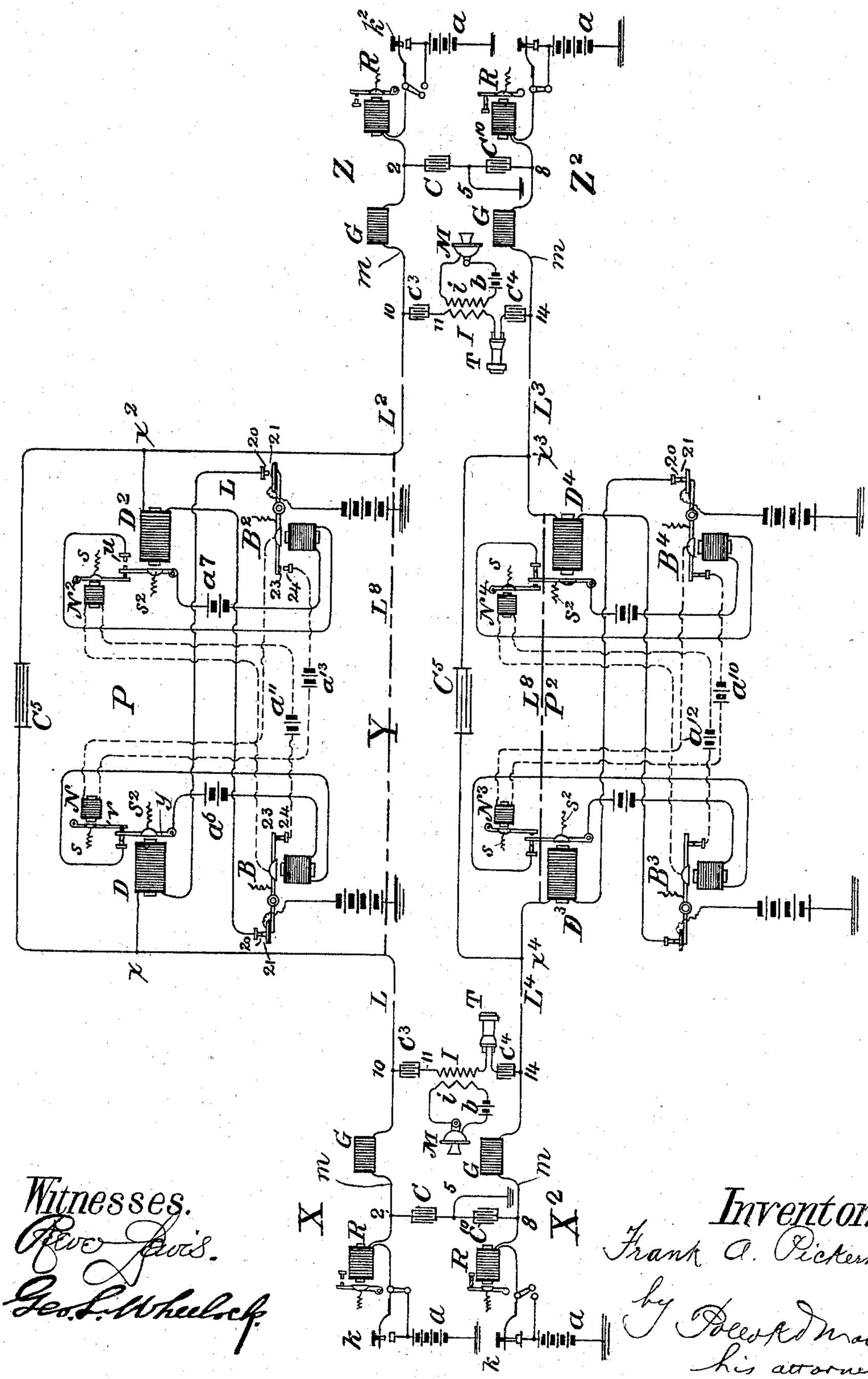
(No Model.)

F. A. PICKERNELL.

SYSTEM OF COMBINED TELEPHONY AND TELEGRAPHY.

No. 492,471. Patented Feb. 28, 1893.



UNITED STATES PATENT OFFICE.

FRANK A. PICKERNELL, OF NEWARK, NEW JERSEY, ASSIGNOR TO THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY, OF NEW YORK.

SYSTEM OF COMBINED TELEPHONY AND TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 492,471, dated February 28, 1893.

Application filed April 29, 1892. Serial No. 431,217. (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 Telegraphic Transmission, of which the following is a specification.

My invention relates to systems of combined telephony and telegraphy, wherein the simultaneous transmission of telephonic and telegraphic signals or communications over the same conductors is effectuated.

When a metallic or double wire telephone circuit is constructed between any two stations, it is possible by arranging certain appliances and conductors in association therewith, to adapt the same for the simultaneous transmission also of telegraphic messages, each of the two conductors of the double wire telephonic circuit being adapted to constitute the main portion of an independent earth completed circuit, so that while one telephonic message is being transmitted over the two conductors arranged to form the two sides of the same circuit two telegraphic messages may be sent one over each of the said two conductors arranged to severally form parts of different earth completed circuits. Such an organization involves the application of condensers to the telephonic circuit so formed, and the application of the two telegraphic circuits, of electromagnetic resistances and auxiliary condensers and is not new. For comparatively short lines—for example—lines of not over three hundred miles long—the efficiency of this arrangement of the telegraphic circuits is practically constant under weather variations, but I have found that when operated over lines which are of materially greater length, it is not absolutely trustworthy, and is not under all conditions of weather satisfactory, although the double wire telephonic circuit at the same time may be working with a substantially uniform efficiency.

The object of my invention is to render the two telegraphic circuits of which the two conductors of the telephonic circuit severally form parts, practically independent of weather variation, over a much longer distance than is now practicable; to cause their operation to be uniformly efficient, and to accomplish these results without detriment to the practical continuity and successful operation of the telephonic circuit.

The drawing which accompanies and forms a part of this specification is a diagram of a combined system of telephony and telegraphy in which my invention is embodied.

The invention consists in dividing at an intermediate station one or both of the two conductors of a double wire telephonic circuit, each of which may individually consititute the line conductor of a telegraphic circuit, and interposing in such conductor or conductors at the point of division, a practical and preferably automatic telegraphic repeater.

It consists also in placing a telegraphic repeater in one or both conductors of the double line telephonic circuit at a suitably located intermediate station, and in looping, bridging, or shunting the same by a branch circuit round it including a condenser, so that while the efficiency of each telegraphic circuit is increased by dividing it at mid-length into two shorter circuits, the receiving instrument of each, at the said intermediate station being enabled to operate the key of the other, or in some equivalent way to repeat into the other; the continuity of the telephonic circuit is at all times maintained by the presence and arrangement of the condensers, through which the telephonic or voice currents readily propagate themselves.

It consists also in associating with such a combined system a Milliken repeater connected in one or both circuit conductors of the double wire telephonic circuit, and in looping a condenser round the same.

In the diagram the terminal stations are characterized respectively by the letters X and Z and the intermediate station by the letter Y. The two terminal stations are united by conductors which form a through double line telephonic circuit L L^2 L^3 L^4 and the said circuit passes through the intermediate station Y. Each of these two conductors may in the manner disclosed by Letters Patent of the United States granted to F. Van Rysselberghe July 28, 1885, No. 323,239, to which reference is made, be provided with telegraphic extensions or earth branches *m* with which the usual telegraphic apparatus

comprising key *k* and relays or receiving instruments R are connected. By manipulating the said keys, the current of the several batteries *a* is sent to or withdrawn from the line, and telegraphic signals are thus transmitted in a manner well understood.

Electromagnetic resistances G, are placed as shown in each telegraphic extension to serve as graduators, and to so modify the natural abruptness of the telegraphic currents that they are prevented from producing distubances in the telephonic instruments connected with the same circuit conductors. To aid in individualizing the operation of the two systems, a cross branch is extended at each terminal station between the two main lines L L^4, and L^2 L^3 at the points 2 and 8 which branch includes the two condensers C C^{10}, a connection 5 being led to earth from a point approximately midway between the said two condensers. The two main conductors are thus adapted each to serve as an independent telegraphic circuit. Each also constitutes one side of the metallic or double line telephonic circuit, and though the two have no conductive connection with one another, they are formed into a continuous voice current or telephonic circuit by extending from the point 10 on one, to the point 14 on the other—these points being outside of the graduators G—a second branch connection which includes the telephone T, the helix I of the transmitter, and the condensers C^3 and C^4.

The transmitter M is preferably connected as usual in the circuit of a local battery *b* and arranged to act upon the main circuit through the intermediation of an induction coil of which I is the secondary, and *i* the primary helix.

The telephone circuit between the terminal stations X and Z, is from the induction coil at X by wire 11, condenser C^3, point 10, main line L L^2 to station Z, there by point 10, condenser C^3, wire 11, secondary helix I, receiving telephone T, condenser C^4, point 14, line conductor L^3 L^4, to station X and there by point 14, and condenser C^4, to the receiving telephone T and to the second terminal of the said induction coil at X. The attendant at Z can therefore communicate telephonically with the attendant at X, the two main conductors being for this purpose connected up through suitable condensers to form an inductively continuous double wire telephonic circuit.

The voice currents are prevented from being short circuited between the two telegraphic earth terminals at the sending station, by the electromagnetic resistances G, together with the resistances of the telegraphic receiving instruments, R. And while this is going on, the telegraphic operator at Z may exchange telegraphic messages with the operator at X over the earth completed circuit of which the line conductor L L^2 forming one side of the telephonic circuit is a part, and another pair of operators at Z^2 and X^2 may exchange telegraphic communications over the independent earth completed circuit of which the line conductor L^3 L^4 forming the other side of the telephonic circuit is a part.

The construction and arrangement which so far I have herein described are not new, although it has seemed necessary to briefly refer to the same, in order that my invention which comprises certain improvements thereon may be fully understood.

Heretofore and prior to my invention the two line conductors extending between the two terminal stations have been continuous and undivided, as indicated by the broken lines L^8 on either side, and this without regard to such intermediate station apparatus as may be included in their circuits. But in the practical operation of combined systems I have as hereinbefore stated, found that when the lines composing such systems exceed a certain maximum length, while for telephonic service their efficiency remains unimpaired, their operation as telegraph lines is influenced by bad weather and tends to become defective. To forestall and provide against this practical defect and to enable the two sides of the telephonic circuit to be operated satisfactorily each as the main conductor of a telegraphic circuit, I divide the said lines L L^2 and L^4 L^3 at the intermediate station, or if there be more than one such, at the most central intermediate station and connect earth terminals with the severed ends thereof. I then place the device or apparatus P known as a telegraphic repeater, at the said intermediate station in connection with each of the said divided line conductors, such device being arranged with a receiving relay or electromagnet in each section of the divided conductor, responsive to signals sent from the terminal station of the said section, which relay operating its sounder by means of a local circuit which it makes and breaks in the usual way, causes the armature lever of said sounder to act as the signal sending key of the other section of the said divided conductor, each section being for this purpose led after passing its own relay, through suitable circuit making and breaking contact points mounted upon and operated by the lever of the sounder of the other section. Many such repeaters have from time to time been devised and are characterized in textbooks which relate to telegraphy as practiced in America, by the names of their respective inventors; the Farmer, and Woodman, Clark, Hicks, Gray, Haskins and Milliken repeaters all being well known types. I may employ any of these for the purpose of my invention, or in place of using a repeater which changes its connections automatically, as either terminal station ceases to receive and begins to transmit, I may employ the device known as a "button repeater" described in "*Modern Practice of the Electric Telegraph*," Pope, N. Y., 1877, tenth edition, page 46, which requires the services of an attendant to turn a switch, upon the occurrence of

the above change in the order of operation. The apparatus however which I prefer, and which I have found well adapted to the peculiar conditions of the case is that commercially known as the "Milliken" or sometimes the "Milliken-Hicks" repeater, and which is described on pages 50 and 51 of the above named textbook.

In the drawing, the operator Z on line section L^2 is supposed to be sending to X, and has just elevated his key, and the circuit is momentarily broken; while the operator X^2 at station X is sending, to Z^2 and has his key depressed, the circuit L^4 being thereby closed. On both sides the lines entering the intermediate station from both terminal stations pass first to their several relays D, D^2, D^3 and D^4, and thence to the opposite sounders on the same side, respectively, and through the repeating points 20 and 21 carried by such sounders, and which serve as the circuit controlling keys to be operated by the other line on the same side, to the intermediate station battery, and to earth. The extra repeater magnets N, N^2, N^3 and N^4 are placed above and in front of the relay magnets, so that when their armatures are released their levers are drawn back by their retracting springs *s*, and come firmly in contact with the relay armature levers, as shown at D in the diagram. The circuits of the said extra repeater magnets two on each side, are shown in broken lines, the magnet N being in circuit with local battery a^{13} and the forward circuit closing points 23 and 24 of sounder B^2, N^2 being similarly associated with battery a^{11} and sounder B, N^4 with battery a^{12} and sounder B^3, and N^3 with battery a^{10} and sounder B^4. The function of these extra repeater magnets N is to keep their armatures fully attracted when the line to which the relay with which they are associated is sending, in order that the armature of said relay may have perfect freedom to move in accordance with the key at the transmitting station, and may therefore operate its own sounder and through that, the circuit controlling automatic key of the continuation line; but to permit their said armatures to be promptly retracted by the springs *s*, when the transmitting key is opened, the relay to which they belong being connected with the receiving line as at D, in order that the armature of said relay D shall not be retracted by its spring s^2, and thereby caused to operate its sounder B, which if permitted would produce a false break between the points 20 and 21 of the transmitting line L^2 controlled by the said sounder. Although the operation of this as well as other repeaters is well understood, it may here be briefly described. Station Z beginning to send, opens its key k^2 and its circuit L^2. The circuit thus being broken, relay D^2 releases its armature and breaking the local circuit of battery a^7 at *u*, allows the lever of the sounder B^2 to fall back. This movement in turn breaks at 23 and 24 the circuit of the extra repeating magnet N, and the receiving main circuit L at 20, 21, repeating by the latter operation the signal into the said main circuit L. But the insulated contact piece 21 is a spring, and its contact with 20 tends thereby to maintain itself an instant longer than does that of the extra local circuit between 23 and 24. The said extra local circuit through the magnet N being broken, the armature *v* thereof is released and drawn backward by its spring *s* against the end or top of the relay lever *y*, holding the latter in its forward position, although the relay magnet D be at this moment demagnetized. Being so retained, the sounder circuit of local battery a^6 is kept closed, and cannot break at its points 20 and 21 the circuit of the sending line L^2 nor can it break at its points 23 and 24, the circuit of the extra repeating magnet of said sending line. The spring *s* requires to have a stronger tension both absolute, and relatively to its magnet than the spring s^2. It is evident that when Z is sending, the armature of relay D cannot operate being held quiescent by lever *v* whenever sounder B^2 opens line L and being held by the magnetism of its own relay when the said sounder again closes line L. The action when X sends, is exactly similar, and the operation of the repeaters on both sides of the double conductor system is alike.

Although I have shown line batteries *a* for each line, both at the terminal and intermediate stations, it is obvious that I am not in this respect restricted, this being a matter largely dependent upon the length of the lines; when such however is the arrangement adopted, care must be taken that the pole presented to line at the intermediate station is opposed to that presented to line at the terminal station. And although I have represented each of the two conductors of the double wire telephonic system as being arranged for use telegraphically, and provided centrally with a telegraphic repeater, yet I may without departing from the spirit of my invention, use but one side in such manner.

In order that the double conductor telephone circuit may work with perfect efficiency and not be adversely affected by the continual opening and closing of the circuit conductors which they involve, I provide for each of the said two lines which are fitted at the intermediate station, with repeaters as described, a condenser C^5 of suitable capacity, and shunt the repeaters thereby, the condenser circuit shunting the repeater P, leaving line L at the point *x* and joining line L^2 at the point x^2, while that shunting the repeater P^2 unites point x^4 on the line L^4 with point x^3 on line L^3. I have found in practice that these condensers for efficient work may have a capacity of about three microfarads.

The electromagnets D of the relays of each of the four lines at the repeating station must be made with a high inductance so that their apparent resistance to telephone currents will

also be high; and so made, the voice currents will not suffer any perceptible loss, by reason of the two sections of each side conductor of the telephonic circuit being grounded at the intermediate station. The addition of the condensers, and the said exalted inductance permits the passage of the telephone currents without any disadvantages attributable to the repeater connections.

Having now fully described my invention, I claim—

1. The combination substantially as hereinbefore described, with the two conductors of a double wire telephone circuit extending between two terminal stations through an intermediate station, the said conductors being divided at the said intermediate station into two sections constituting independent earth completed telegraphic circuits, of a telegraphic repeater located at said intermediate station between and connected with the two sections of the divided conductor, whereby each is enabled to operate the other, and means for maintaining the continuity of the telephonic circuit through said intermediate station.

2. A metallic or double conductor telephone circuit having each of its component conductors centrally divided, and organized to severally constitute the line conducters of independent earth completed telegraphic circuits, combined with a repeater for each such independent telegraphic circuit located at the point of division, and connected with the two divided sections whereby each may repeat its signals into and over the other, and with means for maintaining the continuity of the telephone circuit around said repeater.

3. The combination with a metallic or double conductor telephone circuit extended between two terminal stations through an intermediate station, the said conductors being respectively divided at the said intermediate station into two sections constituting independent earth completed telegraphic circuits, of a telegraphic repeater located at the point of division between and connected with the said two sections of the divided conductor, and a condenser looped or bridged round the said repeater and shunting the same for voice currents, substantially as described.

4. In combination with a system of simultaneous telephonic and telegraphic transmission over the same conductors comprising two line conductors extending between terminal stations through an intermediate station, the said two lines being connected at their ends to form a double line telephonic circuit, and severally constituting centrally divided line conductors of independent earth completed telegraphic circuits; a Milliken repeater interposed at the said intermediate station between the two divisions of each of the said telegraphic line conductors, and having in the circuit of each division a receiving electromagnet of high inductance; and a condenser looping or shunting the said repeater, and having its plates electrically connected with the conductors of the two divisions of each line respectively; substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 21st day of April, 1892.

FRANK A. PICKERNELL.

Witnesses:

STEPHEN D. FIELD,

CHARLES R. BANGS.