

(No Model.)

I. H. FARNHAM.  
SWITCHBOARD SIGNAL.

No. 557,527.

Patented Mar. 31, 1896.

Fig. 1.

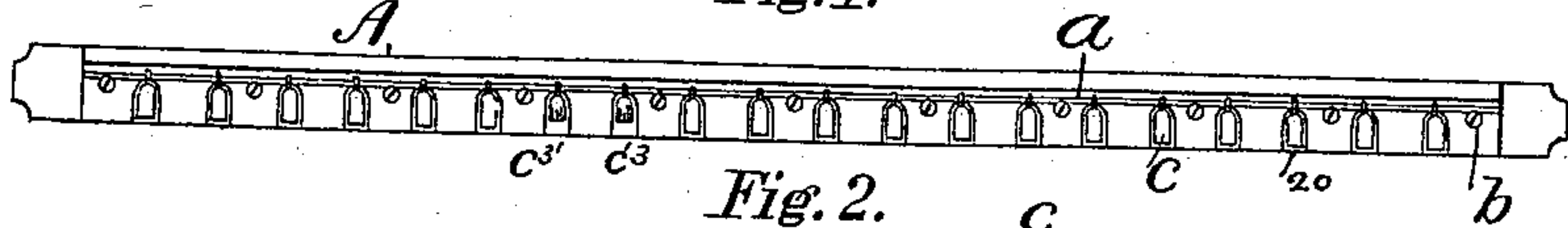


Fig. 2.

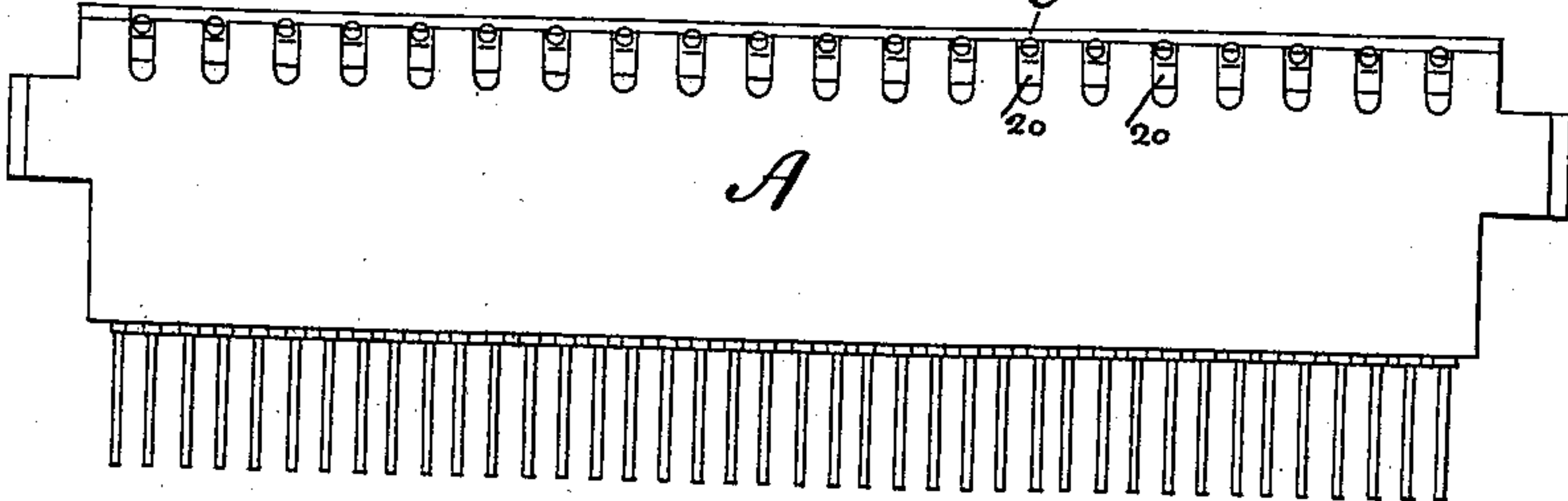


Fig. 3.

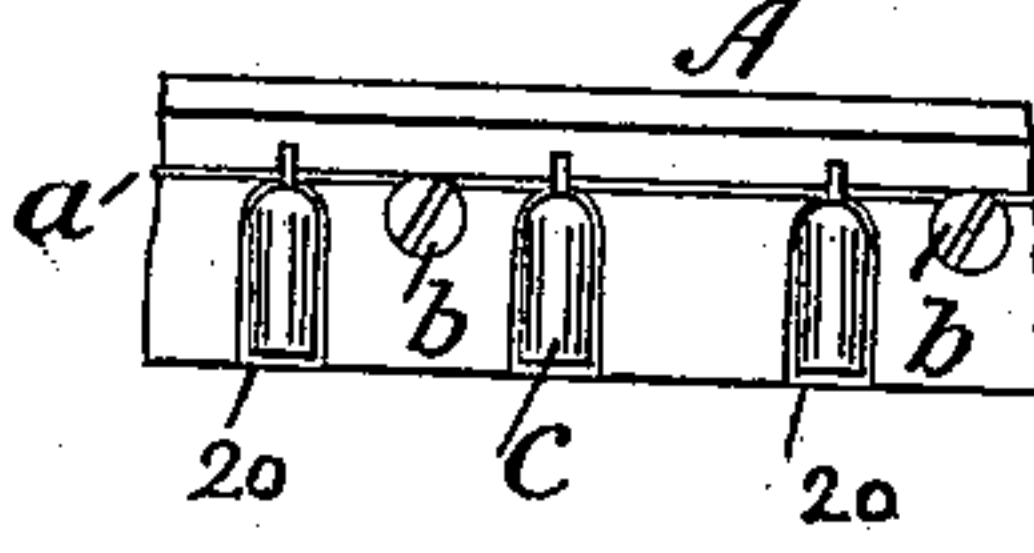


Fig. 4.

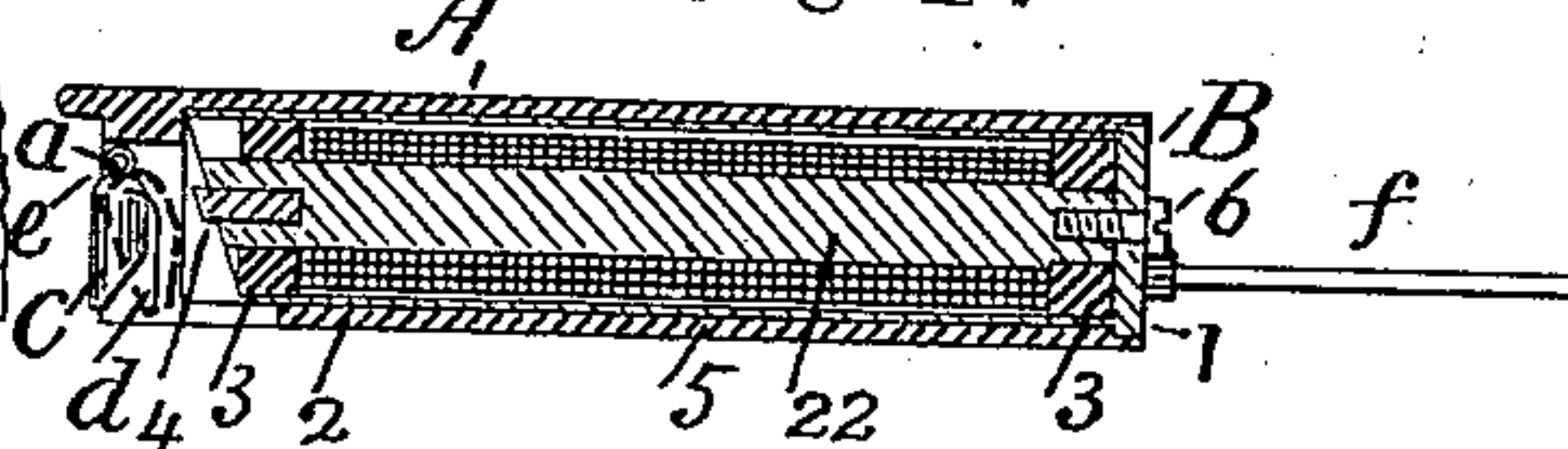


Fig. 5.

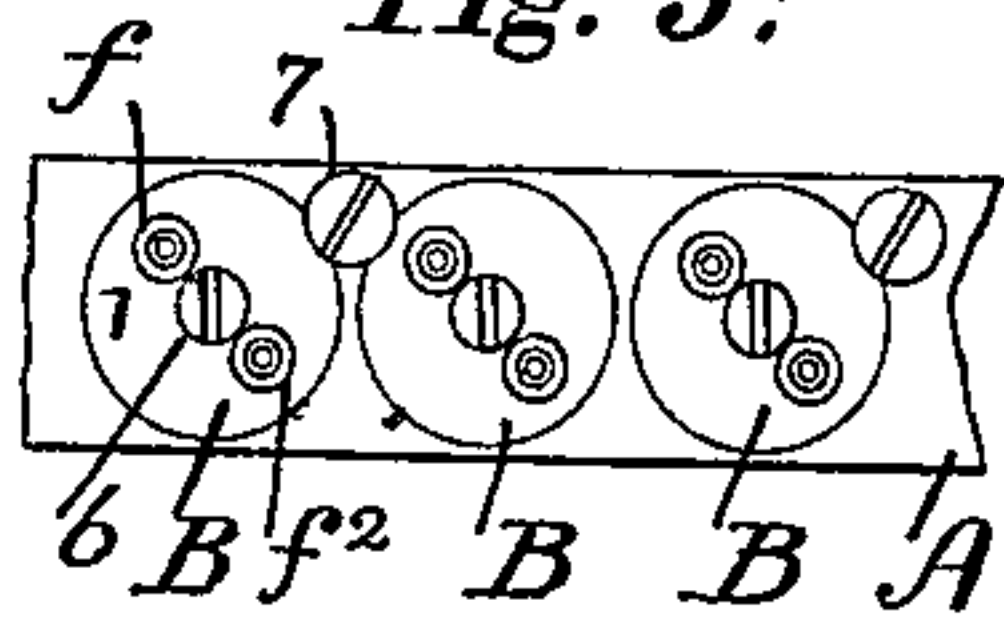


Fig. 6.

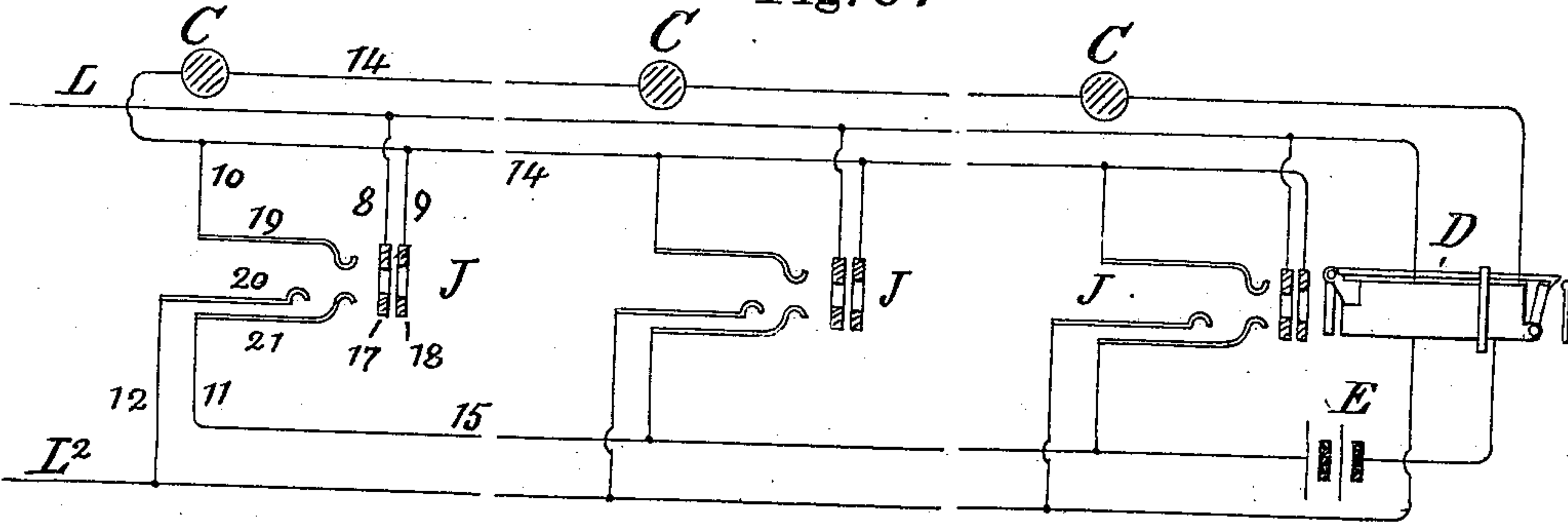
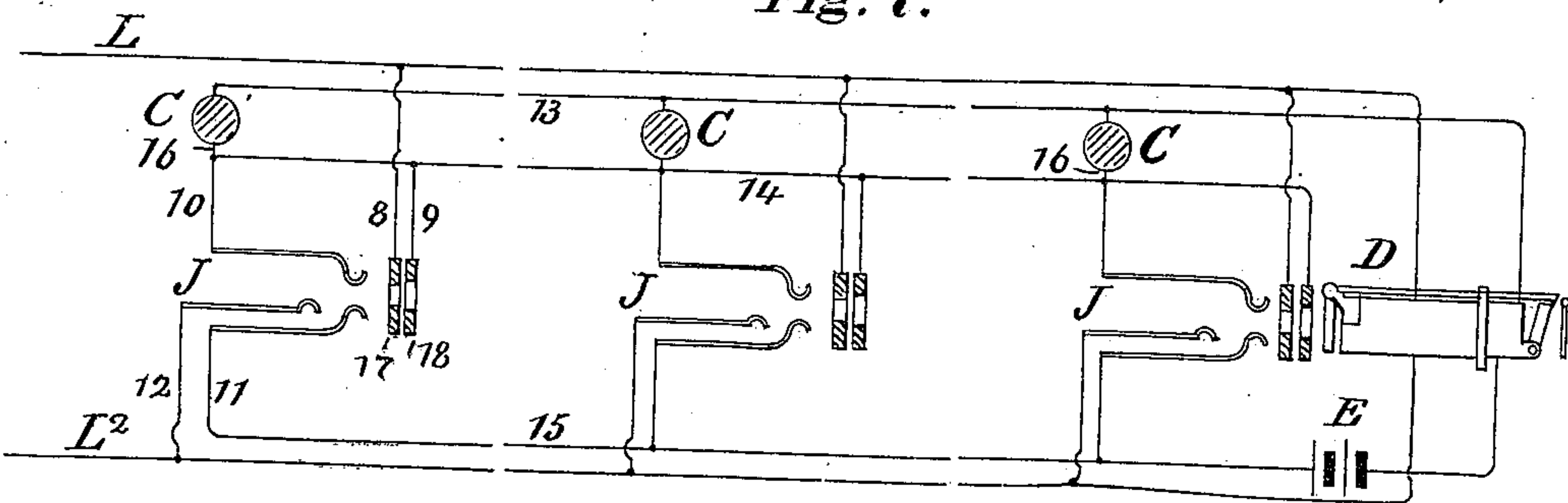


Fig. 7.



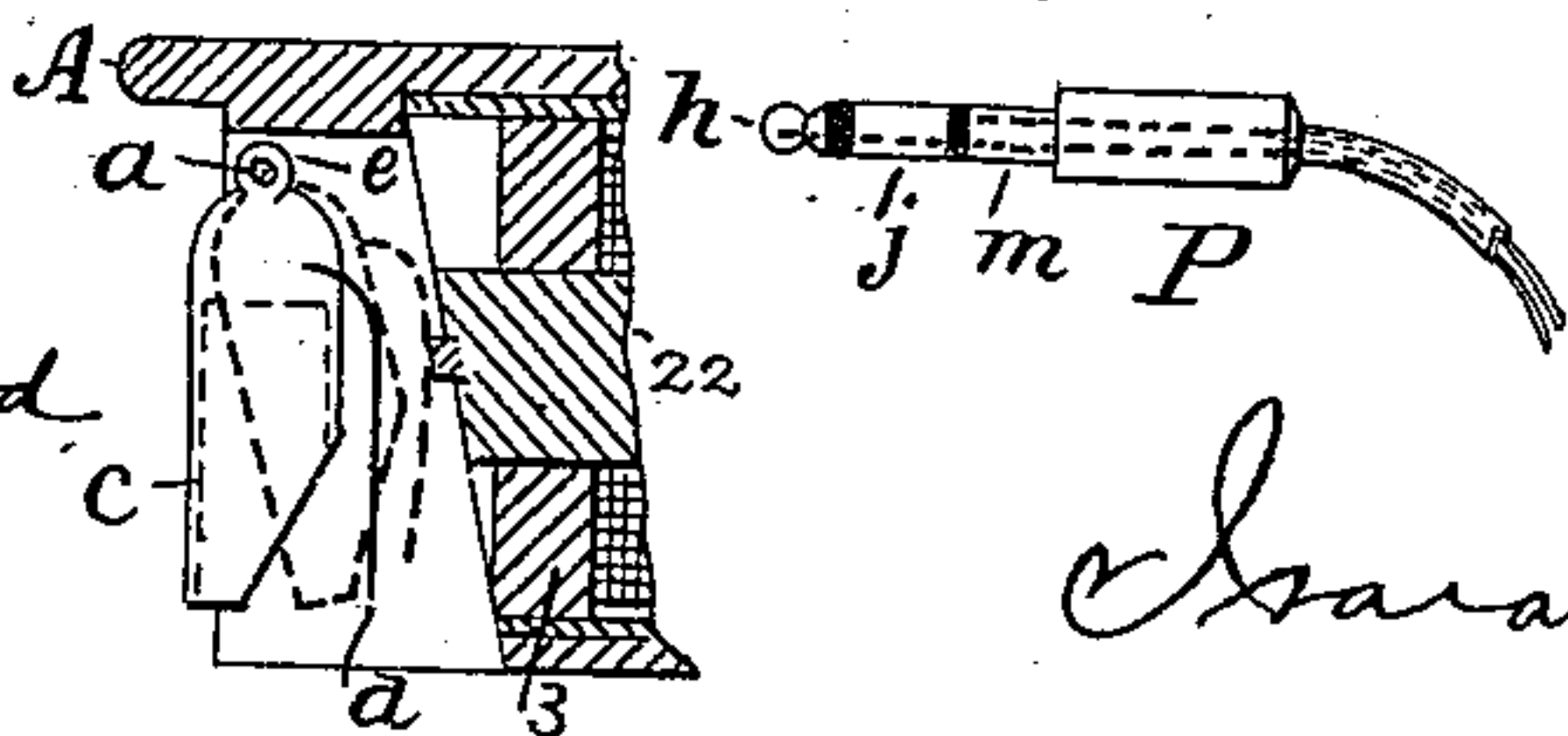
Attest.

Fig. 5 a.

Fig. 8.

Inventor.

Frank C. Lockwood  
For Miller Pierce



Israh H. Farnham



# UNITED STATES PATENT OFFICE.

ISAIAH H. FARNHAM, OF WELLESLEY, MASSACHUSETTS, ASSIGNOR TO THE  
AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

## SWITCHBOARD-SIGNAL.

SPECIFICATION forming part of Letters Patent No. 557,527, dated March 31, 1896.

Application filed January 16, 1896. Serial No. 575,687. (No model.)

*To all whom it may concern:*

Be it known that I, ISAIAH H. FARNHAM, residing at Wellesley, in the county of Norfolk and State of Massachusetts, have invented certain Improvements in Switchboard-Signals, of which the following is a specification.

The present invention relates to visible signals employed in association with electric circuits, especially with the circuits of telephone central offices, such as the trunks between two central offices or between the several sections of the switchboards, and also in connection with the terminals of the substation-lines upon the switchboard.

The use of the signal is to indicate to the operators in charge of such trunks or line-terminals whether a circuit is in use or not. The common way of determining the condition of a circuit is for the operator to touch the tip of the connecting-plug to the ring of the circuit-terminal or spring-jack, and if a "click" or "buzz" is heard in the operator's telephone the fact is indicated in a manner well understood.

I arrange the visible signals in such a manner in a telephone-circuit that when a connecting-plug is inserted in a jack on the switchboard the signals are automatically operated, whether there is one or a plurality of them in the same circuit—that is to say, whether there is, as in some trunk-circuits, but one signal, or, as in other trunk and substation circuits, a plurality of signals, one at each section of the switchboard; and when the connecting-plug is withdrawn from the jack the signals are automatically reset.

The special form of signal devised by me consists of an electromagnet covered with an iron sheath, opposite one end of which is suspended a small light freely-movable self-retracted iron armature. The electromagnet is preferably inserted in a support of suitable material and the armature is hung at its upper end in a space or cavity cut in said support opposite the end of the electromagnet. The inner side of the armature is cut away, so that its face can be further withdrawn from the front of the support to more easily indicate to the operator its attraction to the electromagnet. The armature is made especially light and is hung so that it will respond to an

unusually small amount of current circulating in the helix of the electromagnet. A spring of non-magnetic metal is preferably attached to the inner side of the armature to prevent its sticking to the pole of the electromagnet and also to assist its retraction therefrom.

When the signal is applied to switchboard-circuits, a number of them are inserted in a strip of insulating material of the same size as the strip of spring-jacks used in telephone-switchboards, with the same number of signals as there are jacks, and are placed in alternation with the said strip of jacks in the switchboard one above another, and are so connected that the signal directly over a jack at any section serves to indicate the condition of the circuit.

In carrying out my invention I prefer to apply it to switchboard-circuits in which the line-annunciator is reset by the insertion of the answering-plug, and in which the busy or line-in-use testing circuit is localized—that is, entirely distinct and separate from the main circuit—and in such localized circuits the multiplied signals may be in series or in parallel therewith, all of which I will now proceed to describe in detail.

In the drawings, Figure 1 is a front edge view of a strip of signals embodying my invention. Fig. 2 is a view of the under side of said strip. Figs. 3, 4, and 5 are respectively an enlarged front edge, an enlarged cross-section, and an enlarged rear view of the said strip. Fig. 5<sup>a</sup> is an enlarged sectional view of a single signal. Fig. 6 is a diagram showing the signals associated with a substation or trunk circuit, having switching terminals upon the several sections of a multiple switchboard and in series with a localized testing and line-annunciator-resetting circuit; and Fig. 7 is a similar circuit, showing the busy-signal connected in multiple in the local circuit.

A represents a strip of hard rubber provided at its ends with means of attachment to the frame of a switchboard and shows twenty visible signals *c c* suspended in hollowed-out spaces or cavities 20 20 from a wire *a* in the front edge of the strip. The wire is held in place by means of the screws *b b*. The signals



*c c* are made of short lengths of soft-iron rod with an eye *e* at their upper ends, through which extends the supporting-wire *a*. The inner lower ends of the signals *c* are cut away, as shown, and at their inner upper ends is inserted a non-magnetic metal spring *d*, which extends downward. In order to render the armatures as light as possible, I have constructed hollow armatures, as indicated in Fig. 5<sup>a</sup>, the rod forming the armature having a hole bored from its bottom end to nearly the top end. Opposite each signal *c* in the strip, in holes provided therefor, is inserted an electromagnet B, consisting of a soft-iron core 22, hard rubber ends 3 3, and a soft-iron sheath 5 closed at one end 1, which end constitutes a yoke connecting the sheath with the core and is secured to the core by the screw 6. The ends of the coil 2 are brought out and connected to the metal terminals *f* and *f*<sup>2</sup>. A rod of non-magnetic metal 4 projects slightly from the open end of the electromagnet, and the end of the latter is preferably sloped away, so that when the signal or armature *c* is attracted it will be brought as far inward as possible and be but slightly seen by the operator. The screws 7 between the heads *l l* of the electromagnets hold them in place. The coil 2 is wound to a resistance appropriate to the circuit in which it is placed, and the signal or armature *c* owing to its free suspension and to its extreme lightness is attracted with an unusually small amount of electrical energy, as small an amount as one-twelfth of an ampere having been used in the operation of the signals in a large central office.

In Fig. 6 *L* and *L*<sup>2</sup> are the conductors of a main circuit, which is shown as multiplied by means of the open terminals 17 and 20 of the line-jacks *J J J* at three sections of a switchboard, and are closed through the line-annunciator D.

The local busy-signal and line-annunciator locking or resetting circuit is constituted as follows: From the wire 14 open terminals 18 and 19 branch to each spring-jack *J*. The wire 14 includes the signals *C* at each section in series and extends through the locking-coil of the line-annunciator D to the battery E, and from the wire 15, which extends from the other side of the battery, open terminals 21 are branched to each spring-jack.

In Fig. 7 the circuits are the same as in Fig. 6, except that the signals *C* are in parallel between the two sides of the wire 14 instead of being in series therewith. In many cases it is desirable to employ the herein-described signal in association with only a portion of the trunk or other circuits in connection with switchboards, and all of the circuits may be provided with test-rings 18, (shown in Figs. 6 and 7 as connected by branches 9 with the wire 14,) and the busy test will be made in the usual way by the operator's connecting-plug with the circuits not provided with the signals *C*.

In Fig. 8 is shown a connecting-plug to illustrate the operation of the signals with the circuits shown in Figs. 6 and 7.

The operation of the signal with its associated local circuit will be understood by reference to Fig. 6. Let it be supposed that a person at the opposite end of the circuit (not shown) has caused a current to flow over the conductors *L L*<sup>2</sup>, which has energized the armature of the line-annunciator and that its shutter has dropped. The operator at any of the sections then inserts a plug *P* into a jack *J*. The tip *h* of the plug, which is connected to one wire of the cord-circuit, makes contact with the spring 20 branched from conductor *L*<sup>2</sup>. The insulated sleeve *j* unites the two springs 19 and 21 of the local circuit through its substance. The sleeve *m*, connected to the second wire of the cord-circuit, makes contact with the ring 17 and by branch 8 to the conductor *L*. When the springs 19 and 21 are thus united, a circuit is closed from battery E by wire 15, wire 11, spring 21, sleeve *j*, spring 19, branch 10, wire 14, including all the signals *C* in series, and the locking or resetting coil of the line-annunciator D to the battery E, which results in current flowing from the said battery through the electromagnets of the signals and retracting all of their armatures *c* into the position shown in dotted lines in Figs. 4 and 5<sup>a</sup> and in causing the line-signal shutter to be reset. For the illustration of the invention the circuit shown is that used in a modern telephone-switchboard provided with test-rings 18 at each jack *J*.

Normally the armature - signals *c* stand slightly in advance of the face of the strip A, and when one is attracted to its electromagnet it is drawn so far out of sight as to be noticeable, as shown in dotted lines in Figs. 4 and 5<sup>a</sup> and by *c*<sup>3</sup> *c*<sup>3</sup> in Fig. 1. Upon the withdrawal of the plug *P* from the jack the local circuit is opened and the armatures are automatically returned to their normal position by their own gravity and the resiliency of the spring *d*.

Very great advantages are gained by the use of my improved signal. It is comparatively inexpensive to construct and to operate, maintain, a current of very low energy only being required to operate them in series or in multiple, and upon the opening of the circuit they positively and automatically resume their normal position.

It will not be necessary to describe in detail the operation of the signal, as shown in parallel in Fig. 7, the essential difference being that the current from battery E divides to all of the signals instead of passing through them in series.

Having fully described my invention, I claim—

1. An electric signal consisting of a suitable support in which is inclosed an electromagnet having an iron sheath, and an arma-



ture hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet, as set forth.

2. An electric signal consisting of a suitable support in which is inclosed an electromagnet having an iron sheath, and a light, hollow armature hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet, as set forth.

3. An electric signal consisting of a suitable support in which is inclosed an electromagnet having an iron sheath, and an armature having on its rear side a spring of non-magnetic metal, hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet, as set forth.

4. An electric signal consisting of a suitable support in which is inclosed an electromagnet having an iron sheath, and an armature having the lower end of its rear side cut away and provided with a spring of non-magnetic metal, hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet as set forth.

5. The combination with a strip of insulating material provided with means of attachment to the frame of a switchboard; of a plurality of signals each of which consists of an electromagnet having an iron sheath, inclosed and supported in said strip; and armatures for each electromagnet hung at their upper ends in cavities made in the said strip, in front of the said electromagnet, as set forth.

6. The combination of a main electric circuit provided with normally open branches at

the sections of a switchboard and terminating in the coil of a line-annunciator; a local circuit provided with normally open branches at each section, and closed through a battery and the locking or resetting coil of the said line-annunciator; the said local circuit including a busy-signal at each switchboard-section, consisting of a suitable support in which is inclosed an electromagnet having an iron sheath, and an armature hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet, as set forth.

7. An electric telephone-circuit provided with a battery, and with normally open branches and visible signals at each switchboard-section, each signal consisting of a suitable support in which is inclosed an electromagnet, and an armature hung by its upper end at the entrance of a cavity in the said support, and in front of the electromagnet; whereby upon the insertion of a connecting-plug between the said branches at any section of the switchboard the visible signals at all of the said sections will be actuated, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 9th day of January, 1896.

ISAIAH H. FARNHAM.

Witnesses:

GEO. WILLIS PIERCE,  
JOSEPH A. GATELY.