(No Model.)

4 Sheets—Sheet 1.

I. M. O'DONEL.

TELEPHONE EXCHANGE.

No. 283,806. Patented Aug. 28, 1883.

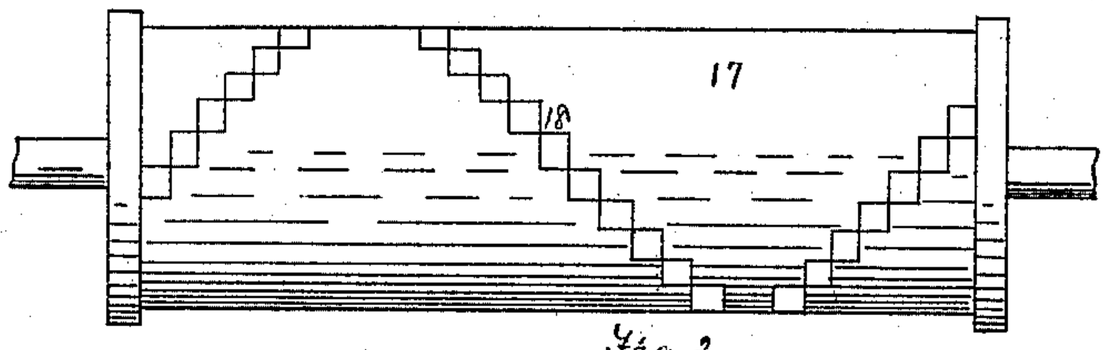

Fig. 2

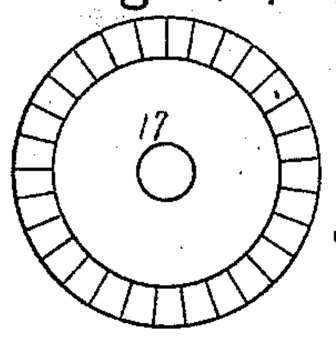

Fig. 3.

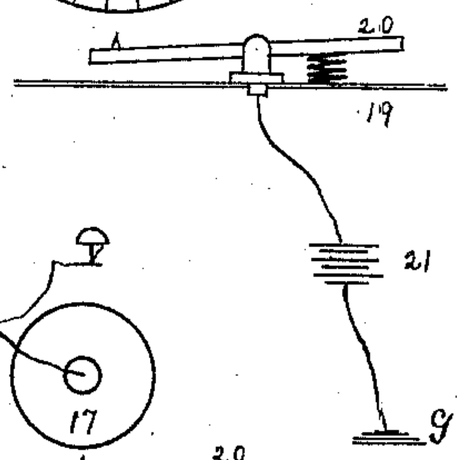

Fig. 4.

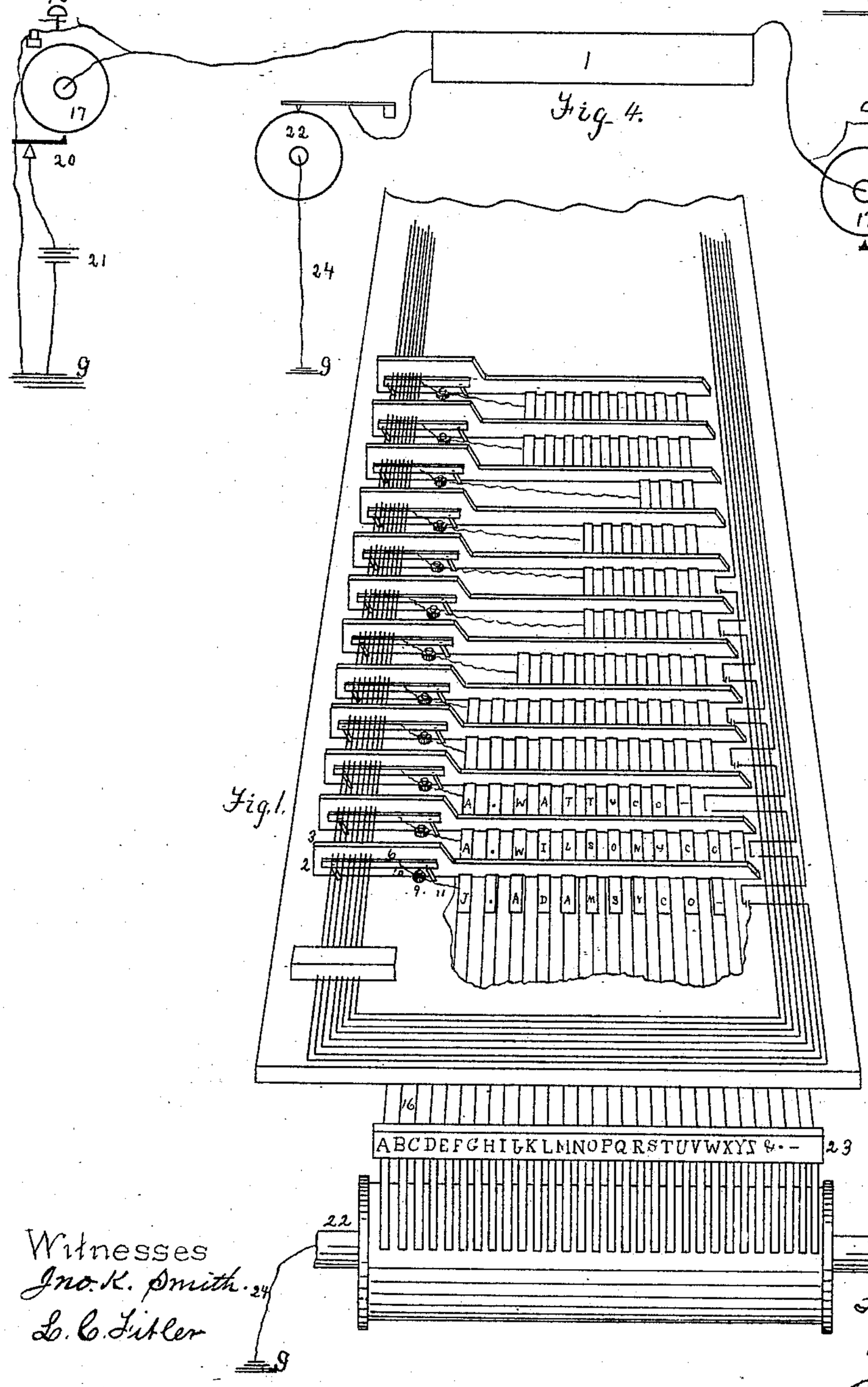

Fig. 1.

Witnesses
Jno. K. Smith.
L. C. Fitler

Inventor
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by his attys
Bakewell & Kerr

(No Model.) 4 Sheets—Sheet 2.

I. M. O'DONEL.

TELEPHONE EXCHANGE.

No. 283,806. Patented Aug. 28, 1883.

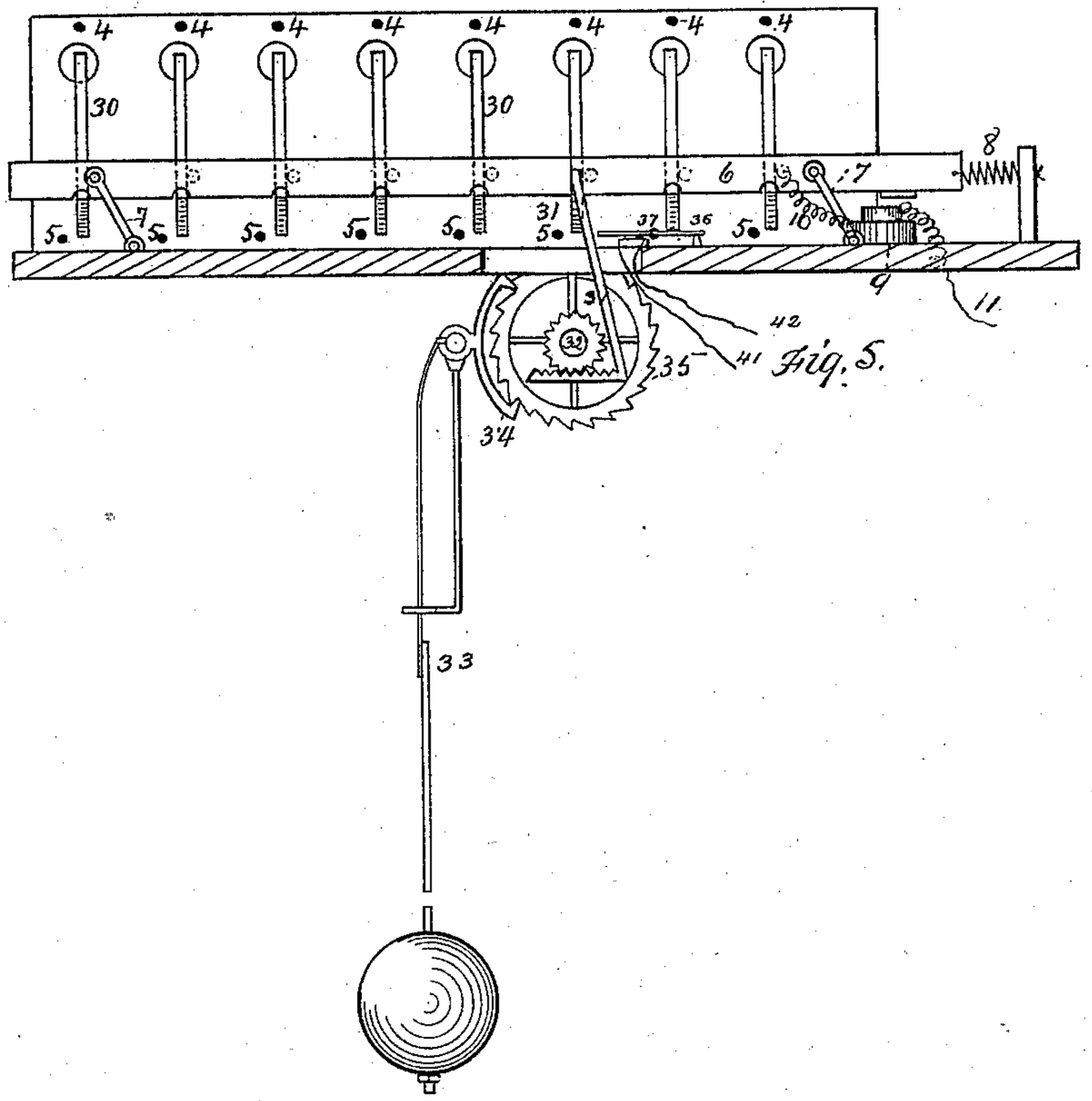

Fig. 5.

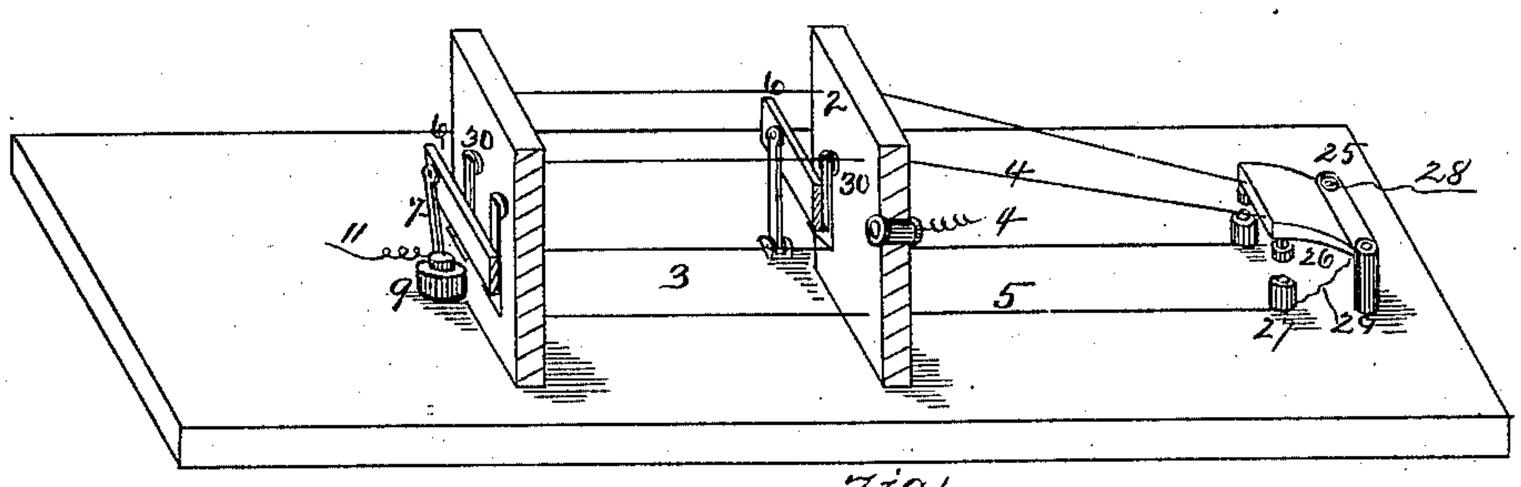

Fig. 6.

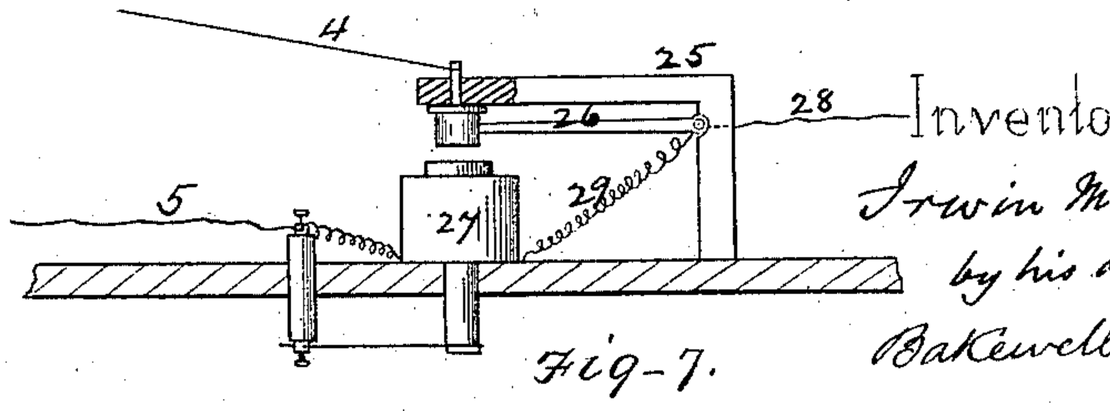

Fig. 7.

Witnesses
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(No Model.)

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I. M. O'DONEL.

TELEPHONE EXCHANGE.

No. 283,806. Patented Aug. 28, 1883.

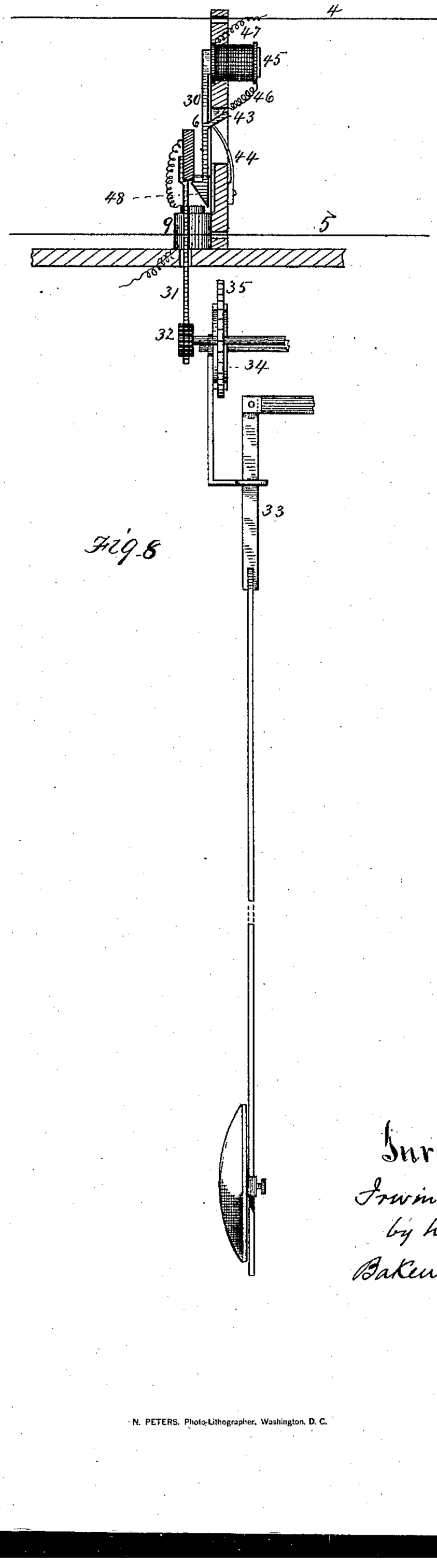

Fig. 8

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(No Model.) 4 Sheets—Sheet 4.

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TELEPHONE EXCHANGE.

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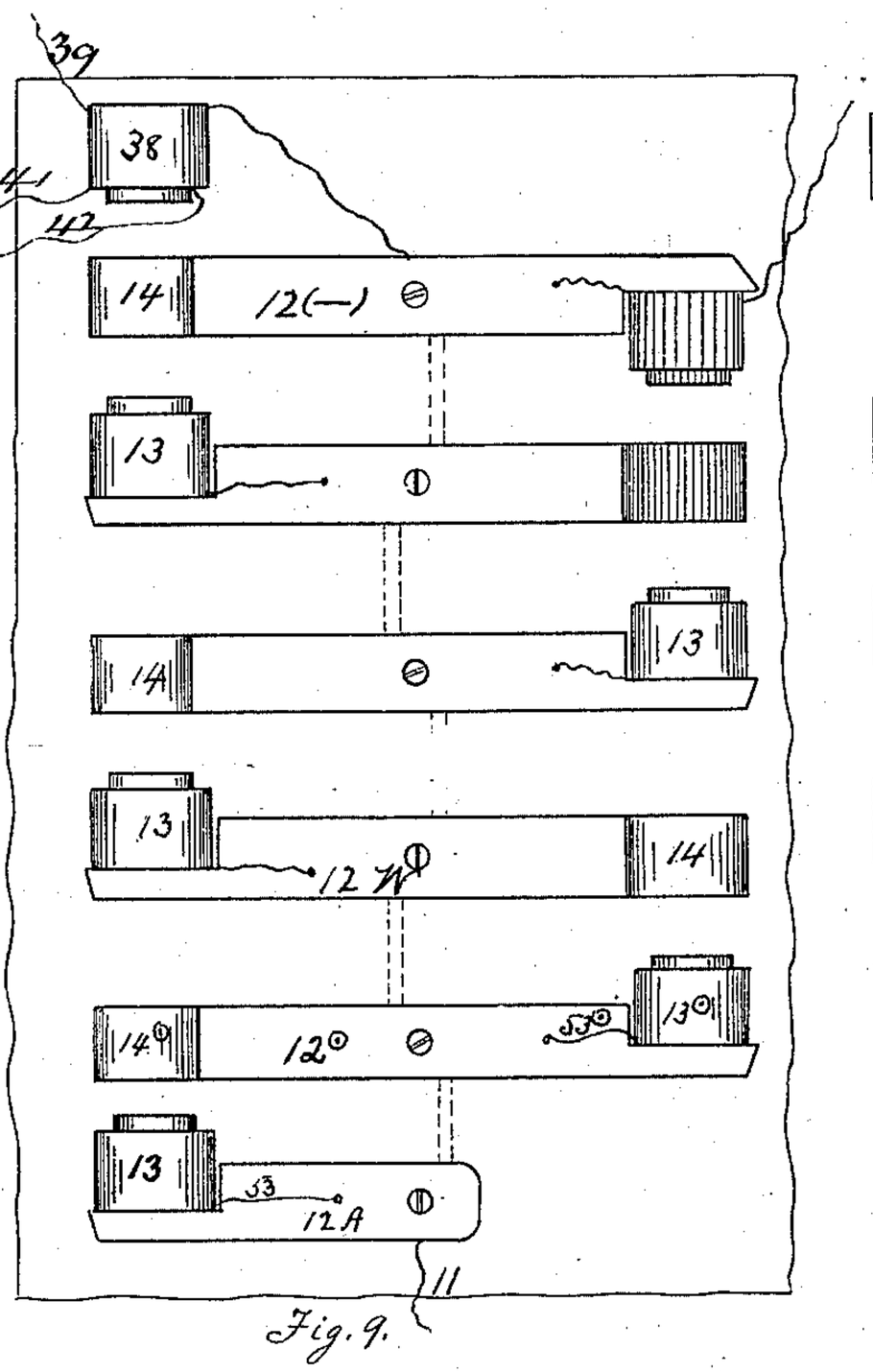
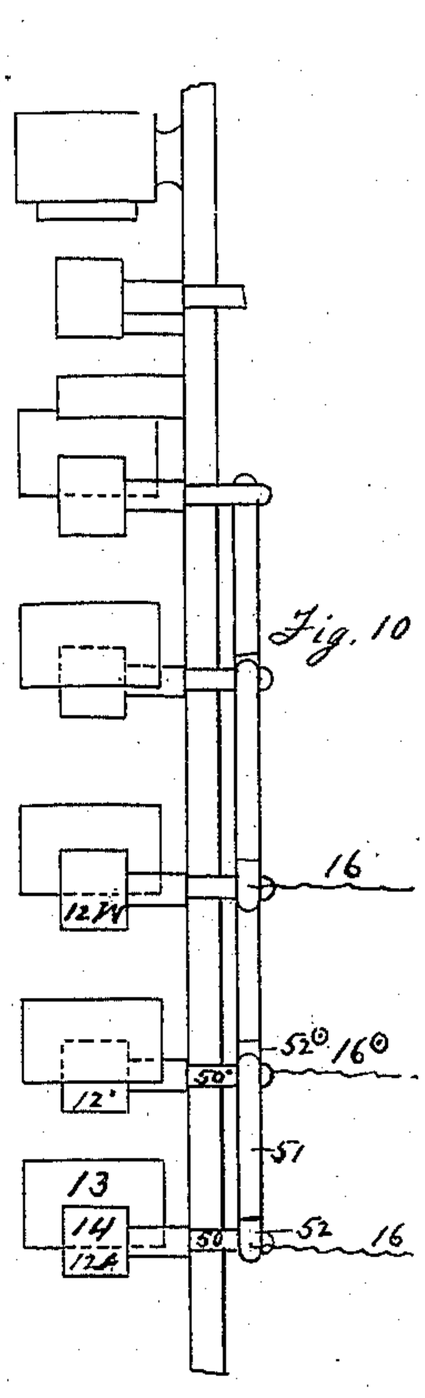


Fig. 9.



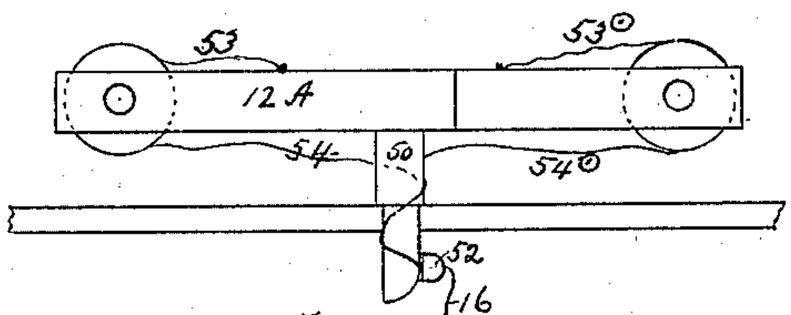


Fig. 11.

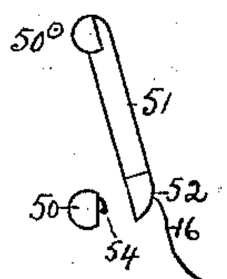


Fig. 12.

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UNITED STATES PATENT OFFICE.

IRWIN M. O'DONEL, OF PITTSBURG, PENNSYLVANIA.

TELEPHONE-EXCHANGE.

SPECIFICATION forming part of Letters Patent No. 283,806, dated August 28, 1883.

Application filed June 5, 1880. (No model.)

To all whom it may concern:

Be it known that I, IRWIN M. O'DONEL, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Telephone-Exchanges; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a perspective view of my improved telephone or telegraph exchange. Fig. 2 is a side view of the call-cylinder. Fig. 3 is an end view of the cylinder and key-board. Fig. 4 is a diagram showing the whole circuit. Fig. 5 is a sectional view of a portion of the apparatus connected with the wires in the central office. Fig. 6 is a perspective view of a portion of the same. Fig. 7 is a side elevation, partly in section, of a portion of the apparatus shown in Fig. 6. Fig. 8 is a vertical cross-section of Fig. 5, with a slightly-modified construction of some of the parts. Fig. 9 is a plan view of the magnetic call-board at the central office. Fig. 10 is a side elevation of the same. Fig. 11 is an end elevation of the same, and Fig. 12 is a view illustrating the breaking of the ground-connection of the keys.

Like numerals of reference indicate like parts in each.

My invention consists of an improved apparatus for use in a district telephone or telegraph system, and its object is to enable subscribers to make connection with each other without the intervention of attendants at the central office.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction.

In the central office I have a long table, 1, divided transversely by partitions 2 into compartments 3, there being a compartment for each subscriber. These compartments contain electro-magnets of peculiar shape, one for each letter and character of the subscriber's name, said letters and characters being inscribed thereon, and each electro-magnet is grounded through the corresponding letter or character on the key-board 23.

At one end of each compartment two rows of wires, 4 and 5, extend through the partitions 2, one above and one below an armature, 6, which is mounted on links 7, and retained in an upright position by a spring, 8. The purpose of the upper wire is to strike the first letter of a name. It strikes also the same letter of all names beginning therewith. The current then passes through an electro-magnet and draws down the armature, bringing the lower wire into the circuit and cutting out the upper wire, because otherwise, when the second letter of the name was struck, the current would flow into all keys having the same letter beginning other names, and thus confusion would be produced. In this arrangement, if the armature is drawn down and the current is going through the lower wire, the first letter of all other names, although it may be the same as that struck, will not be reached, because the first letter can only be reached by the upper wire. Thus by transferring the current to the lower wire we leave out the first letter of all other names.

An electro-magnet or coil, 9, is placed under the armature 6, and is electrically connected therewith by a wire, 10. A wire, 11, extends from coil 9 to the first magnetic key, 12, in the compartment, say, for example, "A" in the name "A. Wilson & Co." The keys 12 are of peculiar shape. They are made of brass or similar metal, with an electro-magnet, 13, at one end and an armature, 14, of steel, at the other. Each has an insulated stem, 50, upon which it has a pivotal movement. All except the first have an arm or radius, 51, extending from the lower end of its stem, and when at rest this arm is in contact with the stem of the preceding key. The arm 51 has a conducting tip or end, 53, which is insulated from the key to which the arm is attached, preferably making this arm itself a non-conductor of electricity. The ground-wire 16 is fastened to the tip 52 by a contact-screw or otherwise. The first key, 12 A, is a half-key, being provided with the electro-magnet 13 only, for the reason that the armature 14 is of no use thereon.

The current from wire 11 is grounded by wire 16 as follows: The core of the electro-magnet 13 is fastened to the body of the key 12 A. The wire 11 is fastened to the key 12 A, and the current is led to the coil of magnet 13 by wire 53, and passes thence by wire 54 to the insulated stem 50, where the conductor 52, being in contact with the wire 56, it passes

from the wire 54 to conductor 52, and thence by wire 16 to ground. The passage of the current through the coil 13 having magnetized its core, the magnet 13 and armature 14 will draw together, causing key 12 to turn on its pivot. The turning of key 12 throws the arm 51 around, so that it is no longer in contact with the wire 54, (see Fig. 12,) and the ground-connection of key 12 is broken. Then when the circuit is closed to key 12 the current passes, by wire 11, key 12 A, and magnet 13, to armature 14, thence along wire 12 to wire 53, thence around the electro-magnet 13, thence along wire 54 to stem 50, and thence, by conductor 52 and wire 16, to the ground. This operation is continued until, as hereinafter explained, connection is made with the subscriber's office. In this arrangement the armatures are always opposite to the electro-magnets.

The apparatus for making the connection-signals is similar to that used with the printing-telegraph. There is a metallic cylinder, 17, covered with a non-conducting surface. Cut through the insulating-covering in spiral lines is a series of slots or depressions, 18, the bottom of which has electrical connection through the shaft and pinions, and by wire therefrom with the central office.

In front of the cylinder is a key-board, 19, provided with keys 20, representing the letters of the alphabet, and such stops as may be desired, which are generally the character &, the period, (.), and the dash, (—). The ends of the keys 20, when struck, bear against the surface of the cylinder 17, and are so adjusted with relation to the slot 18 that they shall enter and pass through them as the cylinder revolves. The cylinder 17 is revolved continuously by clock-work or other suitable means—say at about sixty revolutions per minute. The keys 20 are connected with a battery, 21, and, when depressed, enter into the slots 18 as they come around in the revolution of the cylinder, and thereby close the circuit to the desired letter, transmitting a signal to the corresponding letter in the central office. The continued rotation of the cylinder throws the key out of the slot onto the non-conducting surface of the cylinder, and thereby opens the circuit.

The central office is provided with a cylinder, 22, of similar construction to cylinder 17, and a key-board, 23, like the board 19, except that the keys continue in contact with cylinder 22. The cylinder 22 revolves simultaneously with that in the subscriber's office, and, instead of a battery, it has a ground connection, 24, through the axis of the cylinder.

The object of having the cylinders alike and revolving simultaneously is to cause the current to be grounded, in order to strike a key in the subscriber's name. The subscriber's wire 28 enters the central office, and is attached to a standard, 25, and is connected electrically with the armature 26. The wire 4 leads back from the standard 25 above the armature 6, and at the standard is in contact with the armature 26. Under the armature 26 is an electro-magnetic coil, 27, connected to the wire 25 by the wire 29. Extending from the coil 27 under the armature 6 is a wire, 5.

On the rear side of the partitions 2 a copper link, 30, is pivoted, as hereinafter more fully described, so that the upper end shall be in electrical contact with the wire 4 and the lower end with the armature 6. Appended to the armature 6 is a serrated stem, 31, which meshes into the serrated shaft 32. A pendulum, 33, is provided with a pawl, 34, which works into the ratchet-wheel 35, mounted on the shaft 32. When the coil 9 is magnetized and draws down the armature 6, the serrated stem 31 swings under and gears into the shaft 32. The pendulum 33 regulates the movement of the shaft 32, which is operated by clock-work, and the ratchet-wheel 35 moves in the opposite direction to the downward projection of the stem 31. Consequently each beat of the pendulum moves the stem 31 out one cog until it is released, and then the armature 6 is restored to its normal position by the spring 8. When the armature 6 is drawn down, it catches on the hook on the lower end of the link 33, and draws it out of contact with the wire 4 into contact with the wire 5.

The method of making a connection is as follows: A subscriber desires to call A. Wilson & Co., for instance. He strikes "A" in the key-board 19 in his office. The key comes in contact with the "A" slot upon the revolving cylinder and closes the circuit with the "A" key in the central office. The current passes along the subscriber's line 28 to the standard 25, and thence along wire 4, the wire 5 having at this time no outlet or ground-connection. From wire 4 it passes down the copper link 30 to the armature 6, and thence by wire 10 to the electro-magnet 9, magnetizing it and causing it to draw the armature 6 down. The armature 6, descending, catches on the hook of the link 30 and draws it out of contact with wire 4 and places it in contact with wire 5. This causes the current to switch off of wire 4 onto wire 5 by armature 26 and magnet 27. The current then passes by wire 5, armature 6, to the coil 9, and by wire 11 to the "A" key 12, whence it passes by wire 16 to the key A of key-board 23, which, being at that instant in electrical contact with the cylinder 22, has through it a ground-connection by a wire, 24, extending from its journal. The downward projection of the armature 6 causes the operation of the serrated stem 31, shaft 32, pendulum 33, pawl 34, and ratchet 35, as described, the operation of the pendulum being such that it shall hold the armature down for a certain determined period of time. Ground-connection is secured at the central office simultaneously with the striking of the key in the subscriber's office by causing the uniform and simultaneous rotation of the two cylinders 17 and 22.

The length of time required by the pendulum and ratchet to release the armature 6 be-

ing, say, two seconds, the armature is held down and the link 30 is out of contact with wire 4 and in contact with wire 5. The caller then strikes the period (.) key, and the current again enters by the line 28, whence it passes by wire 29 to the coil 27, which it magnetizes, causing it to cut out the wire 4 by drawing down the armature 26, thence by wire 5 to the armature 6, which is held down by the ratchet-stem 31, (the magnet 9 being magnetized), as before described. The reason the current passes over the wire 5 on striking the second key, instead of wire 4, is that the depression of the armature 6 cuts the wire 4 out of circuit and brings the wire 5 in. The current passes by wire 11 to key 12 A, where it magnetizes the electro-magnet 13, which causes the electro-magnet 13 and adjacent still armature 14 to draw together, and then the current passes to ground through line 16 (.), in the same manner as before described in relation to key A. The other letters of the name are struck in succession, each operation producing the same result and operating in the same way. The last key 14 represents the dash, (—). When it is struck it is not grounded through the central office, but through A. Wilson & Co.'s office. At the outer end of compartment 2 is an electro-magnet, 38. When all the keys of the name "A. Wilson & Co." have been traversed, as described, the magnet 38, connected to A. Wilson & Co.'s wire, 39, attracts armature 14 of the last key, connects therewith, and permits the passage of the current to the wire 39, by which it passes to A. Wilson & Co.'s office, and there rings the signal-bell 40, and then passes to ground. Attention being thus called, the telephone is used in the usual way. In order to preserve connection it is necessary that, on the striking of the dash, which is the closing character of every name, some provision be made for holding down the armature 6 while the telephone is being used. This I accomplish by means of an armature, 36, operated by electro-magnet 37, which is magnetized by means of a leak from the magnet 38. The armature 36 is pivoted to swing over the coil 37. When the current reaches the magnet 38, a portion of it passes by a small wire, 41, to the coil 37 and around it, and returns to the magnet 38 by wire 42. The coil 37, being magnetized, draws the armature 36 in front of the ratchet-arm 38 and prevents the latter from escaping from the shaft 32 while the current continues to pass. The opening of the circuit in the subscriber's office demagnetizes the coils 37, 13, 9, and 27 and restores the keys and armatures to their normal positions.

I will now explain how it is that I am enabled to single out the name of a particular individual from the number of names connected with the central office and to make connection with his instrument.

There is a compartment, 3, with its apparatus, for each subscriber, and each subscriber's wire connects with two wires, 4 and 5, which run back through all the partitions 2 and across all the compartments 3, being insulated at each partition and ending in insulated points. The same letters and stops in every name are grounded through the corresponding key in the key-board 23. When any initial or first letter in any name is struck, the same letter occupying the same position in all the other names will be struck also. Thus by striking "A" in "A. Wilson & Co." the letter "A" will be struck in all the other names in which "A" is the first or initial letter. When the second key (which in "A. Wilson & Co." is the period) is struck, the current passes, as described, through the key 12 A in passing to ground through the second key, (which is 12.) The same sequence—viz., A.—will be struck in all other names having it; but by that time all names beginning with "A," but not having a period following it, will be released, for the reason that the armatures 6 of these compartments are no longer held down. The ground-connection being lost, the circuit is broken through these compartments and the keys demagnetized. Upon striking the third key, "W," the operation is repeated, all other names not having "A. W" dropping out. This sequence would hold in "A. Watt & Co.," as well as "A. Wilson & Co.;" but the striking of the fourth key, "i," would release "A. Watt & Co." Thus in time all other names would be dropped. In case, however, any two persons have the same names, it is easy to vary their telephone names, and thus prevent any two persons having the same combination of letters. All names end with a dash, (—,) which key is grounded in the subscriber's office. When the use of the telephone has been completed, the circuit is opened by means of a stop in the subscriber's office, arranged and operated in the usual way. This operation demagnetizes the coil 37 and releases the armature 36, and thereby permits the operation of the pendulum 33 and ratchet 34 and the release of the armature 6.

In case any of the keys in the subscriber's compartment should stick together from the residual magnetism remaining in the armature 14, the current can be reversed to reverse the polarity, and the keys will separate readily.

Instead of a separate pendulum at each compartment, a long bar may be hung on rods from each compartment and extend the full length of the table, and be operated by a suitable clock-work.

Fig. 8, which is an edge view, partly in section, shows the connection for the link 30. The link is pivoted by the stem 43 on the spring 44. In the partition 2 is an electro-magnet, 45, opposite to the upper end of the link 30. The stem 43 has electrical connection with the magnet 45 by wire 46, and the magnet is connected with wire 4 by wire 47. When the current passes over wires 4 and 47 and through the coil 45, the latter attracts the upper end of the link 30 and throws its lower hooked end, 48, under the armature 6, so that when the armature is drawn down, as before

described, the link 30 is drawn out of contact with the wire 46 and magnet 45 and thrown into contact with wire 5. When armature 6 is released, the spring 44 restores the link 30 to position.

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

1. In a telephone-exchange, the combination of a series of keys corresponding to the subscriber's name, each key having an armature and electro-magnet alternately arranged, a set of synchronously-revolving cylinders for successively grounding the keys as struck, and the final key of the series, grounded through the subscriber's office, substantially as and for the purpose specified.

2. The combination of two conductors, an interposed vibrating switch actuated by an electro-magnet arranged in the circuit, and a clock-work mechanism for retarding the retraction of the armature, substantially as and for the purpose specified.

3. The combination of the table having compartments, with one or more upper and lower wires extending from the standard to which the subscriber's wire is connected across the compartments, an armature arranged in each compartment between the wires, and a link or links operated by the armature to make or break the circuit with either wire, substantially as and for the purposes described.

4. The combination of the armature arranged in the compartment between the wires, a ratchet device which comes into gear on depression of the armature, and a pendulum for effecting the release of the armature, substantially as and for the purposes described.

5. The pivoted keys, provided with a permanent magnet at one end and an electro-magnet at the other, and having a ground-connection through its pivotal point, substantially as and for the purposes described.

6. The combination of a series of pivoted keys, each having an armature and an electro-magnet at its opposite ends, and arranged alternately to each other, and each, except the last, having a ground-connection, which is in circuit when the key is struck with a wire electrically connected to the first key and a wire extending from the last key and grounded through the subscriber's instrument, substantially as described.

7. The combination of a battery and a key-board and cylinder for making the signal, a cylinder revolving synchronously with the first cylinder, a key-board with ground-connection for grounding the current, and a series of electrical keys arranged in the circuit between them, substantially as and for the purposes described.

In testimony whereof I have hereunto set my hand.

IRWIN M. O'DONEL.

Witnesses:
T. B. KERR,
JAMES H. PORTE.