

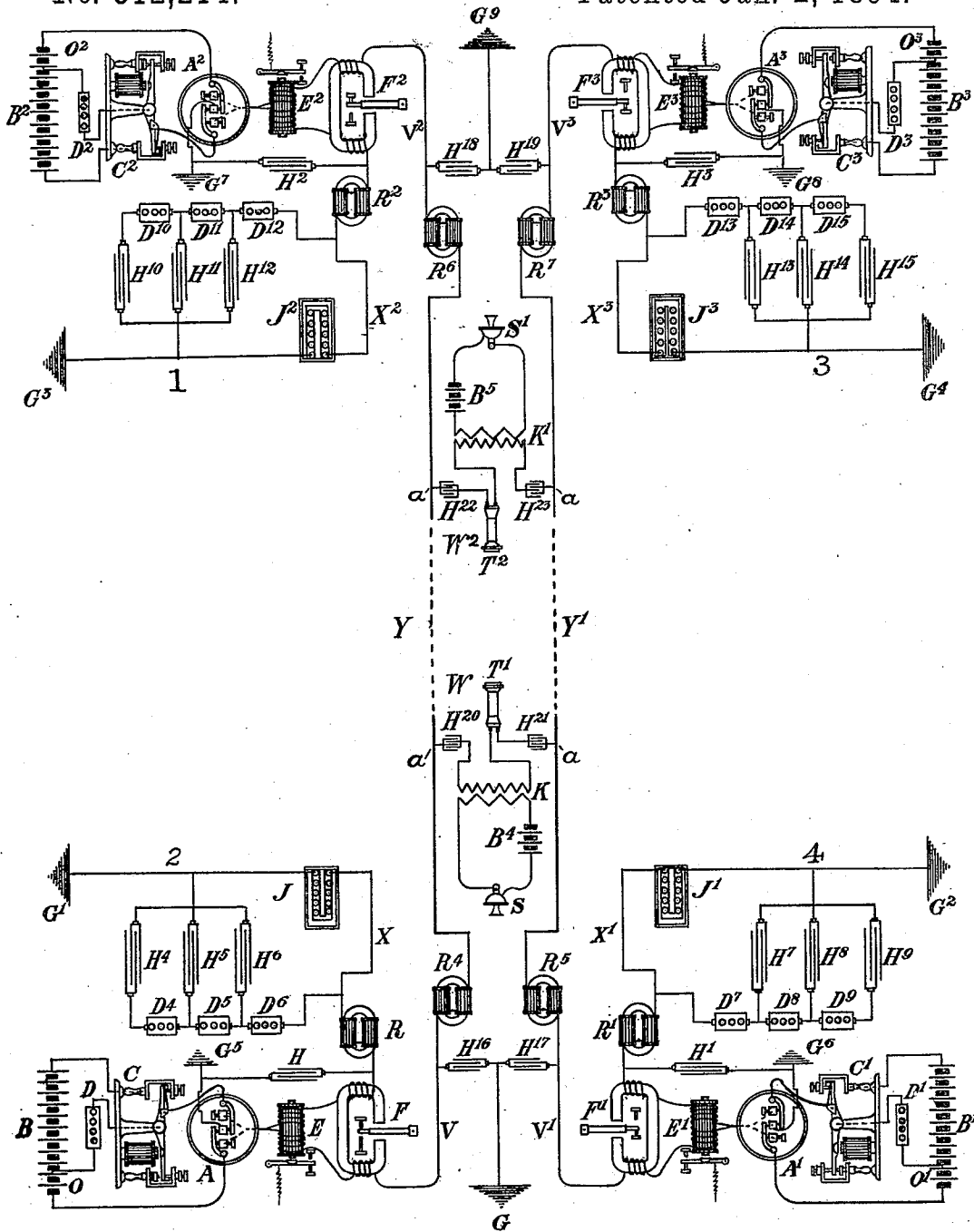
(No Model.)

F. A. PICKERNELL.

COMPOSITE TELEPHONIC AND MULTIPLE TELEGRAPHIC TRANSMISSION.

No. 512,214.

Patented Jan. 2, 1894.



WITNESSES:

Robert Lewis
Samuel H. Fisher

INVENTOR

Fraun A. Pickernell

BY

Jacob Manno
his ATTORNEYS.

UNITED STATES PATENT OFFICE.

FRANK A. PICKERNELL, OF NEWARK, NEW JERSEY.

COMPOSITE TELEPHONIC AND MULTIPLE-TELEGRAPHIC TRANSMISSION.

SPECIFICATION forming part of Letters Patent No. 512,214, dated January 2, 1894.

Application filed August 25, 1893. Serial No. 484,075. (No model.)

To all whom it may concern:

Be it known that I, FRANK A. PICKERNELL, residing at Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Composite Telephonic and Multiple-Telegraphic Transmission, of which the following is a specification.

This invention relates to an improvement in systems of composite telephonic and telegraphic transmission of intelligence, wherein two conductors serve together as the direct and return conductors of a telephonic circuit and severally as the main lines or conductors of two independent earth completed telegraphic circuits respectively. Such systems are well known in the art. Methods for duplexing and quadruplexing telegraphic circuits, so that two or four messages can simultaneously be transmitted over them are also well known, and have long been in commercial use.

In this specification I use the term "multiple telegraphs" as one which is sufficiently comprehensive to include both duplex and quadruplex methods.

In many of the most practical modes devised for the operation of multiple telegraphs, as defined above, an element technically entitled an "artificial line" is involved; the underlying principle of such modes being that the receiving instrument or instruments are so placed in relation to the main line and the artificial line, that with respect to outgoing currents the effect of the main line current is equal and opposite to the effect of the artificial line current upon the receiving instrument which thereby is rendered irresponsible to the transmission of its own station; while remaining fully responsive to the transmission of the distant station, which affects the main line portion only of the said receiving instrument.

The artificial line at each station in a manner well understood, contains a rheostat or like adjustable resistance of such magnitude as to balance the resistance of the main line; and is also provided with a condenser which similarly balances the electro-static capacity of the main line.

In organizing a system of composite transmission in the manner indicated above, the telephone apparatus is at the several stations

connected as a bridge between the two main conductors, a condenser being interposed in the said bridge on one or both sides of the said apparatus. A suitable electro-magnetic resistance, otherwise termed a retardation or choking coil, is interposed in the telegraphic extension of each main conductor at the terminal stations at a point between the junction of the telephone apparatus bridge, branch, or connection, and the telegraph apparatus. Such coils when properly made, (as is well known in the art), offer an extraordinarily high apparent resistance, or in other words a very considerable impedance, to the passage of vibratory or wave currents, such as those employed in the transmission of speech; and they are here employed to oppose the passage of the voice currents in the direction of the telegraphic apparatus; or in other words to prevent the voice currents from being short circuited between the neighboring earth terminals of the two main conductors; and also to so modify the Morse signals that they will not interfere with the telephonic transmission. A condenser for each main conductor is also supplied at each station and is connected in a branch conductor which extends to earth from a point between the said electro-magnetic resistance and the telegraphic apparatus. These condensers are so placed for the purpose of aiding the retardation coils in graduating the Morse signal currents, and in rounding them so that they will not adversely affect the telephonic transmission; and also to neutralize or absorb the static discharge from the lines.

It has heretofore been proposed and attempted to operate the two telegraphic circuits of a composite system by the multiple methods to which I have adverted; but their operation under such conditions has been unsatisfactory and inefficient; and this notwithstanding the fact that such operation in connection with simple circuits which are not organized for composite transmission is in every way perfect; the resistance and capacity of the real or main line or conductor being readily maintained in balance by the same magnitudes in the artificial line. Under these circumstances I have ascertained that the inefficiency and imperfect operation of the multiple telegraph portions of a composite sys-

tem are due to the fact that the balance existing under ordinary circumstances between the real and artificial lines is destroyed by the addition in the said composite system of the electro-magnetic resistance, and condenser, to which reference has been made and which are essential for the efficient working of the telephone circuit.

The objects of my invention are to recreate this balance and thus bring about an efficient operation of the multiple telegraphic circuit; to establish such a balance between the two multiple telegraphic circuits of which the two conductors of the telephonic circuit severally form part; to cause the operation of both to be uniformly efficient; and to achieve these results without detriment to the practical continuity and successful operation of the telephone circuit and apparatus.

To this end the invention consists in associating with the artificial line of a multiple telegraphic circuit an electro-magnetic resistance, impedance, choking coil, or retardation coil, and an auxiliary condenser, the retardation coil being interposed directly in the said artificial line, and the condenser in a branch therefrom to earth; also in combining a multiple telegraphic circuit constituting one member of a double wire telephonic circuit, and duly having an artificial balancing line, with retardation coils and condensers for the main and artificial lines respectively; the said appliances being so placed in the main line as to fit the same for its function in composite transmission; and in the artificial line, similarly placed, in order that those in the main line may be balanced.

It consists also in a system of composite multiple telegraphy and telephony in which a two wire telephonic circuit is formed from two independent earth completed multiple telegraphic circuits, the two latter being provided each with retardation coils and condensers, whereby the telegraphic and telephonic transmission is differentiated; and fitted also, each with auxiliary retardation coils and condensers associated with their respective artificial balancing lines, and bearing a like relation thereto and to the telegraphic apparatus, as is borne by the similar main line appliances to the said main line and said apparatus for the purpose of perfecting the balance of electrical forces in the telegraphic instruments which is essential to satisfactory operation.

The drawing which accompanies this specification is a diagram of a complete system of telephonic and multiple telegraphic transmission in which my invention is embodied.

In the drawing the terminal stations 1, 3 and 2, 4 are united by the parallel main line conductors Y, Y', which form a double line or metallic telephonic circuit with the telephonic apparatus W and W² bridged between them through the interposed condensers H²⁰ H²¹, and H²² H²³ at each end of the main line; and in association with the extension or earth

branches V, V' and V², V³ at each terminal, each conductor Y, Y' constitutes a separate telegraphic circuit, provided with an earth terminal at each end.

R⁴, R⁶ and R⁵, R⁷ represent electro-magnetic resistances or choking coils introduced into the telegraphic extensions V, V² and V', V³ of the respective conductors Y, Y' between the telephonic bridge junctions α , α' and the telegraphic apparatus, in a manner well understood to prevent the voice currents from being short circuited between the two telegraphic earth terminals G', G³ and G², G⁴ and also to round off the abruptness or sharpness of the Morse signal currents so that they may not interfere with the telephonic transmission.

The condensers H¹⁶, H¹⁷, H¹⁸ and H¹⁹ are branched to earth at G and G³ from the telegraphic extensions V of the conductors Y from a point between the electro magnetic resistances R⁴, R⁵, R⁶ R⁷ and the telegraphic apparatus to aid the said resistances in graduating the Morse currents and also to relieve the lines of the effects of their static charge.

As the circuits and apparatus shown at each station for the quadruplex transmission of Morse signals are the same and are not new, I will only describe the devices located at station 2, at one terminal of conductor Y. The conductor Y extends by extension wire V through the multiple telegraph apparatus which is of the usual kind and arrangement for transmitting two classes of Morse signals from each end of the line by the manipulation of telegraph keys and the transmission of electrical impulses over the line to actuate the telegraphic instruments by combining reversals of current and intermittences of current, working in such a manner as to cause one receiving instrument to respond to reversals of current only, irrespective of strength, while another instrument will respond to changes in the strength of current only, regardless of direction; and consists of the polar relay F, the neutral relay E with their respective transmitters A and C, battery B, and resistance coils D. The keys which constitute the actual manipulators and which actuate the transmitters by means of local circuits are not shown and the transmitters are represented by conventional symbols. The artificial line X contains one half of the convolutions of both relays and includes the adjustable rheostat J, the resistance coils D⁴, D⁵, D⁶ and condensers H⁴, H⁵, H⁶ in a branch, and terminates in the earth at G'. The receiving telephones T' and T² are placed in the bridges between the conductors Y Y' with induction coils K and K', in the respective primaries of which are included telephone transmitters S and S' and batteries B⁴ and B⁵.

The telephonic and multiple telegraphic circuits and apparatus described constitute a multiple composite system which has heretofore been proposed and to some extent operated but has been found inefficient in opera-

tion, owing to the fact that the balance between the real and artificial lines ordinarily existing in multiple telegraphic circuits is destroyed by the addition thereto of the electro magnetic resistance R^4 and the condenser H^{16} , (still referring to station 2, as an example), which are essential to the proper working of the telephone circuit. As has been previously stated, the invention provides means to re-
 10 create this balance and thus bring about an efficient operation of the multiple telegraphic circuit. This result is effected by connecting directly in the circuit of the artificial line between the rheostat J, at each station, and the
 15 polar or outermost relay F, an electro magnetic resistance, impedance, choking or retardation coil, such as R, and by extending an earth branch from a point between the said coil R and the said polar relay and including an
 20 auxiliary condenser H therein. It is evident that the said choking coil and condenser so placed, occupy positions in the artificial line analogous to those occupied by their counterparts in the real or main telegraphic lines; and it is a fact that by reason of such similarity in location, the relation they bear to the said artificial line and to such part of the telegraphic apparatus as is contained in the circuit thereof, is closely similar to that borne
 30 by the similar main line appliances, to the said main line, and to its portion of the telegraphic apparatus. The retardation coils R, R', R^2 , and R^3 and also the retardation coils R^4, R^5, R^6, R^7 have a real resistance of one hundred
 35 and fifty (150) ohms and an apparent resistance of fifteen thousand (15,000) ohms at six hundred (600) alternations per second, and the condensers H, H', H^2, H^3 , and also the condensers $H^{16}, H^{17}, H^{18}, H^{19}$ may have a capacity of five
 40 (5) microfarads each. By means of the coil R and condenser H, connected as described, the artificial line X is balanced exactly with the main line Y, and all irregularity in the operation of the telegraphic instruments by the static discharge of the line is thus neutralized or suppressed; the condensers employed in the artificial line tend to discharge through the said retardation coil in addition to the adjustable retarding resistance or rheostat.
 50 The condensers $H^{20}, H^{21}, H^{22}, H^{23}$ in the telephonic circuit have a capacity of two microfarads; while the condensers, rheostats and resistance coils, in the artificial lines of the telegraphic circuits vary in capacity and resistance according to the length of the line, weather conditions, &c., as is well understood.

Having thus described the practical arrangement and operation of the invention, I
 60 claim—

1. In a system of composite telephonic and multiple telegraphic transmission, the combination with the main telegraphic line serving as one side of a double-wire telephone
 65 circuit, and with the artificial line contain-

ing the usual balancing resistance and capacities, of a retardation or choking coil in the main circuit; a condenser in an earth branch thereof, a similar retardation or choking coil in the artificial line, and a similar
 70 condenser in an earth branch thereof, substantially as described.

2. The combination, substantially as specified herein, with an earth completed quadruplex telegraphic circuit main conductor, constituting one side of a double wire telephone circuit; the artificial line or conductor thereof, containing adjustable resistance and capacity appliances adapted to balance the same properties of the main circuit; and
 80 telegraph apparatus having coils or helices in both main and artificial lines; of a retardation or choking coil included in the main circuit between the telegraphic apparatus thereof and the telephone branch junction,
 85 to prevent the passage of voice or other vibratory currents; an auxiliary retardation coil included in the artificial line between the telegraphic apparatus and the said resistance and capacity, and adapted to balance the
 90 said main line retardation coil, and two condensers of like capacity contained independent earth branches diverging from points between the said relays and retardation coils in the main and artificial lines respectively.

3. A system of composite multiple telegraphy and telephony comprising two main conductors constituting together the direct and return conductors of a double wire telephone circuit, and each forming an independent earth completed multiple telegraphic circuit; and electro-magnetic resistance or retardation coil at each terminal station interposed in each main conductor between the telephone connection and the telegraphic apparatus thereof; to prevent the short circuiting of voice currents; and an earth branch including a condenser extending at each terminal station from a point on each main conductor between the said retardation coil and telegraphic apparatus; combined with an auxiliary electro-magnetic resistance or retardation coil; and an auxiliary condenser associated with the artificial line of each multiple telegraphic circuit, and bearing a relation thereto and to the telegraphic apparatus similar to that borne to the said apparatus and to the main line by the similar main line appliances, whereby the balance between the said main lines and their respective artificial
 120 lines is perfected, substantially as and for the purposes described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 17th day of August, 1893.

FRANK A. PICKERNELL.

Witnesses:

G. BURTON HAWLEY,
 W. H. FREEMAN.