

No. 666,444.

Patented Jan. 22, 1901.

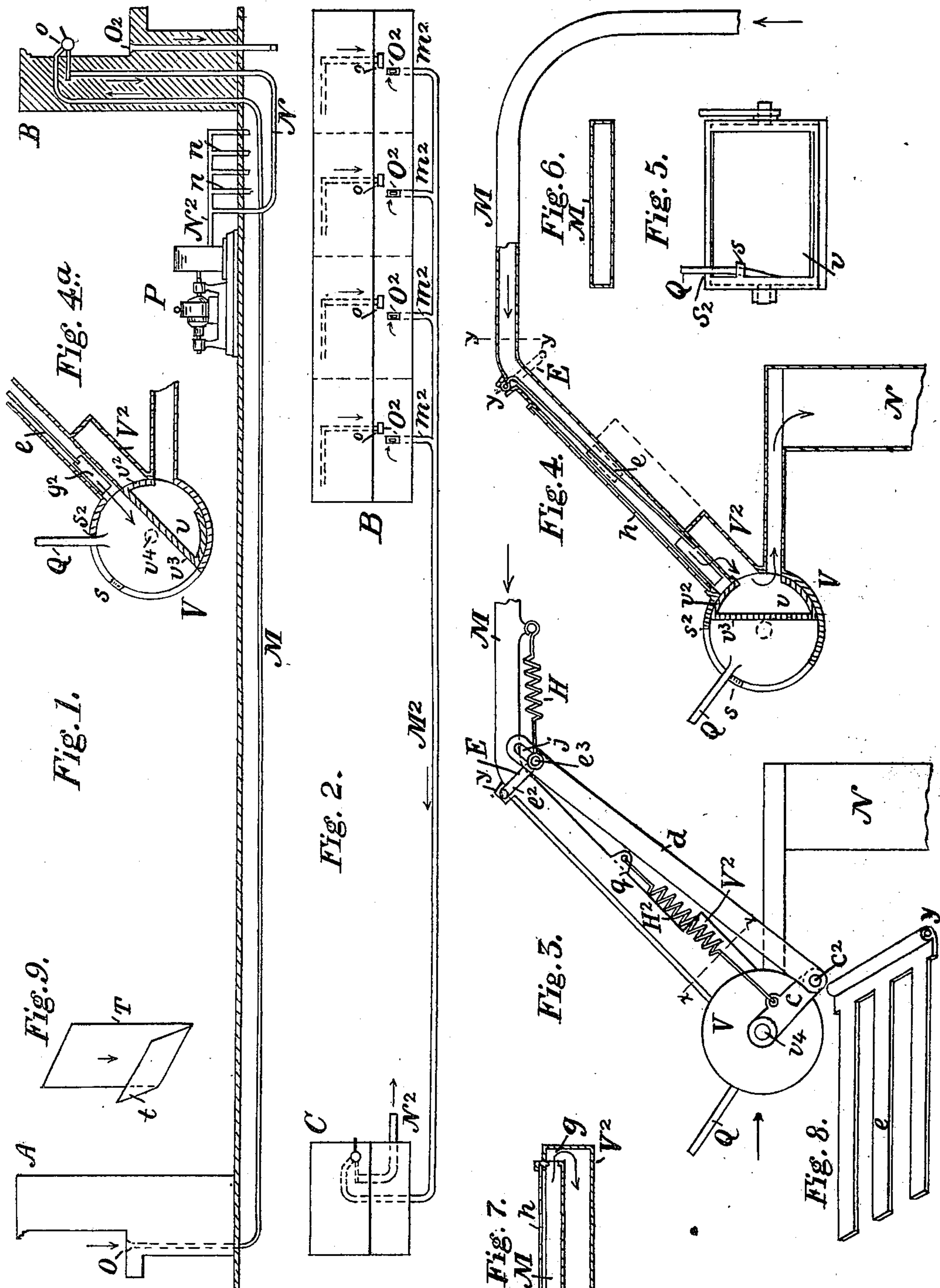
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TELEPHONE EXCHANGE CENTRAL STATION SWITCHBOARD APPARATUS.

(No Model.)

(Application filed Feb. 13, 1900.)

2 Sheets—Sheet 1.



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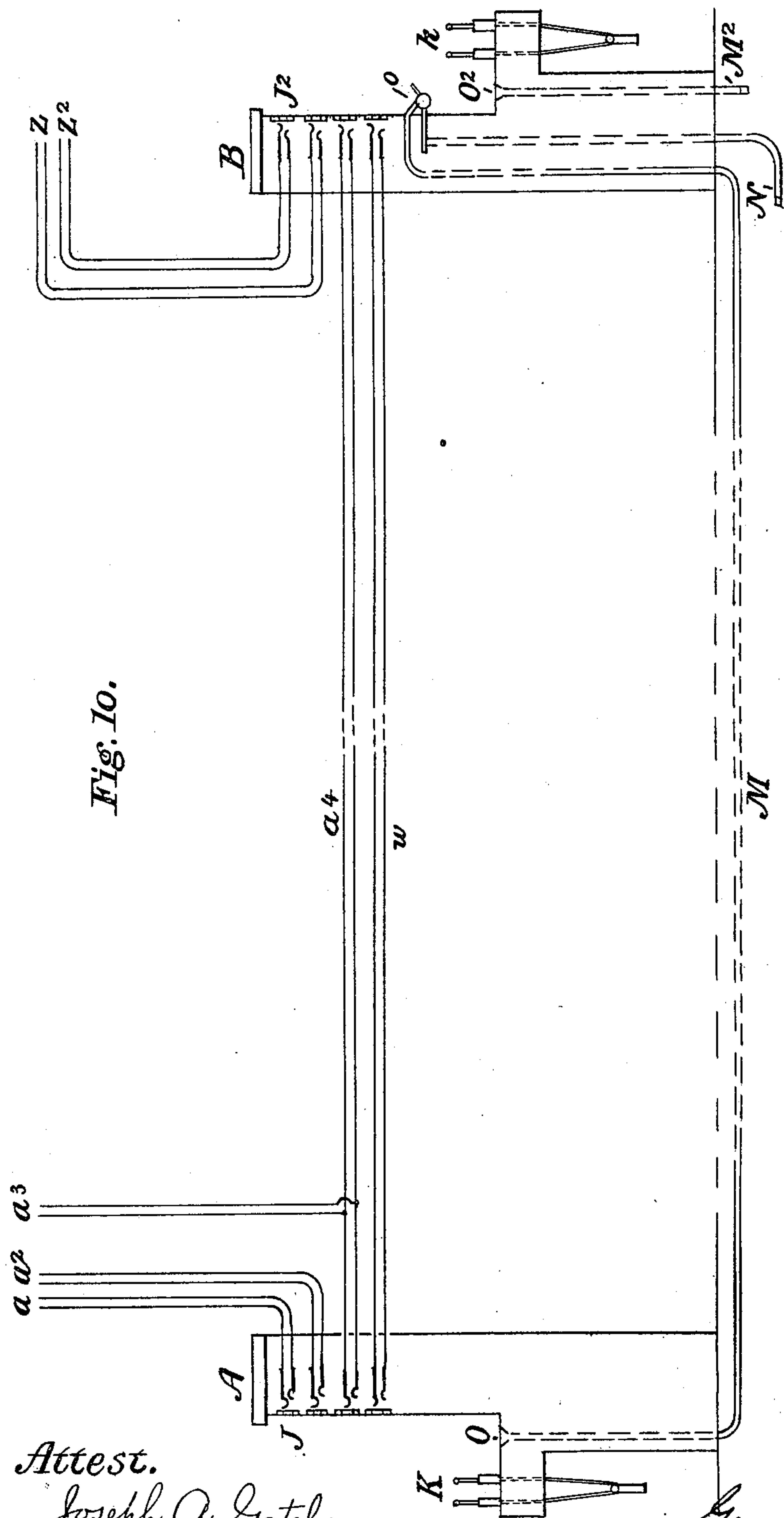
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# UNITED STATES PATENT OFFICE.

GEORGE KNOX THOMPSON, OF MALDEN, AND ERNEST CLIFTON ROBES, OF MEDFORD, MASSACHUSETTS, ASSIGNORS TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

## TELEPHONE-EXCHANGE CENTRAL-STATION SWITCHBOARD APPARATUS.

SPECIFICATION forming part of Letters Patent No. 666,444, dated January 22, 1901.

Application filed February 13, 1900. Serial No. 5,081. (No model.)

*To all whom it may concern:*

Be it known that we, GEORGE KNOX THOMPSON, residing at Malden, and ERNEST CLIFTON ROBES, residing at Medford, in the  
5 county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone-Exchange Central-Station Switchboard Apparatus, of which the following is a specification.

10 This invention relates to telephone-exchange central-station switchboard apparatus, and particularly concerns appliances for conveying between different switchboards instructions regarding the interconnection of  
15 substation-lines or the connection of substation-lines with the lines leading to other central stations belonging to either the same exchange or to other exchanges.

In telephone-exchange traffic messages of a  
20 certain class are known as "toll" messages. In general these are messages between substations of different exchanges or between widely-separated exchange districts, and the lines over which they pass between exchanges  
25 are called "toll-lines." They require special attention and care on the part of the operating force of the central station or the several central stations concerned, and for these messages a special charge is made. Our in-  
30 vention is especially well adapted for use in association with these toll-lines. These conditions render it necessary that the names and telephone-numbers of the call-originating and called-for substations, together with  
35 information as to the date, the time of day, and the time consumed in the exchange of conversation or the transmission of the message, shall be entered on a blank form termed the "ticket." This is done, first, to avoid  
40 the confusion and liability to error, which, as experience shows, is apt to occur if the above-recited information be transmitted orally between the several operators, and, second, to furnish a record of the transaction for future  
45 reference.

In the toll business as at present conducted a substation desiring a toll connection on first sending the call in the usual way is re-  
50 sponded to by a receiving-operator stationed at the switchboard or switchboard-section

where the call-receiving devices of the line of such substation are placed, to whom the order for the desired connection is given. The order, with the necessary detailed information, is at once entered upon the ticket and  
55 the connection is to be made or completed by a toll-line operator at another switchboard or switchboard-section, termed the "toll-switchboard." These toll-boards may be arranged singly or in pairs at different portions of the  
60 entire switchboard or switch apparatus, and it is therefore requisite that the ticket stating the order shall be transferred from the operator who records the order to the particular operator or group of operators who han-  
65 dle the toll-lines extending to the distant point with which communication is to be established. It is furthermore desirable that after conversations are completed and their  
70 duration properly recorded on the tickets or slips the said tickets shall be forwarded to some central point—a "clearing-house," so to speak—whence they may be collected when a  
75 sufficient number shall have accumulated or at the close of the day. Heretofore it has been customary to distribute and collect the tickets by messengers.

The object of our invention is to dispense with messengers and to provide a system and a convenient and serviceable apparatus for  
80 the noiseless, accurate, and swift conveyance of the tickets, first, from the switchboard or section where the orders are received and written to the various toll switchboards or sections where the desired connections are to  
85 be made or completed, and, second, to forward the said tickets after the business to which they refer has been transacted to some suitable depository for ultimate collection. To this end we have invented a system of  
90 pneumatic-tube transmission extending between switchboards and from the switchboard finally concerned in the establishment of complete intercommunication and a form of transmission-tube for use therein  
95 which is capable of conveying between its terminals the tickets, the paper information slips or cards which are required to be transferred from one switchboard or switchboard-section to another loosely and without the  
100



carrier or receptacle, which, so far as we know, has uniformly been a concomitant of pneumatic-tube transmission. We have devised a form of tube capable of efficiently performing this work, the same having a rectangular bore and being preferably thin or flat, as will be more particularly shown and described herein. We have also found that by bending or folding one end of these tickets to an angle with their main portion they become qualified to act as a piston within a transmission-tube of such form or character, and under the impulsion of a current of air traversing the tube, preferably caused by the establishment of a vacuum at the receiving end thereof acting upon them in their capacity as a piston, they are rapidly drawn through the said tube from the end at which they are inserted to the receiving end where they are delivered.

Our invention provides that a pneumatic tube or a plurality of tubes shall especially be extended between the switchboards where substation-calls are originally received to the toll-line switchboards, which are intermingled with and variously placed among the others, the card-receiving end of the said tube or tubes being at the regular board and the delivery end of the tube at the toll-board. It also provides that from the toll-switchboard a supplementary pneumatic tube of the same general character shall extend to a suitable central depository and that if there be a plurality of toll-boards each shall have a branch tube leading into and coalescing with the main supplementary tube extending to such depository. Our invention likewise consists in the combination, with the said pneumatic transmission and supplementary tubes, of an exhaust or extension tube placed at the receiving end and leading from an air-pump or such equivalent device as may be employed to establish the requisite current of air in the proper direction through the said pneumatic tubes, and appropriate and convenient devices also at the receiving end to effectuate and control the proper retention and delivery of the arriving tickets. The said devices comprise a valve placed at the junction of the main and exhaust tubes and so arranged that while normally it holds the air-passage between the tubes open and the delivery-passage of the ticket closed it can be so altered as to close the air-passage and open the ticket-delivery passage, means for operating the valve when desired, means for bringing the arriving ticket to rest and for holding it within the tube until the air-current by the action of the valve shall have been cut off and for then freeing the same, and mechanism connecting the valve-actuating means with the ticket-holding devices for the release operation of the latter, the same being organized to liberate the ticket and permit its delivery as soon as the air-passage shall have been closed.

In the drawings accompanying this speci-

fication, Figure 1 is an elevation, partly in section, showing a pneumatic-tube system between the positions on a central-station-switchboard apparatus of a receiving-operator and a connecting or toll operator, the receiving or delivery end of the tube being at the latter position. Fig. 2 is a plan view of the supplementary or return system, showing a tube extending from a number of connecting-operator's switchboard-sections with which the said tube is connected by branches to a common receptacle or depository. Fig. 3 is a side view, on a larger scale, of the receiving end of the transmission-tube and terminal devices. Fig. 4 is a similarly-enlarged side view of the receiving end of the tube, partly in longitudinal section, to show the valve between the transmission and exhaust tubes, the same being open to the exhaust; and Fig. 4<sup>a</sup> indicates a section of the receiving-end terminal devices with the passage between the tubes closed by the said valve. Fig. 5 is an end view of the valve-cylinder looking in the direction indicated by the arrow, Fig. 3. Figs. 6 and 7 are cross-sections of the transmission-tube on lines *y y* of Fig. 4 and *x x* of Fig. 3, respectively, the latter indicating the air-channels at the sides of the transmission-tube leading to the exhaust. Fig. 8 is a perspective view of the tube-in-closed portion of the elbow-lever, serving as a retarding device. Fig. 9 is a perspective view of a satisfactory form of ticket or slip, and Fig. 10 is a diagram indicating the associated switchboard and pneumatic-tube arrangement.

A represents a switchboard or switchboard-section where the calls of a number of substation telephone-lines are answered or initially attended to, and B is a switchboard or section where connections of the substation-lines of any switchboard-section of the former class are made with trunk or toll lines leading to other central stations. As indicated in Fig. 10, *a*, *a*<sup>2</sup>, and *a*<sup>3</sup> represent substation-lines connected primarily with the substation-board and adapted to have their calls answered thereat. The toll-board comprises switch-terminals of toll or other central-station lines *z* *z*<sup>2</sup>, and the said lines at both boards are provided with suitable switch-sockets *J J*<sup>2</sup> and with switch-plug and cord connection devices, as usual, these being indicated at board A by the letter K and at board B by *k*.

For the necessary establishment of communication between substation-boards and toll-boards the substation-lines *a a*<sup>2</sup> *a*<sup>3</sup>, assigned to any switchboard A, may be continued to the boards B of the latter class, as shown by extension *a*<sup>4</sup> of line *a*<sup>3</sup>, which has a switch-socket at board B on the well-known "multiple-switchboard" principle, or, dispensing with such an arrangement, office-trunks extending between switch-sockets of the switchboards concerned may be employed, such a trunk being indicated at *w* as uniting the



boards A and B. It should, however, also be understood that in practice the switchboard-sections are generally placed end to end in close juxtaposition, so as to make a long continuous structure, and that the toll-line boards or sections are often arranged in pairs and may be intermingled among the substation boards or sections or otherwise placed at different portions of the entire switchboard apparatus.

M is a pneumatic tube extending between the switchboards, having an open terminal O at the substation-switchboard and suitable terminal devices o at the toll-board, holding a channel open to an extension or exhaust tube N, connecting with an air-pump P, and at the same time maintaining closed the passage through which the arriving tickets are delivered. The air-pump is arranged to produce and maintain a partial vacuum at the receiving end of the transmission-tube M, thus establishing through the said tube a current of air from the transmitting end at A to the receiving end at B. Any required number of such transmission-tubes and exhaust-tube extensions may be arranged and employed, as indicated by the incomplete extension-tubes  $n$ , attached to the main exhaust-tube  $N^2$ , which connects directly to the air-pump P.

In our system of pneumatic transmission we dispense with the use of carriers, and cards, tickets, or paper slips are transmitted loosely through the tubes. This is accomplished by making the tubes rectangular in cross-section and flat, as shown in Fig. 6, by employing tickets T having a width slightly smaller than but corresponding to the length of the cross-section of the bore of the tube, and by bending up or folding the end  $t$  of the said tickets, as shown in Fig. 9, in such manner and to such a degree that the said folded-up portion  $t$  substantially closes the bore of the tube and becomes practically a piston therefor, as well as the card or ticket whereon a message to be transmitted is inscribed.

In Fig. 2 is indicated the supplementary system whereby the tickets T, which have reached the toll-boards B through the transmission-tubes M and have had their calls completed, can be sent to a suitable depository C, from which they may be regularly collected.  $M^2$  is the common main tube of this supplementary system, and  $m^2$  branch tubes therefor extending each from one or more toll-boards and all leading to and merging in the common main tube, which at the depository C connects with the extension-tube  $N^2$ , leading from the air-pump and has ticket-delivery terminal appliances similar to those of the transmission-tubes M at switchboards B, which are presently to be described. Both tubes are open at the transmitting end and present merely a rectangular slot-shaped aperture, wherein the ticket to be transmitted is inserted. O represents this aperture for the transmission-tube at board A, and  $O^2$  a simi-

lar aperture in the supplementary tube at board B; but at the receiving or delivery ends of these tubes it is necessary to provide suitable means for noting the arrival of a ticket, for holding it in place on arrival, so that it cannot be drawn into the exhaust, for cutting off the exhaust during delivery, and for enabling its egress from the tube to be conveniently and expeditiously accomplished. For these purposes the tubes are each fitted with a valve-casing chiefly consisting of a short horizontal cylinder V, the axis of which is perpendicular to the center line of the main tube, but in part of a chamber  $V^2$ , overlapping the end of the rectangular main tube, which in its inclosed portion is provided with air passages or channels  $g g^2$ , through which, as indicated in Fig. 7 by the arrows, the air passes, when the channel to the air-pump is open, into the chamber  $V^2$  and thence to the exhaust N.

Within the valve-cylinder, which may be entirely open at the rear side, is a valve  $v$ , mounted on an axis  $v^4$  and having a wing or gate  $v^2$  and an actuating-lever Q, which can be moved between limits  $s$  and  $s^2$  for the purpose of bringing the valve to either of the two positions necessary to the operation of the system. The normal position of the valve is indicated in Fig. 4, where the lever Q being at its lowest point  $s$  the valve-gate  $v^2$  closes the ticket-egress passage, while the front end of the valve-chamber  $V^2$  is unclosed, affording free passage of air between the said chamber and the exhaust-pipe N, leading to the air-pump. The ticket-delivery position of the valve is shown by Fig. 4<sup>a</sup>. Here the lever has been moved to its upper limit  $s^2$  and the gate  $v^2$  has been transferred from its position closing the ticket-passage to one where, leaving this passage open, the air-passage to the exhaust is closed by the presence of the said gate across the opening of the air-chamber  $V^2$ .

Mounted in close association with the valve devices is a bell-crank or elbow lever E, pivoted at  $\gamma$ . The longer arm  $e$  of this lever lies within the tube M and is very nearly as wide as the rectangular cross-section of the tube M is long. As separately shown, this arm is subdivided into several branches or fingers, which, acting in a claw-like manner on the ticket rapidly approaching the end of the tube, retards its motion and, in conjunction with the stop device furnished by the valve-gate  $v^2$ , brings it to rest and holds it within the tube, ready for delivery as soon as the passage for its egress is opened. The shorter lever-arm  $e^2$  is outside of the tube, and the lever normally is held in place, so that the fingers of its longer arm will be made to press against the lower inner surface of the tube by the spring H.

The portion of the rectangular tube M which is immediately in rear of the valve-cylinder and which contains the lever-arm  $e$  is provided in its upper wall with a window  $h$ , of glass or like transparent material, through



which an arriving ticket which has been brought to rest beneath the fingers of said arm  $e$  may be seen.

The web  $v^3$  of the valve  $v$  has a flat rear surface, which is adapted when the said valve is moved to the position where the ticket-egress is opened to form a continuation of the inclined floor of the tube and to facilitate the delivery of the ticket by serving as a mechanical bridge, whereby the said ticket is enabled to cross the valve-cylinder cavity into which otherwise it might be drawn.

Secured to one end of the valve-axis  $v^4$  is a crank  $c$ , and a link  $d$ , slotted at  $j$ , engages at one end with the pin  $c^2$  of said crank and by its slot with a similar pin  $e^3$ , carried by the end  $e^2$  of the short arm of the elbow-lever  $E$ . By means of this mechanism the longer arm of the lever is lifted and caused to release the ticket whenever the valve-actuating lever  $Q$  is operated to move the valve from its resting position to that wherein it opens the discharge position of the ticket and closes the passage between the transmission and exhaust tubes and in consequence of such operation. It is, however, desirable that the operation of the valve shall be slightly in advance of the release of the ticket, so as to avoid the release of the ticket before the valve-web is brought into line with the tube, and this is provided for by the slot  $j$  of the link  $d$ , which permits the said link to move a considerable distance before pressure is exercised on the lever-arm  $e^2$ . It is also desirable that the valve and elbow-lever shall be restored to their normal positions after the discharge of a ticket without the necessity of special action of the operator to that end, and means are provided for carrying this out. The spring  $H$ , attached to the pin  $e^3$  of the elbow-lever arm  $e^2$ , is adapted to perform this service for the said elbow-lever, and the spring  $H^2$ , shown as being attached to the crank  $c$  on the valve-axis at one end and to any suitable fixed point  $g$  at the other, is adapted to restore the valve.

The operation of these devices may briefly be adverted to. When a call from one of the substation-lines of switchboard  $A$  has been received for a substation of an outlying exchange to be reached by one of the toll-lines of switchboard  $B$ , the ticket for this interconnection is made out, as hereinbefore described, and affords all necessary information. The said ticket is then deposited by the original receiving-operator in the aperture  $O$  of the transmission-tube, its end being first turned up, as shown. It is drawn rapidly through the tube by the air-current produced by the air-pump, or, in other words, by the partial vacuum or rarefaction at the receiving end, and, reaching switchboard  $B$ , passes under the fingers of the elbow-lever and is at once observed through the window or may be made to announce itself by a signal in any well-known manner. The toll operator operates the lever  $Q$ , and thereby cuts off the air-pump or exhaust connection and

opens the delivery-gate. The ticket being then released slides through the valve-cylinder over the inclined surface provided for it, its motion being accelerated by the momentum of the column of air within the tube and behind it. The toll operator makes the requisite circuit connections and when the call is completed deposits the ticket in the aperture  $O^2$  of the supplementary tube, through which it is carried to the clearing-house, depository, or any suitable point for accumulation and collection.

The terminal devices may obviously be considerably modified without departing from our invention. For example, the air-chamber  $V^2$ , with which the side air-passages  $g g^2$  from the main tube connect, may be extended farther along the said tube, as indicated in dotted lines in Fig. 4, and the side air-passages themselves may then be placed, as in like manner indicated, farther back in the main tube. Such a modification is sometimes an advantage, as there is then a space at the end of the tube where the air is quiet and the ticket while kept therein will not flutter against the arms of the lever  $e$ .

Having thus fully described our invention, we define it in the following claims:

1. In a pneumatic system, the combination with a transmission-tube, of a card or ticket having a part approximately the shape of the bore of the tube and adapted to act as a piston therefor, whereby the said ticket may be propelled through the said tube.

2. In a pneumatic-tube apparatus, the combination substantially as described herein, of a transmission-tube having a flat rectangular bore; with cards or tickets having flanged or turned-up ends adapted to loosely fit the bore of said tube and to serve as a piston therefor; whereby the tickets may be propelled through the said tube, dispensing with the aid of carriers.

3. The combination substantially as hereinbefore set forth, of a flat rectangular transmission-tube; means for establishing a constant current of air through said tube; and cards or tickets of a width corresponding to the length of the internal cross-section of said tube and having flanged or bent ends corresponding in width to the width of the bore of said tube; whereby each card is enabled to practically close the tube when inserted therein, and to be propelled or drawn therethrough by the said air-current.

4. The combination in a telephone central-station switchboard apparatus, of a series of substation-line switchboard-sections; and a series of toll-line switchboard-sections; with a pneumatic-tube instruction-ticket system, comprising a group of pneumatic tubes extending between switchboards of one series and those of the other, and adapted for the conveyance of loose instruction-tickets uniformly from the switchboard-sections of the substation-line series to those of the toll-line series; and a supplementary pneumatic sys-



tem consisting of branch transmission-tubes leading from the switchboard-sections of the toll-line series respectively, and a common receiving-tube in which the said branches merge, leading to a suitable depository; substantially as set forth.

5. The combination with a pneumatic tube of rectangular cross-section adapted for the transmission of tickets, paper slips, &c., without a carrier; and an exhaust-tube at the receiving end thereof leading to a vacuum or air-current producing apparatus; of a lever-actuated valve capable of being placed in either of two positions, and controlling the connection between the said main and exhaust tubes, and the direct or ticket delivery opening or egress of the former, the normal position of said valve being such as to establish the air-passage between the transmission-tube and exhaust-tube, and to close the ticket-egress of the former, and the position wherein it is placed on the arrival of a ticket being such as to close the said air-passage or cut off the vacuum-producing apparatus, and to open the ticket-egress of the transmission-tube and thus permit the delivery of the ticket; substantially as set forth.

6. In combination with a pneumatic-transmission tube adapted for the conveyance loosely within the said tube of tickets, paper slips, &c., by means of a current of air; and an extension or exhaust tube therefor at the receiving end thereof, leading to an air-pump for the production of such air-current; a valve placed at the junction of said transmission and exhaust tubes and adapted to open the air-passage between them, and to close the ticket-delivery passage of the former, or conversely to close the said air-passage and open the said ticket-passage; means for manually actuating the said valve; a spring-arm within the transmission-tube adapted to act as a retarding device for the ticket, and to stop the same on its arrival, until the valve is opened to permit the delivery thereof; and link-and-lever mechanism uniting the actuating devices of the said valve to the said spring device in such manner as to free the ticket from the said device, as soon as the said valve is operated to close the air-passage; substantially as, and for the purposes set forth.

7. The combination of a pneumatic transmission-tube for the conveyance loosely with-

in the said tube of tickets or slips of paper by means of a current of air traversing the tube from the transmitting to the receiving end thereof; an exhaust-tube leading from the said receiving end of the transmitting-tube to the air-pump producing such air-current; with a valve controlling the air-passage between the said transmission and exhaust tubes, and adapted to close and open the same as required; a stop mechanically attached to, or forming part of said valve, normally opposing the egress of the arriving tickets; a window of glass or like transparent material in the transmitting-tube, immediately in rear of the said stop; and means as indicated for operating the said valve to close the air-passage, and for simultaneously removing the said stop to permit the delivery of a ticket, when the same is observed through the window to have arrived; substantially as specified.

8. In combination with a pneumatic transmission-tube M; and an extension-tube N therefor connecting with an air-pump or equivalent means for establishing a current of air through the transmission-tube from its transmitting to its receiving end; of the valve-casing V placed at the junction of the said tubes; the valve *v* hung in pivots or bearings within the said casing, and controlling the air-channel between the said tubes, and also the ticket-outlet of the transmission-tube; the actuating-lever Q for the said valve, attached thereto, and movable between two positions, in the said valve-casing; the spring-controlled pivoted elbow-lever E having one arm *e* within and the other *e*<sup>2</sup> outside of the transmission-tube; the crank *c* secured to the valve-axis; and the slotted link *d* having its ends attached respectively to the said crank *c*, and the arm *e*<sup>2</sup> of the elbow-lever; substantially as and for the purposes specified.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 6th day of February, 1900.

GEORGE KNOX THOMPSON.  
ERNEST CLIFTON ROBES.

Witnesses:

GEO. WILLIS PIERCE,  
JOSEPH A. GATELY.