(No Model.) 2 Sheets—Sheet 1.

L. W. HILDBURGH.

TELEGRAPH.

No. 571,948. Patented Nov. 24, 1896.

Fig. 1.

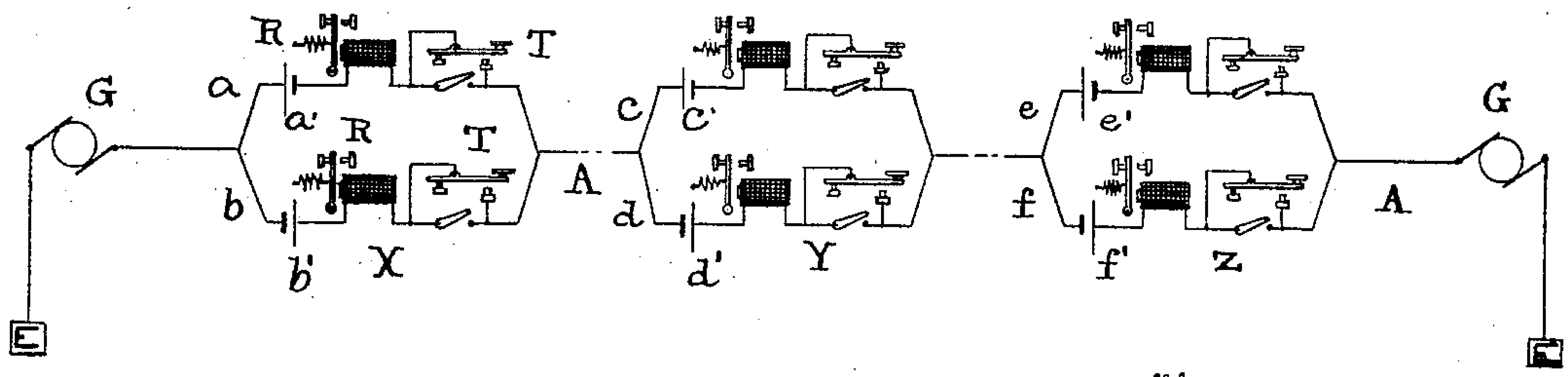


Fig. 2.

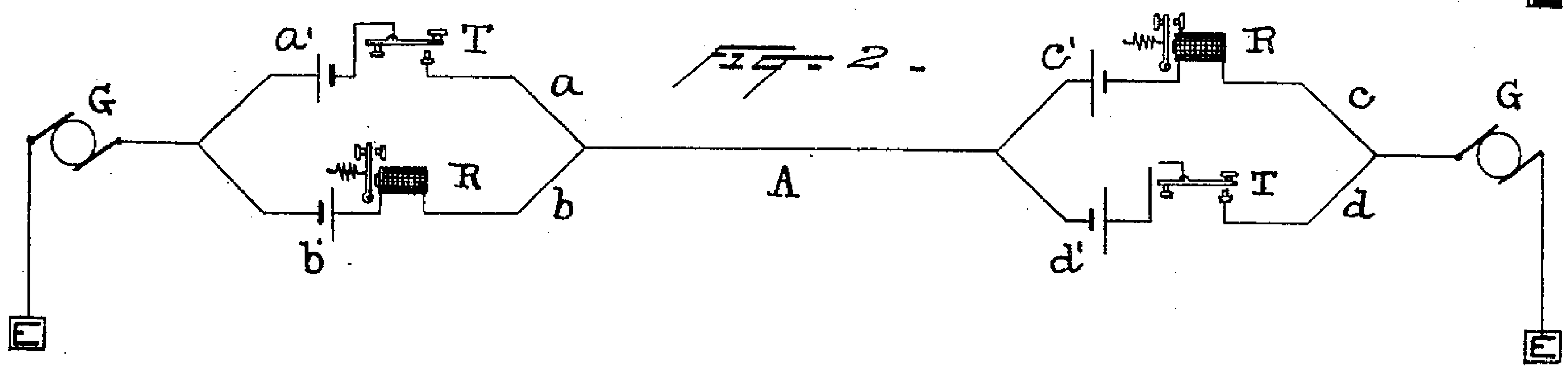


Fig. 3.

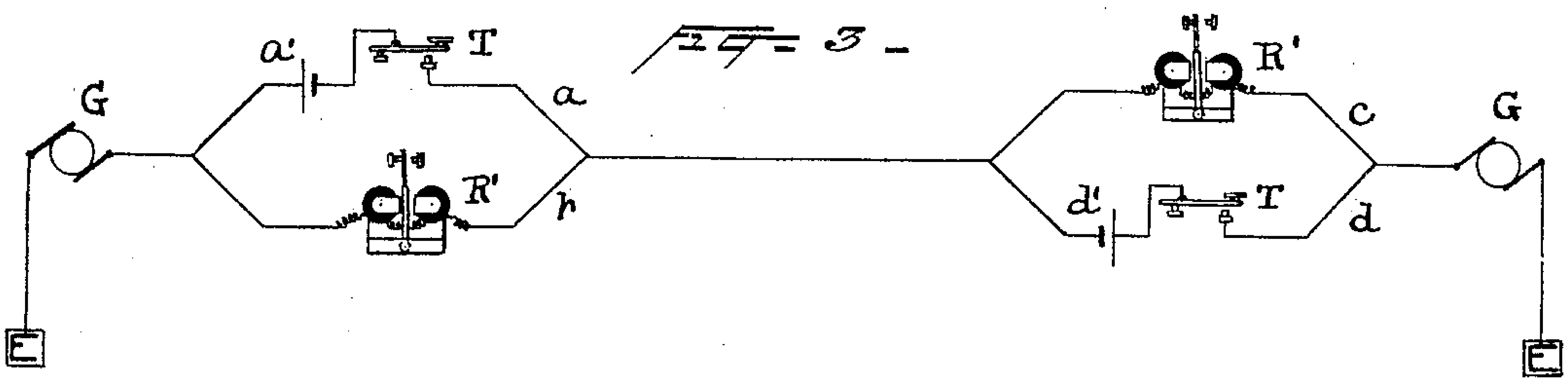
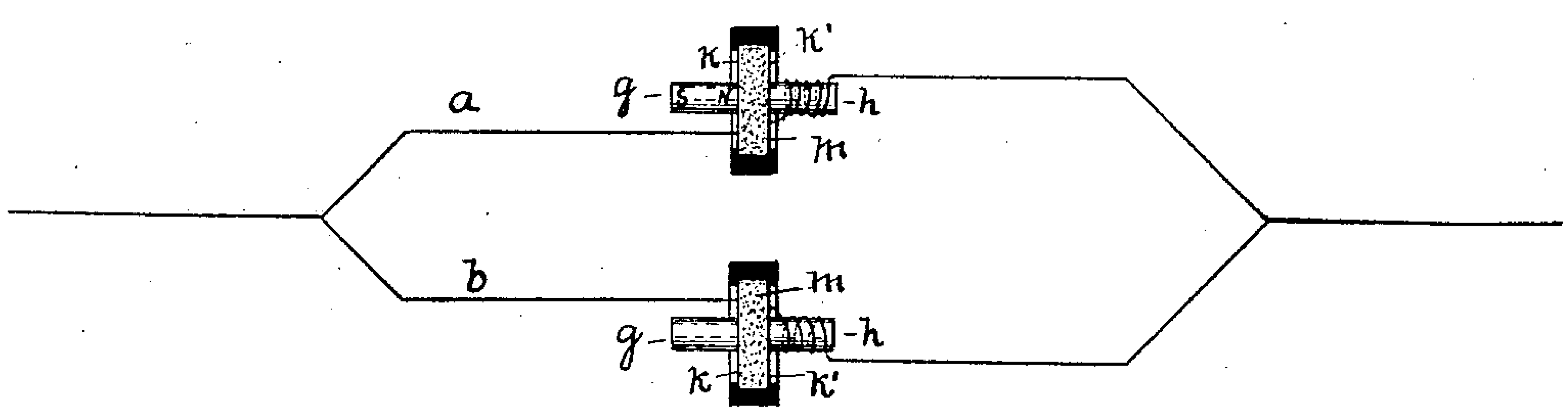


Fig. 5.



Witnesses
Norris A. Clark.
W. [illegible]

Inventor
Leo W. Hildburgh
By his Attorneys
Dyer & Driscoll.

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

(No Model.) 2 Sheets—Sheet 2.

L. W. HILDBURGH.

TELEGRAPH.

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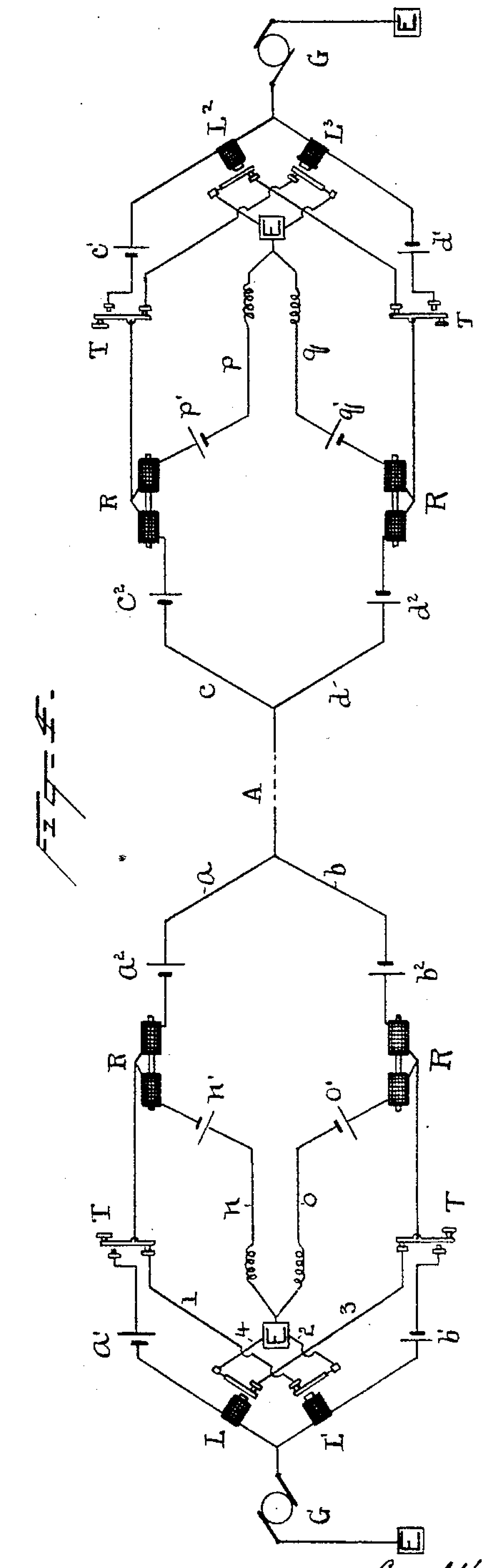

Witnesses
Norris A. Clark.
W. Pelzer

Leo Walter Hildburgh Inventor
By his Attorneys Dyer & Driscoll

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

UNITED STATES PATENT OFFICE.

LEO WALTER HILDBURGH, OF NEW YORK, N. Y.

TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 571,948, dated November 24, 1896.

Application filed March 5, 1896. Serial No. 581,869. (No model.)

To all whom it may concern:

Be it known that I, LEO WALTER HILDBURGH, a citizen of the United States, residing at New York city, in the county and State of New York, have invented a certain new and useful Improvement in Telegraphs, of which the following is a specification.

The object of my invention is to adapt telegraph systems employing alternating currents for the simultaneous transmission of two or more messages in the same or opposite directions without the employment of the special methods and apparatus heretofore found necessary.

In carrying my invention into effect I divide the main line into two loops where the instruments are located, and in each loop I place a set of instruments in series with asymmetric resistances, which resistances, as is well understood, act to separate the positive and negative waves of the alternating current, thus causing the positive waves to pass over one loop of the main line and the negative waves over the other loop, and each set of waves is employed for transmitting and receiving telegraphic messages. In some instances it may be found necessary or desirable to employ condensers in connection with the asymmetric resistances.

It will be readily seen that my invention may be employed with duplex, quadruplex, or multiplex systems, as will be hereinafter described.

In a simple duplex system the transmitting and receiving instruments may be located in each loop at the stations in series with an asymmetric resistance. With the asymmetric resistance properly arranged in each loop the positive and negative waves will be separated, whereby messages may be received and transmitted by the instruments in each loop. Thus two messages may be simultaneously transmitted over a single main line in the same or opposite directions.

A quadruplex system embodying my invention may be arranged either on the bridge or differential method.

In both methods the asymmetric resistances will be located so as to direct the positive waves over one loop and the negative waves over the other loop, and two asymmetric resistances must be employed in each loop, one at each end, so as to properly direct the outgoing and incoming messages. In each quadruplex arrangement there will also be employed a rheotome for each loop, which when in operation opens and closes the earth connections of the transmitting-keys of the opposite loop. The object of this is to prevent the impulses going out over one loop returning over the opposite loop at the same station and operating the receiving instruments therein instead of going out over the main line.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram of a duplex system embodying my invention, the transmitting and receiving instruments being located in each loop at the station in series with an asymmetric resistance, and by which arrangement two messages can be transmitted in the same or opposite directions. Fig. 2 is a diagram illustrating a duplex system having the transmitting instrument in one loop and the receiving instrument in the other loop at each station, and in which arrangement messages can be transmitted only in opposite directions. Fig. 3 illustrates a duplex system similar to that of Fig. 2, but with the asymmetric resistance of the receiving-loop omitted and a polarized relay substituted. Fig. 4 is a diagram illustrating the application of my invention to a quadruplex system on the differential method, and Fig. 5 is a view illustrating an improved form of asymmetric resistance which may be employed.

Referring to Fig. 1 of the drawings, A indicates the main line, grounded at E and having three stations X Y Z. G are the generators of alternating current, which may be located at either or both ends of the line, as may be found necessary or desirable. The transmitting and receiving instruments T and R, respectively, are located in loops *a*, *b*, *c*, *d*, *e*, and *f* of the main line, and in series with each set of instruments is an asymmetric resistance a', b', c', d', e', and f' of any well-known form. These resistances are so arranged that, for instance, the positive waves of the alternating current will pass over the loops *a*, *c*, and *e* and the negative waves over the loops *b*, *d*, and *f*. In this way messages transmitted by the positive waves will be received over the loops *a*, *c*, and *e*, while the messages transmitted by the negative waves will be received over the loops *b*, *d*, and *f*, and, as above stated, by this arrangement two messages may be transmitted simultaneously in the same or opposite directions.

In the arrangement shown in Figs. 2 and 3 the transmitting instruments are placed in the loops *a* and *d* and the receiving instruments in the loops *b* and *c*. In Fig. 3 the asymmetric resistance is dispensed with in loops *b* and *c* and polarized relays R′ are substituted, and the receiving instruments will be placed in local circuits controlled by the relays R′, as is well understood.

The asymmetric resistance illustrated in Fig. 5 consists of a permanent magnet *g*, an electromagnet *h*, and two metallic diaphragms *k k′*, the space between which is loosely filled with particles of carbon *m*, or equivalent material, which when brought into more intimate contact reduces the resistance to the passage of the current. The permanent magnets *g* have their N poles held against or are rigidly attached to the diaphragms *k*, as shown, and the electromagnets are similarly placed adjacent to the diaphragms *k′*. The electromagnet in the loop *a* is wound, for instance, so that its pole in proximity to the diaphragm *k′* will become S when energized by a positive wave and N when energized by a negative wave. The result is that when a positive wave energizes the electromagnet in loop *a* the magnets will attract each other, causing the carbon or like particles to be brought into more intimate contact, thus reducing the resistance and allowing the positive wave to pass over that loop. If a negative wave energizes the electromagnet in loop *a*, the magnets will be caused to repel each other, causing the diaphragms *k* and *k′* to move away from each other and allowing the particles *m* to become more loosely confined, and hence increasing the resistance to the passage of the negative wave. The electromagnet in loop *b* will be wound to produce the opposite result. Thus the positive waves will readily pass over loop *a*, while the negative waves will readily pass over loop *b*. It will be understood that the permanent magnets of the loops *a* and *b* may have their N and S poles, respectively, adjacent to the diaphragms, and that their adjacent electromagnets in such case will be wound to produce S and N poles at the diaphragm ends when energized by positive and negative waves, respectively. The diaphragms should preferably be so arranged that their periods of vibration will correspond to those of the alternating current. It will be readily understood that this form of asymmetric resistance may be modified in various ways; for instance, the carbon particles may be replaced by carbon buttons or equivalent means for varying the resistance by varying the degree of contact.

In Fig. 4, which illustrates a quadruplex system on the differential method, A is the main line, grounded at E, and *a b* are the two loops at one end of the main line, and *c d* the loops at the other end. G are the generators. Each loop is provided with a differential magnet R, controlling the receiving instruments, and from these magnets the artificial lines *n*, *o*, *p*, and *q* are connected to earth. The transmitting-keys T are placed between the grounded ends of the main line and the differential magnets in series with the asymmetric resistances *a′ b′ c′ d′* for directing the positive waves over one loop and the negative waves over the other loop. Between the differential magnets and the main line are located asymmetric resistances a^2 b^2 c^2 d^2 for properly directing the incoming messages. The artificial lines are also provided with asymmetric resistances *n′ o′ p′ q′*.

The rheotomes for preventing the impulses from one loop returning over the opposite loop at the same station are shown at L, L′, L^2, and L^3. The back-stop of each transmitting-key is connected to earth through the vibrating reed of the rheotome in the opposite loop. Thus the back-stop of the transmitting-key in loop *a* is connected by wire *l* to the contact-point of the reed of rheotome L′ in loop *b*, and the reed is connected by wire 2 to earth. The back-stop of the key in loop *b* is connected by wire 3 to the contact-point of the reed of rheotome L in loop *a*, and the reed is connected by wire 4 to earth. Thus, for instance, when the key in loop *a* is closed the reed of rheotome L is caused to vibrate, so that the ground connection 3 4 of the key in loop *b* is continuously opened and closed, thus preventing the impulses from loop *a* returning to earth over loop *b*, and these impulses are prevented from passing to earth by way of the artificial line *o* by reason of the asymmetric resistance *o′*, which opposes the impulses from the loop *a*. In this way the impulses from loop *a* must pass out over the main line. The arrangement of the rheotomes in loops *c* and *d* and the circuits controlled thereby are similar to those of loops *a* and *b* and need no further description.

It will be understood that with slight changes my invention can be readily adapted for telephonic communication without departing from the spirit of my invention, and my claims are intended to include such an application of my invention.

What I claim is—

1. In a system of electrical communication, the combination with a main line and a source of alternating current therefor, of two normally-closed loops at each station over which the positive and negative waves of the alter-

nating current are caused to pass separately, and transmitting and receiving instruments at the stations, substantially as set forth.

2. In a system of electrical communication, the combination with a main line and a source of alternating current therefor, of two normally-closed loops at each station, means for causing the positive waves to pass over one loop and the negative waves over the other loop, and transmitting and receiving instruments at the stations, substantially as set forth.

3. In a system of electrical communication, the combination with a main line and a source of alternating current therefor, of two loops at each station, asymmetric resistances for causing the positive waves to pass over one loop and the negative waves over the other loop, and transmitting and receiving instruments at the stations, substantially as set forth.

4. In a system of electrical communication, the combination with a main line and a source of alternating current therefor, of two or more normally-closed loops at each station, means for causing the positive waves and negative waves of the alternating current to pass over separate loops, and receiving and transmitting instruments at each station, said receiving and transmitting instruments being in separate loops, substantially as set forth.

5. In an electrical circuit, the combination with a line and a source of alternating current therefor, of two loops in said line, and an asymmetric resistance in each loop consisting of two metal diaphragms with particles of carbon or equivalent material between them, a permanent magnet at one diaphragm, and an electromagnet at the other diaphragm, said magnets being so arranged that waves of one polarity will cause the magnets to attract each other, and that the waves of the opposite polarity will cause the magnets to repel each other, whereby the particles between the diaphragm are brought into more or less intimate contact and thereby varying the resistance to the passage of the current-waves, substantially as set forth.

6. In an electrical circuit, the combination with a line and a source of alternating current therefor, of two loops in said line, an asymmetric resistance in each loop consisting of two metal diaphragms arranged so that their periods of vibration will correspond to the alternations of the current and with particles of carbon or equivalent material between said diaphragms, a permanent magnet at one diaphragm and an electromagnet at the other diaphragm, said magnets being so arranged that waves of one polarity will cause the magnets to attract each other, and that waves of the opposite polarity will cause the magnets to repel each other, whereby the particles between the diaphragms are brought into more or less intimate contact and thereby varying the resistance to the passage of the current-waves.

7. In a system of electrical communication, the combination with a main line and a source of alternating current therefor, of two loops at each station, an asymmetric resistance in each loop consisting of two metal diaphragms with particles of carbon or equivalent material between them, a permanent magnet at one diaphragm and an electromagnet at the other diaphragm, said magnets being so arranged that waves of one polarity will cause the magnets to attract each other and that waves of the opposite polarity will cause the magnets to repel each other, whereby the particles between the diaphragms are brought into more or less intimate contact and thereby varying the resistance to the passage of the current-waves, and transmitting and receiving instruments at the stations, substantially as set forth.

8. In a telegraph system, the combination with a main line and a source of alternating current therefor, of two loops at each station, receiving and transmitting instruments in each loop, asymmetric resistances between the source of alternating current and the instruments, and asymmetric resistances between the instruments and the main line, substantially as set forth.

9. In a telegraph system, the combination with a main line and a source of alternating current therefor, of two loops at each station, receiving and transmitting instruments in each loop, asymmetric resistances in each loop for causing the positive waves to pass over one loop and the negative waves over the other loop, and means in each loop for preventing the impulses passing over one loop from returning over the other loop at the same station, substantially as set forth.

10. In a telegraph system, the combination with a main line and a source of alternating current therefor, of two loops at each station, receiving and transmitting instruments in each loop, asymmetric resistances in each loop for causing the positive waves to pass over one loop and the negative waves over the other loop, and a circuit-interrupter in each loop which controls the opposite loop and prevents the impulses passing over one loop from returning over the other loop at the same station, substantially as set forth.

11. In a telegraph system, the combination with a main line and a source of alternating current therefor, of two loops at each station, receiving and transmitting instruments in each loop, asymmetric resistances in each loop for causing the positive waves to pass over one loop and the negative waves over the other loop, a ground connection from the transmitting-key in each loop, and a rheotome in each loop for opening and closing the ground connection of the key in the opposite loop for preventing the impulses passing over one loop from returning over the other loop at the same station, substantially as set forth.

12. In a telegraph system, the combination with a line and sources of alternating cur-

rents at the terminals thereof, of two loops at each terminal, asymmetric resistances for dividing the alternating impulses between the two loops, and an artificial line and duplex transmitting and receiving instruments connected with each loop, substantially as set forth.

This specification signed and witnessed this 25th day of February, 1896.

LEO WALTER HILDBURGH.

Witnesses:
W. PELZER,
EUGENE CONRAN.