SYSTEM FOR THE RECEPTION & TRANSMISSION OF TELLURIC ELECTRIC WAVES

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Part One

I System for the Transmission and Reception of Telluric Electric Waves

(1) Basic System

(a) An electrical system is proportioned in such a manner so as to be attuned to electric wave propagation within the interior of the earth. The specific function may be the reception of naturally generated signals, or the transmission and reception of signals from an artificial, man made origin residing within the earth. These signals result from telluric currents. In general these may be called telluric electric waves.

(b) This system is unlike previous systems in that the electrical apparatus involved are configured to match the generative process and the propagation characteristics of the telluric electric waves within the earth's interior. This system is non electro-magnetic in its basic configuration. It is more an electro-static configuration. This results from the telluric waves having a non electro-magnetic character. The basic and compound telluric systems presented can be considered an advancement upon prior work of Nikola Tesla (1900) and Ernst Alexanderson (1919). In addition the systems presented can be considered improvements upon any existing methodologies or apparatus involving the reception of natural telluric impulses, communications or broadcasting systems utilizing electric wave propagation within the interior of the earth.

(c) The system presented herein consists of various sub-systems configured to perform the reception and transmission processes. This may be divided into three distinct categories:

> 1) That part which represents the space domain, or is distributed with respect to distance, so as to engender the actual electric wave. This is called the antenna sub-system;
>
> 2) That part which represents the time domain, or the time period and duration, so as to respond to the specific telluric wave forms to be produced. This is called the network sub-system;
>
> 3) That part which represents a scalar domain, effecting the attenuation and intensification of the electric waves in their passage through the other sub-systems. This is called the amplifier sub-system.

(d) The antenna sub-system of the basic system is in electrical communication with the interior of the earth through multiple points of contact with the solid mass of the earth. This sub-system is so configured as to be attuned to the complex propagation, directional characteristics, and phases of the telluric waves to be utilized in system operation. In conjunction with the ground contact an aerial structure, the purpose of which is to be isolated from ground, is utilized. This aerial exists in the form of a multiplicity of loaded transmission lines.

(e) The network sub-system of the basic system is such configured as to produce or re-produce specific telluric wave forms in their time base behavior. Telluric wave forms of undesirable form are rejected by the network sub-system, however, this sub-system responds sharply to those telluric wave forms of desirable form. These wave forms can be directed to detection, recording or transducing devices, or they can be directed to the antenna for transmission.

(f) The amplifier sub-system consists of electrical or electronic amplification elements, such as those found in carrier telephone applications. These elements may exist in conjunction with various filters or impulse limiters. These elements may be a conventional unit form or may be of a distributed nature throughout the basic system.

(g) Each individual telluric wave system is adapted to match the existing geological conditions at the specific geophysical location to which it is applied. In addition each system must be specifically adapted for the purposes of broadcasting, communications, natural signal reception or detection of specific geological events. Each unit will have its own special requirements.

(2) Characteristics of the Antenna or Aerial-Ground Sub-System

(a) Telluric signals result from various standing waves and traveling waves which propagate within the interior of the earth. These waves have characteristic velocities, counter-velocities and directions of propagation. The antenna sub-system is proportioned to these specific telluric wave characteristics.

(b) This antenna sub-system is developed on the basis of a <u>complex propagation in two dimensions</u>. This complex wave is a result of the superposition of a pair of electric waves, one wave with a <u>velocity</u> and another wave with a <u>counter-velocity</u>. This is a departure from conventional antenna developments. This antenna sub-system is loaded in such a manner so as to produce a <u>complex electric wave</u> along the transmission (aerial) structure of the antenna. This wave is attuned to that wave produced within the interior of the earth. Hereby the antenna sub-system communicates with the telluric wave through distributed points of contact with the solid mass of the earth. Each point of contact exists in relation with each individual loading element of the antenna transmission structure. Each point of contact can be a resistive element, a reactive element or a complex quantity of both.

(c) This <u>complex, distributed transmission structure</u> is an analog structure. The antenna sub-system serves as an analog computer with the function of establishing an analogy of the conditions that give rise to the electric waves propagating within the interior of the earth. The antenna sub-system hereby reproduces that part of the standing or traveling wave within the earth as coupled through the multiple points of contact with the solid mass of the earth. This condition represents wave refraction between the antenna sub-system and the propagation within the interior of the earth.

(d) The antenna sub-system utilized for telluric wave propagation is not an aerial as commonly understood, nor is the antenna sub-system an electro-magnetic radiator. The antenna sub-system consists of an aerial-ground structure in the application of telluric wave transmission and reception. It is configured to <u>reject electro-magnetic wave transmission and reception</u>. The aerial portion of the telluric antenna sub-system exists in distinction to the ground. This aerial structure operates in a manner such as a finite section of long distance carrier telephone line, carrying several loaded transmission pairs. These pairs are loaded and connected in such a way as to produce the required complex wave propagation in an analog manner. No coupling exists with this transmission structure and external electro-magnetic waves, which propagate in the space external to the solid mass of the earth. Hence the antenna sub-system is a non electro-magnetic structure incapable of the transmission and reception of external electro-magnetic waves.

(e) The antenna sub-system is a wave structure analogous to the wave structure of the interior of the earth. This wave is a <u>complex quantity in space</u>, one quantity in the dimension of velocity (the real part) and another quantity in the dimension of counter velocity (the image part). Hence the complex wave propagation is not a simple velocity, now it is a more complex dimensional arrangement. (This is analogous to impedance as a complex quantity consisting of resistance, the real part and of reactance, the image part.) Electro-magnetic waves of a given velocity are superimposed upon magneto-dielectric waves of a given counter velocity resulting in a complex electric wave. For the transmission and reception of telluric electric waves the complex electric waves on the antenna sub-system follow the complex electric waves inside the earth. These two complex waves unite through the refractive multiple points of contact with the solid mass of the earth.

(3) Characteristics of the Network Sub-System

(a) As it was with the antenna sub-system, the network sub-system serves as analog now to the time domain, the period and duration of the transient electric waves of telluric origin. Like the antenna sub-system, the network sub-system serves as a form of transmission structure. Complex, transient, electric waves result from the superposition of two distinct waves, which each have distinct dimensions, now in time instead of space. Unlike the antenna, the network consists of lumped elements with no distribution in space. The network resembles a special form of electric wave filter, it being for selecting transient impulses rather than steady state waves. The complex electric wave developed by the networks is the superposition of high pass upon low pass electric wave propagations, these developing two distinct dimensions, that of unit time and that of per unit time. The wave developed by the network sub-systems analogous to the wave structure of the transient waves of telluric form.

(b) The network can be developed as a pair of artificial transmission lines, a conjugate relation existing between each line. These artificial lines are configured as time domain analogs of the complex wave factors of the space domain antenna sub-system. The low pass characteristic is the analog of the electro-magnetic propagation of a given velocity. The high pass characteristic is the analog of the magneto-dielectric propagation of a given counter velocity. The low pass function is a condition of lagging phase, or increasing time delay with increasing frequency. A conjugate relationship exists for the high pass function. It is a condition of leading phase, or a decreasing time delay with increasing frequency. The superposition of this conjugate pair of functions results in the time-frequency relation for transient waves of telluric origin.

(c) This electrical network so developed can be proportioned to an analog of, and thus respond to, or produce, a specific transient electric wave of telluric form. This electrical network can hereby be made to respond to a specific telluric signal, such as may be related to advance seismic warning, communications purposes, etc. Or, the electrical network can be made up so as to respond to a general variety of signals in a broadband manner. That network responding to specific signals may be called a discriminator, and that responding to a general variety of signals a band pass filter.

(4) Characteristics of the Amplifier Sub-Structure in the Scalar Domain

(a) In the reception of telluric electric waves it is a condition that the received signals are of extremely small energy. Such signals are further attenuated in their passage along and through the antenna and network sub-systems. Also, in the transmission of telluric electric waves, substantial quantities of energy must be developed for the transmission. Therefore, some method must be introduced to intensify the telluric signals in their passage through the antenna and network sub-systems.

(b) The introduction of unit amplifiers at the transitions between sub-systems serves as a basic method of signal intensification. These unit amplifiers may be electronic units utilizing vacuum or solid state devices. These electronic devices (vacuum tube or transistor) must be of a large gain-bandwidth product and possess a very small degree of intermodulation production.

(c) Utilizing unit electronic amplifiers limits the telluric wave system through their uni-directional nature. That is, a receive only or a transmit only system. Hybrid transmission structures must be utilized for bi-directional or transponding systems. The use of unit electronic amplifiers produces a gain or drift in amplitude in the telluric wave system. Unit electronic amplification also produces undesirable modulation products from higher level signals upon lower level signals. Hereby distortion results and the consequent production of false signals.The principal advantage of unit electronic amplification is its adaptability to the inclusion of pass band and amplitude limiting functions and its simplicity.

(d) An alternative method of amplification can be derived along the same method as the analog layout of the antenna and network sub-systems. The propagation through these sub-systems is derived by the geometric configuration of reactances and suceptances, that is positive and negative energy storage elements. These elements may be of a lumped or a distributed form, or both. Intensification of the telluric electric waves can be derived in an analogous manner to the propagation of the telluric electric waves. The intensification through the sub-systems is derived by the geometric configuration of resistances and conductances, that is positive and negative energy intensification elements. Again, these elements may be of a lumped or a distributed form, or both. Where the discrete reactance and suceptance elements relate to the storage and return of electric energy, the discrete resistance and conductance elements relate to the attenuation and intensification of electric energy.

(e) The signal intensification element of negative resistance can be developed by a transfer resistance or transistor. Conversely, the element of negative conductance can be developed by a transfer conductance or vacuum tube. In the former the transfer resistance gains over the conductance loss and in the latter the transfer conductance gains over the resistance loss. Both may be utilized in an analog relation to the loss or gain of the electric wave generation or propagation within the interior of the earth.

(f) The resistance and conductance elements of energy attenuation and intensification can be directly produced from the reactance and suceptance elements through parametric variation of the energy storage coefficients, that is the variation of the reactance or suseptance with respect to time. In this manner the energy storage element is partially converted into an energy intensification element. The variation is in proportion to a second wave derived from a second network. Such methods are known as a parametric amplification. Similar intensification effects may be achieved directly through the application of negative resistance devices such as tunnel diodes or negative conductance devices, such as multipactor vacuum tubes. These as two terminal devices can be directly incorporated into the antenna and network geometry.

(g) Hereby three distinct methods may be applied to the intensification of received or transmitted electric waves in their passage through the antenna and network sub-systems:

1) Unit electronic amplification utilizing vacuum or solid state devices as transfer elements.

2) Distributed electronic amplification vacuum or solid state devices as either transfer or negative elements.

3) Parametric amplification utilizing electronic, static electrical or rotating electrical devices.

These methods of amplification may be applied individually or in combinations depending upon the overall system requirements.

II Telluric Transmission and Reception System Configurations

(1) Rejection of Interference

(a) The antenna-network system, along with a distribution of signal intensification elements represents an analog of the telluric electric waves, that is the complete system functions as an analog computing structure. This system allows the production or reproduction of the telluric electric waves within the earth as the result of the system functioning as an <u>analog equivalent</u> to the telluric waves.

(b) In addition to this analog attunement of the gerneral system to the desired electric wave forms the system must also reject unwanted electric waves produced outside the solid mass of the earth. Undesired signals are produced or propagate in the atmosphere of the earth, such as lightning discharges, solar noise and manmade interferences. Because of refraction through the surface of the earth, both exterior and interior signals combine to a certain extent, resulting in interference.

(c) Rejection of these unwanted components of the electric wave propagation within the interior of the earth can be established through the use of a separate reference aerial structure, that is a rejection aerial. The inherent band pass characteristics of the antenna and network sub-systems can be also applied to the rejection of unwanted signals and interference. Rejection filter structures can be incorporated into the unit amplifier sub-systems for the elimination of manmade signals that give rise to interference effects in the telluric wave system.

(d) The rejection aerial constitutes a sub-system of a general system of telluric wave transmission or reception. The rejection aerial sub-system represents an electro-magnetic structure operating in the dimension of velocity. The function of this rejection aerial is to establish an electro-magnetic field of induction in the free space surrounding the general telluric system. Hereby the rejection aerial engenders the interference of non telluric origin.

(e) This rejection aerial sub-system is compounded with the aerial structure of the antenna sub-system as a form of counterpoise. Physically the rejection aerial is located over the aerial structure of the antenna in the manner of an overhead ground plane. The rejection aerial serves as a reference plane in the compound aerial-ground structure. As with the telluric aerial structure the rejection aerial consists of multiple, loaded transmission pairs. This loading is so proportioned to propagate electric waves at exactly the velocity of light in the same space as the compounded aerial structure. Here the velocity of light has a unit value and is considered a relative condition of rest with regard to the telluric aerial structure. The transmission pairs are configured in such a manner that the rejection aerial establishes an external electro-magnetic field of induction, this in contradistinction with the configuration of the telluric aerial, which rejects an external electro-magnetic field of induction. The rejection aerial is proportioned as an analog structure analogous to the propagation of electro-magnetic waves in the dimension of velocity, this numerically equivalent to the velocity of light.

(f) In conjunction with the rejection aerial sub-system is a rejection network sub-system, together forming a basic system for the rejection of electro-magnetic interference. This basic rejection system is analogous to the basic reception system in a conjugate form. Both serve as analogs of a given electric wave condition and serve as contrary analogs of each other. The resultant condition is the subtraction of the electro-magnetic interference from the telluric electric waves. The rejection network sub-system and the telluric network sub-system are compounded together to produce a subtractive process. This compounding is analogous to the compounding of the rejection aerial sub-system with the aerial-ground or antenna sub-system.

(2) Directional Characteristics of the Antenna Sub-System

(a) The telluric wave antenna sub-system and rejection aerial sub-system respond to or emit electric waves in a directional manner. The reception of or transmission of electric waves can be directed to or from specific geographical directions, while rejecting electric waves from all other directions. In general, the telluric antenna sub-system is directional broadside to the axis of the aerial structure while the rejection aerial sub-system is directional endfire to the axis of the aerial structure. However, these axes of propagation can be altered by adjustment of the aerial loading constants. The two aerial structures propagate in a perpendicular manner with respect to each other since their propagation factors are conjugate analogs.

(b) In telluric wave systems set up for transmission or reception, to or from a specific direction, a quadrature pair of aerial-ground sub-systems is utilized. Two systems exist in a perpendicular crossing over a central feed point. This configuration allows for the direction of operation to be determined by the relative phase difference between each system's network sub-systems. Hereby the compound aerial-ground structure consisting of quadrature basic systems can be directed by the network sub-systems. The network sub-systems of the pair of basic systems can be compounded with each other into a compound or common network sub-system. The directivity of this compound or complex aerial-ground system hereby is derived from an analog function residing in the common network sub-system.

(c) For telluric wave systems configured for the transmission or reception of electric waves to or from a specific geographical location the quadrature compound systems are established in quadrature groups of four[1] in a space quadrature configuration. Hereby four distinct quadrature compound systems exist in a geographical square of extent exceeding the wavelength of the telluric electric waves involved. The specific geographical location is resolved within the relative phase difference existing between the network sub-systems of each individual quadrature compound system. These multiple network sub-systems can be united into a master network sub-system. The geographical location of this master system is hereby derived from an analog function residing in the master network sub-system.This master system can be adapted to the determination of the location of specific geographical events that produce telluric electric waves. The master network sub-system serves as a resolver for the indication or display of a specific wave originating at a specific geographical location. Such application is Advanced Seismic Warning Systems. Plan position devices (P.P.I.) are incorporated into the master network structure.

(d) Each sub-system of the general, complex system for the transmission and reception of telluric electric waves serves as an analog function. Each sub-system serves as a direct or conjugate analog of each other sub-system. Each system serves as a direct or conjugate analog of each other system. The master system serves as a specific or general analog of telluric electric waves. The master system thus may serve as an archetype of telluric waves.

(3) Telluric Wave Systems for Specific Applications

(a) The principal application of the system for the transmission and reception of telluric electric waves is the development of Advance Seismic Warning, A.S.W. Telluric wave systems also may be developed for the broadcast of telluric electric waves to multiple reception locations or may be developed to communicate or transpond, with complimentary systems at specific geographical locations. Any waveform can be developed by a telluric wave system consistent with the archetype of telluric electric waves. This is limited only by the maximum degree of response possible with the physical structures that form the telluric wave systems.

(b) Advance Seismic Warning is one special condition of the general archetype. In this application of telluric wave reception an array of reception points are positioned around the specific geographic area producing electric waves relating to seismic activities. The electric waves produced in an advance time interval relating to a seismic event are of a specific, distinct waveform. This distinct waveform can be detected, apart from the general variety of telluric signal produced within the interior of the earth. This discrimination of seismic signals from the general activity is effected by the network sub-systems of the compound, complex systems described. In this application the network serves as a discriminator isolating the particular waveforms and directing these to the recording, indicating or transducing devices.

(c) The above system applied to Advance Seismic Warning is described in part by (2) (c). Multiple

1 groups of three in Scott configuration

systems of reception are configured to pinpoint the specific location of an impending seismic event. For the applications of communication or general reception a configuration of sub-systems, basic systems, compound systems or compound complex systems can be developed.

III General Theory of Telluric Electric Wave Transmission and Reception

(1) Introduction

(a) The reception and transmission of telluric electric waves employs methods and principles unlike those found in conventional electro-magnetic wave systems. Electric wave propagation within the interior of the earth is of a character much different than that propagation in the space exterior to the solid mass of the earth. The space within the mass of the earth is complicated by various degrees of magnetic permeability, dielectric permittivity, conductivity and resistivity, all these of various magnitudes for various directions. Further is the presence of significant static magnetic and static dielectric fields of induction.

(b) With conventional electro-magnetic structures the principles of wave reception are equivalent to the principles of wave transmission, this is known as the law of reciprocity. In part this law can be applied to the various sub-systems that form the telluric wave systems. However, certain antenna configurations depart from the reciprocity law in that the propagation factor for reception must lag in phase behind the electric wave to be received, where as the propagation factor for transmission must lead in phase ahead of the electric wave to be transmitted. This situation is analogous to the alternating current induction machine. For a given frequency in radians per sec. of electric excitation to the field of the induction machine the frequency in radians per second of rotation must fall behind the excitation frequency for the induction machine to receive energy as a motor. Conversely the frequency of rotation must push ahead of the excitation frequency for the induction machine to transmit energy as a generator. In this situation the angular frequency of excitation is of unit value or represents a relative condition of rest. The angular frequency of rotation has a relative negative or positive value, for positive or negative power flow respectively. For the antenna the situation is the same. The lagging velocity for receive and the leading velocity for transmit, this relative to the velocity of the electric wave in the medium of transmission or reception.

(c) An important condition for the transmission and reception of telluric electric waves is a single wire or uni-polar connection to the solid mass of the earth. Electro-magnetic transmission and reception requires a multi-polar or multiple wire connection, two wire being common. It is required for telluric wave operation that the antenna sub-system be self referencing, that is the antenna sub-system not grounding in the usual sense, since ground is now an active terminal. There can be no second wire since there is nothing to connect it to. Hence, the need for a single wire or uni-polar antenna characteristic.

(d) In the transmission and reception of telluric electric waves two departures exist with regard to the transmission and reception of electro-magnetic waves:

> 1) The law of reciprocity is not applicable to the transfer of energy between the telluric wave and the antenna sub-system.
>
> 2) The boundary condition or circuit law is not applicable to the connection of the antenna to the solid mass of the earth.

(e) Such electrical conditions, once common in early wireless development, have become largely unknown. Two principal systems emerged from this era having the proper characteristics for telluric electric wave applications:

1) The oscillation transformer as developed by Nikola Tesla, 1900

2) The multiple loaded aerial as developed by Ernst Alexanderson, 1919

(2) The Oscillation Transformer

(a) The first development in the wireless transmission of electric waves was a telluric system based upon the application of an antenna sub-system known as the oscillation transformer. This transformer is a single winding coupled magnetically to an external resonant structure. Transformer operation resembles a constant current or ballast transformer. The single winding of the oscillation transformer resembles that of a simple reactance coil, however, only a single lead exists for communicating energy in and out of this coil structure. It is a single wire, uni-polar connection. The second lead of the coil is only connected to a small free space electro-static condenser.

(b) In the operation of the oscillation transformer the winding is not a simple reactance coil and magnetic field of induction. The dielectric field of induction now plays an important role, as energy now resides in the dielectric field in addition to energy residing in the magnetic field. In oscillation transformer operation the total energy divides evenly between the magnetic field and dielectric field of induction. The superposition of these two fields of induction give rise to complex electric waves. The oscillation transformer winding, thus operates as a wave guide structure, giving rise to electric waves through the exchange of magnetic and dielectric energy.

(c) Complex electric waves exist on the oscillation transformer winding during its resonant exchange of energy between the two fields. These standing waves produce a phase displacement in <u>time</u> cycle of energy exchange and in <u>length</u> along the winding structure. The displacements exist as a hysteresis cycle, displacing the cause-effect relationship. This results in the transformer winding operating as a uni-polar system.

(d) The resonant structure coupled to the oscillation transformer winding is a simple magnetic reactance coil in a resonant relation with a simple electrostatic condenser. This circuit is proportioned to have minimal dissipative losses, that is it has a large magnification factor. This circuit provides the two wire connection for the supply or abstraction of energy to or from the oscillation transformer winding and its uni-polar connection to the earth.

(e) In conjunction with the coupled resonant circuit the oscillation transformer winding serves as a phase transformer. This phase transformation provides the basis conversion from a multi-phase to a uni-phase connection. This phase transformation provides the basis conversion from a multi-phase to a uni-phase connection. This provides the single wire connection for the telluric electrical waves, transforming this to the multiple wire connection to a network sub-system.

(f) The complex electric wave produced by the resonant electric fields of the oscillation transformer winding is analogous to those electric waves, which exist within the interior of the earth. This complex electric wave in the winding is the resultant of the superposition of transverse electric waves of a specific velocity and of longitudinal waves of a specific counter-velocity. This pair of electric waves propagate within the electric field of the winding. This winding can be proportioned to be attuned to the complex electric wave propagation within the interior of the earth. The winding becomes an analog of the specific telluric waves to be transmitted or received.

(g) The transient impulses produced by the oscillation transformer are of analogous form to the transient impulses resulting from telluric wave propagation within the earth. In this manner the oscillation transformer responds as does the network sub-system previously described. The high and low pass functions are a direct result of transformer actions. Hereby the oscillation transformer serves as the network sub-system in addition to serving as the antenna sub-system. Thus the oscillation transformer in itself serves as a system for the transmission and reception of telluric electric waves.

(h) The principal drawback in the application of the oscillation transformer to telluric waves is the inability to respond to a wide range of signal frequencies. Also is the lack of directivity in the spatial distribution of its response. Thus in the application of the oscillation transformer to telluric waves it can be proportioned to respond only to telluric waves of a single frequency and its related harmonic structure, that is to one specific transient electric wave form. Transformer response is to telluric waves from all directions, it having no directional character. This limits the use of the oscillation transformer to specific communication or broadcast functions and thus prohibits its use for broadband or generalized transmission or reception functions.

(3) The Multiple Loaded Aerial

(a) Following the development of the oscillation transformer was its application to the system of wireless trammission developed by Guglielmo Marconi (1910). During its development by Nikola Tesla the wave guide and uni-polar properties of the oscillation transformer were not fully understood. Tesla repeatedly attempted to force the winding to operate as a simple magnetic reactance coil. The importance of the dielectric field of the winding and its complex relation to the magnetic field were to be missed by Tesla and his contemporaries. This situation would be further compounded by the efforts of Marconi.

(b) The application of the oscillation transformer to the transmission and reception of telluric waves was under patent protection by Nikola Tesla. For Marconi to proceed with his wireless development, significant alterations had to be made. In the telluric wave system of Nikola Tesla the oscillation transformer alone served as the basic system for the transmission or reception of electric waves. Marconi would make important changes to the Tesla system in order to secure a wireless patent of his own. The basic modification was the extreme enlargement of the electro-static capacity of the free terminal of the oscillation transformer winding. An aerial-ground structure known as the Marconi "Flat Top", of considerable extent, was connected as a basic condenser to the oscillation transformer winding. The electro-static capacity of this aerial-ground structure greatly exceeded that of the oscillation transformer winding. Hereby the function of the oscillation transformer was reduced to that of a basic magnetic reactance coil. Now unable to resonate with the winding dielectric field, the winding lost the ability to operate as a phase transformer. It now operates as a di-polar or two wire system.

(c) The aerial portion of the Marconi Flat Top was positioned over a similar structure in the ground. The length of this aerial-ground system several times larger than the width, this forming a large strip-line transmission structure. Thus the aerial-ground structure is a electrically short section of electro-magnetic transmission line. Within the electro-magnetic field of this section of line, a very large reactive power flow exists, this in an oscillitory energy exchange with the transformer. The coil and aerial-ground structure reduce to a basic resonant circuit. The power flow in this circuit contributes little to the ability of the Flat Top to transmit or receive electric waves. The Flat Top derives its ability to transmit or receive principally from it external dielectric field of induction. The lag of phase along the length of the Flat Top produces a small portion of external electro-magnetic activity and resulting waves. Hence, the Marconi Flat Top aerial-ground system is an ineffective structure for both electromagnetic and telluric electric waves.

(d) The large reactive power flow within the confined portion of the Flat Top represents a useless or parasitic power flow. Its loading upon the oscillation transformer renders the winding a reactance coil. Therefore, the confined electro-magnetic field of induction inhibits the operation of this aerial-ground system in the transmission or reception of telluric electric waves.

(e) While Marconi resorted to simple terminal impedance methods to minimize the effects of this reactive power flow, the basic situation remained unchanged. Ernst Alexanderson, while employed by the General Electric Company and the U.S. Navy (1919), developed a significant advancement in the Flat Top system. This development became the Alexanderson multiple loaded aerial. This aerial-ground system finds important applications to the transmission and reception of telluric electric waves.

(f) The Alexanderson system is a direct adaption of the Marconi Flat Top. The basic external geometry is unchanged. However, the aerial and the ground elements of the strip-line configuration are sectionalized into a series of sub-section elements. Loading elements are inserted in the transitions between sub-section elements. The Alexanderson principle utilized this sequential loading to cancel or neutralize the reactive electro-magnetic power flow of the Flat Top system. The result is the aerial-ground system becomes a non electro-magnetic structure, with the dimensions of velocity and wavelength becoming undefined.

(g) The Alexanderson system is no longer the simple strip-line of Marconi, but has become a complex system of alternate, sequential sections of transmission and loading structures. This configuration is analogous to a loaded long distance telephone line. The Alexanderson system has rendered the strip-line of Marconi a wave-guide type structure. The superposition of the magnetic field and the dielectric field in this wave-guide give rise to complex electric waves as with the oscillation transformer of Tesla. Hereby the Alexanderson system enables telluric wave transmission and reception.

(h) The basic oscillation transformer winding exists in multiple with the Alexanderson system, each being connected at each of the sequential loading sections. These windings now operate unhampered by reactive power flow. Operation of these phase transformer windings in multiple allows for directional operation, unlike a single unit. In addition, in conjunction with the loading elements, the windings in multiple allows for a band pass characteristic to be established. Hereby the Alexanderson multiple loaded aerial-ground system overcomes the principal limitations of the oscillation transformer system of Tesla, the lack of directivity and bandwidth.

(4) Development of the Alexanderson System for the Propagation of Telluric Waves

(a) The basic Alexanderson system can be developed further for adaption to the propagation of telluric waves. Alexanderson would follow the path that Marconi followed from the Tesla system. The Alexanderson system was operated as a di-polar configuration for the propagation of electro-magnetic waves. This led to the extinction of the Alexanderson system as well as the systems from which it developed. Advancing the Alexanderson concept one step ahead, while retaining the original uni-polar concept of Tesla, results in an aerial-ground sub-system of perfect adaptability to the transmission and reception of telluric waves.

(b) In the layout of the Alexanderson system upon that of Marconi, the earthed portion of this system basically remained unchanged. This portion continued to operate as a single grounded conductor under the aerial portion of the system. No significant phase or potential differences exist along the continuous earthed portion of the Alexanderson system. Therefore, no electric waves can exist along this length of grounded conductor. This earthed portion of the aerial-ground system acts as a single ground electrode and can propagate telluric waves only in the manner of a single point source, as with the Tesla system. During the period of history during which the Alexanderson system existed, it was considered as a system for the propagation of electro-magnetic waves. This related to the vertical conductors rising from the grounded loading sections to the aerial structure above. The electric current related to this conductor gives rise to the propagation of electro-magnetic waves. However, the energy of these waves exists as a small portion of the total electric wave propagation of the Alexanderson aerial-ground system. Alexanderson as well as Marconi engineers understood that the Flat Top aerial and its adaptation by Alexanderson operated as an antenna for the propagation of electro-static, rather than electro-magnetic waves. Therefore, the Alexanderson aerial operates as a system for the transmission and reception of dielectric waves through its external dielectric field. Part of this dielectric field of induction is directed by the earthed ground structure into the interior of the earth. This induction gives rise to the propagation of telluric waves in a manner similar to that of Tesla.

(c) The Alexanderson aerial-ground system is an advancement upon the Marconi system. The Marconi system is an adaptation of the Tesla oscillation transformer system. The antenna sub-system of the basic system for the propagation of telluric waves represents an advancement upon the system of Tesla, this lacking directivity and bandwidth and represents an advancement upon the system of Marconi/Alexanderson, which primarily propagated waves exterior to the mass of the earth. The advancement upon the Alexanderson system is the elimination of the external propagation of electric waves. Advancement centers upon the earthed portion of the aerial-ground system. Unlike the Alexanderson configuration loading is divided in a balanced fashion between both the aerial and earthed portions of the system. Hereby complex electric waves within the interior of the earth can be developed. The elements of the earthed portion of this system operate each independent of the other with no inter-connection. Each element consists of a vertical section projecting within the mass of the earth. The earthed portion of the aerial-ground structure exists as a sequential row of vertical earthed elements along the aerial axis. No longer is the earthed portion of the layout in the Flat Top configuration.

(d) The aerial portion of the aerial-ground structure serves as a loaded section of transmission line, providing energy exchange to the individual loading sections and related earthed elements. This aerial configuration remains as with Alexanderson systems. However, the undivided ground portion of Marconi/Alexanderson design now exists as an aerial counterpoise above the loaded aerial portion of the antenna-ground system. Hence, the Flat Top has become inverted, with the ground portion above the aerial portion of the system. The upper Flat Top configuration serves to neutralize the electric wave propagation in the space external to the mass of the earth. This neutralizing aerial confines the electric wave propagation of the antenna sub-system to the interior of the earth. The actual Alexanderson aerial is reduced to a loaded transmission line, unbalanced with respect to an elevated ground plane. No external electric wave propagation exists.

(e) A loaded transmission system is an analog system. Loading in its general form is a sequential series of alternate sections of real transmission line and of artificial transmission line. The artificial lines are analog equivalents of real propagation. Hereby the propagation on the aerial can be chosen at will through the interaction of real propagation with artificial (imaginary) propagation. The entire aerial becomes an analog network of real and imaginary parts, analogous to a complex wave propagation within the earth.

(f) Development of the telluric wave antenna centers upon the control of the phase relation or lead-lag time element, along the row of vertical earthed elements. The reflection at the surface of the earth of standing and traveling telluric waves within produce specific images of phase displacement upon the surface of the earth. That is, the telluric waves develop specific points at the surface boundary. An analog of these waves is reproduced by the aerial portion of the antenna and connected with the earthed portion to facilitate the exchange of energy with the real wave through its projection upon the surface of the earth. The phase displacements of the individual earthed elements are now in mutual relation with the displacements of the telluric wave. The described antenna sub-system is attuned to the wave propagation within the interior of the earth.

(5) General Theory of Complex Electric Waves

(a) Any electric wave is the product of the superposition of a magnetic field of induction and a dielectric field of induction. The pair of fields each represent the storage of electric energy within the structure of the field, magnetic or dielectric. Electric waves result from the exchange of electric energy between dielectric and magnetic fields of induction.The displacements of these inductions with respect of phase and distance determines the character of the resultant electric wave. Complex displacements give rise to complex electric waves.

(b) In common use are those electric waves that propagate along the axis of a system of two or more electric conductors. In this form of electric wave the magnetic and dielectric fields are both perpendicular to the axis of the system of electric conductors. The magnetic and dielectric fields are perpendicular to each other. Hence, the magnetic and dielectric fields of induction travel broadside or transverse to the propagation of the resultant electric wave along the electric conductors. The proportion of magnetic induction with respect to the portion of dielectric induction within an electric wave of this form is a numerical constant. This constant is numerically equivalent to the velocity of light in the space between the electric conductors. Also, it is a transverse electric wave, which propagates as a velocity, this velocity equivalent to the velocity of light in the space between the electric conductors. This common form of electric wave is called a transverse electro-magnetic wave (T.E.M.). The magnetic and dielectric fields are transverse to wave propagation.

(c) A complimentary electric wave exists in quadrature with the transverse electro-magnetic wave. Where the transverse wave propagates along the axis of the electric conductors, the quadrature wave propagates perpendicular to the axis of electric conductors. This conjugate electric wave is in space quadrature with the T.E.M. wave in any system of two or more electric conductors. As with the T.E.M. wave, this quadrature wave is the product of the superposition of the magnetic and dielectric fields of induction. With the quadrature electric wave the pair of fields of induction are co-liner or longitudinal to the direction of electric wave propagation. Hence, the magnetic field, dielectric field and electric wave propagation are all in space quadrature with the axis of the system of electric conductors. This quadrature electric wave is called the longitudinal magnetic-dielectric wave (L.M.D.). The proportion of magnetic induction to the proportion of dielectric induction is not numerically equivalent to the velocity of light, nor is the dimension of propagation a velocity. That is, the longitudinal electric wave is not of the dimensions of unit length per unit time, as was the transverse electric wave. With the longitudinal electric wave the dimension of propagation is that of per unit length per unit time (per unit length-time). This propagation may be called a counter-velocity, representing propagation of electric waves through counter-space of per unit length.

(d) In the general case of telluric electric waves, the transverse wave propagates from a point of origin to distant location through space of unit length over a period of unit time. The longitudinal wave propagates within the magnetic and dielectric fields themselves, within the point of origin, through a counterspace of per unit length over a period of per unit time. These two distinct forms of electric waves exist in a conjugate relation to each other. Hereby a complex electric wave propagates on a system of two or more electric conductors, with a real part, the T.E.M. wave and an image (imaginary) part, the L.M.D. wave. Their product is a complex quantity in the dimension of space. Thus the telluric electric wave is a complex electric wave consisting of a radiation component (T .E.M.) and a field of induction component (L.M.D.) in quadrature relation.

(6) Harmonic Structure of Transverse and Longitudinal Waveforms

(a) In the propagation of transverse electro-magnetic waves a progressive phase lag or delay results as the wave propagates outward from its origin, along the propagating structure. This results in an increasing phase shift or time lag for increasing frequency of energy exchange. For finite, resonant systems of electric conductors this phase lag is in unit integral multiples of quarter cycle delays. These delay factors result in harmonics of the cycle of energy exchange within the system of electric conductors. For example, Fo, 3Fo, 5Fo, etc. as this harmonic series progresses each harmonic becomes progressive diminished in amplitude. For example, Ao, l/3 Ao, l/5 Ao, etc.

(b) The harmonic series is contrary for the condition of longitudinal magneto-dielectric waves. In this case a progressive phase lead is produced as the wave propagates inward from its origin, within the propagating structure. This results in an increasing phase shift or time lag for decreasing frequency of energy exchange. For finite, resonate systems of electric conductors the phase shift is in unit differential divisions of quarter cycle advances. These advance factors result in the production of harmonics of the cycle of energy exchange. These harmonics exist as a series of divisions upon the fundamental frequency of energy exchange. For example, Fo, 1/3 Fo, 1/5 Fo, etc. As this harmonic series progresses the amplitude of each harmonic is progressively diminished as with the T.E.M. wave. For example, Ao, l/3 Ao, l/5 Ao, etc.

(c) The generalized, complex electric wave is the superposition of the time periods of T.E.M. propagation and its conjugate, the time periods of L.M.D. propagation. The resultant electric wave is a complex quantity in the domain of time as well as the domain of space. Where in the space domain it is unit length for T.E.M. and per unit length for L.M.D., it is in the time domain unit time for the T.E.M. and per unit time for the L.M.D. with respect to harmonic production. The complex electric wave is the product of a progressive harmonic series and of a degressive harmonic series. Hereby the wave structure can be proportioned to produce a variety of electrical transient impulses with respect to time as well as space.

Part Two

OUTLINE OF THE SYSTEM FOR THE TRANSMISSION AND RECEPTION OF TELLURIC ELECTRIC WAVES

(1) The Basic System

(a) A basic system for the propagation of electric waves within the interior of the earth (Telluric waves).

(b) A basic system specifically proportioned to the character of the propagation, growth and decay of telluric waves.

A basic system specifically proportioned to exhibit a complex electric wave relating to the propagation, growth and decay of telluric waves.

(c) A basic system consisting of specific sub-systems, the space domain sub-system, the time domain sub-system and the scalar sub-system.

A basic system consisting in part of an antenna sub-system, relating to the dimension of space.

A basic system consisting in part of a network sub-system, relating to the dimension of time.

A basic subsystem consisting in part of an amplifier sub-system, relating to a scalar quantity in the dimensions of time and space.

(d) An antenna sub-system, an aerial-ground structure.

An antenna sub-system having a spatial distribution of multiple points of contact with the physical mass of the earth.

An antenna sub-system so derived as to match the propagation, directional and phase, character of the telluric waves within the physical mass of the earth.

(e) A network sub-system, a lumped network of electric components.

A network sub-system having a input port and output port, each of a multiple conductor, multiple phase configuration.

A network sub-system, so derived as to match the frequency and time periods of the telluric waves within the physical mass of the earth.

(f) An amplifier sub-system, a distributed or lumped configuration of electrical or electronic components.

An amplifier sub-system within the antenna or network sub-system.

An amplifier sub-system to effect the attenuation or intensification of electric waves in their passage along or through the antenna or network sub-systems.

An amplifier sub-system so derived as to match the generative or dissipative character of the telluric waves within the physical mass of the earth.

(g) A basic system comprising an antenna, network and amplifier sub-system derived for the propagation of telluric waves relating to a specific geographical location or responding to a specific geological event.

A basic system as described configured to match the geo-physical character of the specific geographical location to which it is implemented.

(2) The Antenna Sub-System

(a) An antenna sub-system so configured as to match the propagation factors of the telluric waves within the interior of the earth.

(b) An antenna sub-system exhibiting a complex propagation in two distinct dimensions.

An antenna sub-system with two distinct propagations, one in the dimension of velocity and another in the dimension of counter-velocity.

An antenna sub-system in which two distinct propagations, velocity and counter-velocity result in a complex electric wave.

An antenna sub-system developing complex electric waves through a distribution of sequential contact points in electrical communication with the physical mass of the earth.

An antenna sub-system developing a complex electric wave upon a sequence of distributed points of contact, these contacts having conductive or suceptive or both, electrical relation to the physical mass of the earth.

(c) An antenna sub-system in the form of a distributed transmission structure derived as an analog computing system.

An antenna sub-system serving as an analog structure in analogy to the propagation of telluric waves within the interior of the earth.

(d) An antenna sub-system, which rejects the transmission or reception of electro-magnetic waves.

An antenna sub-system comprised of a multiple of, loaded transmission pairs, rejecting electro-magnetic waves and accepting telluric waves.

An antenna sub-system with an earthed, distributed array of complex mutual admittances as a refractive boundary between the complex electric wave propagation of the antenna and the complex electric wave propagation within the interior of the earth.

(3) The Network Sub-System

(a) A network sub-system so configured as to match the frequencies, durations and time periods in general, relating to the telluric transient waves within the interior of the earth.

(b) A network sub-system exhibiting a complex transfer function, this the product of propagation in two distinct dimensions.

A network sub-system, the product of two distinct transfer functions, one in the dimension of unit time and another in the dimension of per unit time, representing a low pass function and high pass function respectively.

A network sub-system producing a resultant electrical transient waveform by the superposition of a pair of electrical waveforms, each with a distinct dimension.

A network sub-system producing an electrical transient waveform from the superposition of a low pass function and a high pass function.

(c) A network sub-system formed by the superposition of a pair of artificial transmission lines, each artificial line serving as an analog to the velocity or counter-velocity, propagation of the antenna sub-system.

A network sub-system formed by the superposition of a pair of artificial transmission lines serving as analogs of the velocity and counter-velocity propagation of electric waves within the interior of the earth.

A network sub-system configured as a transient electric wave filter rather than a conventional steady-state electric wave filter.

A network sub-system acting as an analog to a specific telluric transient waveform with the exclusion of all other telluric transient waveforms.

(4) The Amplifier Sub-System

(a) An amplifier sub-system so configured as to match the scalar magnitudes of the growth and decay of the telluric waves within the earth.

(b) An amplifier sub-system formed by the superposition of positive and negative resistance and conductance elements the growth and decay of electric energy along or through the antenna and network sub-systems.

An amplifier sub-system giving a specific intensification of the magnitude of electric waves through the superposition of a pair of factors representing the growth or decay of electric energy.

(c) An amplifier sub-system consisting of lumped electrical constants, a part of which exhibit synchronous parameter variations, thus converting a part of the energy storage constants into energy intensification constants.

An amplifier sub-system in which the growth and decay of electric waves is derived from parametric gain or loss produced by lumped electrical constants.

(d) An amplifier sub-system existing through negative and positive resistance and conductance elements within the loading sub-sections of the antenna sub-system.

An amplifier sub-system existing through negative and positive resistance and conductance elements within the lumped structure of the network sub-system.

An amplifier sub-system existing as unit gain structures or repeaters and unit loss structures or attenuators at the transitions between the various sub-systems that make up the basic telluric wave system.

(e) An amplifier sub-system of a distributed loading, lumped constants or of unit form serving as artificial transmission lines analogous to the gain or loss in propagation for velocity and counter-velocity waves along their travel through space and counter-space.

An amplifier sub-system, of any form described, consisting of the superposition of artificial propagation gain and loss serving as an analog of the propagation gain and loss of the telluric waves within the interior of the earth.

(5) Basic System for the Rejection of Non Telluric Signals

(a) A basic system for the rejection of electro-magnetic waves external to the physical mass of the earth.

(b) A basic system, a rejection system, specifically proportioned to the propagation of waves of a non telluric form.

A rejection system proportioned to exhibit electro-magnetic wave propagation.

(c) A basic system, a rejection system, comprising an aerial sub-system, a network sub-system and an amplifier sub-system representing the space, time and scalar dimensions respectively.

An aerial sub-system, an electro-magnetic antenna.

An aerial sub-system so derived as to match the propagation, directional and phase characteristics of the electro-magnetic interference external to the physical mass of the earth.

(d) A network sub-system, a lumped network with an input port and an output port, each of a multiple conductor and phase configuration.

A network sub-system so derived as to match the frequency and time periods of the electro-magnetic interference in the space external to the physical mass of the earth.

(e) An amplifier sub-system, a distributed or lumped configuration of electrical or electronic components.

An amplifier sub-system within the aerial or network sub-systems.

An amplifier sub-system to effect the attenuation or intensification of the electro-magnetic interference in its passage along or through the aerial or network sub-systems.

An amplifier sub-system so derived as to match the generative or dissipative character of the electro-magnetic interference external to the physical mass of the earth.

(6) The Aerial Sub-System

(a) An aerial sub-system exhibiting a complex propagation in two distinct dimensions.

An aerial sub-system having a pair of propagations, one in the dimension of velocity and another in the dimension of counter-velocity.

An aerial sub-system in which two distinct propagations, velocity and counter-velocity, result in a simple electric wave dimensionally and numerically equivalent to the velocity of light in free space.

An aerial sub-system developing an electro-magnetic field in the space external to the basic system for propagation of telluric waves.

(b) An aerial sub-system in the form of a distributed transmission structure derived as an analog computing system.

An aerial sub-system serving as an analog structure in analogy to the propagation of electro-magnetic waves exterior to the physical mass of the earth.

(c) An aerial sub-system which rejects the transmission and reception of telluric waves.

An aerial sub-system comprised of a multiple of loaded transmission pairs, rejecting telluric waves and accepting electro-magnetic waves in the space extemal to the physical mass of the earth.

(7) Directional Antenna and Aerial Sub-System Configurations

(a) An antenna sub-system so derived to respond to or direct to telluric waves of a specific geographical direction, while excluding telluric waves from all other geographical directions.

(b) A complex antenna sub-system consisting of a space quadrature pair of basic antenna sub-systems.

A complex antenna sub-system of a controlled directional character to direct or respond to a specific variety of directions, while excluding all other directions in the propagation of telluric waves.

A complex antenna sub-system so derived as to determine the geographical direction of telluric waves.

(c) A compound antenna sub-system comprised of a multiple of directable complex antenna sub-systems, spaced at distances greater than the physical wavelength of the telluric waves.

A compound antenna sub-system comprised of a multiple of complex antenna sub-systems arranged in a spaced quadrature geographical configuration.

A compound antenna sub-system derived to respond to or direct telluric waves to or from a specific geographical location, while excluding telluric waves from all other geographical locations.

A compound antenna sub-system derived so as to determine the specific geographical origin of telluric waves.

(d) A compound antenna sub-system comprised of a multiple of analog antenna sub-systems.

A compound antenna sub-system derived as an analog system, comprised of analog sub-systems, serving as an analogy to the telluric wave propagation characteristic of the geophysical extent of the physical mass of the earth.

A compound antenna sub-system derived as an analog system, analogous to the interior of the earth, as a propagation medium for telluric electric waves.

(e) A complex network sub-system comprised of a pair of network sub-systems.

A complex network sub-system derived from the superposition of a conjugate pair of network sub-systems, superposed to establish a directional character to the related quadrature pair of antenna sub-systems.

(f) A complex network sub-system analogous to a complex antenna sub-system.

A complex network sub-system consisting of a quad of artificial transmission lines, each serving as an analog to the propagation factors of the complex antenna sub-system.

A complex network sub-system derived from the superposition of a pair of complex artificial transmission structures, each structure the superposition of a pair of analogs to propagation of the dimensions of velocity and counter velocity, respectively.

(g) A master network sub-system comprised of a quad of complex network sub-systems.

A master network sub-system derived from the superposition of multiple network sub-systems of a quad of directable basic systems.

A master network sub-system derived from the directional character of a superposed quad of directional complex systems.

A master network sub-system serving as an analog of the master directivity of a quad of complex systems.

A master network sub-system serving as an analog of a specific geographical location as determined by the master antenna sub-system.

(h) A master system, comprised of a master antenna sub-system, a master network sub-system and a master amplifier sub-system.