No. 735,508. PATENTED AUG. 4, 1903.

P. E. HEINA.

MULTIPLEX TELEGRAPHY.

APPLICATION FILED JAN. 22, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1

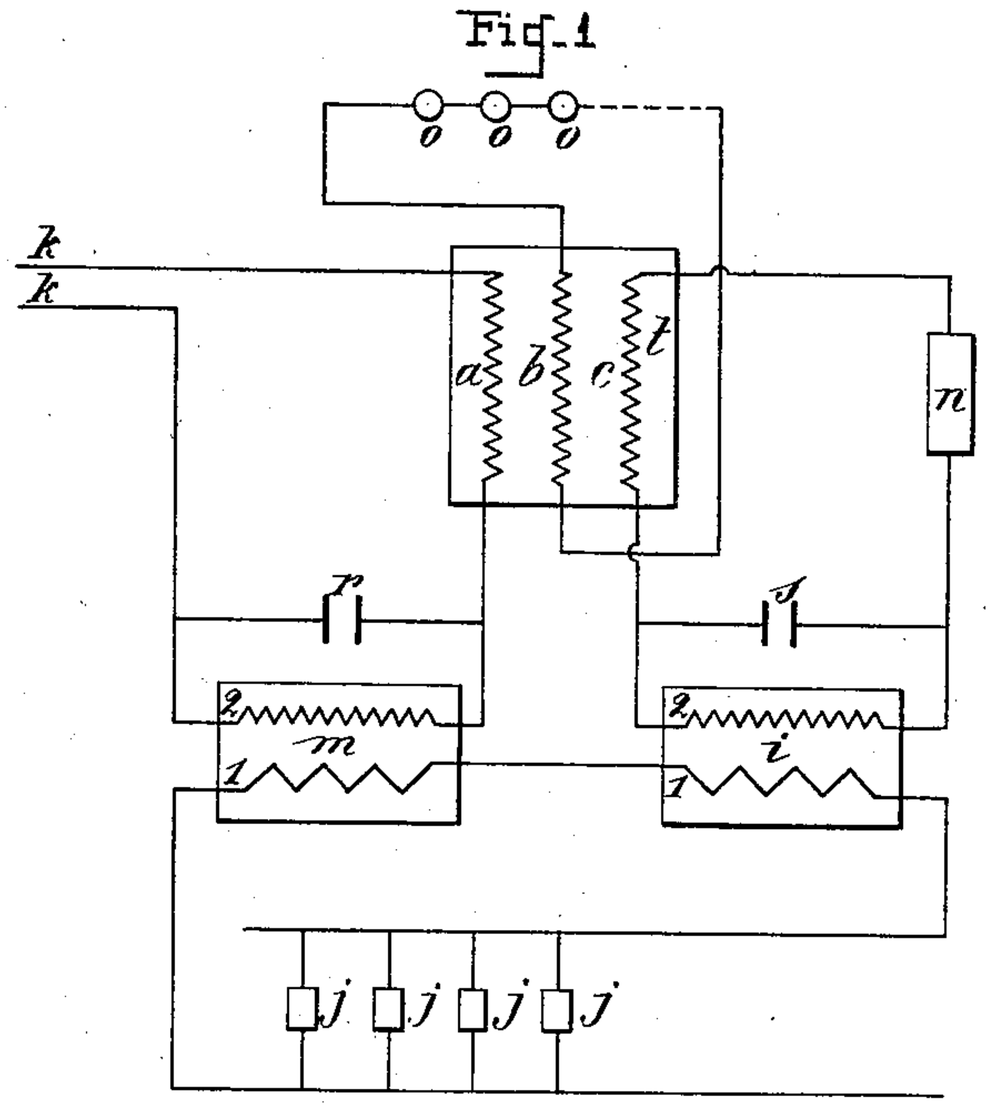

Fig. 2

Witnesses.
John T. Dewhirst
Jed. Page.

Paul E. Heina, Inventor,
Marion & Marion
Attorneys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3

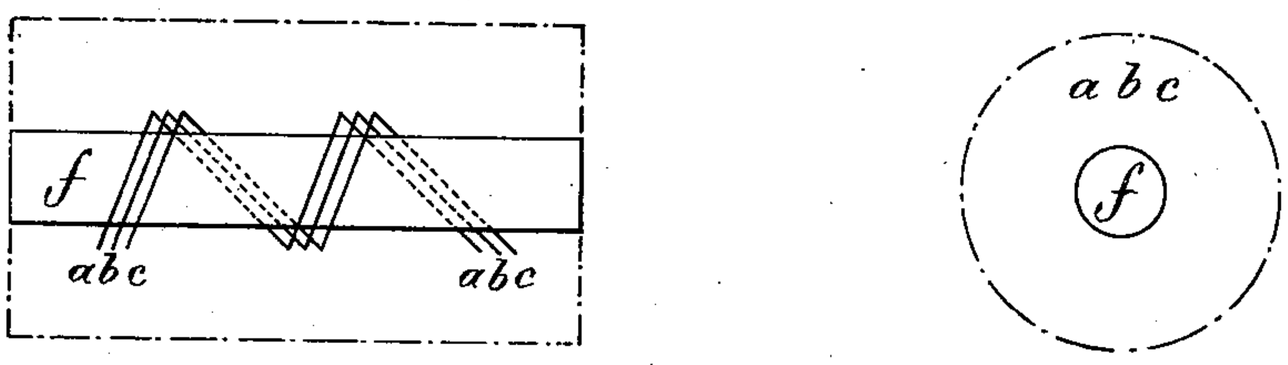
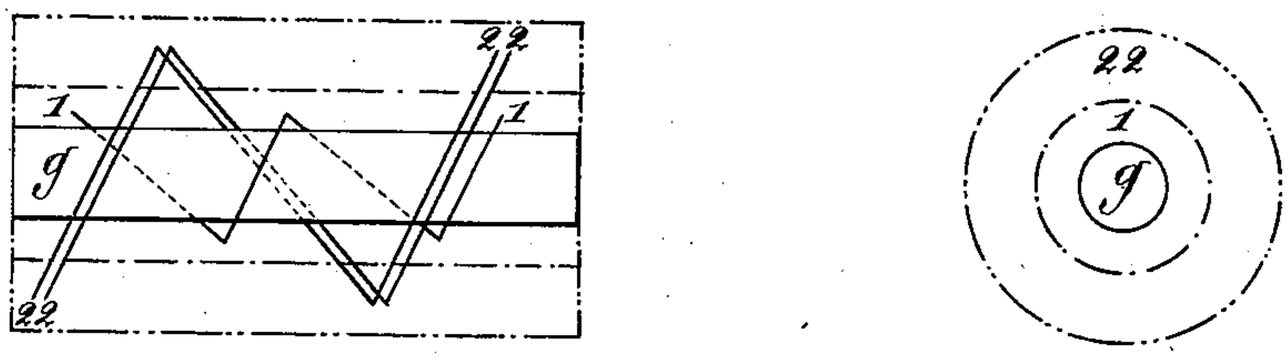


Fig. 4



Witnesses:

J. Ed. Page

F. D. Amerman

Paul E. Heina, Inventor,

By Marion & Marion

Attorneys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 735,508. Patented August 4, 1903.

UNITED STATES PATENT OFFICE.

PAUL EDOUARD HEINA, OF PARIS, FRANCE.

MULTIPLEX TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 735,508, dated August 4, 1903.

Application filed January 22, 1902. Serial No. 90,823. (No model.)

To all whom it may concern:

Be it known that I, PAUL EDOUARD HEINA, a citizen of the French Republic, residing at Paris, France, have invented new and useful Improvements in Multiplex Telegraphy Using Undulatory or Pulsating Currents, of which the following is a specification.

This invention consists in the application of a differential triple-wire transformer for transmitting duplex signals in the various systems of multiplex telegraphy where undulatory or pulsating currents are employed and its combination with two induction-coils the primary wires of which are connected with the transmitting apparatus.

The system of multiplex telegraphy devised by Mr. E. Mercadier and which has been the object of various patents taken out in the United States, respectively on the 4th of February, 1890, under No. 420,884, on the 24th of February, 1891, under No. 447,194, and on the 4th of April, 1899, under No. 622,629, is based on the use of undulatory currents. These undulatory currents are obtained by utilizing tuning-forks the vibratory movement of which is kept up electrically.

It is known that a tuning-fork can in vibrating give one, and only one, sound corresponding to an invariable number of vibrations in a second. It is therefore easily conceived that by utilizing different tuning-forks, B (*si*) C (*ut*) C sharp (*ut dieze*) for instance, one is enabled to produce different undulatory—that is to say, pulsating direct—currents each of which is characterized by the frequency of those oscillations.

If we use a single telegraphic wire to effect several transmissions simultaneously and we make use for each of these transmissions of different undulatory currents, it is possible to realize at the other end of the line the sorting of these currents and to receive each of them separately in distinct apparatuses after they have been sent along the wire without getting mixed up, as the experiment proves. To this end Mr. Mercadier has combined special telephonic receivers, to which he has given the name of "monotelephones" and the membrane of which can be set vibrating by a given note, and by that one alone, and remains silent to all other notes. The code of signals used is the Morse alphabet. The transmissions are effected by means of Morse manipulators, the working of which is identically the same as in the case of an ordinary Morse transmission, but which are connected with sources of undulatory currents (electric tuning-forks) instead of being connected with generators of continuous currents, (batteries of any kind.) The receiving agents can read off by the sound the signals that they receive in their receivers, for these signals, according as they represent a dash or a dot of the Morse alphabet, are of shorter or longer duration. That auditive reading is much easier than that ordinarily practiced with the sounder. Each agent perceives only the signals he receives through his monotelephone. If at one end of a line three agents, for instance, send messages by utilizing undulatory currents corresponding to the notes B C C sharp, it will be sufficient at the other end of the line to send the currents into three monotelephones corresponding to those three notes and applied to the ear of three different agents that each of the latter may perceive the signals transmitted by one, and only one, of the three sending agents.

Let us proceed to the description of the new improvements.

The present invention consists in the application of a specially-constructed transformer to the transmission of duplex signals in all systems of multiplex telegraphy in which undulatory currents are made use of and in the combining of this transformer *t* with two induction-coils *m* and *i*, the primary wires of which are connected with the sending apparatuses *j*, (generators of undulatory or pulsating currents—for instance, electric tuning-forks.)

In the accompanying drawings the transformer in question is represented as adapted to Mercadier's system of multiplex telegraphy, although it can be used with all those utilizing undulatory currents, and herein

Figure 1 is a diagram of one form of the system. Fig. 2 is a diagram showing a modified form, and Figs. 3 and 4 are diagrammatic views showing the mode of winding the transformer-coils.

This transformer *t* consists of a core *f*, of iron wires, which core is covered with three

equal and insulated copper wires. These three copper wires *a b c* are wound around simultaneously instead of being wound one after the other, as is usually done with multiple-wire transformers. (See Fig. 3.) This transformer is therefore constructed like a coil the only conductor of which would have been replaced by a bundle of three wires. These three wires occupy positions side by side all along instead of being disposed in successive layers, as in an ordinary transformer. The first wire *a* of the transformer (see Fig. 1) is directly connected with the secondary wire 2 of an induction-coil *m* on one hand and on the other hand with the telegraphic circuit *k k*. Through the primary wire *l* of that induction-coil *m* pass the undulatory currents produced by the transmitters *j j*, (electric tuning-forks.) The second wire *c* is directly connected with the secondary wire 2 of an induction-coil *i* on one hand and on the other hand with an artificial line *n*. Through the primary wire *l* of the coil *i* pass the same undulatory currents as in the primary of the coil *m*. The secondary wires of the coils *m* and *i* are shunted by condensers *r* and *s*. The object of these dispositions is to equalize the currents which pass at the same time along the wires *a* and *c* in opposite directions, and consequently to annul their inductive action on the third wire *b*. This third wire *b* is directly connected with the circuit of the receiving apparatuses *o o*, (monotelephones.)

Working of the transformer "t," consisting of three wires wound simultaneously.—The transmitters *j j* send undulatory currents by induction into the wires 2 of the coils *m* and *i*, and consequently into the wires *a* and *c* of the transformer *t*, Fig. 1. In order to annul the inductive effects of these currents on the wire *b* of this transformer, the condensers *r* and *s* and the artificial line *n* are properly regulated as regards resistance and capacity. The receiving apparatuses *o o* (monotelephones of the sending station) then remain silent; but the currents are propagated along the circuit *k k* to the corresponding station. When they have reached this station (which is disposed in the same way) the currents pass through the wire *a* of the transformer *t*, which is in the said station, act by induction on the wire *b* of this apparatus—for nothing hinders that inductive effect—and the receivers of the station in question work.

The mode of operation of the construction above described is as follows: In sending a signal over the line *k k* from the station shown in the drawings the transmitting devices *j j j* are operated independently to produce Morse signals each having a pitch peculiar to itself, and the compound pulsating current thus produced is transmitted successively through the transformers *m* and *i* or the compound transformer *p* of Fig. 2. As the secondaries of these transformers are wound in opposite directions and the primaries *a* and *c* are wound in the same direction, the current induced in the line *k k* will balance that induced in the artificial line *n* so far as relates to the secondary coil *b*, these two lines being regulated by the capacity-shunts *r* and *s*, so as to properly balance the system. Hence no effect will be produced by the action of the transmitters *j j* upon the receivers *o o* of the same station. On the other hand, the impulses will be properly transmitted over the line *k k* to the receiving-station at the other end. Regarding the station shown in Fig. 1 as the receiving end of the line, the impulses transmitted over the line *k k* and reaching this station will in passing through the coil *a* of the transmitter *t* induce corresponding currents in the coil *b*, and thus affect the monotelephone-receivers *o*, according to the transmitters in use. The artificial line *n* will in this case have no effect upon the receivers *o*.

It is thus seen that the transformer *t* enables two corresponding stations to interchange signals simultaneously in both directions, and consequently to effect duplex transmissions.

The coils *m* and *i* can be replaced by a single coil *p*, with three wires wound around, Fig. 2, made as follows: On the core of iron *g* is first wound a primary wire 1. (See Fig. 4.) Over it are then placed two equal secondary wires 2 2, wound around simultaneously in the way indicated for the triple-wire transformer *t*, described above. In order to make use of this coil *p*, the primary winding *l* is connected with the transmitters *j*, and the two equal secondary windings 2 2 are directly connected, one with the real line *k k* and the other with the artificial line *n*, as the secondary wires of the coils *m* and *i* were in the preceding combination.

We claim as our property—

1. A system of multiplex telegraphy comprising a primary transmitting-circuit, a plurality of electric transmitting devices located therein, a line-circuit, a counterbalance-circuit, a receiving-circuit, a plurality of receivers located in said receiving-circuit, an inductive connection between said primary circuit and said line-circuit, an inductive connection between said primary circuit and said counterbalance-circuit, and inductive connections between said receiving-circuit and each of said line and counterbalance circuits, said inductive connections being such that the currents induced by the primary circuit in said line and counterbalance circuit neutralize each other's inductive effects upon said receiving-circuit, whereby said receiving devices are not affected by the transmitting devices at the station, but only by the induced currents transmitted through the line-circuit from the next station, substantially as described.

2. A system of multiplex telegraphy of the alternating-current type, comprising a primary circuit, a series of electric transmitting

devices located therein, a transforming device having its primary located in said primary circuit and two secondaries, a line-circuit having one of said secondaries connected therein, a counterbalance-circuit having the other secondary connected therein, a transformer having three independent coils, two of which are equal and connected respectively in said line and counterbalance circuits so that the inductive effects on the third wire due to the currents induced in said line and counterbalance circuits by the primary circuit neutralize each other, a receiving-circuit in which said third coil is connected, and a series of receiving devices located in said receiving-circuit.

3. A system of multiplex telegraphy of the alternating-current type, comprising a primary circuit, a series of electric transmitting devices located therein, a transforming device having its primary located in said primary circuit and two secondaries, a line-circuit having one of said secondaries connected therein, a counterbalance-circuit having the other secondary connected therein, a transformer having three independent coils, two of which are equal and connected respectively in said line and counterbalance circuits so that the inductive effects on the third wire due to the currents induced in said line and counterbalance circuits by the primary circuit neutralize each other, a receiving-circuit in which said third coil is connected, and a series of receiving devices located in said receiving-circuit, in combination with suitable capacity and resistance branches arranged to shunt the two secondaries in the line and counterbalance circuits respectively, whereby the currents induced therein may be regulated and balanced with respect to each other.

4. A system of multiplex telegraphy comprising a primary circuit, a plurality of transmitting devices located therein, a transformer having a primary coil connected in series with said circuit, and two equal and opposite secondary coils simultaneously wound side by side on said transformer, a second transformer having three equal coils simultaneously wound side by side on the core thereof, a receiving-circuit connected in series with one of said coils, a plurality of receiving devices located in said receiving-circuit, a line-circuit connected in series with one secondary of the first-named transformer and one primary of the second transformer, and a counterbalance-circuit connected in series with the other secondary of the first-named transformer and the other primary of the second transformer, the connections of said counterbalance-circuit being reversed with respect to those of said line-circuit, whereby the induction on said receiving-circuit due to the current in said primary circuit is neutralized.

5. A system of multiplex telegraphy comprising a primary circuit, a plurality of transmitting devices located therein, a transformer having a primary coil connected in series with said circuit, and two equal and opposite secondary coils simultaneously wound side by side on said transformer, a second transformer having three equal coils simultaneously wound side by side on the core thereof, a receiving-circuit connecting in series with one of said coils, a plurality of receiving devices located in said receiving-circuit, a line-circuit connected in series with one secondary of the first-named transformer and one primary of the second transformer, and a counterbalance-circuit connected in series with the other secondary of the first-named transformer and the other primary of the second transformer, the connections of said counterbalance-circuit being reversed with respect to those of said line-circuit, whereby the induction on said receiving-circuit due to the current in said primary circuit is neutralized, in combination with resistance and capacity branches located in said counterbalance-circuit and line-circuit, whereby the induced currents in each of said circuits may be regulated with respect to each other.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

PAUL EDOUARD HEINA.

Witnesses:

EDWARD P. MACLEAN,

JULES FAYOLLET.