(No Model.) 4 Sheets—Sheet 1.

W. W. JACQUES.

MULTIPLEX TELEPHONY.

No. 518,367. Patented Apr. 17, 1894.

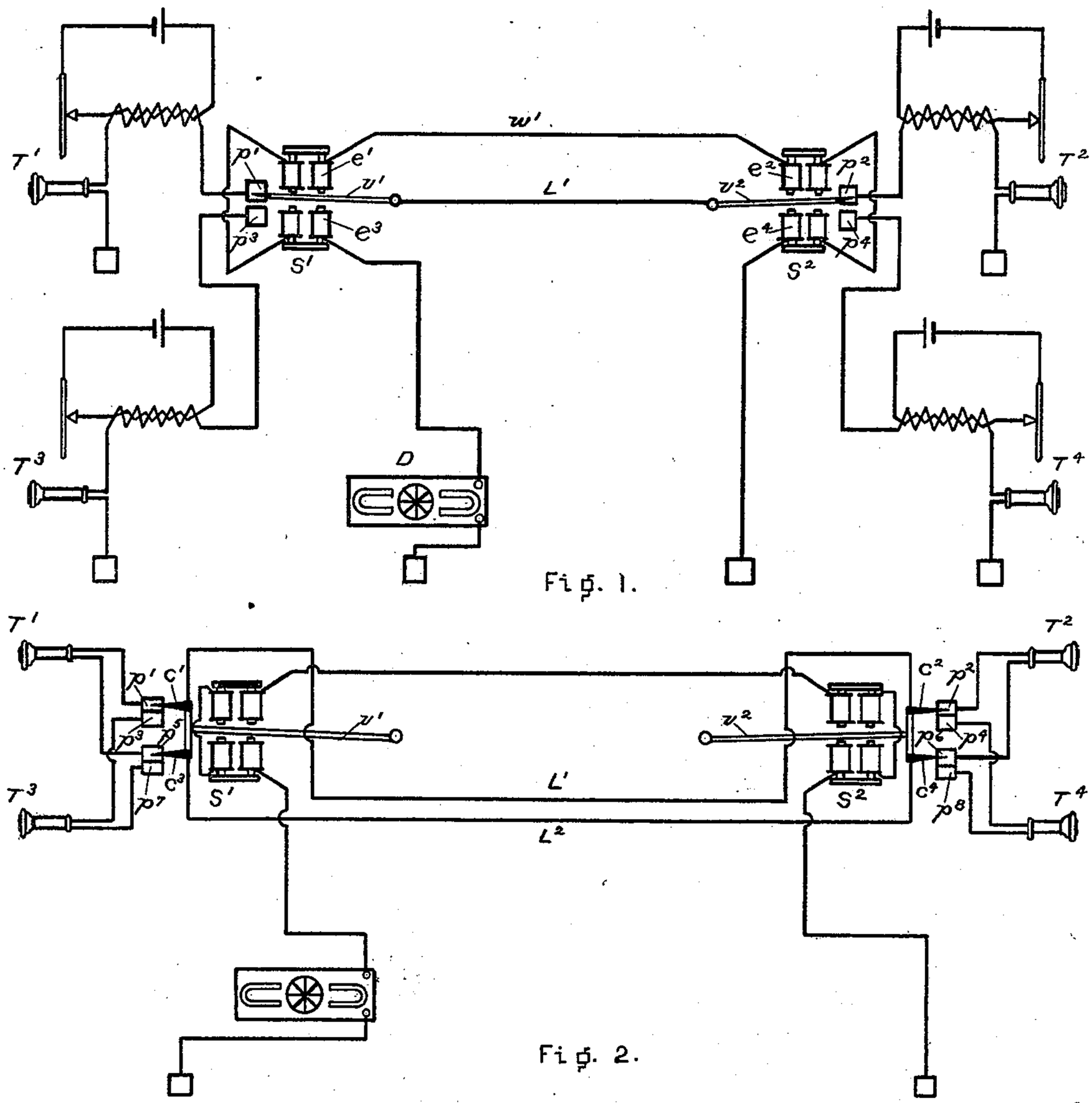

Fig. 1.

Fig. 2.

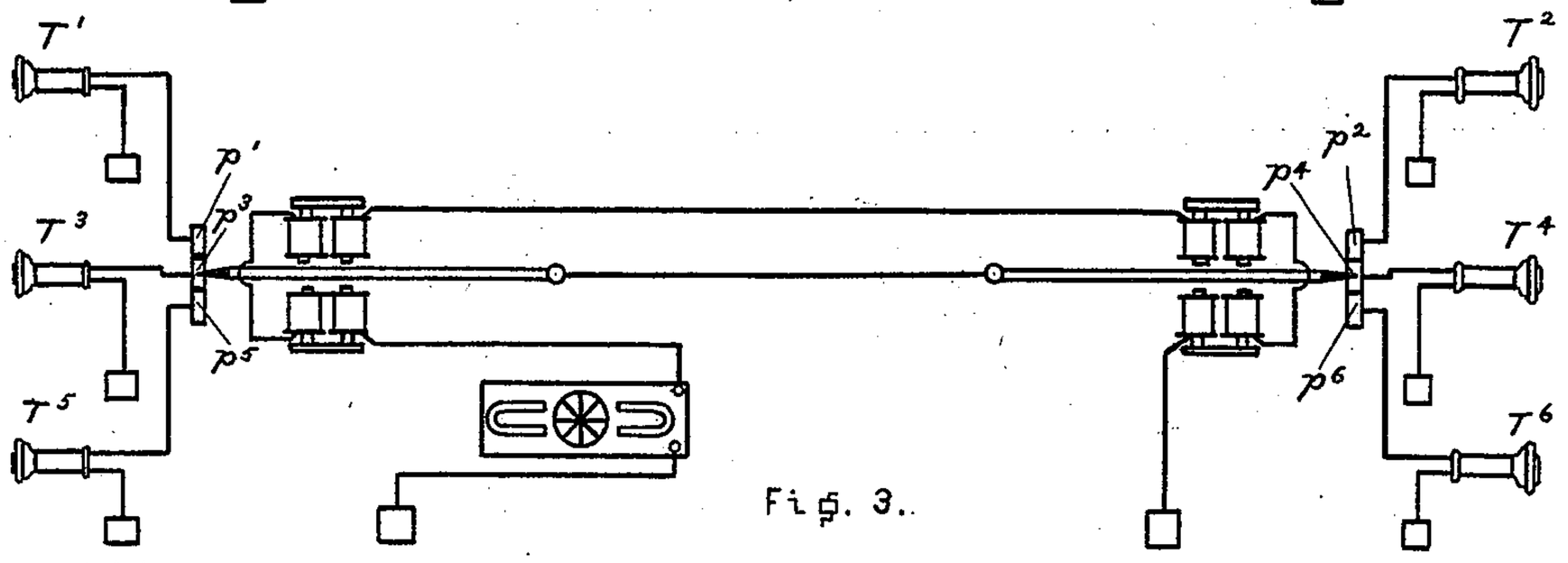

Fig. 3.

WITNESSES.

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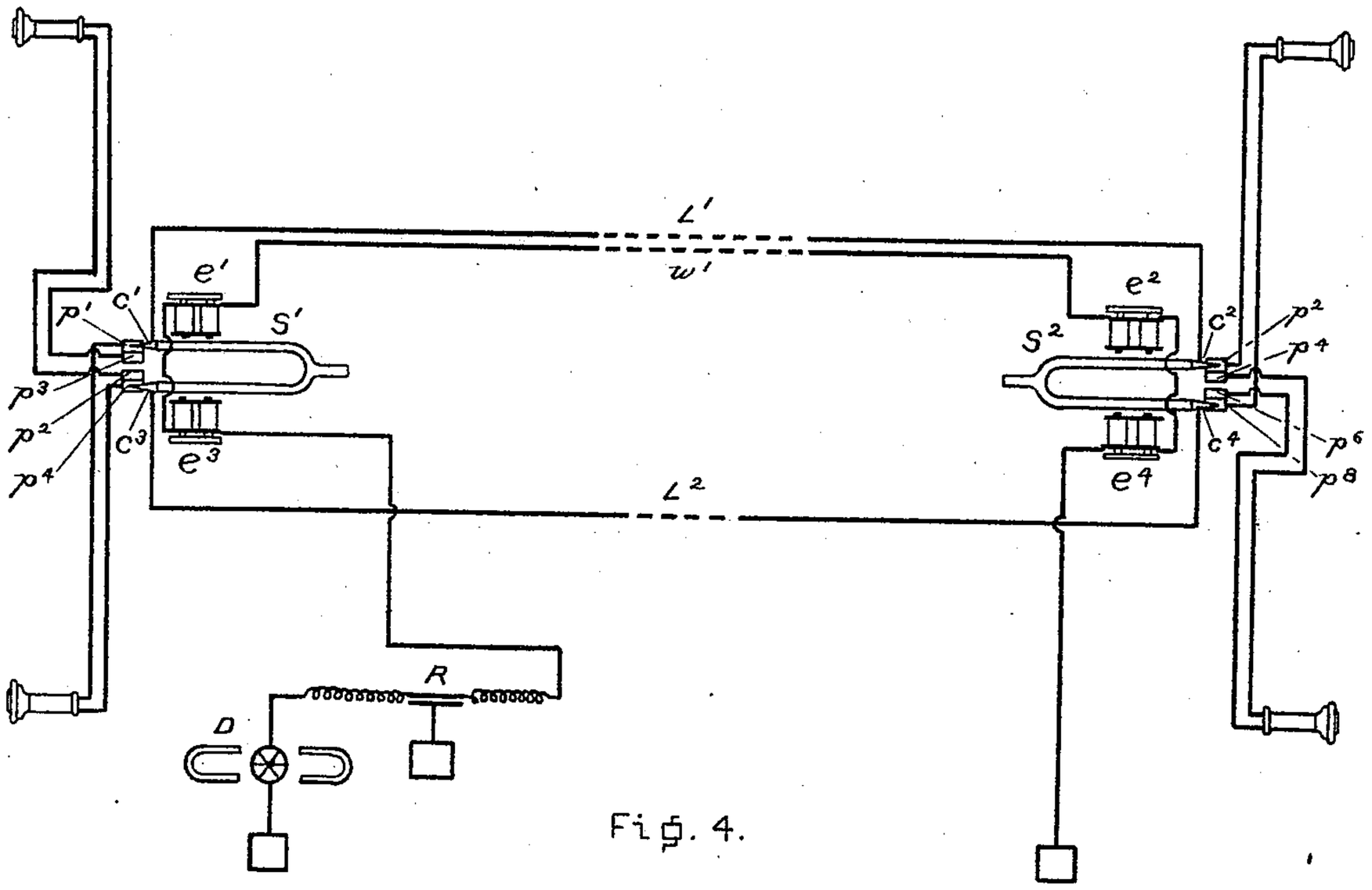

Fig. 4.

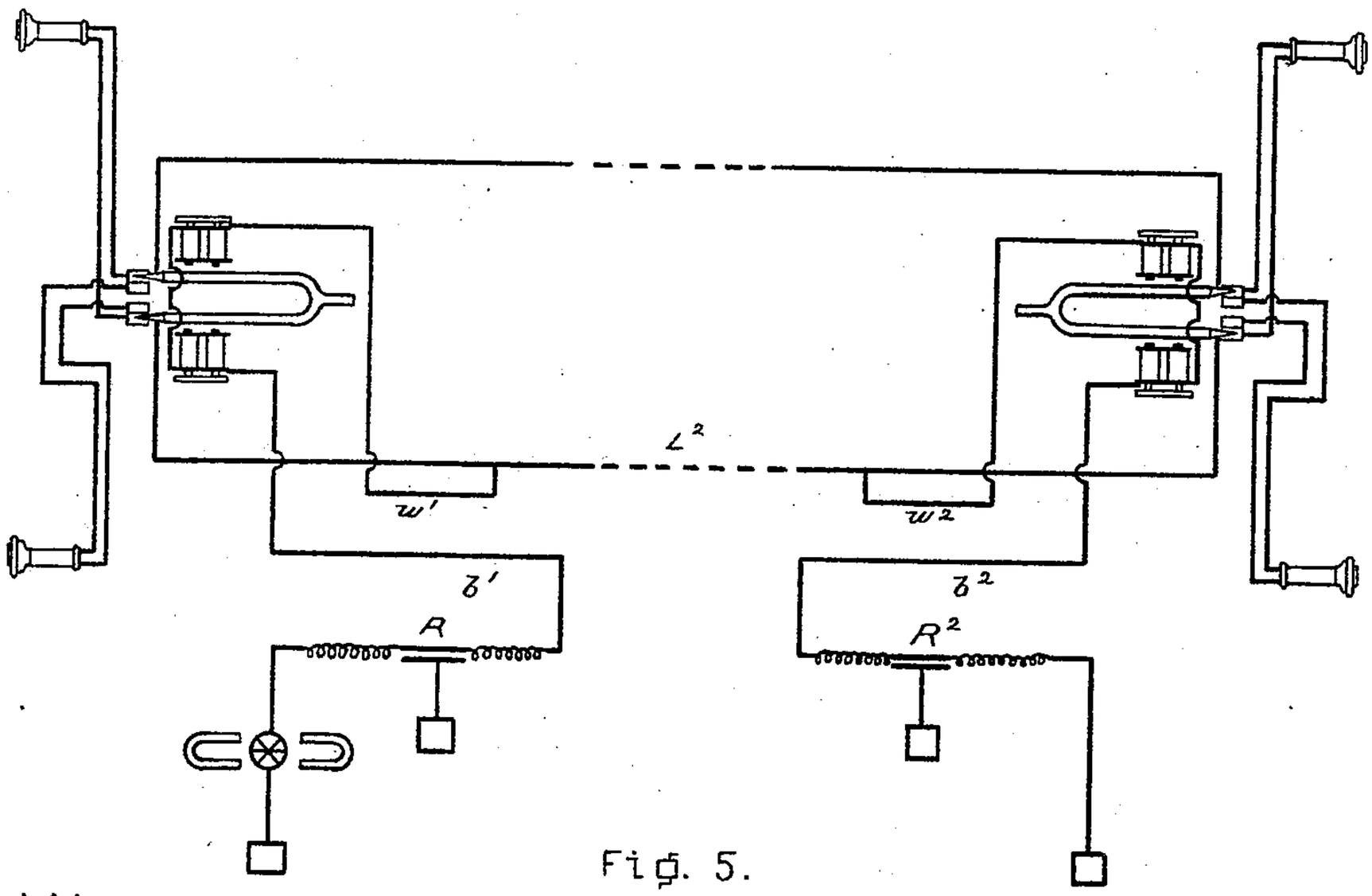

Fig. 5.

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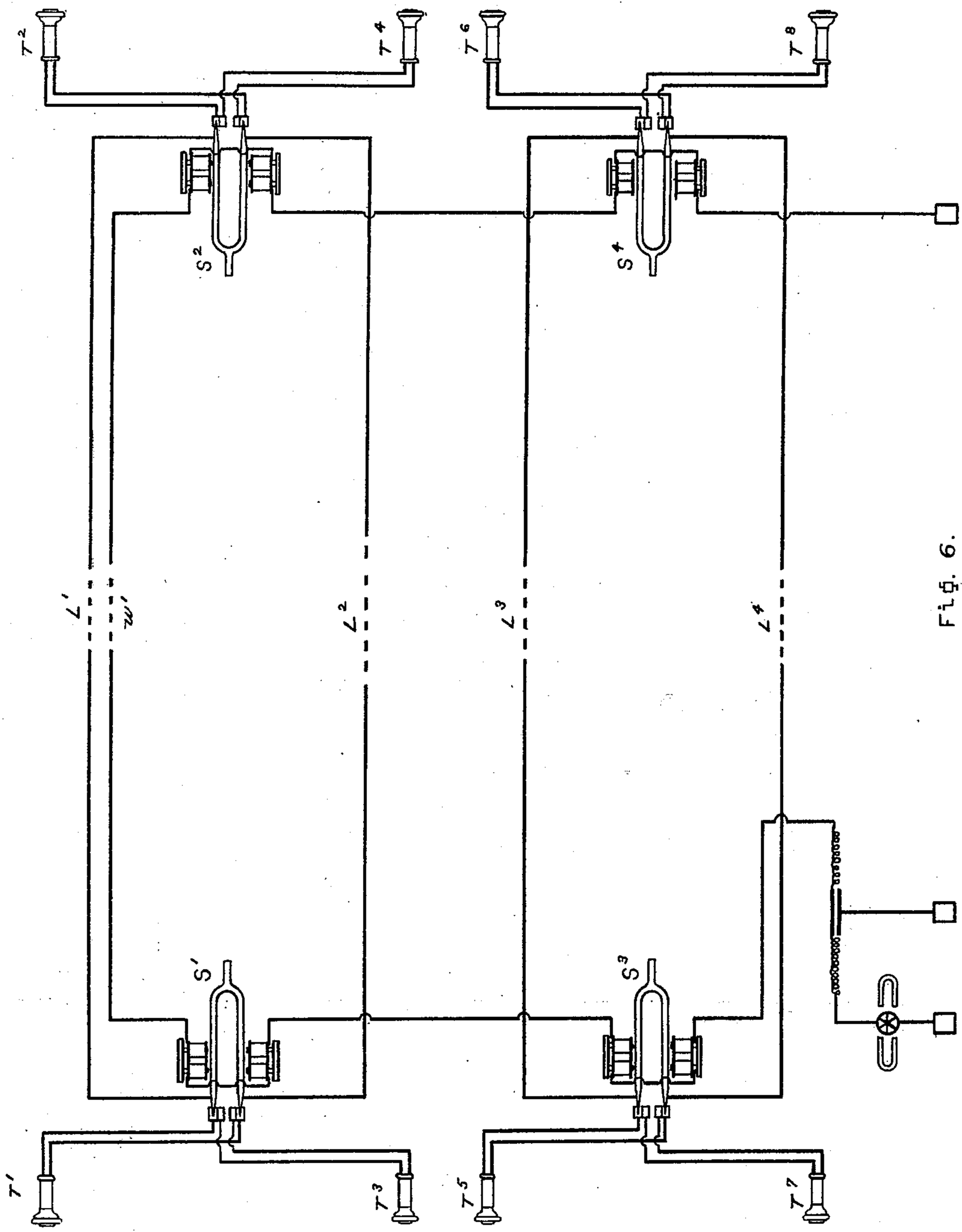

Fig. 6.

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MULTIPLEX TELEPHONY.

No. 518,367. Patented Apr. 17, 1894.

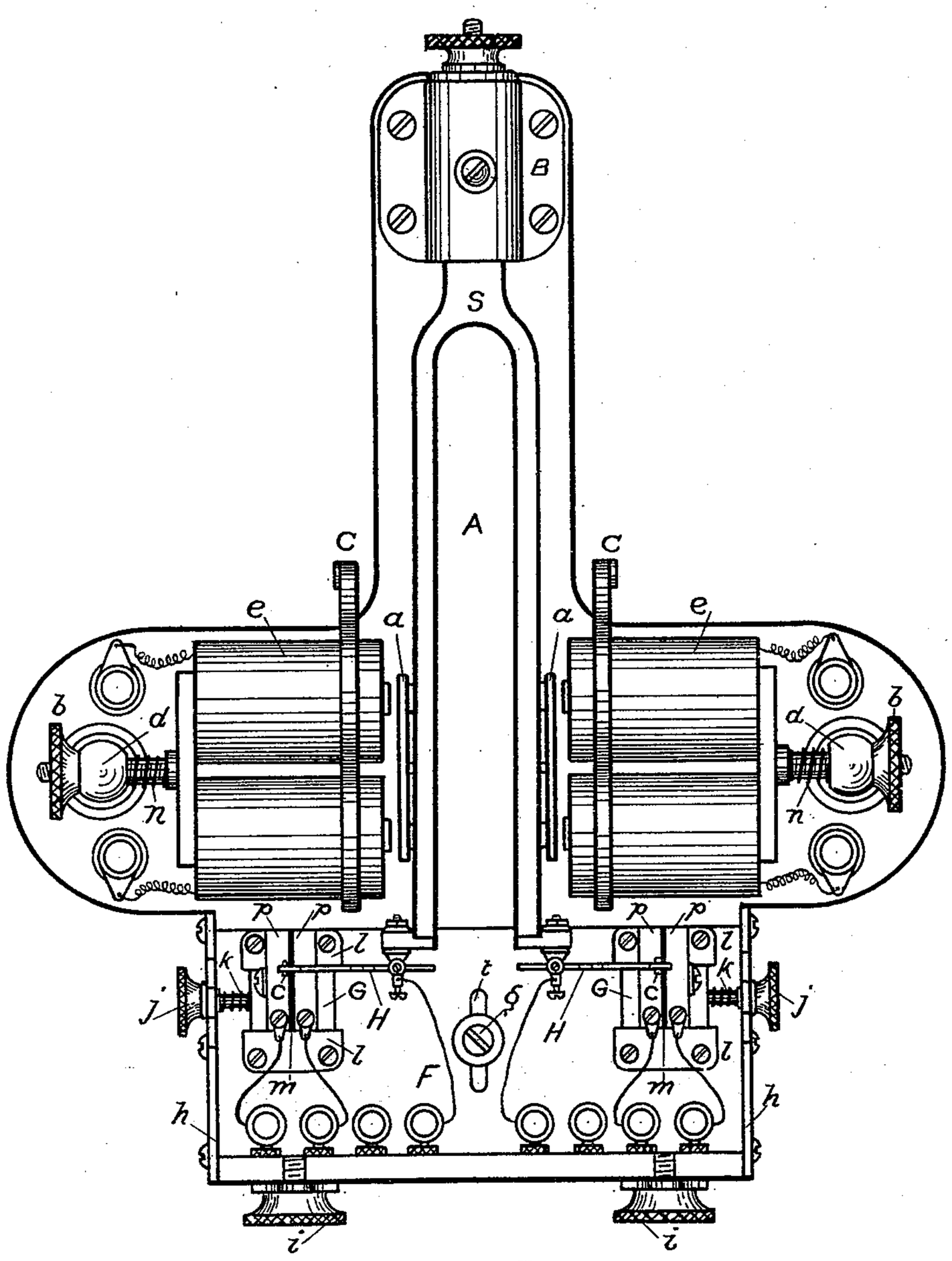

Fig. 7.

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UNITED STATES PATENT OFFICE.

WILLIAM W. JACQUES, OF NEWTON, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

MULTIPLEX TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 518,367, dated April 17, 1894.

Application filed November 22, 1893. Serial No. 491,675. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. JACQUES, of Newton, in the State of Massachusetts, have invented an Improvement in Multiple Telephony, of which the following is a specification.

It is a well known fact in physiological acoustics that a sound falling upon the human ear for a minute fraction of a second, for example one one-hundred-and-fifty-thousandth of a second, will be audible, while the ear will utterly fail to detect an interruption for a far greater interval, for example only one one-hundredth of a second, in a sound continuous but for said interruption. It follows from this that if articulate sounds be conveyed over a wire by means of an electric telephone, the circuit may be interrupted for a considerable portion of the time without interfering with or disturbing conversation, provided that no one interval of interruption is of sufficient duration to be noticed by the ear, for example, one one-hundredth of a second or thereabout. Taking advantage of this fact or principle I have invented a method and apparatus by which several telephonic conversations can be carried on simultaneously over one and the same line wire, or over one and the same pair of line wires in metallic circuit. The method consists in talking simultaneously into each of several transmitting telephones and meanwhile successively making and breaking a circuit over a common line wire, or pair of line wires in metallic circuit, between each of said transmitting telephones and its respective receiver at the other end of the line, so that while the circuit is established between one of said transmitters and its receiver at the other end of the line over said common line wire, or pair of line wires in metallic circuit, it is broken between the other transmitters and their respective receivers at the other end of the line, with such rapidity that the human ear will not take notice of the interruption or mutilations of the sounds received at the receivers due to the interruptions of the currents successively established, between the transmitters and their respective receivers at the other end of the line.

Broadly stated apparatus for practicing the invention consists essentially of line wire, either single and grounded or double and adapted to be used in metallic circuit, two telephones at each end of said line wire or wires, a switch at each end of said line wire or wires adapted to make and break the circuit between said line wire or wires and the telephones at the same end successively, and mechanism for vibrating said switches continuously, rapidly and synchronously. By such apparatus multiple conversation may be had intelligently over a single circuit, either grounded or metallic; but in order to practice the invention commercially, or to arrange for two simultaneous independent conversations over the same circuit, neither conversation to be disturbed by or to disturb the other, and neither conversation to be disturbed by the switching mechanism, I make use of details of construction herein set forth, which form subordinate features of my invention.

In the drawings,—Figure 1 represents in diagram a grounded telephone circuit embodying my invention, with two complete sets of telephone apparatus at each end. Fig. 2 represents a metallic circuit embodying the invention with two telephones at each end, each telephone serving both as a transmitting and receiving telephone. Fig. 3 represets a single wire or grounded circuit with three telephones at each end. Fig. 4 represents a metallic circuit embodying the invention with details of construction, as mentioned above, to prevent disturbance between two conversations or from the switching mechanism. Fig. 5 differs from Fig. 4 by showing the synchronizing mechanism in grounded wires branching from one of the wires of the metallic circuit, instead of showing it in an independent circuit. Fig. 6 represents the perfected invention as embodied in two metallic circuits. Fig. 7 is a plan view of the switching mechanism.

The same letters in the different figures indicate like parts, and numerals added to the letters have reference to the situations of like parts. Complete telephone sets are shown in but one of the figures, but it will be readily understood that the telephones shown in the other figures represent or may represent telephone sets.

In Fig. 1, L′ is a line wire common to all the telephones. T′ and T³ are telephone sets at one end of said line wire, each consisting of a transmitting telephone, a battery, an induction coil, and a receiving telephone as ordinarily used and as conventionally shown. T² and T⁴ are telephone sets at the other end of the said line. S′ is a switch at one end of said line, consisting of a vibrating reed v' and contact-plates p' p^3. S² is a similar switch at the other end of the line consisting of vibrating reed v^2 and contact-plates p^2 p^4. The secondaries of the induction coils of telephone sets T′, T², T³, and T⁴ are connected respectively with contact-plates p' p^2 p^3 p^4. When the reeds v' and v^2 are in contact with contact-plates p' and p^2 a telephone circuit is established between telephone sets T′ and T² and broken between T³ and T⁴; and when they are in contact with contact-plates p^3 and p^4 a telephonic circuit is established between telephone sets T³ and T⁴ and broken between T′ and T². And if the reeds are vibrated at the rate of about one hundred times per second, continuous telephonic conversation can be carried on between T′ and T² and at the same time between T³ and T⁴, neither conversation interfering with the other.

Any suitable mechanism or mechanisms may be employed within my invention, broadly considered, for shifting the two switches synchronously. In the drawings I show the two reeds as the armatures of two polarized relays operated by a common alternating current dynamo machine. Thus D is the dynamo, e' e^3 the polarized magnets having reed v' for an armature, and e^2 and e^4 are the polarized magnets having reed v^2 for an armature, while w' is the conducting wire of the synchronizing system.

In Fig. 2 where the invention is represented as embodied in apparatus employing metallic circuits single telephones are shown instead of telephone sets, and the construction and arrangement of apparatus is such that telephones T′ and T² may alternately be connected and disconnected in metallic circuit and so also telephones T³ and T⁴. L′ and L² are two line wires forming, when connections are made as directed, the main part of a metallic circuit. S′ and S² are switches placed respectively at the two ends of the metallic circuit and synchronously operated by a dynamo and polarized magnets as before described. The vibrating reed of each switch, v' or v^2, carries two contact-points insulated from each other, c' and c^3 being attached to read v', and c^2 and c^4 being attached to read v^2. Line L′ terminates in contact-points c' and c^2, and line L² terminates in contact points c^3 and c^4. Each contact-point vibrates over two contact-plates, c' over p' and p^3; c^2 over p^2 and p^4; c^3 over p^5 and p^7; c^4 over p^6 and p^8. Telephone T′ is connected up between contact-plates p' and p^5; telephone T² between contact-plates p^2 and p^6; telephone T³ between contact-plates p^3 and p^7; and telephone T⁴ between contact-plates p^4 and p^8. When contact-points c' and c^2 are in contact with contact-plates p' and p^2, contact points c^3 and c^4 will be in contact with contact-plates p^5 and p^6 and there is a metallic telephone circuit as follows: from telephone T′ to contact-plate p', contact-point c', wire L, contact-point c^2, contact-plate p^2, telephone T², contact-plate p^6, contact-point c^4, wire L², contact-point c^3, contact-plate p^5 back to telephone T′. The other or alternate circuit is obvious.

In Fig. 3 hand telephones are shown as taking the place of the telephone sets of Fig. 1, three being shown at each end of the circuit. There are at each end an equal number of contact-plates, p' p^3 and p^5 corresponding to telephones T′ T³ and T⁵ at one end of the line wire, and p^2 p^4 p^6 corresponding to telephones T² T⁴ T⁶ at the other end. The circuits are obvious. The reeds should be vibrated at such rate as not to be absent from contact with any one contact-plate for more than one one-hundredth of a second.

In Fig. 4 is shown in diagram an apparatus embodying the invention as adapted to commercial use. Two improvements upon the apparatus of the preceding figures are represented. The first of these consists in the substitution for the vibrating reeds at each end of the circuit, of two approximately synchronous tuning forks, and in the employment with said tuning forks of a dynamo whose currents are approximately synchronous with the normal rate of vibration of the tuning forks. The arms of the tuning forks are made to do the office of continuously vibrating switches, being set and kept in vibration by the electro-magnets shown, which receive impulses of current from the dynamo synchronous as near as may be with the rate of vibration of the vibration of the tuning forks. The second improvement consists in the use of an inductive resistance in the synchronizing circuit to prevent the noise of the dynamo from being heard in the telephone circuits. Accordingly in Fig. 4, S′ is a tuning fork, one arm of which carries a contact-point c' that vibrates over and upon contact-plates p' and p^3, while the other arm carries a contact-point c^3 that vibrates over and upon contact-plates p^2 and p^4; and in like manner S² is a tuning fork at the other end of the metallic circuit L′ L² having the same rate of vibration as the tuning fork S′, and having at the ends of its arms contact points c^2 and c^4 to vibrate respectively over contact-plates p^2 p^4 and p^6 p^8. The connections of the telephones with the said contact-plates are, as shown, such that, when the arms of the tuning forks open one of the telephones at the same end of the line as the tuning fork is thrown upon the line, while its mate at the same end is disconnected, but is itself disconnected while its said mate is thrown upon the line, when the arms of the tuning fork close upon each other. The magnets e' e^3 and e^2 e^4 in the synchronizing circuit w' are not polarized. D

is the dynamo and R is an inductive resistance in said synchronizing circuit, consisting of a Muirhead condenser with an electro-magnet on either side, substantially as described in my Patent No. 485,279.

Fig. 5 shows the same arrangement of apparatus that is shown in Fig. 4, except that the inductive resistance R is placed in a synchronizing circuit, b' w', branching from one of the wires L^2 of the metallic circuit instead of an independent synchronizing circuit. In this case also a second inductive resistance R^2 is placed in a branch synchronizing circuit b^2 w^2 at the other end of the telephone circuit. The dynamo machine though shown in branch b' w' may be in either branch.

Fig. 6 represents the invention as embodied in two metallic circuits with a single synchronizing circuit. Each circuit taken by itself is the same as the circuit shown in Fig. 4.

Fig. 7 is a plan view of the switch mechanism as actually constructed. In Fig. 7 A is the bed-plate, S is the tuning fork clamped in a bracket B by screws, as shown; while *e e* are electro-magnets supported in spectacle frames C C and adjustable two and from armatures *a a*, mounted upon but insulated from the arm of the tuning fork by screws *b*, *b*, working through posts *d d*, and screws *n n*, as shown. F is a sliding plate of insulating material held by means of slot and screw *g* between ways *h h* at the front of the bed-plate A and having an adjustment to and from the front ends of the tuning fork by means of screws *i i*. The said sliding plate F at each end carries a block G of insulating material having a to and fro motion by means of screw *j* and spring *k* in ways *l*, also of insulating material, which are screwed to the bed-plate. The blocks G G′ carry each two contact-plates *p p* which are separated by a thin mica plate *m*. H H are rods adjustable lengthwise on the front ends of the arms of the tuning fork and carry each a contact-point *c* which by the vibrations of the tuning fork is given a rapid reciprocating motion over the contact-plates *p p* and mica plate *m*. The connections are sufficiently indicated in the diagrams.

I claim—

1. The herein described method of carrying on multiple telephonic conversation, or several telephonic conversations at the same time over the same line wire, or over the same pair of line wires in metallic circuit, consisting in talking into each of two or more transmitting telephones and meanwhile successively making and breaking a circuit between said transmitting telephones and their respective receivers at the opposite end of the line, so that while a circuit is established between one of said transmitters and its receiver at the opposite end of the line, the circuit is broken between the other transmitter and its corresponding receiver, or between the other transmitters and their corresponding receivers, with such rapidity that the human ear will not notice the interruptions or mutilations of sounds received at the receivers due to the interruption of the currents successively established between the transmitters and their respective receivers.

2. The combination with a telephone circuit, whether grounded or metallic, and two telephones or telephone sets at each end of said telephone circuit, of two vibrating switches, one also at each end of said circuit adapted to connect and disconnect therewith each of said telephones or telephone sets at the same end at every vibration, and mechanism for vibrating said switches synchronously and with a rapidity, substantially as described.

3. The combination with line wires adapted to be used in metallic telephone circuit or circuits, telephones or telephone sets at each end of each pair of said line wires, and switches at each end of each pair of line wires, each said switch being adapted to connect and disconnect two of said telephones or telephone sets with a pair of said line wires, of a synchronizing circuit, either independent or branching from said telephone circuits, and a dynamo machine and electro magnets in said synchronizing circuit adapted to operate and synchronize said switches, said switches being vibrated with a rapidity substantially as described.

4. The combination with line wires adapted to be used in metallic telephone circuit or circuits, telephones or telephone sets at each end of each pair of said line wires, and switches at each end of each pair of line wires, each said switch being adapted to connect and disconnect two of said telephones or telephone sets with a pair of said line wires, of a synchronizing circuit, either independent or branching from said telephone circuits, electro-magnets and a dynamo machine in said synchronizing circuit for operating with the rapidity indicated and synchronizing said switches, and an inductive resistance in said synchronizing circuit, substantially as described.

5. A metallic telephone circuit or circuits, tuning forks having a uniform rate of vibration of a rapidity such as specified, there being one of said tuning forks at each end of each of said circuits and the two wires of each of said circuits terminating each at each end in an insulated contact-point carried by a separate arm of the tuning fork at the same end, and telephones or telephone sets in pairs and corresponding contact-plates in double pairs at each end of each of said circuits, the said insulated contact-points on said tuning forks being adapted to vibrate each over two of said contact-plates, in combination with a synchronizing circuit either independent or branching from one of said telephone circuits containing electro-magnets, one for each arm of said tuning forks, and a dynamo machine

adapted to send impulses corresponding to the rate of vibration of said tuning forks, substantially as described.

6. A metallic telephone circuit or circuits, tuning forks having a uniform rate of vibration of a rapidity such as specified, there being one of said tuning forks at each end of each of said circuits and the two wires of each of said circuits terminating each at each end in an insulated contact-point carried by a separate arm of the tuning fork at the same end, and telephones or telephone sets in pairs and corresponding double pairs of contact-plates at each end of each of said circuits, the said insulated contact-points on said tuning forks being adapted to vibrate each over two of said contact-plates, in combination with a synchronizing circuit, either independent or branching from one of said telephone circuits, containing electro-magnets, one for each arm of said tuning forks, a dynamo machine adapted to send impulses corresponding to the rate of vibration of said tuning forks, and an inductive resistance, substantially as described.

7. The combination with a metallic telephone circuit, two pairs of telephones or telephone sets, one of said pairs at either end of said telephone circuit, two tuning forks of the same rate of vibration such as hereinbefore specified, one of them also at either end of said telephone circuit and suitable contacts whereby the telephones or telephone sets at either end of said circuit may be connected and disconnected therewith by the vibrations of the said tuning fork at the same end, of a synchronizing circuit containing electro-magnets and a dynamo machine adapted to send impulses corresponding to the rate of vibration of said tuning forks, 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 November, 1893.

WILLIAM W. JACQUES.

Witnesses:
B. L. RUGGLES,
GEO. WILLIS PIERCE.