

(No Model.)

2 Sheets—Sheet 1.

F. W. DUNBAR.

APPARATUS AND SYSTEM FOR COMPOUND TELEGRAPHY AND TELEPHONY.

No. 476,618.

Patented June 7, 1892.

Fig. 3.

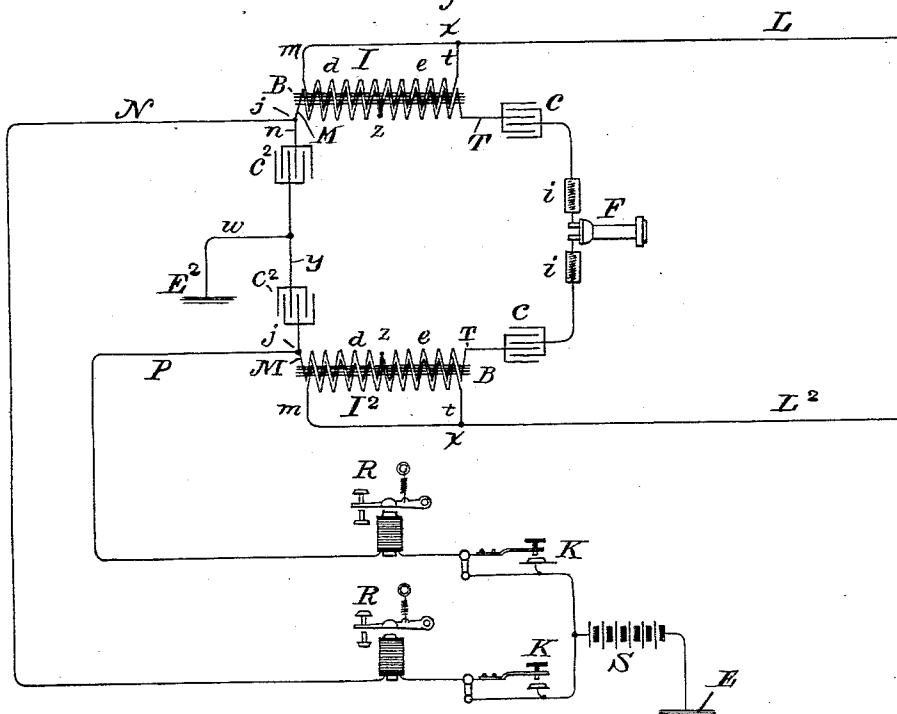


Fig. 2.

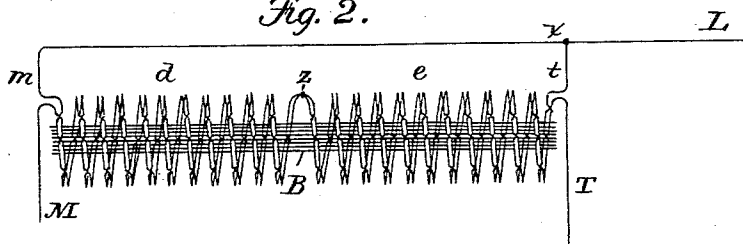
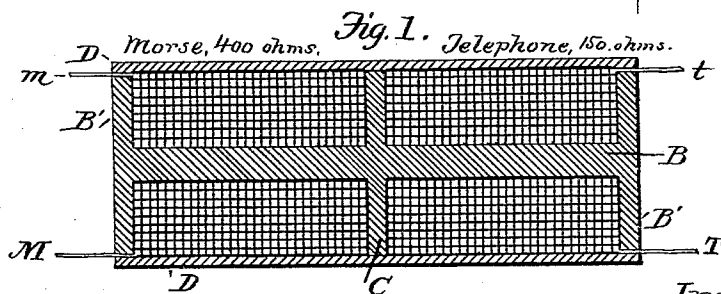


Fig. 1.



Witnesses.

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(No Model.)

2 Sheets—Sheet 2.

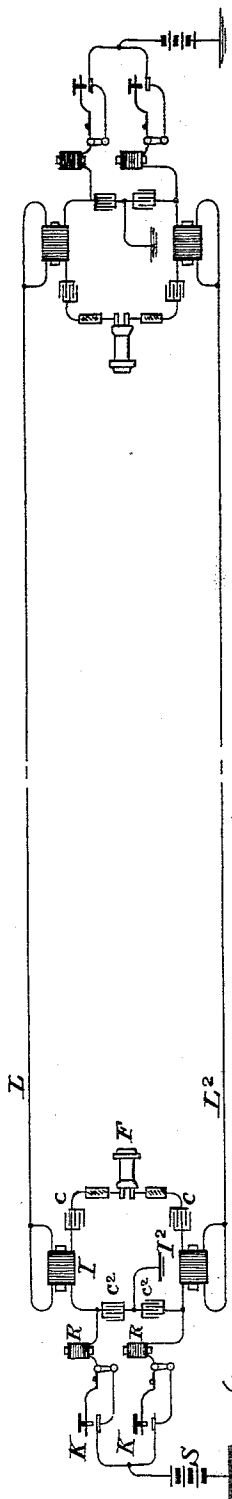
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APPARATUS AND SYSTEM FOR COMPOUND TELEGRAPHY AND TELEPHONY.

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Fig. 4.



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UNITED STATES PATENT OFFICE.

FRANCIS W. DUNBAR, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK.

APPARATUS AND SYSTEM FOR COMPOUND TELEGRAPHY AND TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 476,618, dated June 7, 1892.

Application filed January 25, 1892. Serial No. 419,190. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS W. DUNBAR, residing at Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Apparatus and System for Compound Telegraphy and Telephony, of which the following is a specification.

This invention relates to means for the simultaneous transmission upon the same circuit of telegraphic and telephonic signals. One way of accomplishing such simultaneous transmission has heretofore been devised; and it consists in providing suitable inductive and other resistances and condensers and in so connecting these appliances with the main and branch circuits that the two main conductors serving as the two sides of a given metallic telephonic circuit may each be used as a single-conductor telegraph-line, and this plan is substantially disclosed in United States Patent No. 323,239, granted July 28, 1885, to François Van Rysselberghe for "means for preventing interference in combined telegraphic and telephonic systems." It is found in practice that this plan, in virtue of the construction and mode of connection of the retardation-coils, is imperfect and results in sluggish transmission of the telegraphic signals.

The object of my invention is to so construct and connect the requisite apparatus that while the independence of the telegraphic and telephonic signals is maintained as effectually as heretofore no retardation or obstruction shall be offered to either telegraphic or telephonic currents by the means employed to effect such independence.

The invention comprehends a new form of inductive or electro-magnetic resistance, in the association of the said new form of inductive resistance with the conductors of the main circuit and the telegraphic and telephonic branches, respectively, and in organizing the connections of the said inductive resistance so that it is interposed between the telegraphic and telephonic branches in such a manner that it presents a very high inductive resistance, constituting a practical barrier to the passage of currents between said branches, while, although interposed,

also, between both branches and the main conductor, it presents in that respect a path for the currents of said branches, respectively, of practically no self-induction or other retardation.

In the drawings which accompany and form a part of this specification, Figure 1 is a longitudinal section of an electro-magnetic resistance which has been successfully employed. Fig. 2 is a diagram of the electrical construction of said induction-coil. Fig. 3 represents in diagram one terminal station of a two-wire circuit adapted for simultaneous telephonic and telegraphic transmission and embodying this invention, and Fig. 4 is a diagram of a complete circuit embodying the same principles.

Figs. 1 and 2 show the construction and winding of the inductive resistance - coil, which technically is frequently called a "retardation-coil." It has an iron core B and preferably, also, an iron surrounding shell D and iron end plates B', so that its magnetic circuit is closed. The core is preferably made up of wires or is laminated, and to prevent the circulation of eddy currents the end plates and external shell should be respectively radially and longitudinally slitted.

The coil I is divided into two parts, as indicated by the central partition C, and both parts are wound in the same direction with a twisted pair of insulated copper wires. The winding is clearly shown in Fig. 2, where it will be observed that the helical direction of the part *d* is the same as that of the part *e*. The four inner terminals of the two pairs of wires are all permanently united, as shown at *z*. Of the four outer terminals of the said pairs two of them *m* and *t*, one from each winding, are connected together at *x*, and at this point are adapted to be united to the main line L, forming one side of a double conductor-circuit. Of the remaining two wire ends or terminals one M is connected directly to the telegraph-instruments, and the other T connects with the telephone apparatus. An inductive resistance which has been practically operated and found efficient was four inches and one-half long and one inch and three-fourths in diameter. The two twisted

wires wound on the telegraph end had a resistance of four hundred ohms each, and the two wound on the other end to form a part of the telephone branch were each of one hundred and fifty ohms resistance, the size of the wires on both ends being such that with the desired resistance the disposable space might be filled.

It is evident from the foregoing that this apparatus forms a simple resistance only to currents traversing its helices from either end to its middle and back to the same end differentially, but an inductive resistance or retardation coil as respects currents traversing its helices from end to end.

In Fig. 3 the connections for double transmission are fully shown. $L L^2$ are the two conductors of a metallic circuit leading to a distant station. $R R$ are Morse relays in circuit with the said lines, respectively, and adapted to respond to incoming telegraphic signals. $K K$ are signal-sending keys for the said lines, and S is a main battery, which may be common to both. $I I^2$ are the inductive resistance-coils, whose construction has already been described. c and c^2 are condensers. $i i$ are the two halves of the telephonic-transmitter induction-coil split to maintain a balance, and F is the receiving-telephone connected between them. The telephonic circuit is a double-line circuit, which, coming in by line L , continues by the differentially wound and twisted wires t and T of the retardation-coil I , condenser c , induction-coil i , and receiving-telephone F , condenser c , differential wires T and t of retardation-coil I^2 to line L^2 , and out to the distant station. The telegraph-circuits coming in by lines L and L^2 diverge each from their main conductors at x , and each continues through the two wires m and M of its retardation-coil I or I^2 , one of them passing by conductor P through its relay and key to the battery and earth terminal E , while the other passes in like manner by conductor N to earth. In addition to the two condensers c , which are interposed in the telephone-loop, other two c^2 are interposed in earth branches $n y$, passing from a point j on the conductors N and P to earth at E^2 .

Fig. 4 requires no further description, since it merely indicates a complete circuit and its two terminal stations, which are similarly arranged to the one which has been described, the letters of reference being the same.

The operation of this apparatus is as follows: The telegraphic current on either side traverses the twisted conductor $M m$ on one end of the coil to the point z and back, and by reason of its differential traverse is not retarded or obstructed on its way to line. The telephonic currents also going through their twisted pair $T t$ for the same reason pass to line unopposed, both reaching the main conductors at the point x . But currents are prevented from passing between the telegraphic

and telephonic apparatus by way of z by the high inductive resistance which they would experience in virtue of the fact that they would have to traverse the entire coil, winding in that case in the same direction.

The incoming telegraphic currents can have no effect upon the telephones, partly because the said telephones are in a metallic circuit, partly because the abruptness of the signals is largely removed, or, as it may be stated, they appear in a rounded form, the crests being smoothed off, owing to the resistance and capacity of the line, and partly because the condensers c , placed directly in the telephonic circuit, prevent a steady flow of current through the telephone. The two inner terminals of the two pairs of insulated coil-wires are connected together at z to prevent the passage of outgoing telegraphic currents to the home telephones by way of the point x . If such a circuit were permitted, it is obvious that it would offer no retardation to the telegraph-currents, to which the telephone would then respond. The junction at z of the middles of the two twisted pairs prevents such a passage of current, as in view of its presence it would be required that the same point should assume two different potentials at the same instant of time, which is a manifest absurdity.

The object of the condenser c^2 is to absorb the discharge of the relays R at the moment of breaking the circuit, and thus to prevent a sharp click in the telephones.

The objects of the condensers c are, first, to prevent the passage through the telephone-circuit from one side of the line to the other of the current from the Morse battery, and consequent confusion of the Morse signals on the two separate sides of the telephonic circuit, each serving as an independent Morse circuit; second, in view of the fact that the telephone F may be at the end of a loop extending to a sub-station to prevent a subscriber's ring—such as a disconnecting signal—from reaching the main line, and thus interfering with the Morse signals; third, to prevent the grounding or short-circuiting of the receiving telegraph-station by the connection of an earth-completed line or an imperfectly-insulated line, either at the transmitting or receiving end of the circuit.

It will be observed that in this system the telephone is provided with a double-line circuit, while the two sides of such circuit each serve as an independent telegraph-line.

By this invention the sluggishness of any system employing large electro-magnets as differentiators in the main circuits is avoided, and the line having no retardation-coil in circuit is made as promptly responsive as an ordinary simplex telegraph-line. The liability of the interference of one telegraph-circuit with another on account of imperfect insulation of the lines arising from wet

weather or other causes is also greatly diminished because less battery-power is required to secure equal sensitiveness.

Having thus fully described my invention and its application, I claim—

1. A combined simple and inductive resistance apparatus consisting of an iron core having its length divided into two wire-spaces and a coil formed of a twisted pair of insulated wires wound in each of the said wire-spaces in the same helical direction, the four inner terminals of the said pairs of wires being electrically united, substantially as specified.

2. A combined simple and inductive resistance apparatus comprising an iron core and two twisted pairs of insulated wires wound thereover, one of the said pairs from one end to the center of said core and the other from the center to the remaining end, the wires of one pair differing in resistance from those of the other pair and the central or inner ends of all four wires being electrically connected together, substantially as described herein.

3. The combination, in a resistance and retardation apparatus, of an iron core having iron end plates and an approximately central partition, twisted pairs of insulated wires wound in the spaces between the central partition and the end plates, respectively, the inner terminals of all four conductors being joined electrically to each other at the said central partition, and an outer iron shell or sheath, substantially as described.

4. In a system for the simultaneous transmission of telephonic and telegraphic signals over the same conductors, the combination, with two main conductors severally provided with earth-terminal branches and including telegraphic apparatus, and constituting direct and return conductors united by branches or bridges, including telephonic apparatus and condensers, to form a double-wire telephonic

circuit, of a resistance and retardation apparatus interposed at the junction of each of the main conductors with its telegraphic and telephonic branches or extensions and having two independent differential helices, each formed of a double and twisted insulated conductor wound in the same helical direction on the two ends of an iron core and included, respectively, in the said branches, but having their inner terminal ends all connected together, whereby is provided a simple resistance between each branch and the main line, but an inductive resistance between the telegraphic and telephonic branches, substantially as described.

5. The combination, substantially as hereinbefore described, in a system for the simultaneous transmission of telegraphic and telephonic signals, of two main conductors extending between terminal stations, an earth branch at each station for each conductor, including telegraphic stations, and provided with condensers to absorb the static discharge of said instruments, a branch, loop, or bridge at each station joining the said two main conductors and including in its circuit a telephone and a condenser, and a resistance apparatus constructed as described herein, connected at the junction of said main conductors with the telegraph and telephone branches and forming a simple resistance between each branch and the main line, but an inductive or retardation resistance between the telegraphic and telephonic branches.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 22d day of January, 1892.

FRANCIS W. DUNBAR.

Witnesses:

CHARLES R. BANGS,
F. DE LYSLE SMITH.