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PATENTED FEB. 23, 1904.

P. O. PEDERSEN.

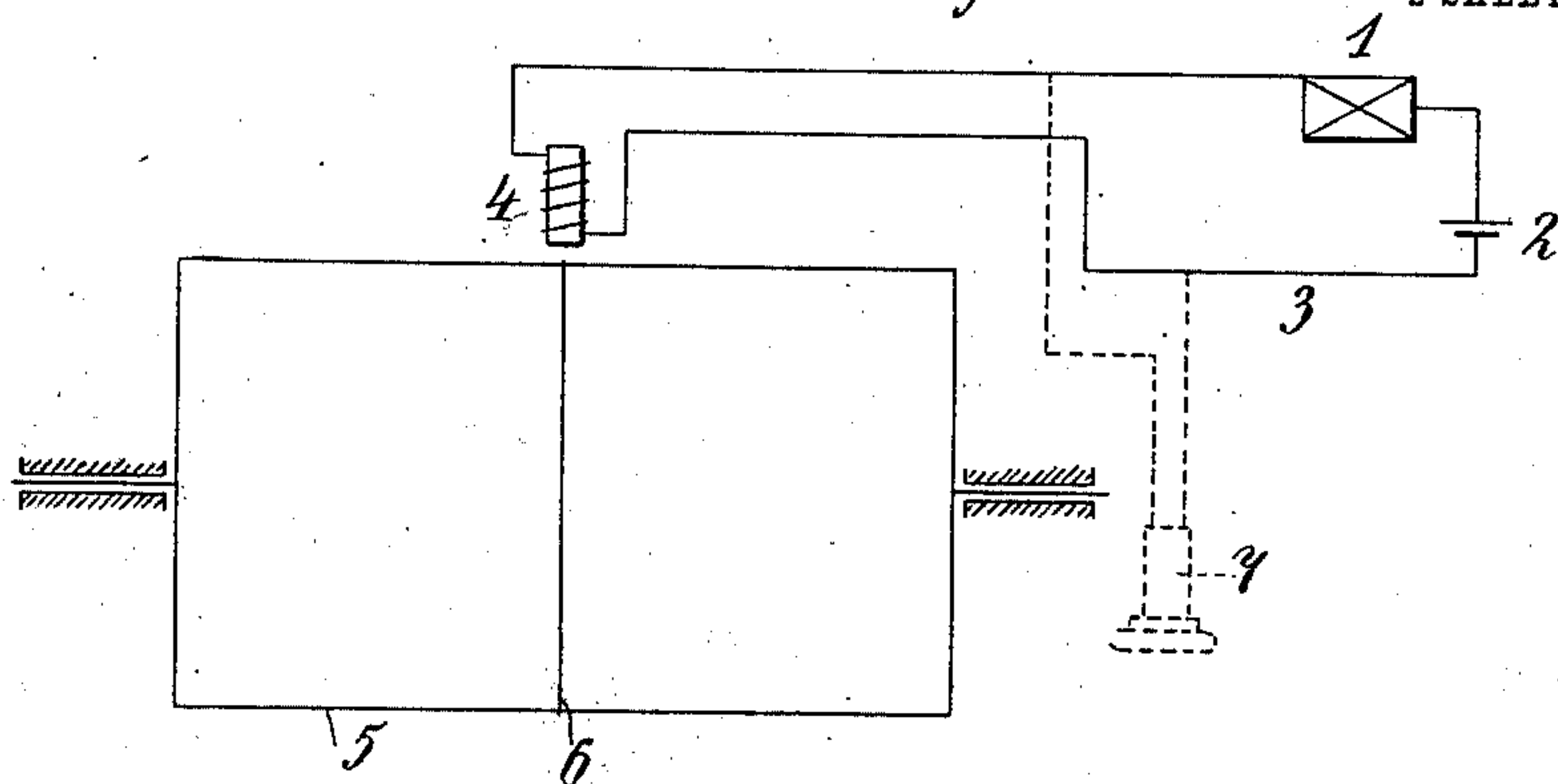
ELECTROMAGNETIC SWITCH DEVICE FOR APPARATUS FOR MAGNETICALLY RECORDING AND STRENGTHENING THE REPRODUCTION OF SPEECH, &c.

APPLICATION FILED JUNE 21, 1901.

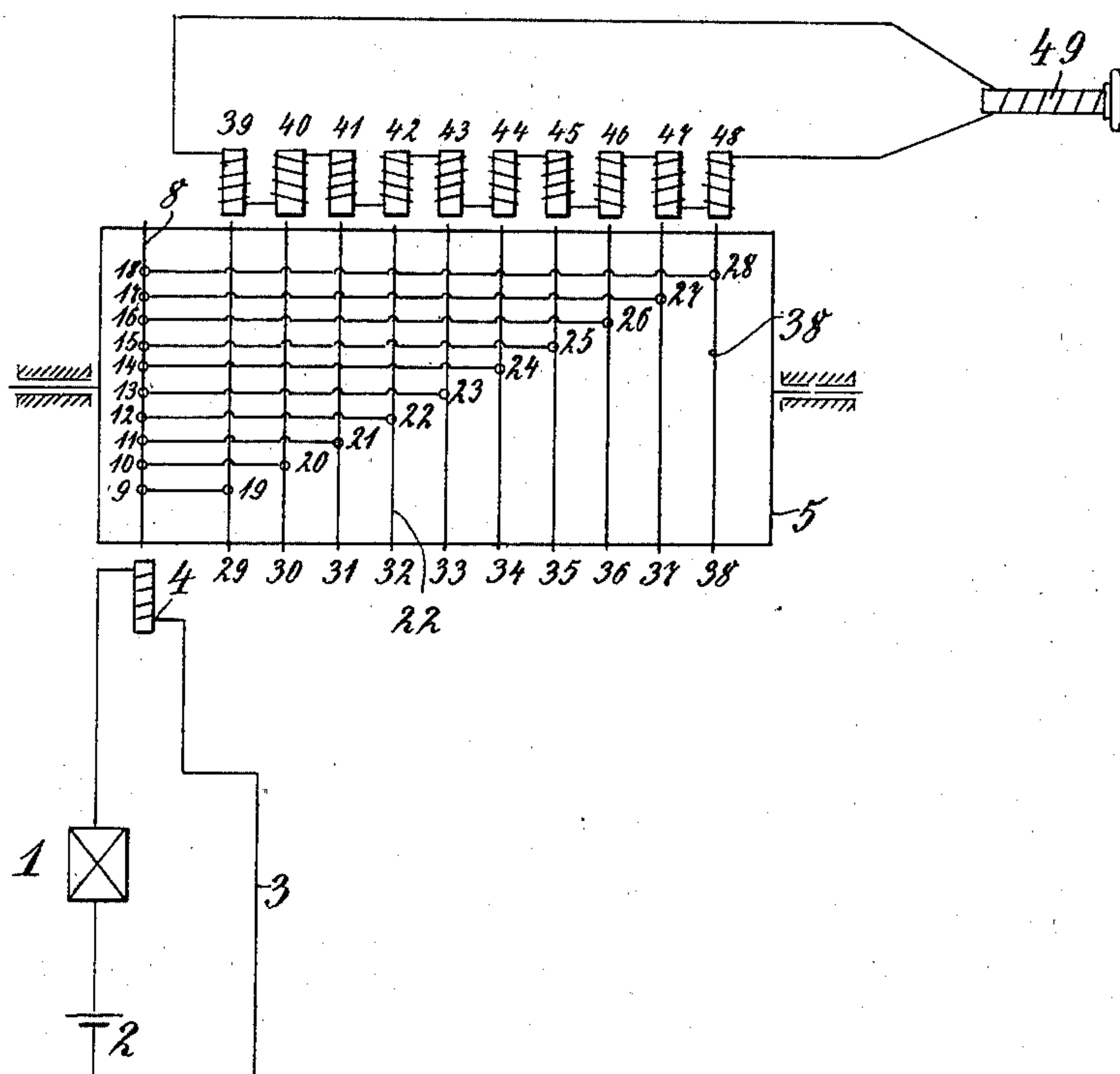
NO MODEL.

*Fig. 1.*

2 SHEETS—SHEET 1.



*Fig. 2.*



Witnesses  
Waldo M. Chapin  
Frank S. Ober

Inventor  
Peder O. Pedersen  
by *Wm. A. Rembaum*  
att'y.

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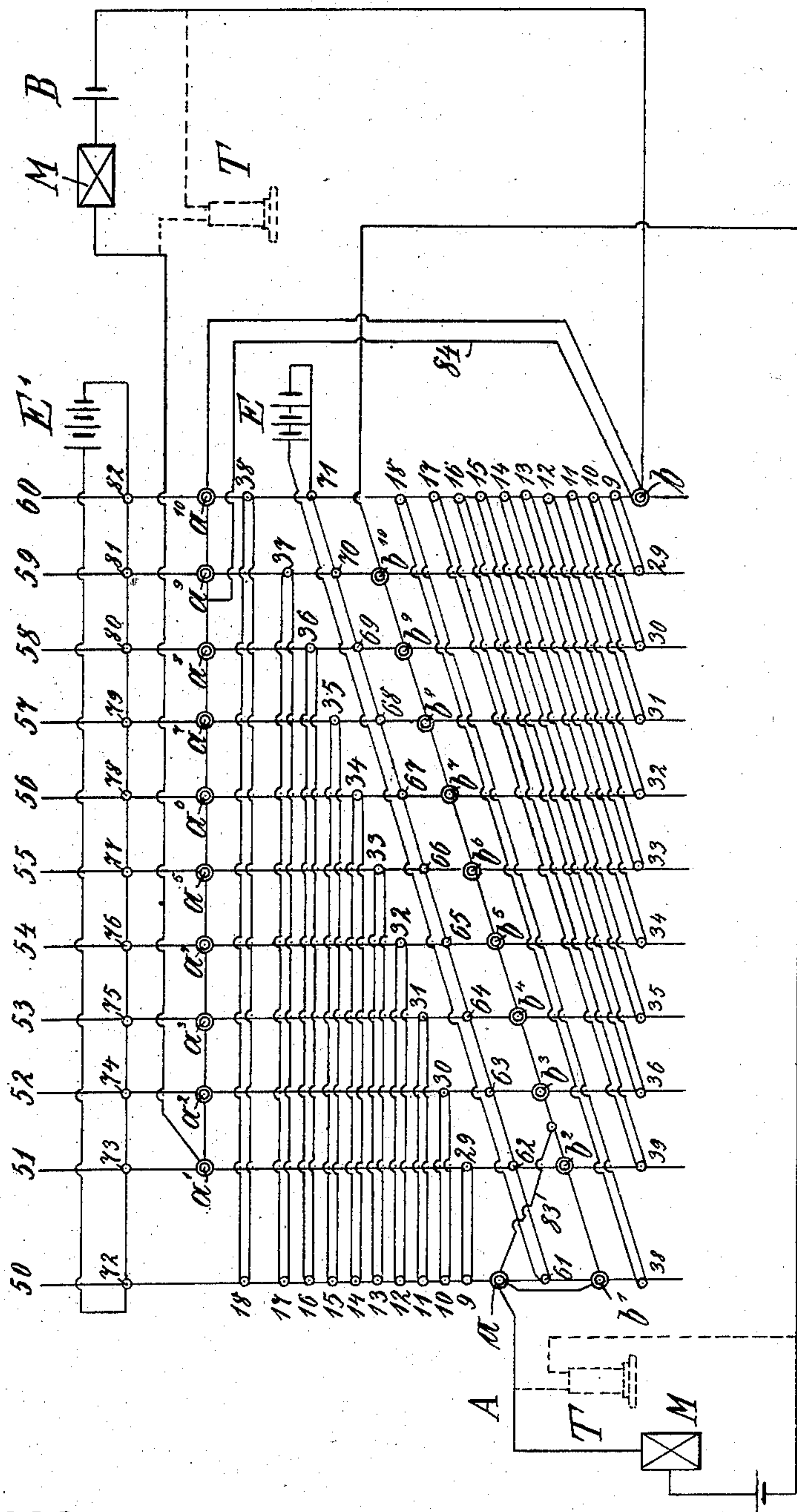
ELECTROMAGNETIC SWITCH DEVICE FOR APPARATUS FOR MAGNETICALLY  
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NO MODEL.

2 SHEETS—SHEET 2.

Fig. 3.



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# UNITED STATES PATENT OFFICE.

PEDER OLUF PEDERSEN, OF COPENHAGEN, DENMARK.

ELECTROMAGNETIC SWITCH DEVICE FOR APPARATUS FOR MAGNETICALLY RECORDING AND STRENGTHENING THE REPRODUCTION OF SPEECH, &c.

SPECIFICATION forming part of Letters Patent No. 752,858, dated February 23, 1904.

Application filed June 21, 1901. Serial No. 65,422. (No model.)

*To all whom it may concern:*

Be it known that I, PEDER OLUF PEDERSEN, a subject of the King of Denmark, residing at Copenhagen, in the Kingdom of Denmark, have invented certain new and useful improvements in and relating to electromagnetic switch devices for apparatus for magnetically recording and strengthening the reproduction of speech and such like, of which the following is a specification.

My present invention has reference to apparatus which enable speech, messages, signals, or the like to be magnetically recorded and reproduced at any desired time.

Figure 1 is a conventional representation of an apparatus for recording and reproducing messages and signals represented by electrical impulses. Fig. 2 is a conventional representation of an apparatus for augmenting the reproduction of the recorded messages or signals, and Fig. 3 is a conventional representation of my improvement upon the device illustrated in Fig. 2.

Fig. 1 is a diagram illustrating the principle on which such apparatus are based. On speaking into the transmitter 1 magnetic conditions will be produced in the electromagnet 4 corresponding to the variations of the electric current in the conductor 1 2 3 4 which correspond with the matter spoken. If while the electromagnet 4 is thus excited a wire 6, of steel or other magnetizable material, wound on a cylinder 5, for example, so as to form a ring, is moved relatively to the electromagnet by rotating the cylinder, magnetic conditions will be produced in this wire 6 corresponding with the matter spoken into the transmitter 1. If now the transmitter 1 is switched out of the circuit and the electromagnet 4 is connected to a telephone-receiver 7, as shown in dotted lines in Fig. 1, the matter previously spoken into the transmitter 1 will be reproduced in the telephone-receiver 7 if the wire 6 is again moved relatively to the electromagnet 4. In order to strengthen the reproduction of speech, messages, signals, and the like recorded in this manner, the arrangement set forth in Fig. 2 has been proposed. On rotating the cylinder 5 the matter spoken into the transmitter 1 will

be transferred by the electromagnet 4 to the wire 8, of steel or other magnetizable material wound in the form of a ring on the cylinder 5, and produce magnetic conditions in this wire in exact accordance with the matter spoken. In contact with the wire 8 is provided a number of electromagnets 9 18, each of which is connected by a conductor with corresponding electromagnets 19 28, each of which is in contact with one of a number of wire rings 29 38. When the cylinder 5 rotates, each of these wire rings 29 38 will be magnetized in accordance with the matter spoken, so that the electromagnets 39 48, which are connected together in series, will receive the spoken matter from the wires 29 38 and deliver it to the telephone-receiver 49, where the previously-spoken matter is reproduced in an augmented degree.

The object of my invention is to arrange an apparatus of this kind in such a manner that it can be connected with two telephone-lines, each of which is connected to a transmitter and receiver, so that from each station speech, messages, signals, or the like may be delivered to or received from the other station by using a single apparatus. In order to obtain this end, a special system of connecting the necessary electromagnets is required, which is illustrated in Fig. 3. In this figure eleven wires 50 60 are represented. These wires are supposed to be wound in the form of closed rings on a cylinder. In contact with the wire 50 is provided the recording-electromagnet *a* of the station A, and in contact with the wire 60 is provided an electromagnet *b*, which belongs to the station B. Corresponding to the electromagnet *b* is provided a number of electromagnets *b'* *b''*, which form the receiving-electromagnets and transfer the matter communicated by the electromagnet *b* to the wire 60 in an augmented degree to the station A. The matter received by the electromagnet *b* from the station B and recorded on the wire 60 will be strengthened in its reproduction in the station A, while the matter received from the station A by the electromagnet *a* and recorded on the wire 50 will be reproduced in the station B in an augmented degree by the elec-



tromagnets  $a' a^{10}$ , which bear on the wires 51 60. In order to strengthen the reproduction, the speech, messages, or other matter recorded on the wire 50 is communicated in the manner already explained with reference to Fig. 2 to the wires 51 60 by means of a number of electromagnet pairs 9 18 and 29 38. Matter recorded by the electromagnet  $a$  will be transmitted in an augmented condition by the electromagnets  $a' a^{10}$  and reproduced in the station B, while, on the other hand, matter received from the station B, which will be recorded on the wire 60 by the electromagnet  $b$ , is communicated to the wires 50 59 by the action of the electromagnet 9 18 and 29 38 and then reproduced by the electromagnets  $b' b^{10}$  in the conductor leading to the station A. Between the rows of electromagnet  $a$  29 38 and the rows of electromagnets  $b' b^{10}$  is provided a number of electromagnets 61 71, which are connected with the battery or other source of electricity E. This battery E delivers a continuous current to the electromagnets 61 71, so that the wires of magnetizable material charged with the spoken matter are demagnetized on passing these electromagnets, and the wires can consequently be used for a new record. It is assumed that the cylinder carrying the wires is moved in the direction of the arrow. A second series of electromagnets 72 82 is provided, which is connected with a battery or other source of continuous current electricity E', so that the wires 50 60 in passing these electromagnets are likewise demagnetized.

The essential feature of the system of connection is that the recording electromagnet  $a$  which receives speech, messages, &c., from the station A is connected in series with the receiving-magnets  $b'$  to  $b^{10}$ , which are designed to reproduce in the station A the matter recorded by the magnet  $b$ , and that from the electromagnet  $a$  there is a branch conductor 83, which is connected between two of the electromagnets  $b' b^{10}$ . Corresponding to these connections the electromagnet  $b$  is connected in series with the electromagnets  $a' a^{10}$  and connected by a branch circuit 84 with a point between two of the electromagnets  $a' a^{10}$ . With this system of connection the following result is obtained: Assuming that somebody speaks into the transmitter of the station A, and thus excites the electromagnet  $a$  in conformity with the matter, the latter will be recorded on the wire 50. As the electromagnets  $b' b^{10}$  are connected in series with the electromagnet  $a$ , the spoken matter will likewise be transferred to the wires 51 60. On rotating the cylinder in the direction of the arrow the parts of the wire which have received the spoken matter from the electromagnets  $b' b^{10}$  will arrive under the action of the demagnetizers 61 71, so that the matter recorded from the electromag-

net  $b' b^{10}$  is wiped out before it can be taken up by the receiving-electromagnet  $a' a^{10}$ . Only that which after the reception of the speech by the electromagnet  $a$  is transferred from the wire 50 through the electromagnets 9 18 and 29 38 to the wires 51 60 will be audibly reproduced in the station B, as the said speech after being transferred by the above-mentioned electromagnet to the wires 51 60 is taken up by the electromagnet  $a' a^{10}$ . From the electromagnet  $a' a^{10}$  the speech does, indeed, arrive at the electromagnet  $b$  before it is conducted away to the station B for the purpose of being reproduced in the telephone-receiver T. However, owing to the peculiar connection of the electromagnet  $b$  with the electromagnets  $a' a^{10}$  the magnetic effects are not produced in the electromagnet  $b$ , as the branch conductor 84 causes the currents that would be produced in the electromagnet in consequence of the connection in series of this electromagnet with the electromagnets  $a' a^{10}$  to be neutralized by causing the same currents to simultaneously pass through the electromagnet  $b$  in the opposite direction. It is for this reason possible to hear without interruption in the station B what is spoken at the station A. On the other hand, however, speech received by the transmitter M of the station B can be reproduced in the station A with the system of connections illustrated. By the speech delivered to the transmitter M of the station B the electromagnet  $b$  is excited, and the speech is thus transferred to the wire 60, from which it is communicated by the electromagnets 9 18 29 38 to the wires 50 59. The electromagnets  $b' b^{10}$  take up this speech, and it is reproduced in the receiver T of the station A. In this case also no disturbance occurs, owing to the passage of the current passing through the electromagnets  $b' b^{10}$ , also through the electromagnet  $a$ , because the branch conductor 83 neutralizes the current in the electromagnet  $a$  by passing through the same in the opposite direction.

It is evident that by suitably choosing the branch line 83—that is to say, by connecting this line with a point between two suitable electromagnets of the series  $b' b^{10}$ —the effect can easily be so regulated that the currents passing through the electromagnets  $b' b^{10}$  does not produce any disturbances in the electromagnet  $a$ , as all the currents entering this electromagnet from the conductor connected in series with the electromagnet  $b' b^{10}$  can be entirely neutralized.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. The combination of two circuits each containing transmitting and receiving apparatus, a paramagnetic body adapted to receive magnetic records of electrical impulses or signals traversing either of said circuits, and means whereby the signals recorded by either of



said circuits in said body are reproduced and augmented in the other circuit, substantially as described.

2. In an apparatus for electromagnetically recording and reproducing speech and other signals, the combination of a body adapted to receive a magnetic record, two circuits each containing transmitting and receiving devices, a recording device, means for making a magnetic record in said device of the signals traversing each circuit and means for reproducing the record created by the signals of each circuit and transferring them to the other circuit, for the purpose set forth.

3. In an apparatus for electromagnetically recording and reproducing speech and other signals, the combination of a body adapted to receive a magnetic record, two circuits each containing transmitting and receiving devices, a recording-magnet and a series of reproducing-magnets in each circuit, the reproducing-magnets of one circuit being adapted to reproduce the record made by the recording-magnet of the other circuit and means whereby each recording-magnet will not record signals reproduced by the reproducing-magnets in its own circuit.

4. In an apparatus for electromagnetically recording and reproducing speech and other signals, the combination of a body adapted to receive a magnetic record, two circuits each containing transmitting and receiving devices,

a recording-magnet and a series of reproducing-magnets in each circuit, the reproducing-magnets of one circuit being adapted to reproduce the record made by the recording-magnet of the other circuit and a branch circuit connecting each recording-magnet to an intermediate point of the series of reproducing-magnets in its own circuit, whereby a counter-current traverses the recording magnet to neutralize the effect in the recording-magnet of the current reproduced by the reproducing-magnets.

5. In an apparatus for electromagnetically recording and reproducing speech and other signals, the combination of a body adapted to receive a magnetic record, two circuits each containing transmitting and receiving devices, a recording-magnet and a series of reproducing-magnets in each circuit, the reproducing-magnets of one circuit being adapted to reproduce the record made by the recording-magnet of the other circuit and means whereby the current reproduced in a given series of reproducing-magnets is divided and traverses the recording-magnet in the same circuit in opposite directions, for the purpose set forth.

In testimony whereof I have hereunto set my hand in the presence of two witnesses.

PEDER OLUF PEDERSEN.

Witnesses:

E. S. HAYEMANN,  
V. POULSEN.