 2, speaks through one of the mouthpieces 10 9, closing the other. For receiving he stops the fan and holds 10 and 9 to his ears. The fan is used only in sending. The apparatus then works in a manner based on the well-known principles of the conjugate mirrors, and I find that the addition of certain kinds of light improves the effects in sending and receiving. The apparatus so taken may not be of great commercial value. However, I claim it, because, properly speaking, it constitutes the transmitter of my own wireless telephone, as my own selenium-cell, here described, constitutes its receiver. In my own wireless telephone—that is, with the coöperation of my own photophonic devices—my clear actinic light is absolutely necessary. I say "clear actinic light"—that is, light composed of clear light and actinic rays, as is that produced by an arc-lamp or by a blue glass in front of a source of common light. For sending at long distance I prefer the composite light produced by an arc-lamp. For producing actinic rays of violet light I may adjust inside or outside of the deflector 17 a thin pellicle made of suitable diaphanous substance. Thus in the top of the tube 15 a telephone-receiver 50 is mounted, connected in local circuit 55, containing a battery 51 and also including the selenium-cell 40 50. It is well known that the resistance of amorphous selenium varies inversely as the amount of light to which it is exposed, nearly. I have discovered that it varies more particularly as the intensity or density of the violet or actinic rays, giving thus a very delicate test for the presence of such rays. In this apparatus when a light from the distant station falls upon the selenium its resistance varies as the intensity of the light varies, that in turn varying with the sound-waves to which its source has been exposed, as already described, and the telephone-receiver 50 thereby reproduces these sounds with great fidelity. The listener can then hear by holding the telephone 50 or the mouthpieces 10 9 to his ears. In the last case he must close the communication between the members 16 and 15, Fig. 2. It is a singular and important fact that if the receiver be entirely removed, however, and the selenium not employed the apparatus shown still reproduces the sounds as stated above. I regard this as an important discovery and consider myself entitled to cover its application to useful purposes.

Located within the barrel 29, Fig. 2, and in the focus of the mirror is a Crookes tube or cathode-lamp 31. A series of wires 35 in the form of a crown surrounds the lamp and projects toward the mirror 30. The points of these wires are bent inward toward each other radially at right angles to the axis of the barrel and terminate in a small circle whose axis is coincident with the circle of their support. One of the extremities of this crown is contracted for receiving inside of it the selenium-cell. These two series of wires are electrically connected with each other and the binding-screws 44 39. They have communication only with one of the terminals of the selenium plate 40. Terminals 38 and 43 are provided for the Crookes tube and 39 44 for the crown-wires. The Crookes tube is carried on a stem 53 on post 78 and is connected with an oscillator 56, Fig. 1, provided with proper appliances, including sparking terminals 57 and condenser 59. The primary battery for the oscillator is shown at 58, with a suitable switch 60. The sparking apparatus as a whole is marked A. When switch 60 is thrown into the position shown, sparks that would normally pass between balls 57 pass to the Crookes tube in the usual manner. The rays from the tube are transmitted in all directions; but those passing straight out and those deflected by the mirror are united in a beam in the same path as that of the composite light.

At B, Fig. 1, is shown another sparking apparatus. Battery 65 is connected by transmitting-key 66 and switch 70 with condenser 67 and Ruhmkorff coil 68, having spark-gap

Fig. 11. Patent 775 337. Page 5/7. Source: http://www.uspto.gov.

and knobs, as usual. One knob is grounded by wire 106 and the other is connected by wire 69′ to points 34 35. Switch 70 being thrown into the position shown and key 66 depressed according to a prearranged code there is an oscillatory discharge between the knobs 69 and the points 34 35 throw off etheric waves. I find that the reflector 30 serves to render these parallel, or substantially so, and to increase the distance of transmission, especially when short waves are employed. Key 66 thus serves to send waves corresponding with Morse or other signals and for calling.

A coherer 71 is connected by wires 96 97 with wires 39′ and the crown-wires above described. These wires act as antennæ, not only transmitting but receiving the Hertzian waves. The uses of this coherer in receiving signals, and its associated parts, will appear clearly from a statement of their operation. Incoming waves are conveyed to coherer 71 as electrostatic surgings along the wires from points 34 35, 64 61 and cause its coherence. Battery-current from L then passes through the coherer and the two windings of the induction-coil N, also to the tapper H, in the usual way to decohere the coherer. From the coil N connections are made to the harmonic call or "howler" M, which will be described. This consists of a telephone-receiver and a microphone brought together with an interposed column of air, so that when one starts to vibrate its diaphragm it starts the other, and as they are in closed circuit they mutually react to produce a steady noise of considerable loudness to serve as a call to the operator. The howler is particularly shown in Fig. 4. With the switch 75 as shown in Fig. 1 the current would pass to the bell 100; but with the switch thrown to 103 the howler is in circuit. A Morse register K may also be employed, having its own switch 74 and connected to the lowermost contact of switch 75.

Suppose now that the distant operator depresses his signaling-key 66, causing etheric waves to be thrown off from his wire-points 34 35. These incoming waves, as stated, cause the bell 100 or the howler M to be actuated and call the attention of the home operator. He answers by means of his key 66, and conversation proceeds by means of the mouthpiece 9 and the earpiece 10, or telegraphic signals may be interchanged by means of the keys. These may be roughly taken on the howler, if desired. For sending electric impulses the operator closes the switch 69′ on the terminal of 69. For receiving the electric impulses he puts the same switch on the terminal of 96 and closes the switch 61. For sending articulate speech he lights the arc-lamp and speaks through one of the mouthpieces 9 or 10, closing the other. For receiving he closes the switch 53 and holds 50 to his ears or the two mouthpieces 9 10, closing in this case the acoustic communication between 15 and 16, as is said above. The coil 56 serves to augment the potential on the extremities of its secondary wires when it is used, together with the other coil, 68, through the secondary wires for the purpose of telegraphing by electric waves and flickerings of light, as is fully explained in the specification of my wireless-telegraph application, Serial No. 89,976. The wires 96 and 97 are provided with ordinary bobbins, and the parts H, K, 72, and 100 are provided with suitable resistances.

Referring to Fig. 4, 88 is a containing-box with carbon back electrode 90, adjustable by screw 92 and thumb-nut 95, and 86 is a carbon diaphragm with damper-spring 87. Granular carbon is interposed between back electrode and diaphragm, as usual, and connections made through the binding-posts 89. 78 is another box containing the receiver-magnets 79, acting on the diaphragm 81 and having terminal posts 80. The box 88 and the box 78 are connected by the tube 82, carrying a column of air and having an enlargement 83, with pressure-openings 84, which also serve to convey the vibrations out. In some cases the openings 84 may be made at one end to make the air-column a closed column. When the receiver-diaphragm is vibrated, it vibrates the column of air and thence the transmitter-diaphragm, which again produces changes in the current to the receiver, which again reacts, and so on harmonically, producing a long-drawn musical note of increasing and sustained loudness.

From this description it will be apparent that my invention consists, broadly speaking, in projecting electrical and other obscure waves of high penetrative force between stations and impressing on the column thus established the vibrations corresponding to speech-waves. In this way I have found the sound to be perfectly transmitted and apparently receivable without special apparatus. I do not assume that all sonorous waves or vibrations produced by my apparatus are limited or affected by means of the luminous column, but that all sonorous waves that start in the same path and travel therein with this column arrive therethrough at the receiving-station. Many ways of stating this may be conceived, but I shall claim its application. I shall also claim the means for rendering parallel all rays by means of a grating such as I have described and some details in the structure of the howler.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a system of wave transmission, a source of waves, and a grating having its members coated with lampblack, substantially as described.

Fig. 12. Patent 775 337. Page 6/7. Source: http://www.uspto.gov.

and knobs, as usual. One knob is grounded by wire 106 and the other is connected by wire 69′ to points 34 35. Switch 70 being thrown into the position shown and key 66 depressed according to a prearranged code there is an oscillatory discharge between the knobs 69 and the points 34 35 throw off etheric waves. I find that the reflector 30 serves to render these parallel, or substantially so, and to increase the distance of transmission, especially when short waves are employed. Key 66 thus serves to send waves corresponding with Morse or other signals and for calling.

A coherer 71 is connected by wires 96 97 with wires 39′ and the crown-wires above described. These wires act as antennæ, not only transmitting but receiving the Hertzian waves. The uses of this coherer in receiving signals, and its associated parts, will appear clearly from a statement of their operation. Incoming waves are conveyed to coherer 71 as electrostatic surgings along the wires from points 34 35, 64 61 and cause its coherence. Battery-current from L then passes through the coherer and the two windings of the induction-coil N, also to the tapper H, in the usual way to decohere the coherer. From the coil N connections are made to the harmonic call or "howler" M, which will be described. This consists of a telephone-receiver and a microphone brought together with an interposed column of air, so that when one starts to vibrate its diaphragm it starts the other, and as they are in closed circuit they mutually react to produce a steady noise of considerable loudness to serve as a call to the operator. The howler is particularly shown in Fig. 4. With the switch 75 as shown in Fig. 1 the current would pass to the bell 100; but with the switch thrown to 103 the howler is in circuit. A Morse register K may also be employed, having its own switch 74 and connected to the lowermost contact of switch 75.

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Referring to Fig. 4, 88 is a containing-box with carbon back electrode 90, adjustable by screw 92 and thumb-nut 95, and 86 is a carbon diaphragm with damper-spring 87. Granular carbon is interposed between back electrode and diaphragm, as usual, and connections made through the binding-posts 89. 78 is another box containing the receiver-magnets 79, acting on the diaphragm 81 and having terminal posts 80. The box 88 and the box 78 are connected by the tube 82, carrying a column of air and having an enlargement 83, with pressure-openings 84, which also serve to convey the vibrations out. In some cases the openings 84 may be made at one end to make the air-column a closed column. When the receiver-diaphragm is vibrated, it vibrates the column of air and thence the transmitter-diaphragm, which again produces changes in the current to the receiver, which again reacts, and so on harmonically, producing a long-drawn musical note of increasing and sustained loudness.

From this description it will be apparent that my invention consists, broadly speaking, in projecting electrical and other obscure waves of high penetrative force between stations and impressing on the column thus established the vibrations corresponding to speech-waves. In this way I have found the sound to be perfectly transmitted and apparently receivable without special apparatus. I do not assume that all sonorous waves or vibrations produced by my apparatus are limited or affected by means of the luminous column, but that all sonorous waves that start in the same path and travel therein with this column arrive therethrough at the receiving-station. Many ways of stating this may be conceived, but I shall claim its application. I shall also claim the means for rendering parallel all rays by means of a grating such as I have described and some details in the structure of the howler.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a system of wave transmission, a source of waves, and a grating having its members coated with lampblack, substantially as described.

Fig. 13. Patent 775 337. Page 7/7. Source: http://www.uspto.gov.

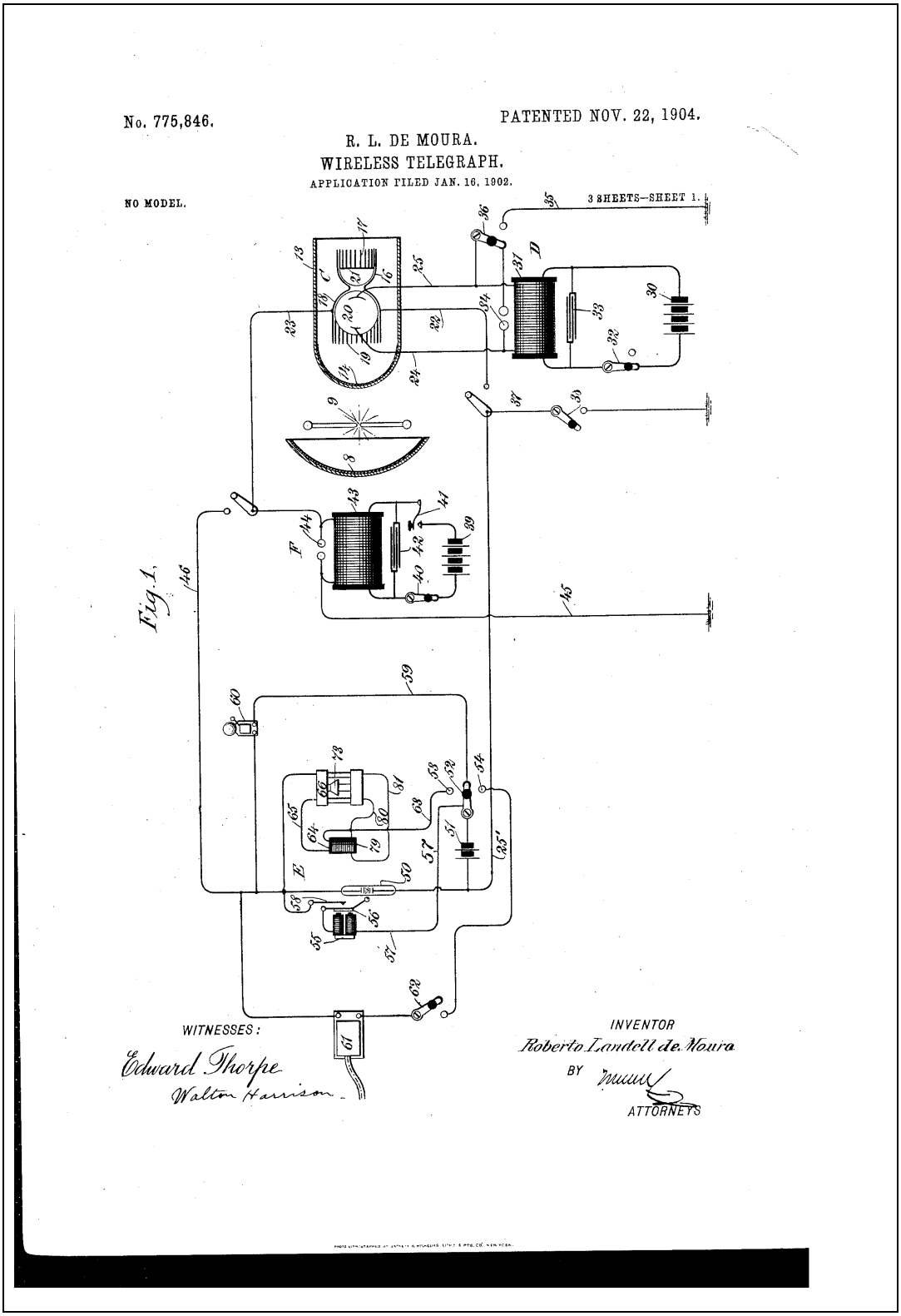


Fig. 14. Patent 775 846. Page 1/7. Source: http://www.uspto.gov.

No. 775,846. PATENTED NOV. 22, 1904.

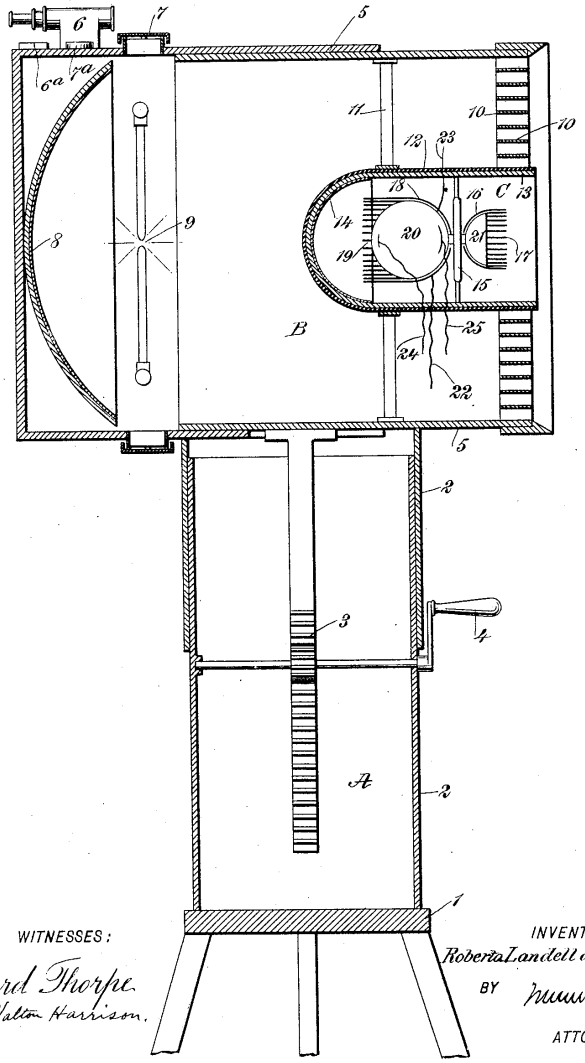
R. L. DE MOURA.

WIRELESS TELEGRAPH.

APPLICATION FILED JAN. 16, 1902.

NO MODEL. 3 SHEETS—SHEET 2.

Fig. 2.



WITNESSES:

Edward Thorpe.

Walter Harrison.

INVENTOR

Roberto Landell de Moura

BY

ATTORNEYS

Fig. 15. Patent 775 846. Page 2/7. Source: http://www.uspto.gov.

No. 775,846. PATENTED NOV. 22, 1904.

R. L. DE MOURA.

WIRELESS TELEGRAPH.

APPLICATION FILED JAN. 16, 1902.

NO MODEL. 3 SHEETS—SHEET 3.

Fig. 3.

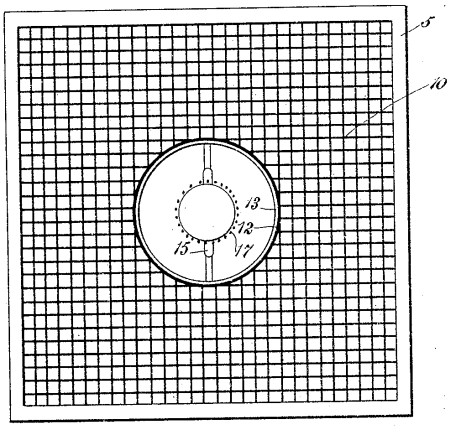
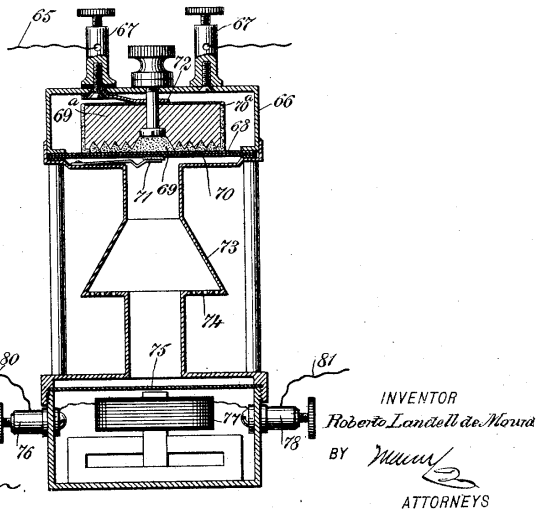


Fig. 4.



WITNESSES:

Edward Thorpe

Walter Harrison.

INVENTOR

Roberto Landell de Moura

BY

ATTORNEYS

Fig. 16. Patent 775 846. Page 3/7. Source: http://www.uspto.gov.

No. 775,846. Patented November 22, 1904.

UNITED STATES PATENT OFFICE.

ROBERTO LANDELL DE MOURA, OF NEW YORK, N. Y.

WIRELESS TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 775,846, dated November 22, 1904.

Original application filed October 4, 1901, Serial No. 77,576. Divided and this application filed January 16, 1902. Serial No. 89,976.

(No model.)

To all whom it may concern:

Be it known that I, ROBERTO LANDELL DE MOURA, a citizen of the Republic of Brazil, and a resident of the city of New York, (borough of Manhattan,) in the county and State of New York, have invented a new and Improved Wireless Telegraph, of which the following is a full, clear, and exact description.

My invention relates to a wireless-telegraph system employing common electric waves, and contemplates the use of such waves, either directly transmitted—that is, non-reflected—or reflected and of short lengths, in connection with certain apparatus and devices for generating and responding to the same to send and receive graphic and harmonic or phonetic signals through space or, it may be, through fogs or through water.

The present application is a division of my former application, filed October 4, 1901, Serial No. 77,576, for an improvement in wireless telephones and telegraphs.

According to my invention a local circuit is provided which may be either constantly or intermittently closed and in which is connected a device capable of giving a continuous or an intermittent sound. This sound-producing device is energized by a local battery, and its action is modified in intensity in accordance with the intermittent electric impulses from the sending-station, which act upon a variable-resistance device, (which may be a coherer.) For continuous sounds the variable-resistance device does not act specifically as a coherer, but more properly as a very sensitive granular microphone whose resistance is controlled by the impulses from the sending-station, these changes in resistance effecting the intensity in the sound by affecting the local current-supply to the sound-producing device.

Although I thus specify and shall describe the use of a local circuit, however I wish to say that there are other means by which my invention may be practiced. The underlying principle is simply that of modifying the resistance of the local microphone, and the functions of the receiver may be exercised by any radio-detector of the Branly type provided with a controllable electrode. Furthermore, although I speak of reflected impulses and short-length waves, these are not essential, although I use them in some cases and at relatively short distances in order to obtain improved effects. The same holds with regard to certain light or other active rays used in connection with reflected waves.

My invention is illustrated in the accompanying drawings, in which the same reference characters indicate the same parts in all the figures.

In the drawings, Figure 1 is a diagram representing the entire telegraphic apparatus used at one of the stations. Fig. 2 is a section showing a part of the transmitting and receiving apparatus. Fig. 3 is a front elevation of the upper portion of the same, and Fig. 4 is a detail view showing my device for producing telegraphic signs phonetically.

The apparatus consists of a stand A, (see Fig. 2,) a barrel B, a smaller barrel C, a sparking device D, receivers E, and a sparking device F. (See Fig. 1.) The frame 1 (see Fig. 2) of the stand A is mounted upon vertically-disposed concentric tubes 2, the outer of which is movable and is connected with a rack and pinion 3, actuated by a handle 4, whereby the barrel B may be raised or lowered at will. The barrel B consists of two cubical or cylindrical boxes 5, telescopically adjustable one in the other, upon one of which boxes are mounted a telescope 6, a spirit-level 6^a, and a compass 7^a for the purpose of training the barrel upon a distant station. The barrel is provided with a parabolic mirror 8 and an electric light 9 for use in my wireless telephone, which is fully described in my other application.

A grating 10, made of metal covered with lampblack, is provided in the front end of the barrel for the purpose of rendering the rays of light from the mirror 8 parallel. The smaller barrel C is mounted upon the supports 11 and is disposed centrally of the larger barrel. The smaller barrel consists of an intermediate jacket of an insulating material 12, in which is mounted a metallic cylinder 13, provided with a hemispherical end in which is disposed a

Fig. 17. Patent 775 846. Page 4/7. Source: http://www.uspto.gov.

concave mirror 14, made, preferably, of metal. Inside of this barrel is an insulated support 15, and upon this support is mounted a crown-shaped bunch of wires 16 18, having one extremity contracted to support a selenium cell 21, the ends of the crown terminating in points or antennæ 17 19, bent over radially and at right angles to the axis of the tube. The members 10 and C are fully described in my prior application referred to.

A Crookes tube 20 and a hollow hermetically-sealed vacuum-cell 21 of glass, having no pneumatic communication with each other, are provided and are placed within the wires in such manner that the wires form cages partially surrounding them. The hermetically-sealed glass cell is of hemispherical shape and is used for holding a selenium plate, as described in my other application. The selenium cell is shown here, because it may be used for telegraphing by flickerings of light in connection with the lamp 20, which has an action on the selenium plates of the receiving and of the sending stations.

The wire 23 is connected with the bunches of wires 16 and 18 and is also connected with 44 alone for sending and with 46 alone for receiving. The switch 38 is open in sending, but closed in receiving. The wires 46 and 25 and the members 55, 58, 56, and 60 are provided with suitable resistance. Electrical connections 24 25 are provided for the Crookes tube in the usual manner. The Crookes tube is excited in the usual manner by means of a sparking apparatus D, which consists of a battery 30, a Ruhmkorff coil 31, connected thereto and controlled by a switch 32, a condenser 33, and a pair of polished knobs 34, and a ground-wire 35, provided with a switch 36, is used for throwing the polished knobs as exciter out of use when desired and of grounding the wires as a protection against lightning or against accidents. The wire 22 is connected with the wire 37, which is provided with a grounding-switch 38, which must be closed in receiving, as stated. The switch 32 may sometimes be substituted for the key 41—that is, when the secondary connections of coils 43 and 31 coact to augment the potential difference between the ends of the secondaries of coil 31. Then 44 being out of action connects only with the antennæ through 23, and 24 connects with 23, 22 with 25, and at its other extremity 22 connects only with 37. 37 connects with 38 and this with 45 through the ground. In this case the switch 36 connects with 34, where the oscillating discharges are produced, and the conventional interruptions are made by the key 32. For sending by flickerings of light I may use the same arrangement, the switch 36 being in a neutral position, as also the terminals 34. For receiving by flickerings of light I use the same devices described in my previous applications referred to.

A signaling device proper is shown at F and consists of a local battery 39, a switch 40, a Morse key 41, a condenser 42, and a Ruhmkorff coil 43, provided with polished knobs 44 of the usual pattern. From one of these knobs a wire 45 leads to the ground, and another wire, 46, leads to the crown of wires 16 18. This crown of wires may vary indefinitely in form, and it is used inside of the member C only when working with waves of short length, and then only if it is desired to use the light from 18 or C.

The coherer is shown at 50. It is connected with a local battery 51, provided with a switch 52, the same being adapted to engage the contacts 53 54. The decoherer is shown immediately at the left of the coherer and consists of an electromagnet 55, provided with an armature 56 of the pattern generally used in coherers, said armature being adapted to tap the tube of the coherer 50. The decoherer is connected, through wire 57, with the wire 25, and 57 may connect with 53, 59, and 54 by means of the switch 52. The contact 58, which is adapted to engage the armature 56, is connected with the wire 25′. The wire 59 is for the purpose of establishing communication between the battery 51 and the bell 60.

A Morse recording apparatus of the usual pattern and provided with all of the auxiliaries accompanying such apparatus is shown at 61 and is controlled by a switch 62, connected when closed to contact 54 of switch 52. From the contact 53 a wire 63 leads to the primary 64 of an induction-coil, and from this primary a wire 65 leads to the sonorous receiver 66. This receiver is shown more particularly in Fig. 4.

Binding-screws 67 are mounted upon the frame of the receiver, the screw at the left-hand side being insulated, as shown. A diaphragm 68, protected by a disk 70 of insulated material, is mounted directly across the frame, and over it is a layer of comminuted carbon 69 in loose form. This carbon is engaged by the carbon button 69^a, upon which is mounted an insulating-jacket 70^a. A spring-tongue 71 normally presses the diaphragm 68 gently against the comminuted carbon, and a somewhat similar spring 72 presses the button 69^a downward. A funnel-shaped member 73 is provided with perforations or holes 74, arranged in concentric rings. These holes or perforations are for the purpose of emitting phonetic signals. A diaphragm 75, of iron, is mounted across the frame, and binding-screws 76 and 78 are connected with the magnet 77.

The operation of my apparatus when used with short-length reflected waves and with light-waves is as follows:

The switch 36 is connected to wire 35 and the switch 32 is closed, as shown in Fig. 1, thereby exciting the Crookes tube and causing the same to emit cathode-rays in the usual manner. The signal-key 41 is now disposed

Fig. 18. Patent 775 846. Page 5/7. Source: http://www.uspto.gov.

in the manner peculiar to Morse telegraphy. The Ruhmkorff coil 43 causes the polished knobs 44 to spark in response thereto. The wire 45 being grounded, as shown, the antennæ 17 19 (being then connected with 44 through 23) are caused to throw off etheric waves similar to the Hertzian waves, which pass out of the barrel toward the distant station.

The operator by depressing the key 41 merely causes the Ruhmkorff coil 43 to spark continuously while the key is depressed and to cease sparking while the key is raised. The cathode-rays made by the Crookes tube are of course reflected by the mirror 14, and thus given a general direction of propagation, which follows the general direction of the axis of the barrel. These cathode-rays, like the actinic and the etheric waves, above described, apparently reinforce each other in their effects, and the result is that the telegraph is more effective when both are employed. The cathode-rays are emitted in continuous oscillation and are not controlled directly by the transmitting-key. The Hertzian waves alone are controlled by the key, and the cathode-rays merely facilitate the propagation of the Hertzian waves. When the sparking apparatus D is stopped, the telegraphic signals are not as distinct as when the said sparking apparatus is in action.

The device considered as a receiving apparatus will be described.

The Hertzian waves made by depressing the key at the sending-station produce effects in the crown-wires 17 19 and in the member 10, which serves as a capacity connected to the crown-wires or antennæ.

Incoming waves cause surgings in the wires 23 and 46, 38, 37, and 25′ to the coherer 50, thereby affecting its resistance. The result is that with the apparatus in the position as indicated in Fig. 1 at E, the battery 51 sends the current through 50, 60, 59, 57, 56, and through wire 58 back to the battery. The bell therefore rings when the coherer is excited and only at that time.

The bell having rung, the operator merely moves the switch 52 in order to receive the message. If he wishes to receive the message upon the Morse recorder, he moves the switch 52 downward so as to engage the contact 54 and also closes the switch 62. The current from the battery now passes through the Morse recorder and through the coherer back to battery. If, however, the operator desires to receive the message upon the phonetic receiver, he moves the switch 52 upward, engaging the contact 53. For receiving messages by means of modifications produced in a continuous sound in accordance with the intermittent impulses sent out by the transmitter the contact 58 should be pressed firmly against the armature 56, the switch 62 should be opened, and switch 52 placed on contact 53. The coherer being excited by the closing of the key at the distant station, the following circuit is established: 51, 50, 50′, 66, 65, 64, 63, 57, (through 52 from 53,) 58, to battery. The primary 64 being thus energized excited the secondary 79 and established a local secondary alternating current through the wires 80 and 81, Fig. 4, and the magnet 77. The magnet responds to the action of this current by causing the diaphragm 75 to vibrate violently. The vibrating diaphragm causes the column of air in the funnel-shaped member 73 to be alternately compressed and rarefied, thereby causing the diaphragm 68 to vibrate and to vary the resistance offered by the comminuted carbon. The length of the column of air should be such that the diaphragm 75 will cause the diaphragm 70 to vibrate in a predetermined space of time, the idea being to amplify the variations of the battery-current flowing through the comminuted carbon. This phonetic receiver acts to some extent as a relay. It is clear that the mechanical action of the vibrating column of air can be made to increase and decrease the resistance of the comminuted carbon, and if this be done at the proper moments of time the ultimate effect of the current passing through the comminuted carbon can be increased.

The vibration of the diaphragm 75, by causing the above-mentioned condensation and rarefaction of the column of air in the funnel-shaped member 73, causes the perforations 74 to emit a musical note, which I find to be somewhat similar to a flute-note. The general effect is about the same as if a person were sounding a Morse signal upon a flute, a short note representing a dot and a comparatively long note or variations in intensity of the note representing a dash. The connection of a relay is necessary for prolonged effects.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A wireless-telegraph system comprising means to generate two or more sets of waves of different lengths or different periods, means to direct said waves toward a distant station, and to modify those of one or more of the sets in accordance with a code, together with means at the distant station rendered sensitive by some of the waves to respond to changes or modifications in others, to thereby reproduce the signal.

2. In a wireless-telegraph system, a transmitting apparatus comprising a set of Hertz-wave antennæ, a source of cathodic waves, and a source of actinic waves, means whereby the changes of a prearranged code may be impressed on one or more of said sets of waves, and means for directing all the waves to a distant station.

3. In a wireless-telegraph system, a receiver comprising elements sensitive to etheric waves due to light projection and to electrical surgings or oscillatory discharges, means to combine the effects of said elements, and means to effect alinement with a transmitting-station.

Fig. 19. Patent 775 846. Page 6/7. Source: http://www.uspto.gov.

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Fig. 20. Patent 775 846. Page 7/7. Source: http://www.uspto.gov.