

P. V. CHRISTENSEN.  
CALL DISTRIBUTING SWITCH.  
APPLICATION FILED JUNE 23, 1906.

959,462.

Patented May 31, 1910.

2 SHEETS—SHEET 1.

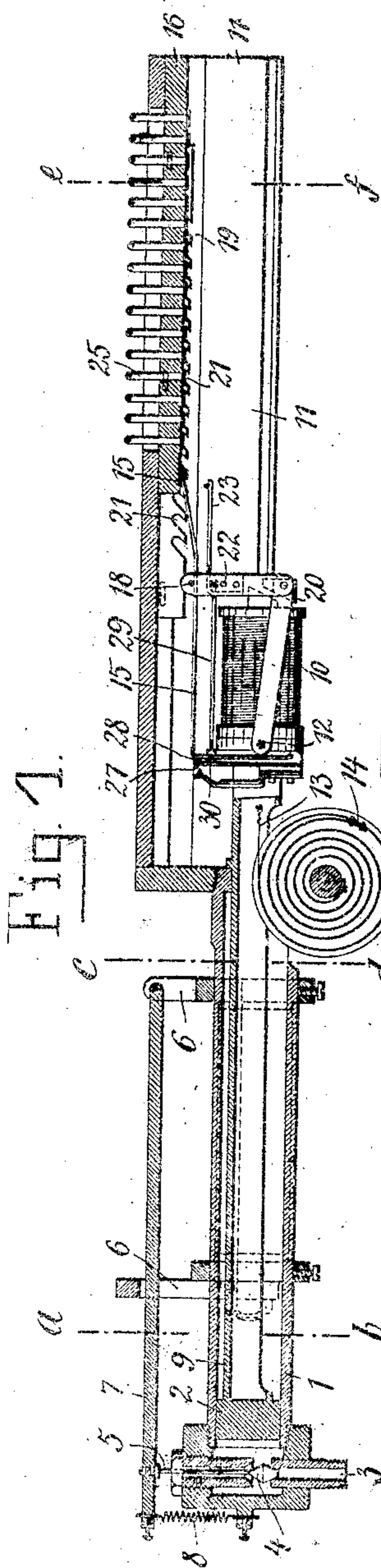


Fig. 1.

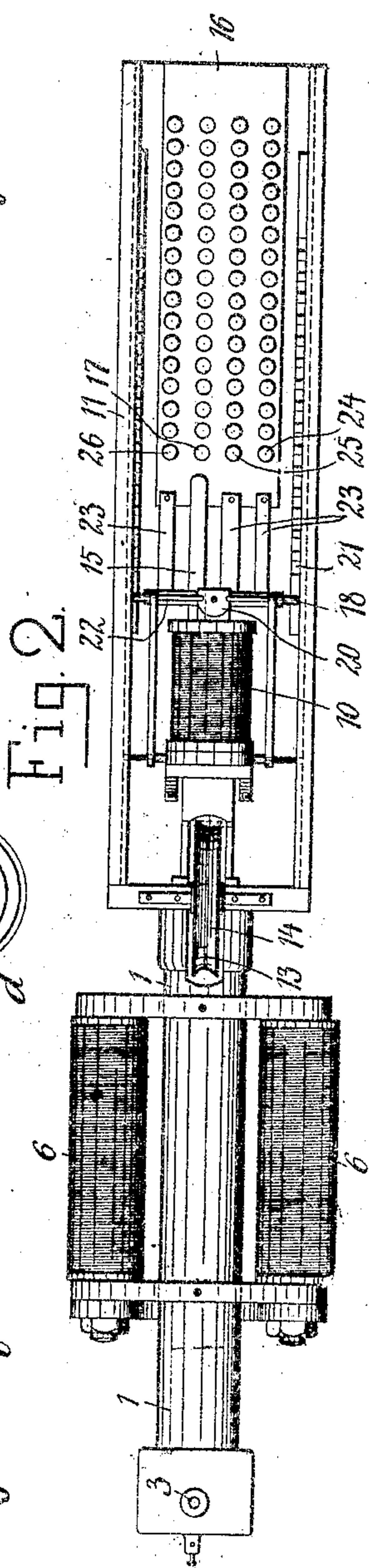


Fig. 2.

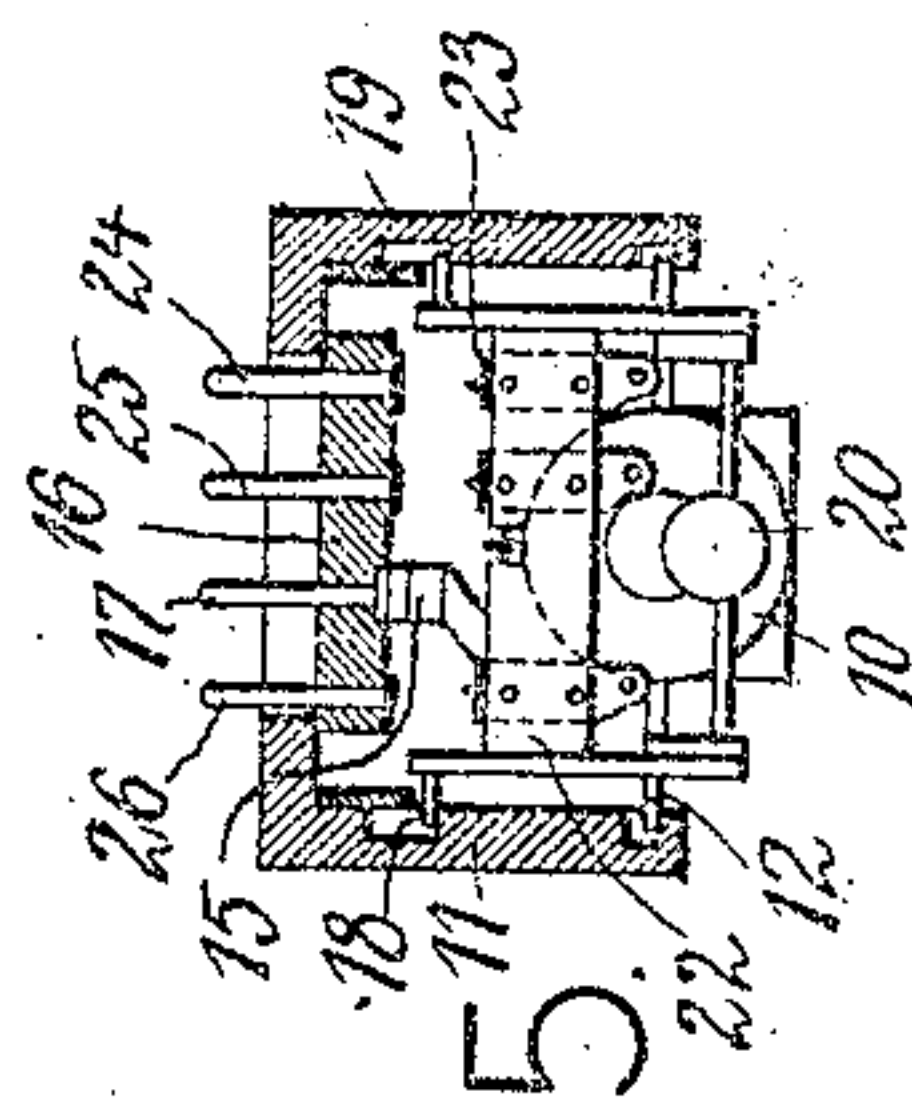


Fig. 3.

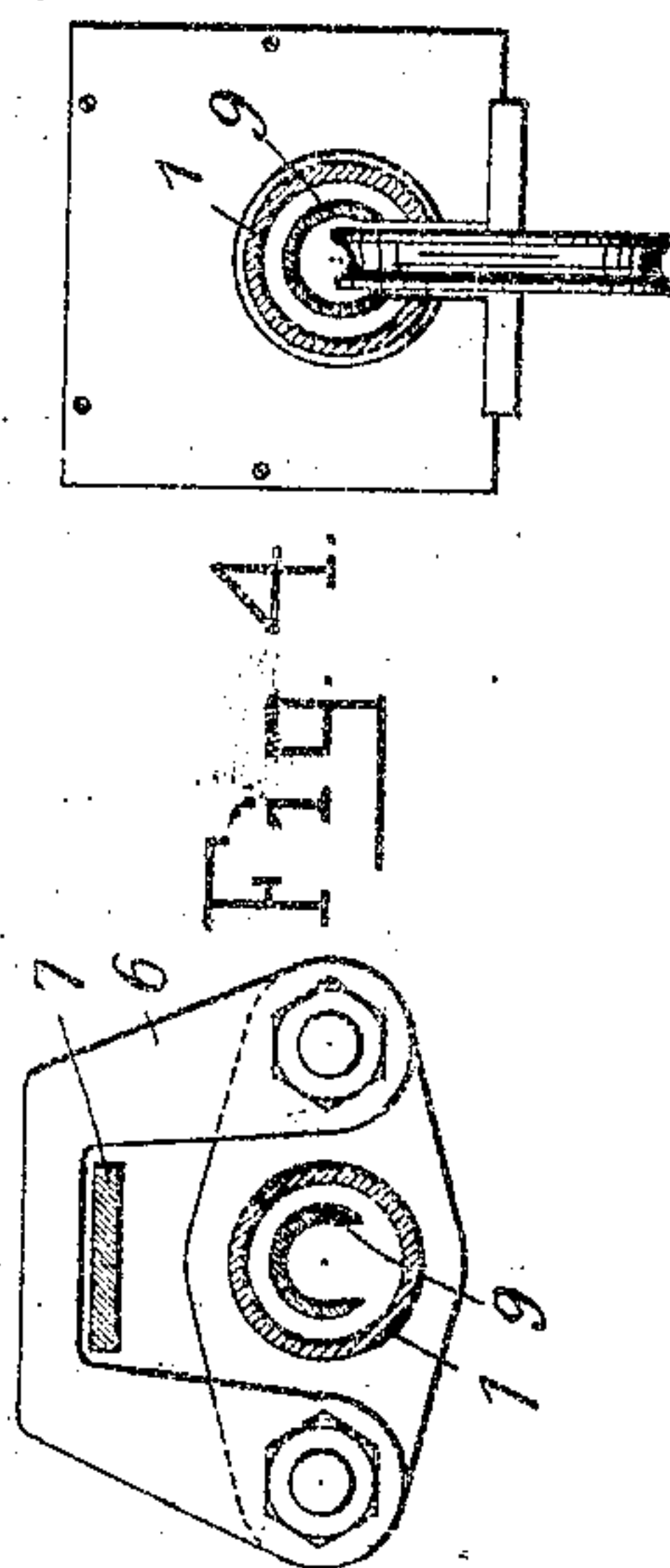


Fig. 4.

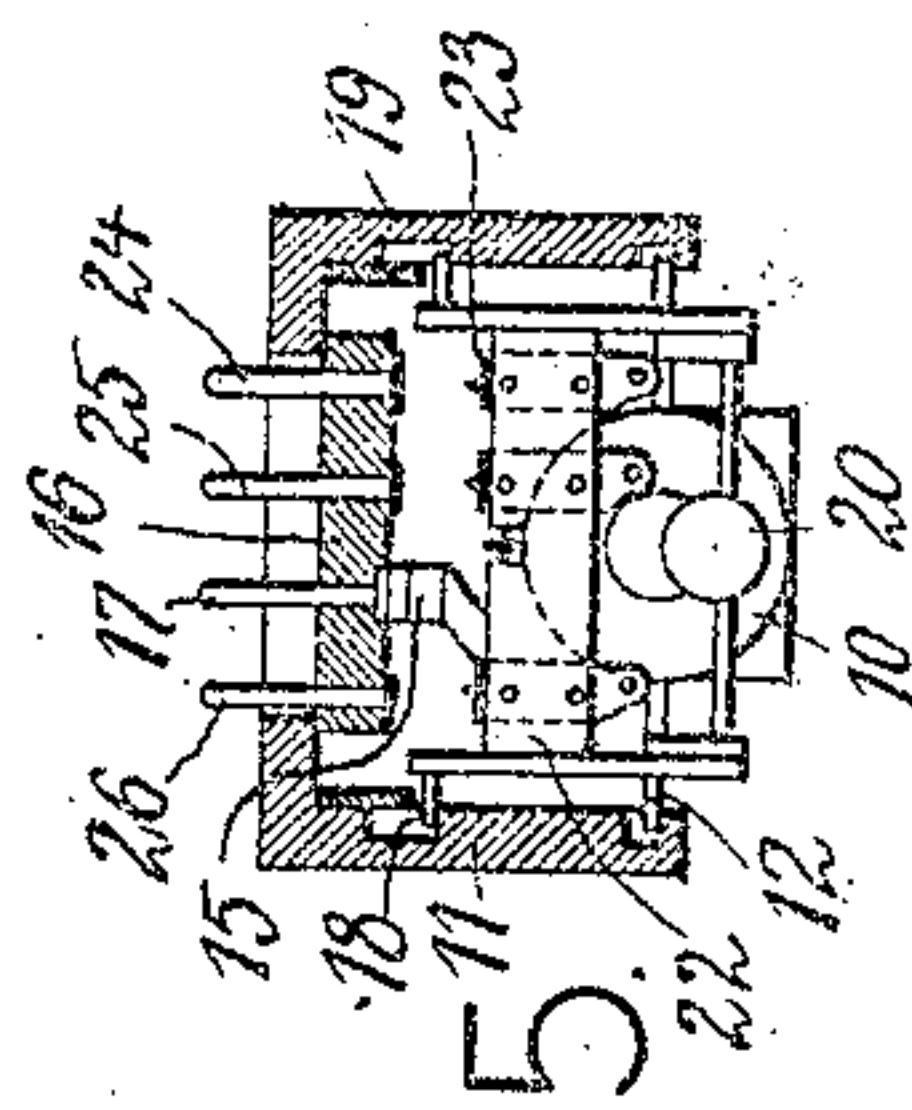


Fig. 5.

Witnesses  
J. M. Skynbrook  
H. A. Lottin.

Inventor  
Peter Valdemar Christensen  
by Knight Bros attys.

P. V. CHRISTENSEN.  
CALL DISTRIBUTING SWITCH.  
APPLICATION FILED JUNE 23, 1906.

959,462.

Patented May 31, 1910.

2 SHEETS—SHEET 2.

Fig. 6.

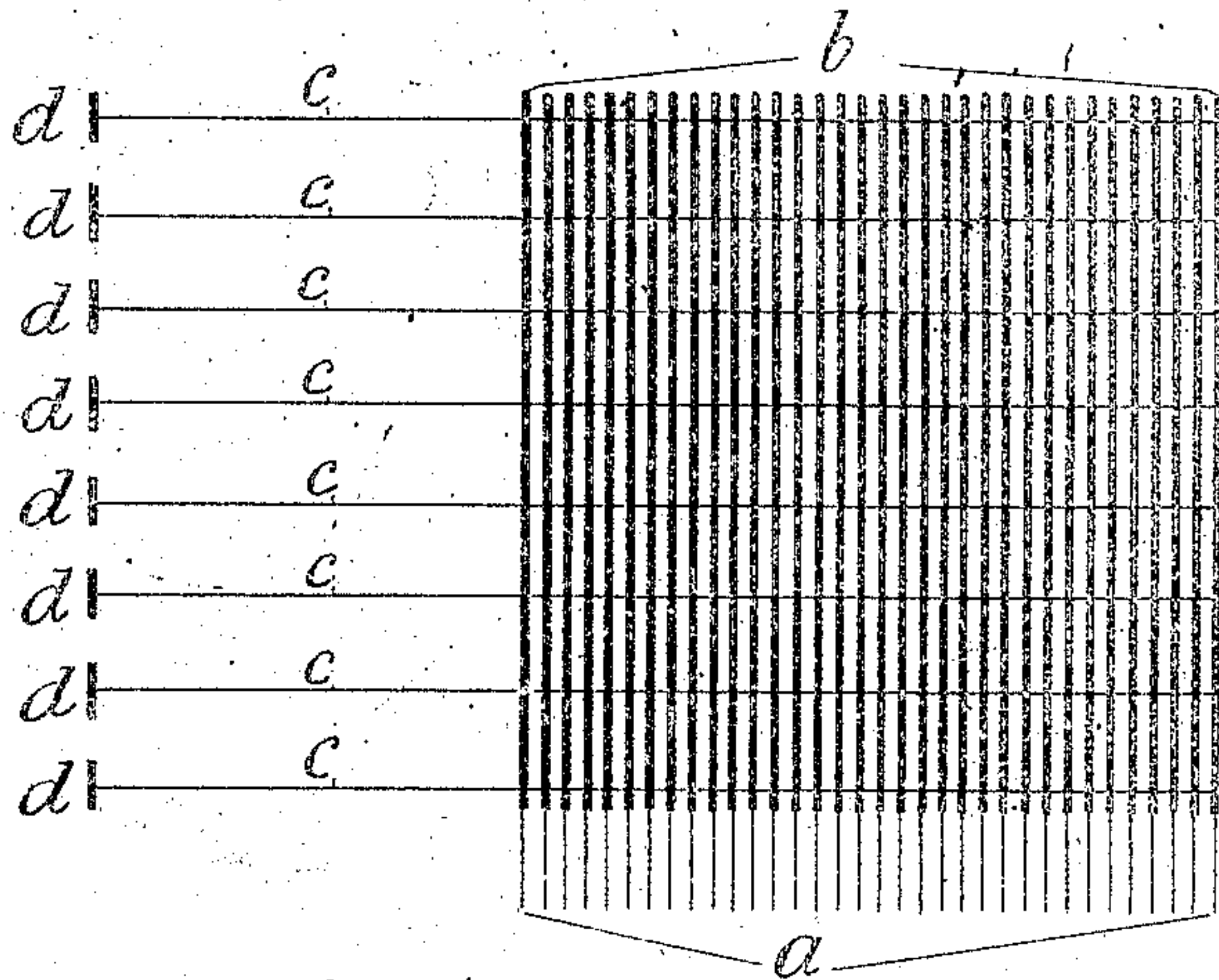


Fig. 7.

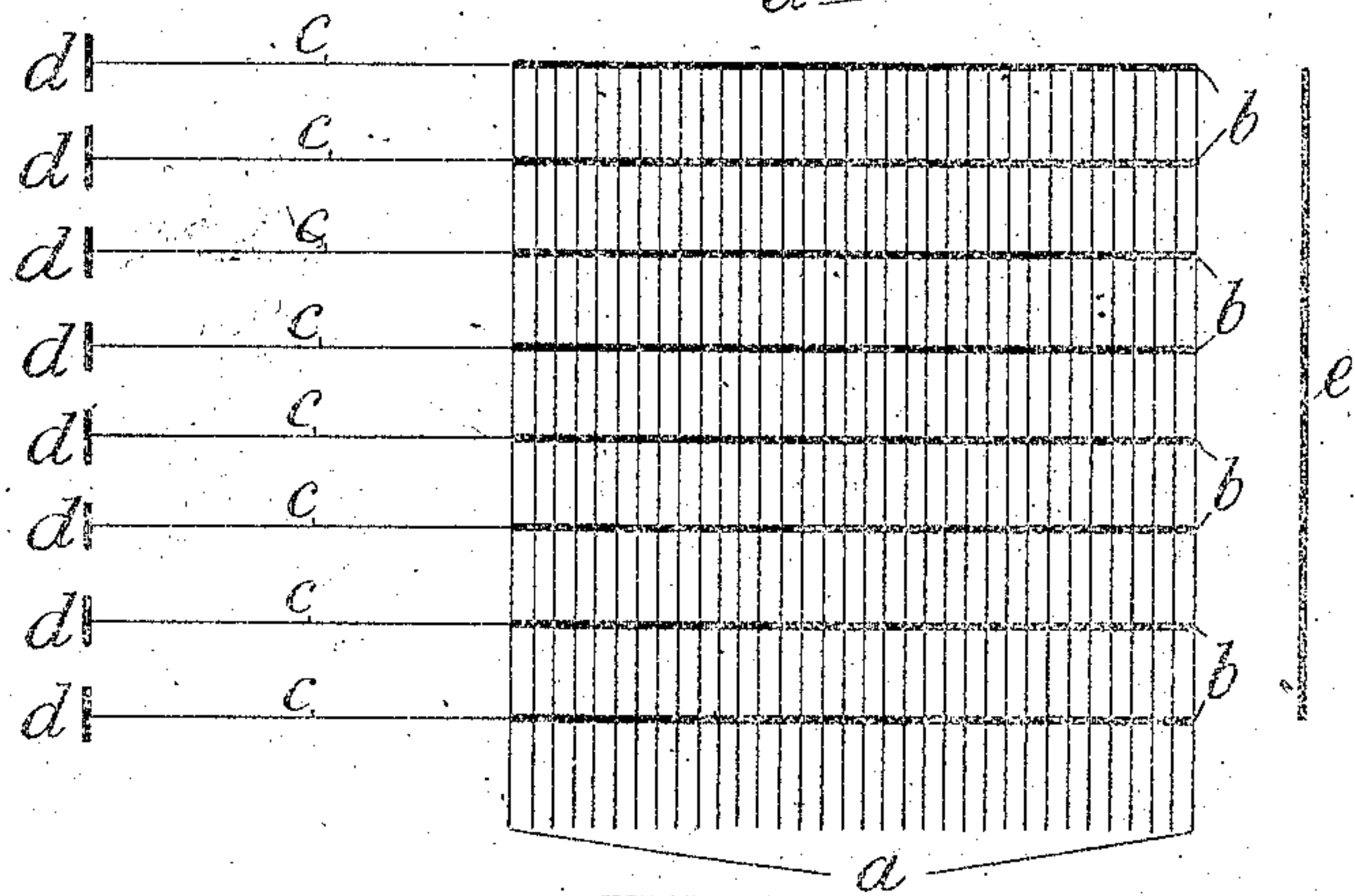
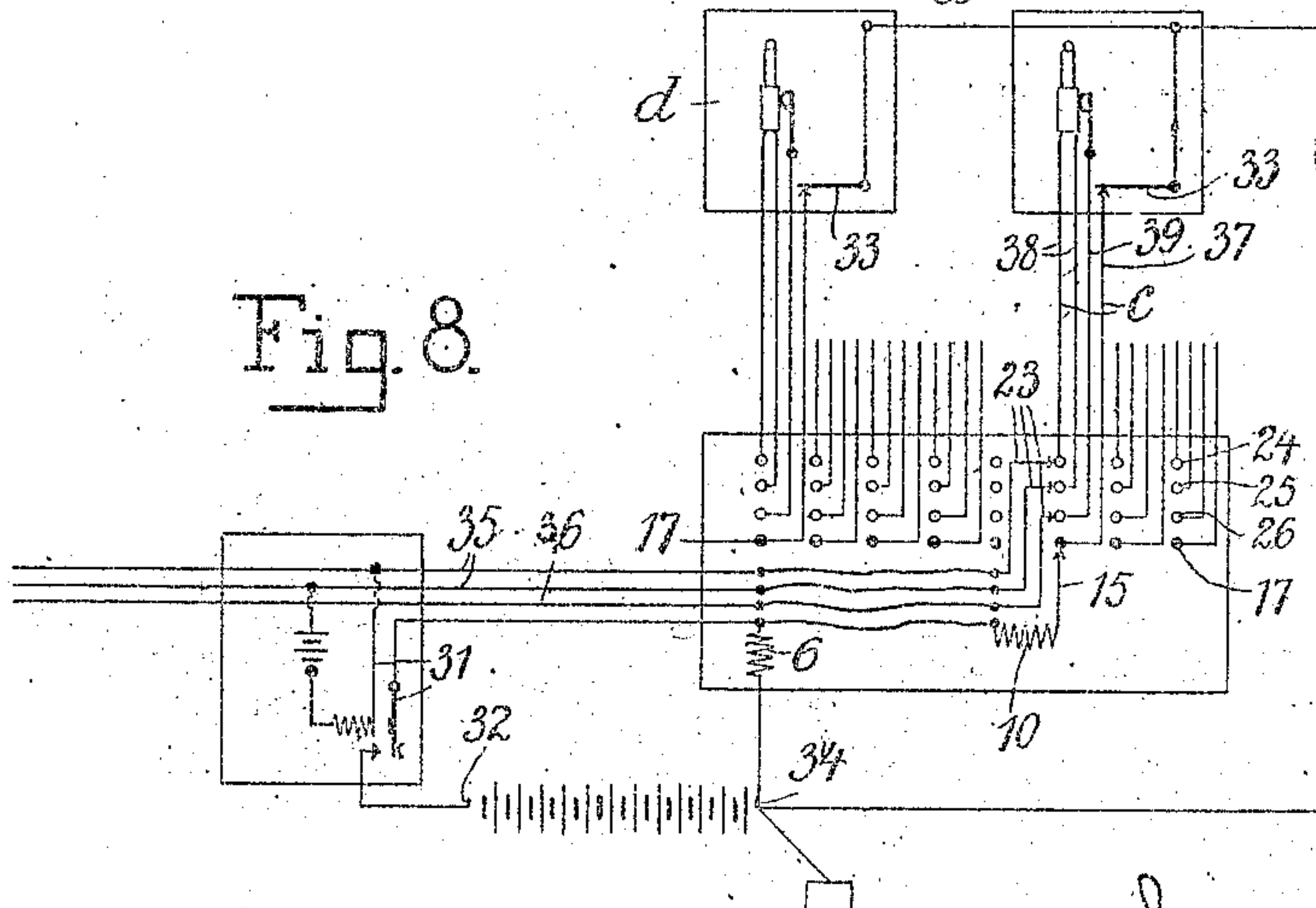


Fig. 8.



Witnesses.  
J. M. Skyles  
H. A. Lott

Inventor  
Peter Valdemar Christensen  
by Rough Bros attys.



# UNITED STATES PATENT OFFICE.

PETER VALDEMAR CHRISTENSEN, OF COPENHAGEN, DENMARK, ASSIGNOR TO AKTIE-  
BOLAGET L. M. ERICSSON & CO., OF STOCKHOLM, SWEDEN.

## CALL-DISTRIBUTING SWITCH.

959,462.

Specification of Letters Patent.

Patented May 31, 1910.

Application filed June 23, 1906. Serial No. 323,100.

*To all whom it may concern:*

Be it known that I, PETER VALDEMAR CHRISTENSEN, electrical engineer, a subject of the King of Denmark, residing at Copenhagen, Denmark, whose postal address is 18 Helgolandsgade, Copenhagen, Denmark, have invented a new and useful Call-Distributing Switch, of which the following is a specification.

10 This invention relates to an arrangement for automatic and uniform distribution to the operators of the multiple boards of the operating service, in order to prevent the present overworking of some individual operators, while others are, at the same time, idle.

15 In the heretofore usual telephone arrangements the subscribers' lines are, at the exchange, divided into groups, each one consisting of a number of lines, corresponding to the average efficiency of a single operator. It appears however,—even if, with due regard to the empirical number of calls from the subscribers concerned, by means of the  
20 so-called intermediate distributing fields, the lines of the various groups are so distributed; that each operator might be expected to get a uniform share of the work,—that, in the course of time, matters will be altered, so that the individual operators will again be unevenly occupied, and besides it may happen, that one of the positions is crowded with work, during certain hours of the day, while other positions are comparatively  
25 short of work. This state of things causes delays and uncertainty in the telephone service, as well as overworking of the operators at the unduly busy positions. These bad conditions may of course be remedied by planning the exchange so that the number of lines belonging to each group is made small enough to enable the operators, at any time, even at the busiest positions, to perform the exchange service with ease, but this arrangement necessarily means a heavy first cost  
30 and a numerous operating staff. An attempt has been made to remedy the before-mentioned draw-back by terminating the subscribers' lines at a peculiarly constructed distribution board from where they are, when a call is made, switched onto any multiple board operator happening to be  
35 idle at the given moment: this method however causes too great a delay in the operating. This draw-back is completely removed

by the present invention, the improvement being attained in such a manner that when the subscribers call, connections are made automatically and instantaneously with the operator happening to be idle at the moment. 60

The main feature of the invention is that the line to be connected with an idle line belonging to a certain group of distributing lines, is run as a main line, to an automatic switching device, the latter, by closing a contact belonging to one of the main line wires, starting the motion of a group of contact springs, until one of these, sliding along a contact row, reaches a contact corresponding to an idle distributing line 70 whereby a so-called search magnet is excited and consequently closes the contacts, necessary for the desired connection.

On the accompanying drawings, Figure 1 is a longitudinal vertical section of the switching device used for the automatic distribution. Fig. 2 is a bottom-view of the same. Figs. 3, 4 and 5 are cross-sections *a—b*, *c—d*, and *f—e* respectively. Figs. 6, 7, and 8 are wiring diagrams showing, by way of example, how the circuits may be arranged. 80

In the arrangement shown in Fig. 6 the subscribers' lines *a* are divided into groups of one hundred, there being but a single group shown on the drawing, and on each subscriber's line is provided an automatic switch *b*, adapted to connect the subscriber's line with any of the distributing lines *c* common to all the automatic switches in the same group. These distributing lines are run to the stations of a certain number of operators, for instance one to each of fifteen, or three lines to each of five different stations. For the sake of clearness, only eight distributing lines are shown on the drawing. At each station *d* terminates a certain number of distributing lines, thirty for instance, starting from as many or fewer different groups of automatic switches. 100 With the numbers chosen, by way of example, one operator serves two hundred subscribers, but each operator may, by means of the distributing lines *c*, be connected with any one of three thousand subscribers. 105

The duties of the automatic switch are, upon the call of a subscriber, to connect his line with one of the idle distributing lines terminating at the station of an idle operator, and there to indicate the call, be- 110



sides which the corresponding station is to be blocked, until the message is completed, and the corresponding distributing line is to be blocked, until the operator, after the clearing-off signal, opens the connection.

Fig. 7 shows another arrangement of the circuit where again the subscribers' lines are divided into groups of one hundred. On the drawing is shown but a single group. For each of the latter is provided a certain number, fifteen for instance, of distributing lines *c*, terminating at a certain number of positions *d*, for instance one for any one of fifteen. On the drawing are shown only eight distributing lines *c*, each one of which terminates at an operating station *d*. In each distributing line *c* is inserted an automatic switch *b*, adapted to make connection between the said line and any one of the hundred subscribers' lines *a* in the group. In addition there is provided a main automatic switch *e*, arranged to be actuated by a subscriber's call to select an idle automatic switch which it then sets into action, in such a manner that the latter (*b*) makes connection between its corresponding distributing line *c* and the calling subscriber's line *a*. Besides the two wiring diagrams shown by way of example, various other wiring arrangements may be used for the automatic distribution.

The action of the automatic switching device illustrated in Figs. 1-5 of the drawing will be understood from the following.

Referring to the drawings, 1 is a cylinder wherein a piston 2 may be moved by means of compressed air admitted into the cylinder, through a tube 3 and a valve 4, the valve stem 5 passing loosely through the wall of the valve housing and resting against the armature 7 of an electro-magnet 6. By means of a spring 8 the armature 7 of the electro-magnet 6 is, when the line is idle, kept in its lower position, so that the inlet from the compressed air pipe to the cylinder is closed, while the latter is in open connection with the atmosphere; when now the electro-magnet 6, which in the following description is called the controlling magnet, attracts its armature 7, the valve 4 will open, giving access for the compressed air and shutting off the open air inlet. The piston 2 will then move toward the right.

To the piston is fixed a hollow piston rod 9, carrying at its extreme end, toward the right, an electro-magnet 10, hereinafter called the search-magnet. During the motion of the piston, the magnet 10 is guided by the pins 12 sliding in the guides 11. When the controlling magnet 6 drops its armature 7, and consequently the valve 4 enters its lower position, the piston 2 with the piston rod 9 and the search magnet 10 are drawn back by means of a steel band 13, attached to the circumference of the hollow

pulley 14, containing a spiral spring, the outer end of which is fastened to the pulley 14, while its inner end is fastened to the middle part of the fixed axle of the pulley. A contact spring 15 is fastened to the search-magnet, or to other parts moving with the piston 2; this spring has electrical connection with one end of the coil of the magnet 10, and during the movement of the piston slides along a contact row 17, containing one contact more than the number of distributing lines *c* to be connected with the automatic switch. The other end of the coil of the search magnet 10 is connected with the central battery 32, through the armature and working contact of the subscriber's line-relay 31 (Fig. 8). Each contact in the contact row 17 is connected, by means of a distributing line *c*, to an operating station *d*, and also through the switch 33, there provided, connected to the ground 34, so that the contact at 33 is made, as long as the corresponding position and distributing line is free, while it is open, as long as the station or the line is busy. The one end of the coil of the controlling magnet 6 is connected with the ground 34, while its other end, as the armature of the subscriber's line-relay 31 is attracted, becomes connected to the other terminal 32 of the battery, so that a call causes a forward motion toward the right of the piston 2 and the search magnet 10, as well as of the contact spring 15.

During the movement to the right, the pins 18 (Figs. 1, 2, 5), connected by means of a link system to the search magnet 10, follow the rectilinear rails 19 in the guides 11, but when the contact spring 15 touches a contact 17 that has connection with an idle distributing line *c*, and thereby with an idle operating station, as well as with the ground, then the search magnet 10 will receive current from the battery 32, by the way of 31, 10, 15, 17, *c*, 33, 34; it will now attract its armature 20, and consequently lift the pins 18, so that the latter are deviated into the corresponding branch- or side-track 21, pointing upward in a slanting direction. This movement is continued, until the pins 18 have reached the bottom of this individual side track; during the last part of the movement the pins 18 and the armature 20 are raised still more, and all the parts are held in this position, even if the contact spring 15 may perhaps have left the contact 17. As the controlling magnet 6 remains excited, the air pressure remains active and keeps the search-magnet 10 pressed against the end of the side-track. On a plate 22, fastened to the armature 20 are fixed three contact springs 23, the latter being, by a flexible wire, connected to the line wires 35 (Fig. 8) and to the subscriber's test wire 36. When the armature of the search magnet 10 is attracted, and the pins



18 have entered a side-track 21, then the three contact springs 23 will also be raised and press against three contacts 24, 25 and 26 attached to an insulating plate 16 and, by a distributing wire *c*, connected to a working station *d*. On the contact strip 16 are arranged, in all, four parallel rows of contacts, and each row contains one more contact than what corresponds to the number of distributing lines belonging to the automatic switch.

Each distributing line *c* contains four wires, namely a search wire 37 (Fig. 8), two line wires 38 and one test wire 39; these four wires are connected on the one hand to four contiguous contacts of the contact strip 16 and on the other to one working station. One distributing line is common for a group of say one hundred automatic switching devices.

The functions of the apparatus are the following: When a subscriber calls, *i. e.*, lifts his micro-telephone from its stand or hook, the armature of the line-relay 31 will be attracted, and the controlling magnet 6 will thus receive current from the battery 32; consequently the valve 4 will open, the search magnet 10 will move toward the right, until the contact spring 15 touches a contact 17 corresponding to an idle distributing line *c* and an idle station; then the search magnet 10 receives current through 31, 15, 17, *c*, 33 from the battery 32. The armature 20 is now attracted, the pins 18 are guided into a side-track 21 corresponding to the idle distributing line *c* and to the position belonging thereto; the three contact springs 23 are pressed against the three corresponding contacts 24, 25, 26, and the subscriber's three lines 35, 35, 36 are thus brought into direct connection with the idle operating position where then the operating is performed in the usual manner. As long as the conversation lasts, the corresponding distributing line *c* must remain blocked; this may be effected by means of the switch 33, opened directly by the corresponding plug-switch or by a special relay, and located on the search wire 37, at the operating station.

When the operator, upon the clearing-off signal, opens the connection, the line relay 31 and consequently also the controlling magnet 6 is cut out of the circuit; therefore the valve 4 drops down, the pressure behind the piston 2 ceases, and the search magnet 10 is brought back, by means of the spiral spring 14, to its original position.

In order to prevent the search magnet from using any unnecessary current there is provided, in the line from the battery 32 to the contact spring 15, a switch 27 (Fig. 1) that breaks the circuit, as soon as and as long as the pins 18 press against the extreme end of any of the side tracks 21.

In the manner of execution of this inven-

tion that is illustrated on the drawing, the wire from the battery 32 is run to a contact spring 27, normally touching the contact 28 on the contact spring 15, but as soon as the pins 18 press against the bottom end of a side-track 21, a bar 29 is pressed against an insulating block 30, and thereby the spring 27 is removed from the contact 28 and pressed against another contact. The opening of the contact 28 has for its object to save current by breaking the current in the magnet coil 10, at the very moment when the pin presses against the bottom end of the branch track; thus the first breaking of the search magnet circuit is effected at the moment when the action of the magnet is not needed any more, while the second breaking of the current does not take place until later on, at 33. The switch 33 is nevertheless indispensable, as it serves to block the distributing line concerned.

In the above description of the automatic switching device, reference is solely made to its use in connection with the wiring diagram shown in Fig. 6; the same apparatus may however, also be used with the diagram shown in Fig. 7, or with any other suitable wiring arrangement, that might be preferred for the automatic distribution. Any other suitable motor may be substituted for the one herein shown.

What I claim as my invention and desire to secure by Letters Patent is:

1. The combination of a motor, a member moved by the motor and comprising a plurality of contacts, a search magnet in circuit with one of the contacts, a series of selecting contacts, over which the last named contact travels, series of speaking and signaling contacts adapted to engage the other movable contacts, and a locking means operated by the search magnet and adapted to stop the travel of the moved member against the force of the driving motor.

2. The combination of a series of selecting contacts, series of speaking and signaling contacts, a motor, a member moved by the motor, a contact carried by the member and traveling over the series of selecting contacts, a search magnet in circuit with the contact carried by the member, a plurality of contacts carried by the member and adapted to engage the series of speaking and signaling contacts, but normally supported so as to not engage the series of contacts during the movement of said member, and a locking means operated by the search magnet and adapted to stop the travel of the moved member against the force of the driving motor and to effect the movement of the plurality of movable contacts into engagement with contacts of the series of speaking and signaling contacts.

3. The combination of a series of selecting contacts, series of speaking and signaling



contacts, a motor, a member moved by the motor, a contact carried by the member and traveling over the series of selecting contacts, a search magnet in circuit with the  
5 contact carried by the member, a plurality of contacts carried by the member and adapted to engage the series of speaking and signaling contacts, but normally supported so as to not engage the series of contacts  
10 during the movement of said member, and a locking means operated by the search magnet and adapted to stop the travel of the

moved member against the force of the driving motor and to transfer the force of the motor so as to move and press the plurality 15 of movable contacts against contacts of the series of speaking and signaling contacts.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

PETER VALDEMAR CHRISTENSEN.

Witnesses:

JULIUS LEHMANN,  
HERMAN RÉE.