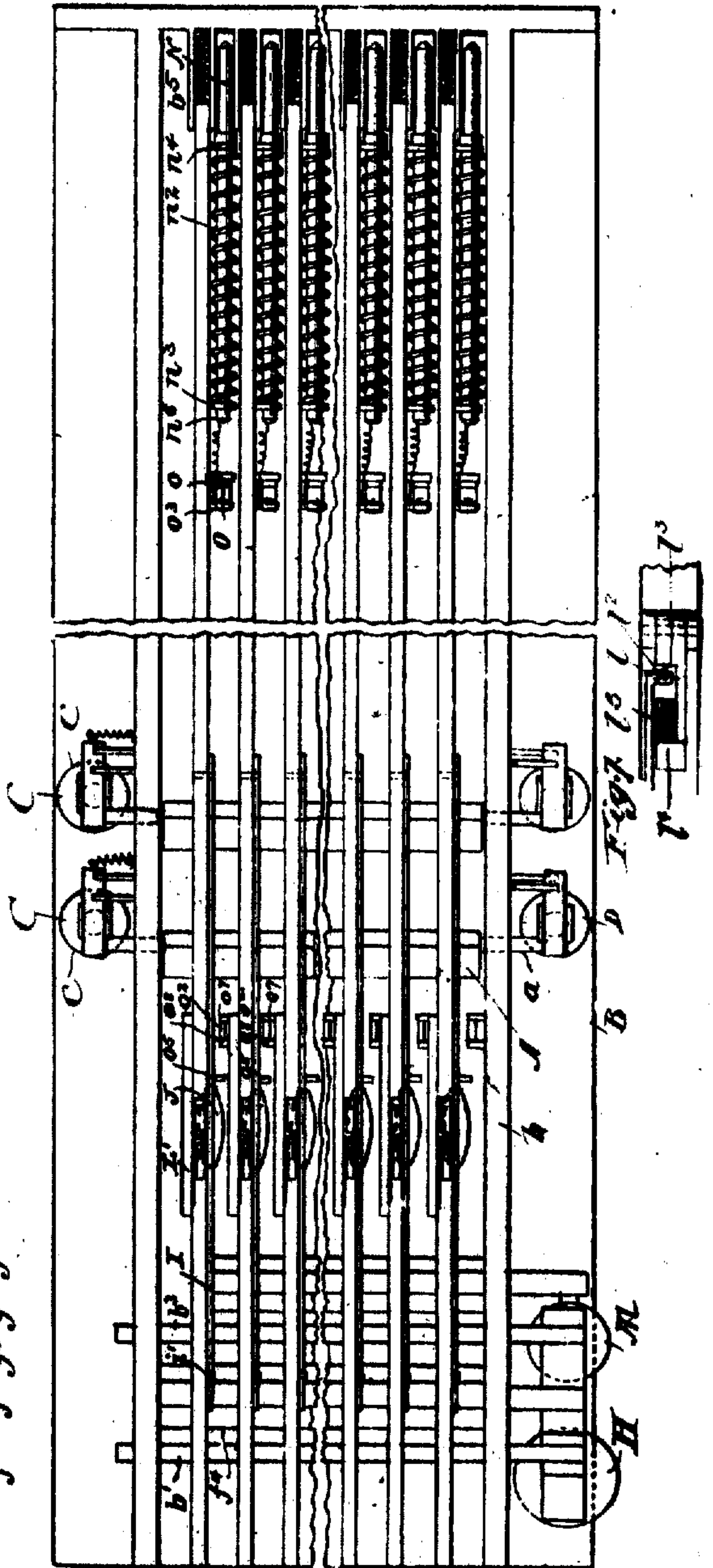
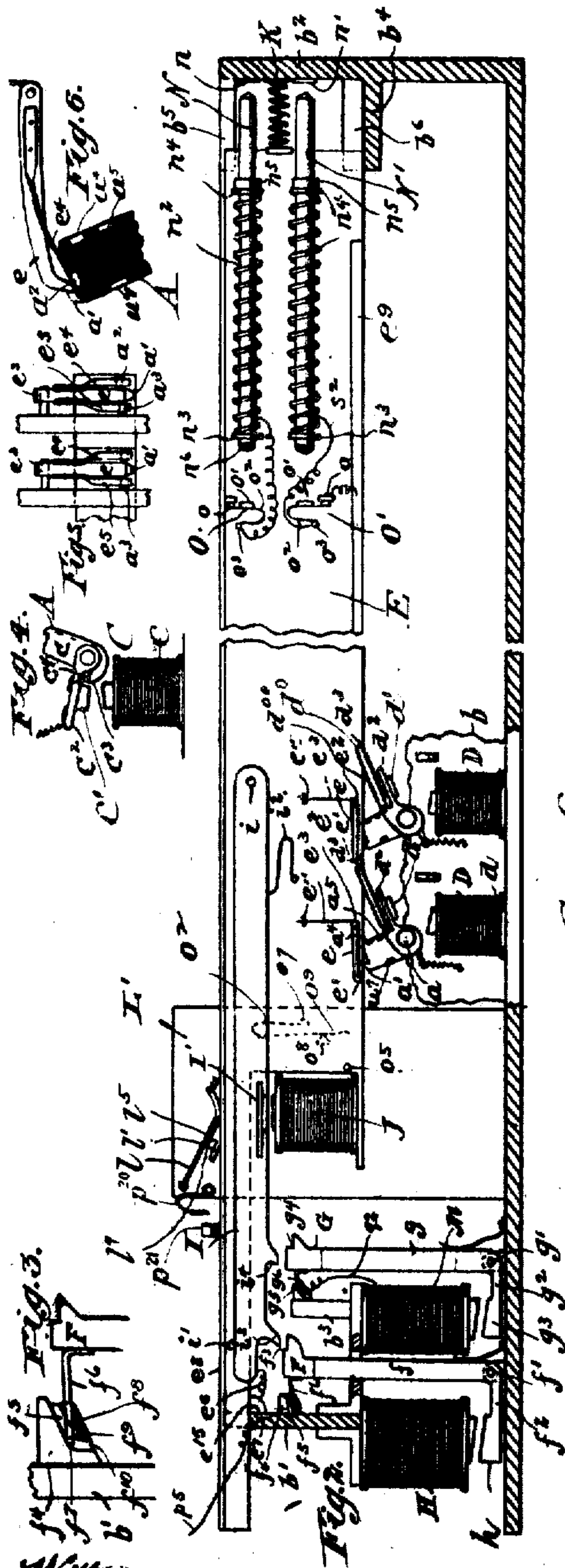


1,297,251.

Patented Mar. 11, 1919.

13 SHEETS—SHEET 1.



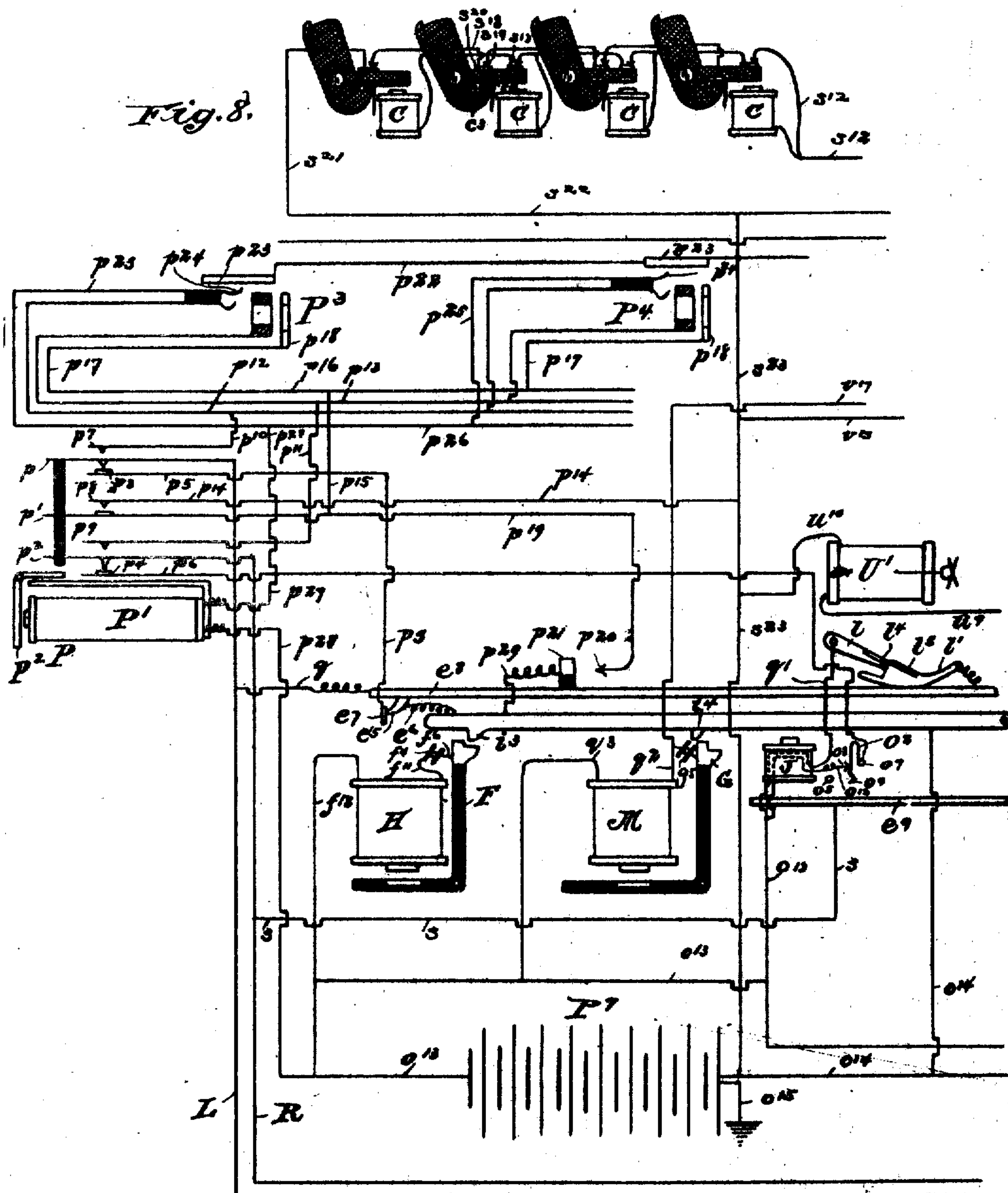
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H. J. ROBERTS,
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APPLICATION FILED JUNE 2, 1901.

1,297,251.

Patented Mar. 11, 1919.
13 SHEETS—SHEET 2.



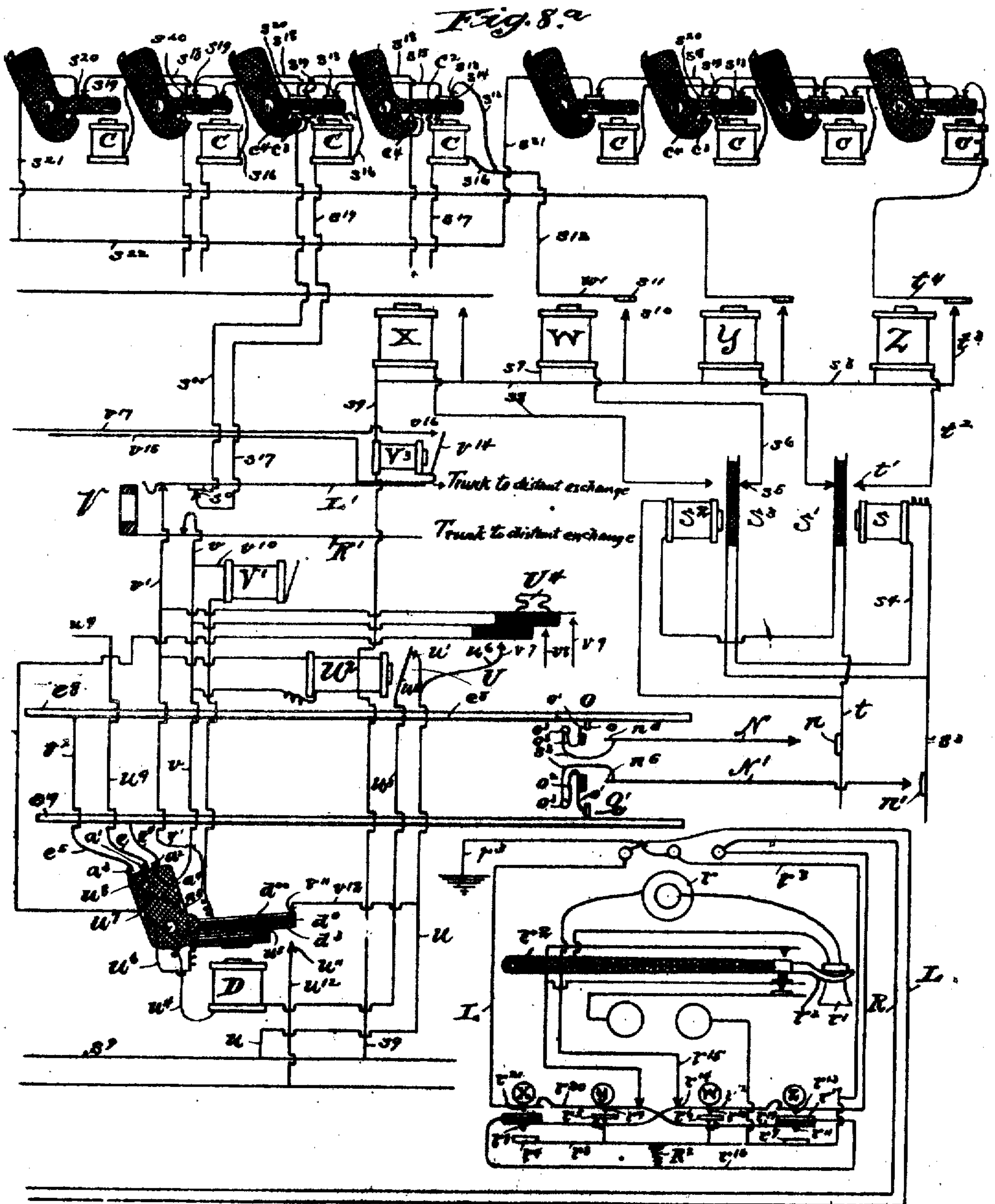
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1,297,251.

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13 SHEETS—SHEET 3.

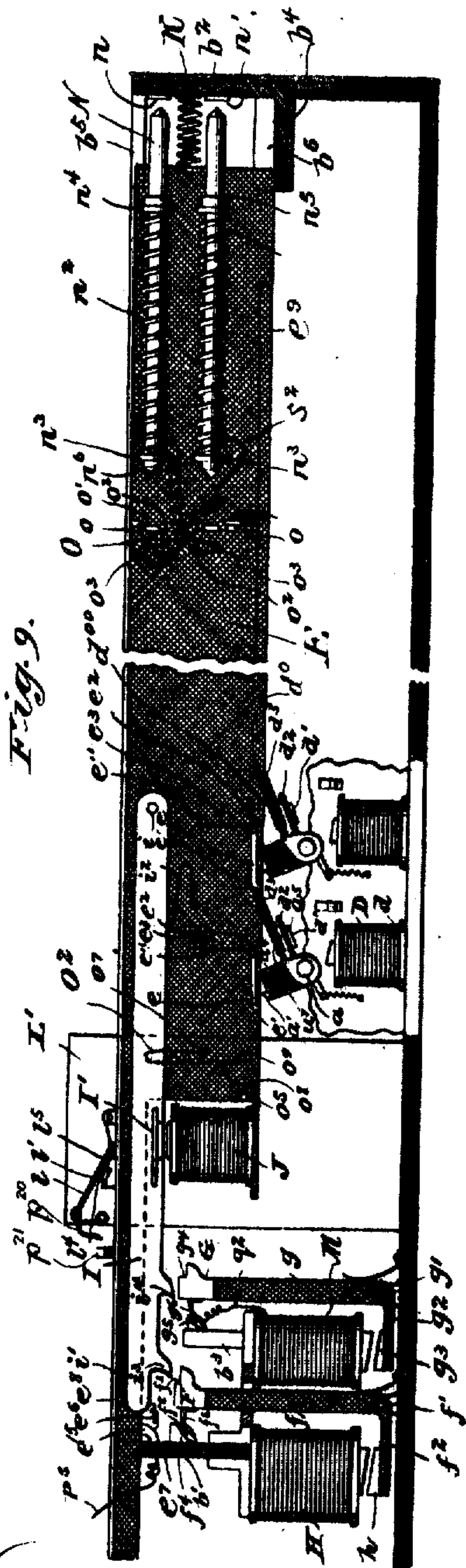


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13 SHEETS--SHEET 4.



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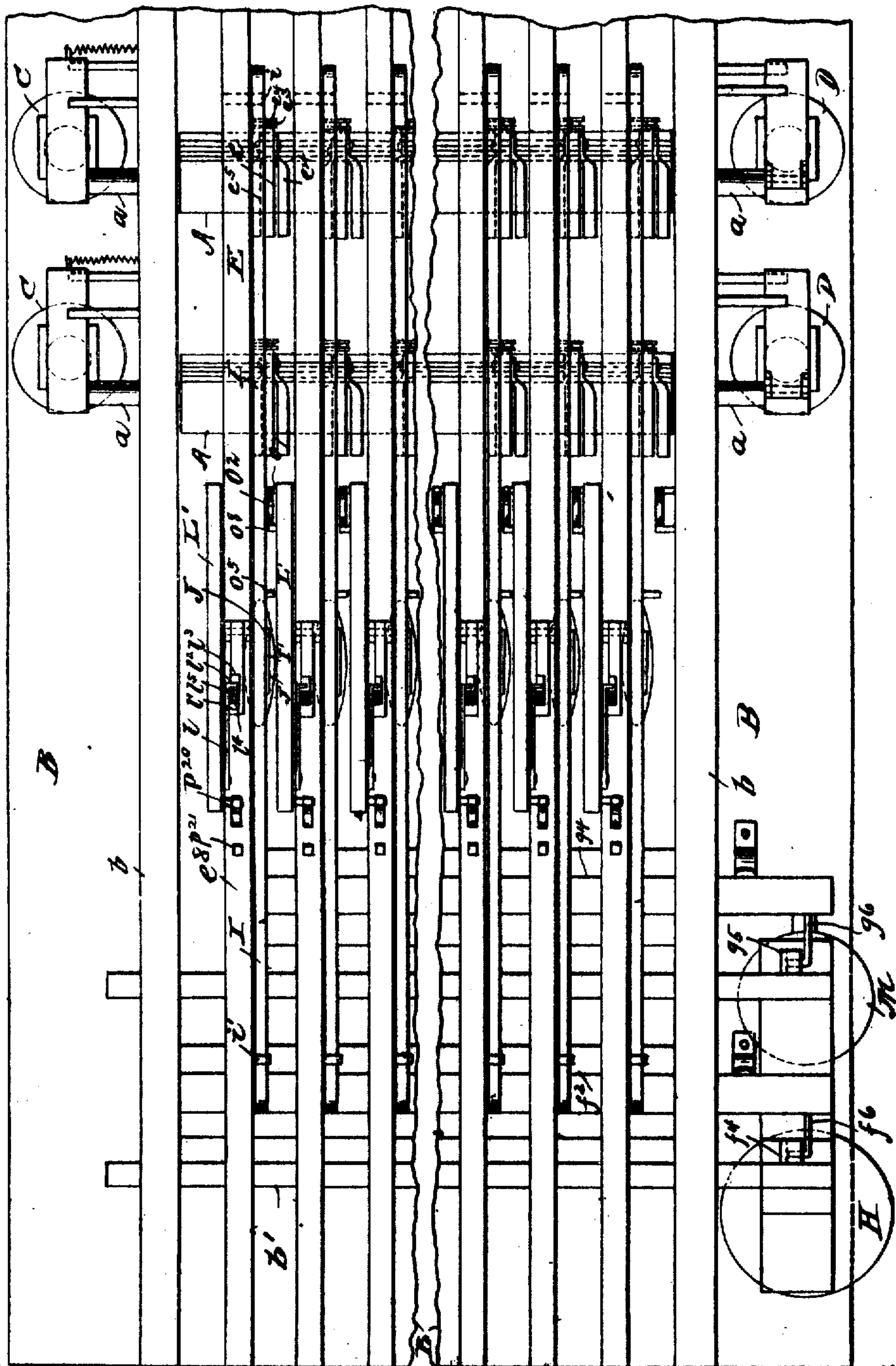
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13 SHEETS—SHEET 5.

Fig. 10.



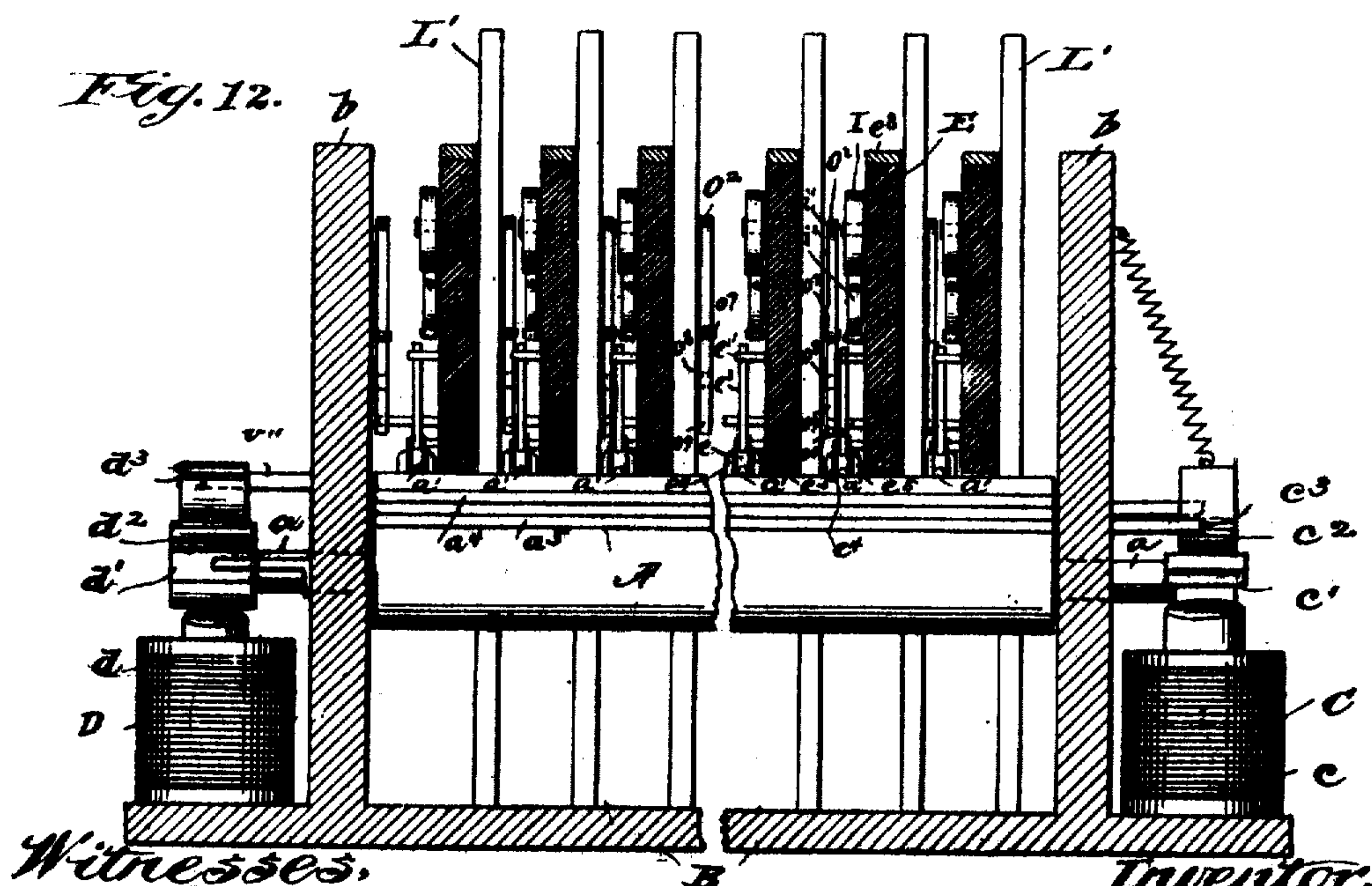
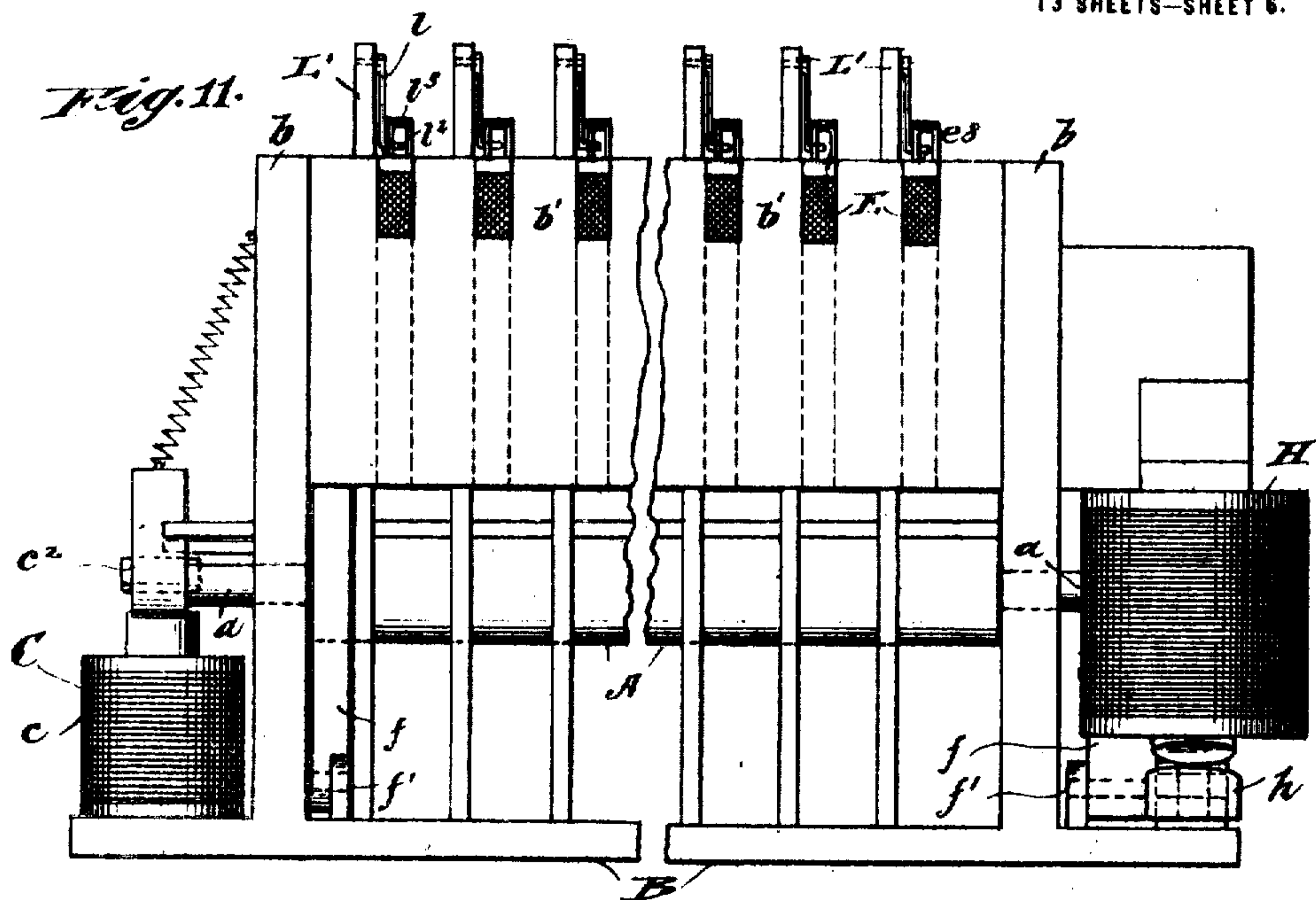
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13 SHEETS—SHEET 6.



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13 SHEETS—SHEET 7.

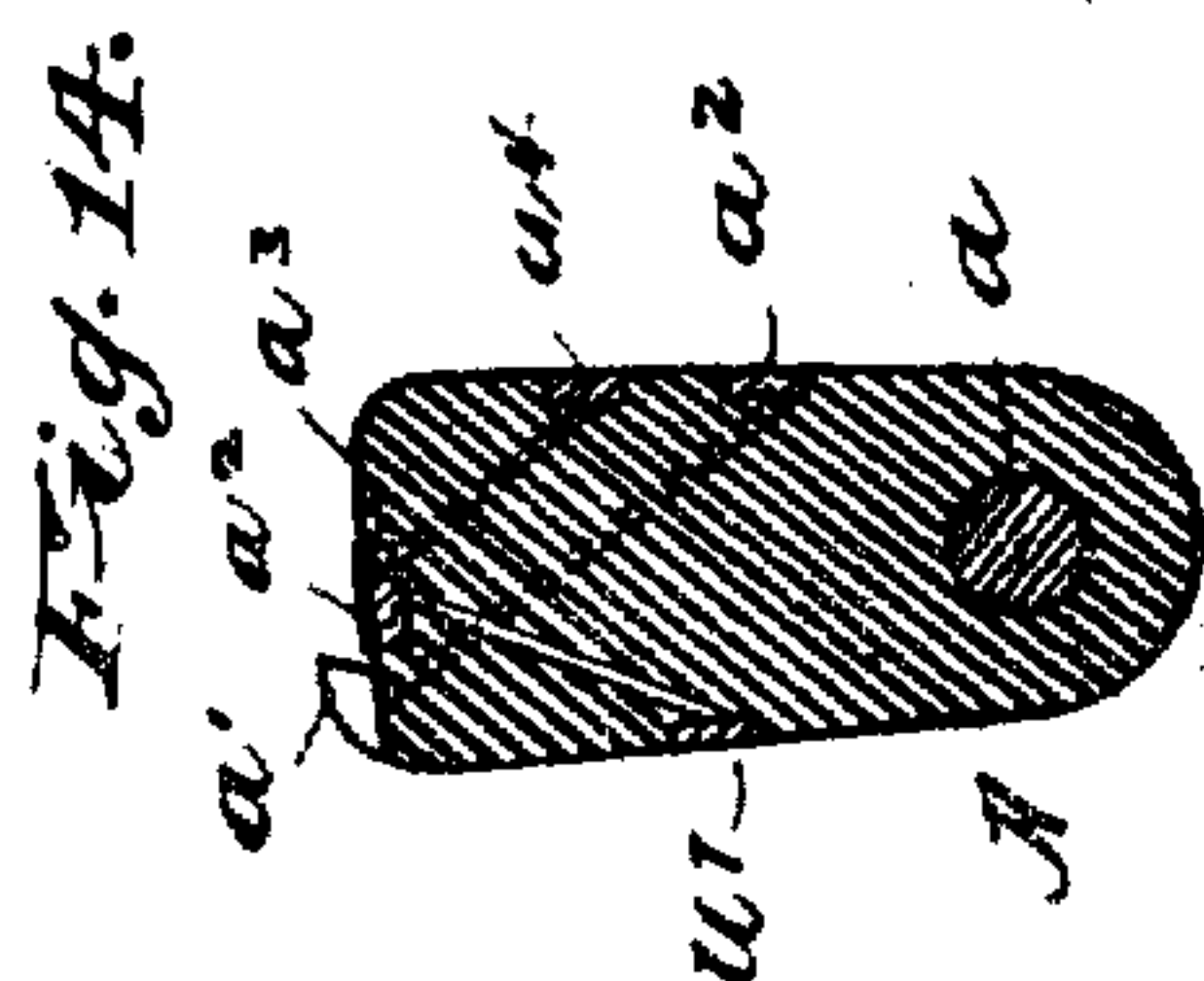
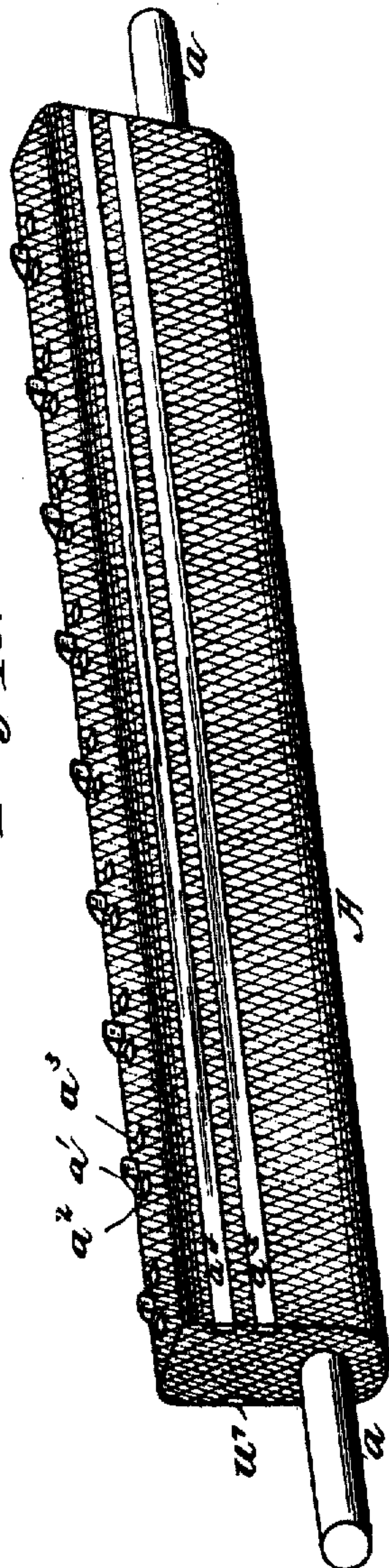


Fig. 13.



Witnesses,
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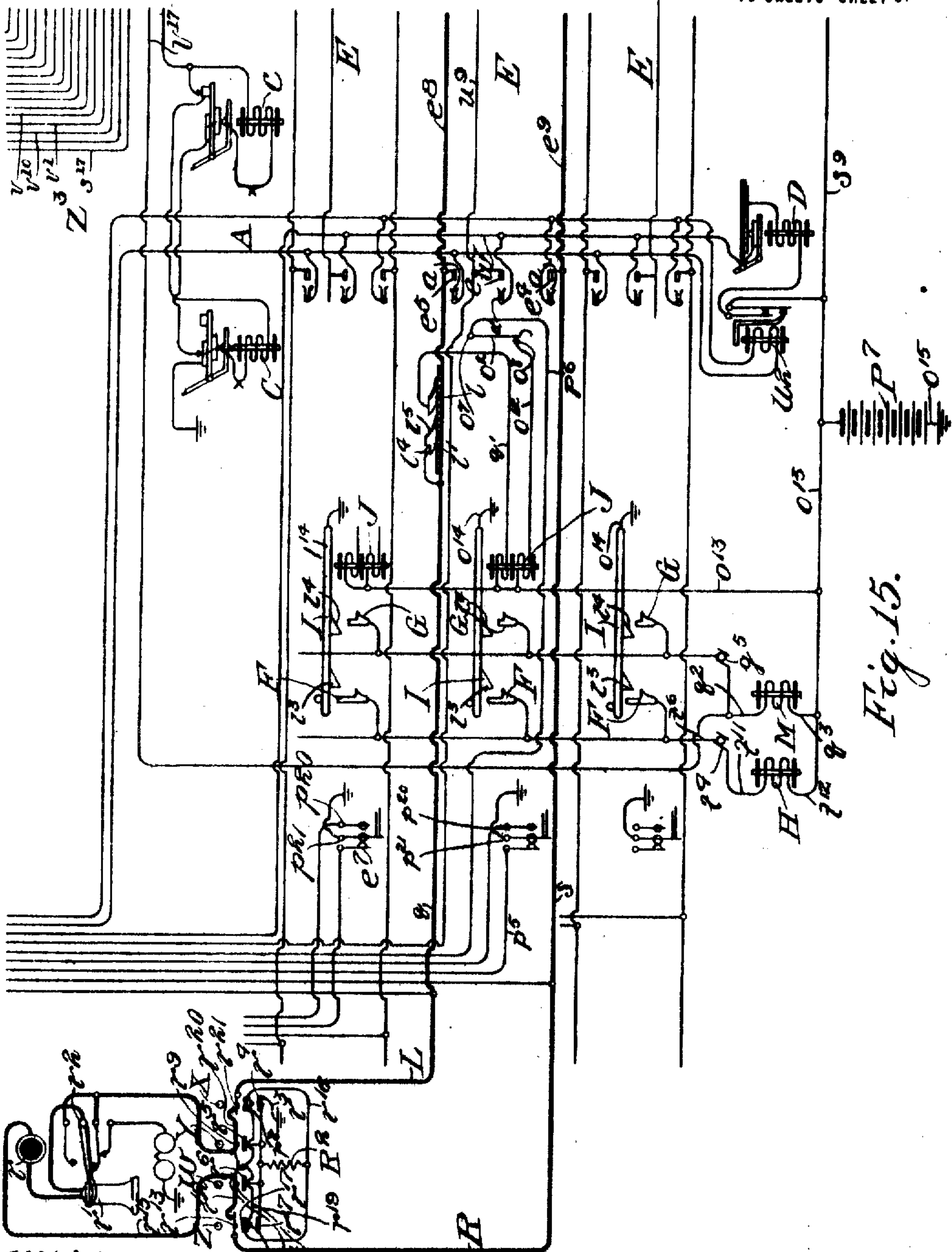
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13 SHEETS—SHEET 8.

1,297,251.



Witnesses

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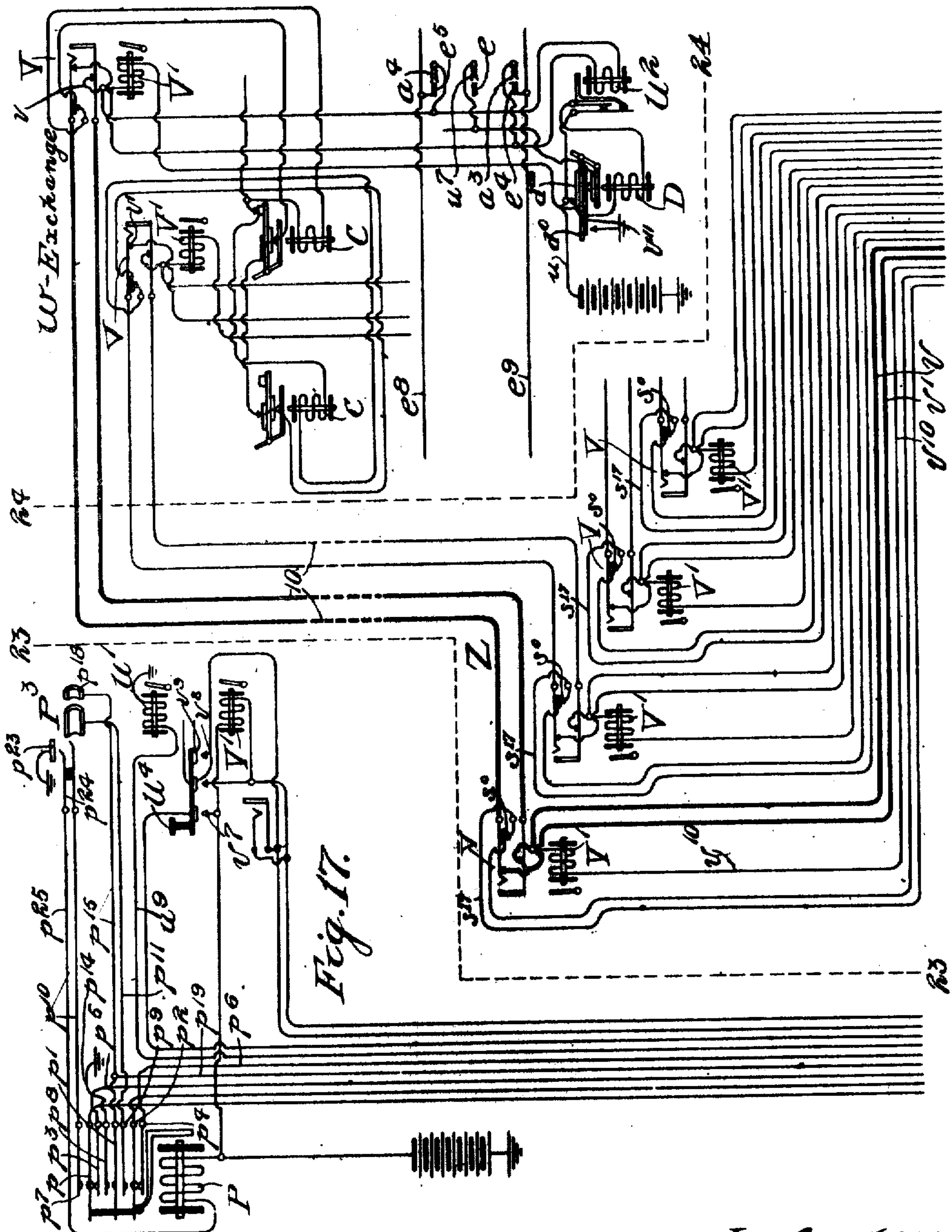
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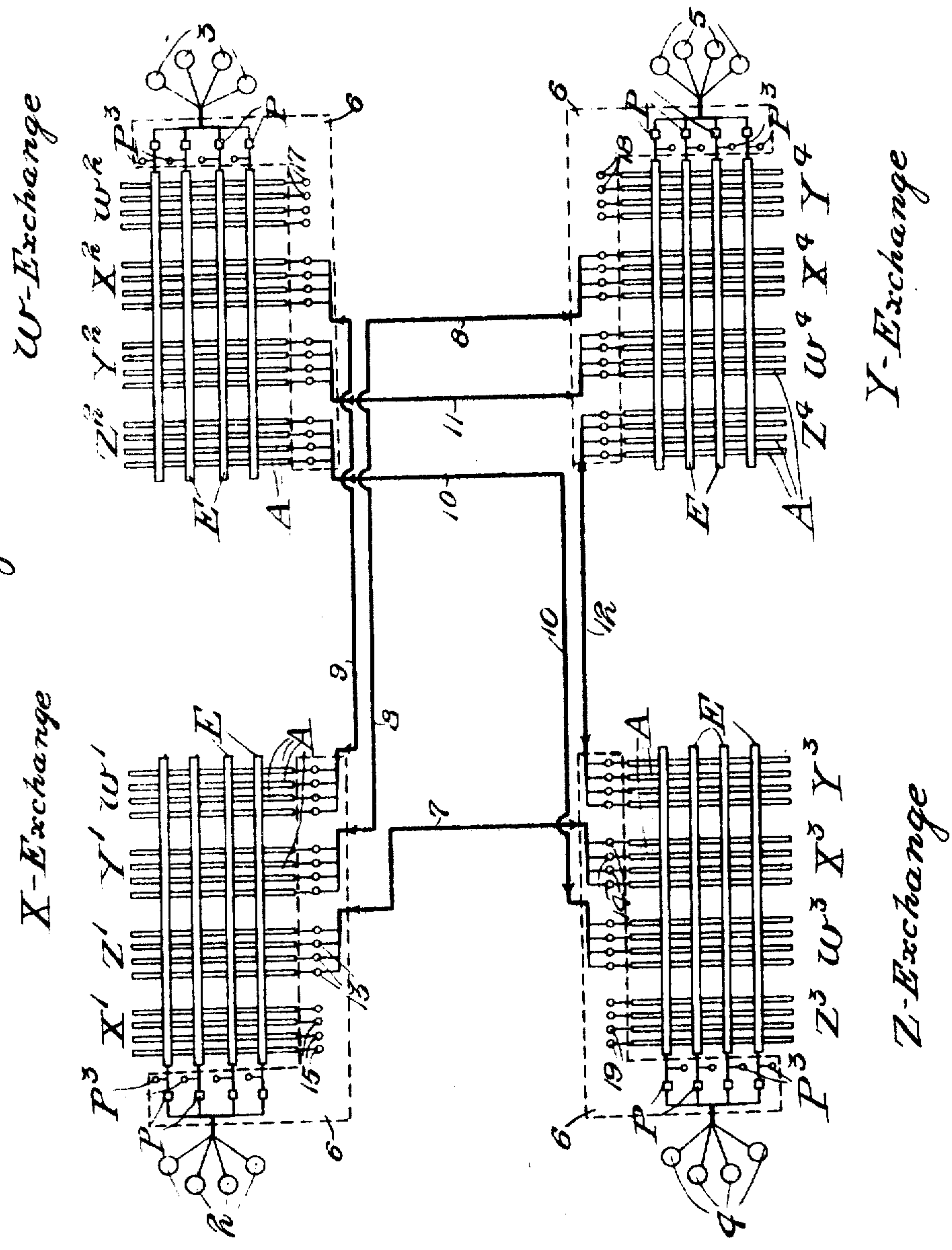
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1,297,251.

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APPLICATION FILED JUNE 3, 1901.

Patented Mar. 11, 1919.
13 SHEETS SHEET 11.

Fig. 18.



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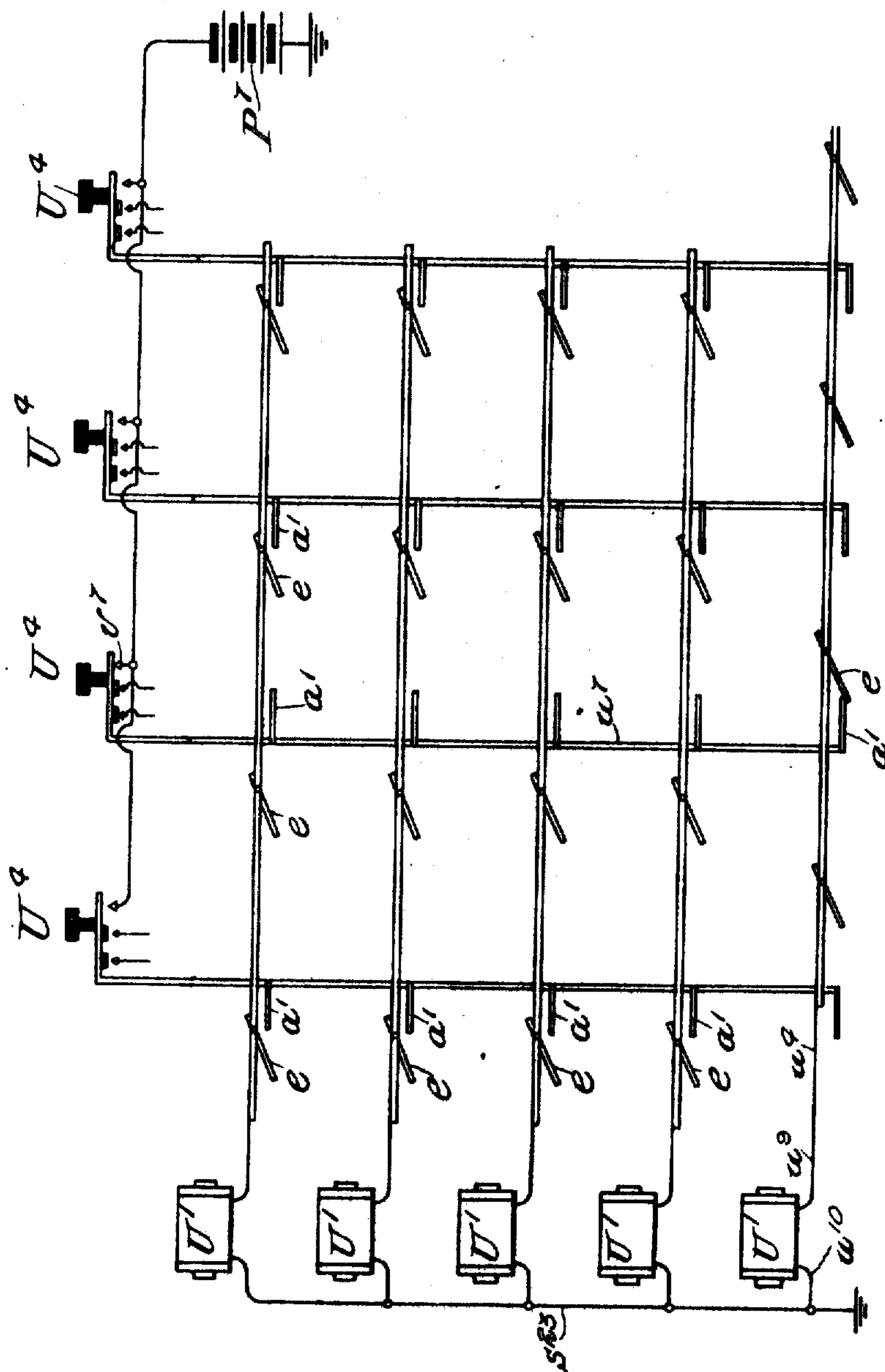
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1,297,251.

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APPLICATION FILED JUNE 3, 1901.

Patented Mar. 11, 1919.
13 SHEETS—SHEET 12.

Fig. 19.



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1,297,251.

Patented Mar. 11, 1919.
13 SHEETS--SHEET 13.

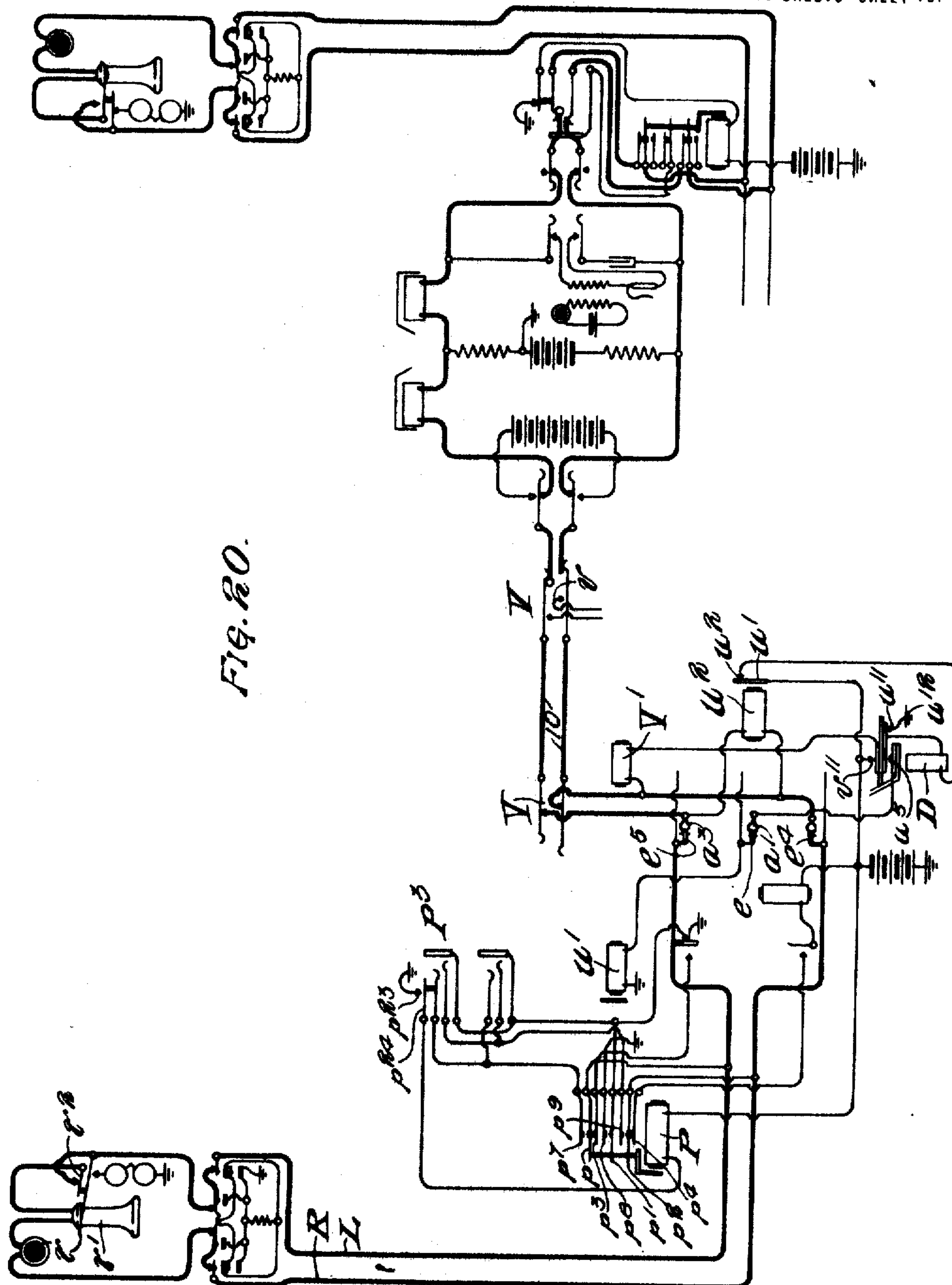


Fig. 20.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,297,251.

Specification of Letters Patent.

Patented Mar. 11, 1919.

Application filed June 3, 1901. Serial No. 62,941.

To all whom it may concern:

Be it known that I, HOMER J. ROBERTS, of Evanston, Cook county, Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in general, but more particularly to telephone exchange systems in which provision is made for trunking between exchanges, or between different divisions of the same exchange, and especially to systems in which current is supplied to the subscribers' lines from a central source for operating purposes, as well as for talking purposes.

Generally stated the object of my invention is to provide a telephone exchange system in which provision is made for extending the calls with rapidity and certainty, and in which the cost of installation and the expense of maintenance are low, and the efficiency high, considering the methods employed.

Special objects are to provide means by which a calling subscriber may automatically connect his line with an idle trunk-line leading to a manual switchboard; to provide two-way trunks, and means for automatically seizing either end thereof, for the purpose of trunking between exchanges, or between different divisions of the same exchange; to provide an improved automatic trunk selector for selecting idle trunks; to provide an arrangement by which a calling subscriber may automatically connect his line with either a local trunk or a long-distance trunk, depending upon whether he is calling a subscriber of his own exchange or division, or a subscriber of some other exchange or division; to provide two-way trunks and means for automatically seizing either end thereof, together with means for automatically precluding the seizure of either end of a trunk by other subscribers, whereby the subscriber already in possession of such two-way trunk is protected against interference by said other subscribers; to provide two-way trunks and means for automatically seizing either end thereof, together with means for manually connecting with either end of the same, whereby connection can be extended automatically to one end of a trunk, and connection from the other end thereof to the called line then completed manually; to provide a novel ar-

angement whereby the answering jacks on a manual switchboard are not individual to the subscribers' lines terminating thereat, said answering jacks being common to all of such lines, and the subscribers being equipped with means at the central station for automatically selecting idle jacks, there being a common trunk leading to each jack, each jack having a line signal which is displayed when the trunk-line is seized by a calling subscriber; to provide a novel arrangement whereby the signals by which the calling subscribers attract the attention of the switchboard operator are considerably less in number than the subscribers having lines terminating at such board, the said signals being common to all of the subscribers, and whereby the manual switchboard operator may determine which line is calling before answering the call; to provide means by which a manual switchboard operator may release a calling subscriber from a trunk to which the said subscriber automatically extended his line in making the call, and whereby the said operator may do either before or after answering the call, and either before or after the called subscriber answers; to provide an arrangement whereby the calling subscriber can push one button or equivalent device and thereby automatically extend his line into connection with a trunk-line at his own exchange, or push another button and thereby automatically extend his line into connection with a trunk-line leading to another exchange, there being as many push-buttons or equivalent devices as there are exchanges or divisions of the same exchange; and to provide certain details and features of improvement and combinations tending to increase the general efficiency and serviceability of a telephone exchange system.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings Figure 1 is a plan view (with parts broken out to reduce the size of the figure) of a trunk selector embodying the principles of my invention.

Fig. 2 is a view showing one of the selector bars and principal operating parts in side elevation, a fragment of the side casing *b* opposite the pair of magnets *D* being shown in side elevation, and the remainder

100

105

110

of the casing being shown in longitudinal vertical section.

Fig. 3 is a fragmentary detail of one of the circuit-opening devices shown in Figs. 1 and 2.

Fig. 4 is an end elevation of one of the trunk selector elements (and the magnet which operates the same) looking at the end of the element opposite that shown in Fig. 2.

Fig. 5 is a fragmentary plan view of two adjacent selector-bars, contact devices carried thereby, and the subjacent trunk elements with which said contact devices cooperate.

Fig. 6 is a detail side elevation of the contact device shown in Fig. 5.

Fig. 7 is a plan view of a mechanical detent whereby the selector-bar is temporarily held at the end of its initial movement.

Figs. 8 and 8^a taken together constitute a diagrammatic view of a telephone system embodying the principles of my invention.

Fig. 9 is a reproduction of Fig. 2 with the several insulating parts properly shaded to indicate their character.

Fig. 10 is a plan view on an enlarged scale of the left-hand end of the selector instrument shown in Fig. 1.

Fig. 11 is an end elevation of the same.

Fig. 12 is a transverse sectional view taken in a vertical plane between two of the trunk elements and looking toward the left-hand end of the instrument.

Fig. 13 is a perspective view of one of the trunk elements in enlarged detail.

Fig. 14 is a cross-section of Fig. 13.

Figs. 15, 16 and 17 taken together are a detail diagrammatic representation of the whole system.

Fig. 18 is a simplified diagram of the entire telephone system.

Fig. 19 is a diagrammatic view showing the circuits and other means whereby an operator can identify a calling subscriber after he has signaled the operator.

Fig. 20 is a simplified diagram representing the complete talking circuit between two connected substations in a system embodying the principles of my invention.

In carrying out my invention a plurality of exchange stations are connected by trunks which severally terminate at each end in an instrument or apparatus capable of operation by any one of a series of subscribers of the exchange in which the instrument is located, and said instrument operating to automatically select one of the trunks terminating thereat, whereby the operating subscriber is placed in direct communication with the exchange operator at the other end of the trunk. Automatic means are provided whereby the act of selecting a trunk gives to the subscriber for the time being the exclusive use of this trunk and prevents

interference by other subscribers belonging to the same or any other exchange. Therefore, the system embodies means whereby all of the trunks extending between a subscriber's local exchange and any and all other exchanges are equally available to him when not in use. In other words, the said trunks are common, the operation of selecting one of these trunks giving him the exclusive use of the trunk for the time being.

Having thus outlined the general plan of the system, the main instrument whereby the automatic selection of the trunk-lines is accomplished will first be described in detail, and thereafter the interconnections or system as a whole, and in this connection it may be stated that in its broader sense the scope of the invention is not confined to the use of the particular instrument herein described, but, on the contrary, any suitable apparatus may be employed for effecting the several connections and operations.

Referring to Figs. 6, 8^a, 13, 15, 16 and 18, A designates as a whole a series of oscillatory trunk elements pivotally mounted to extend parallel with each other across a suitable frame B (Figs. 1, 11 and 12); and E (Figs. 1, 2, 9, 10, 16 and 18) designates a series of subscribers' selector-bars arranged to extend parallel with each other and transversely of the trunk elements A.

In the drawings (Figs. 1, 2, 9 and 10) but two of the trunk elements A are shown, but in practice as many trunk elements will be provided as there are trunk-lines, and they will be grouped together electrically in as many groups as there are exchanges interconnected. (See Figs. 8, 8^a, 15, 16 and 18.)

As a convenient construction the trunk elements A are of bar-like construction, made of insulating material and provided at each end, near the lower edges, with trunnions *a* (Figs. 11 and 12) on the main frame, whereby they are pivotally supported so as to be capable of oscillation through a limited range of movement. The trunk members are adapted to be oscillated forwardly in two distinct and successive steps, electromagnets as indicated respectively at C and D (Fig. 1), located at the ends of said elements, being employed for this purpose. The magnet C, which is the first in order of operation, comprises the usual spool *c* (Figs. 11 and 12) arranged to act upon an armature *c'* (Fig. 4) mounted upon an arm *c''* pivotally secured upon the trunnion *a* (Fig. 13) of the trunk element. In order that the armature may itself oscillate the trunk element forwardly a certain distance, and thereafter permit the trunk element to be oscillated a second step by the magnet D at the opposite end thereof, a stop *c'''* is provided upon the trunk element in position to be engaged by the under side

of the arm e^2 when the trunk element is in its normal or retracted position and the armature held retracted from the magnet.

The magnets D at the opposite ends of the trunk elements are similar to the magnet C, comprising the usual spool d (Figs. 2, 11 and 12) mounted upon the frame and arranged to act upon the armature d' mounted upon an arm d^2 which is rigidly secured upon the trunnion a of the adjacent end of the trunk element. The arm d^2 is secured upon the trunnion a in such angular relation thereto that when the trunk element has been rotated forwardly the first step by the magnet C at the opposite end thereof, the armature d' will be brought into position to be effectively attracted by the magnet D for imparting the second forward step to the trunk element, at which time the armature d' is drawn down into engagement with the core of the magnet D. Both the magnets C and D operate to open and close electrical contacts, as will hereinafter be more fully described. The arm d^2 carries also upon its upper side a pivoted arm d^0 of insulating material and provided upon both its upper and lower sides with contact strips d^{00} and d^3 , respectively. (See Fig. 8^a.) A back contact device v'' (Fig. 12) normally forms both an electrical contact with the strip d^{00} and a mechanical back stop for the armature arm.

Upon each trunk element A is mounted a series of contact-studs (see detail Fig. 13), severally designated a' , these studs being arranged in longitudinal alinement with each other and in position to register with each of the individual selector-bars E. The several studs a' constitute contact devices adapted for engagement with corresponding contact fingers e (Figs. 2, 8^a, 9 and 10) mounted upon the selector-bars E, these contact fingers e serving not only to form an electrical contact with the trunk elements, but also as tappets whereby the selector-bars are thrust forward by the forward oscillation of the trunk elements, as will hereinafter appear.

In the operation of the instrument the selector-bar is moved bodily endwise forwardly a certain distance before the trunk element is oscillated, this distance being such as to bring the engaging ends e' (Figs. 2, 9 and 10) of the several contact fingers vertically above the trunk elements and slightly in advance of the several contact devices a' carried thereby. The location of the contact fingers relatively to the path of movement of the contact studs a' is such that after being thus advanced to a position directly above the trunk elements their engaging ends will lie in the path of the contact studs, so that when the trunk element is oscillated forwardly one of the contact studs which is opposite whichever one of the selector-bars

that happens to be moved forward will engage its corresponding contact finger and thrust it forward during the two advanced steps of the trunk element afterward affected by magnets C and D. The first step of the trunk element carries its contact devices a' into a position approximately vertically above its axis, while the second step carries it into a position beyond the perpendicular, so that when the trunk element is in its normal retracted position, and when it is advanced to its forward limit, its contact studs are below the path of movement of the contact fingers e' , as the latter move horizontally forward when the selector-bar is shifted bodily. The object of this arrangement is to prevent interference with the particular trunk element in operation by the movement of other selector-bars while thus in selected position in any given operation. In order that the contact fingers e may retain contact with the studs a' after they have been thus once engaged, said fingers are pivotally mounted upon the selector-bars, as indicated at e^2 (Figs. 2, 6 and 9), and are provided with rigidly attached upstanding plate springs e^3 having their studs confined between guide studs e'' which serve to hold the several contact fingers in exact position to register with the contact studs, as described, while permitting the contact fingers to oscillate downwardly after engagement with the contact studs. In order to prevent such contact fingers from slipping out of engagement with the contact studs, the latter are made of under-cut form at their engaging sides, as best indicated in detail Fig. 6. At the same time that the electrical contact is closed between the several contact fingers and studs a' , two other circuits are closed between the trunk element and selector-bar, and for this purpose each contact finger e carries at each side a contact strip e^4 and e^5 (Fig. 5) respectively, secured rigidly thereto and arranged to project at their free ends at each side of the engaging end of the finger and in position to engage with contact plates or surfaces a^2 and a^3 (Figs. 5, 6, 13 and 14) located at the respective sides of the contact studs a' . The shape of the contact strips e^4 and e^5 is such that when the engaging end of the contact finger is engaged with the stud a' , the toggle-like movement of the contact finger relatively to the trunk element will rock the ends of said contact strips into certain engagement with the respective contact plates or surfaces upon the trunk element, thus insuring the closing of the three circuits. As hereinbefore intimated, the selector-bars are thrust forward previous to their engagement by the trunk elements. As a convenient means of imparting the initial forward movement to the selector-bars, I provide a pair of transversely-extending pivotally-

supported bars designated respectively F and G (Figs 2, 3, 8, 9 and 10), each of said bars being of a length sufficient to extend entirely across the series of selector-bars, said bars F and G being severally mounted upon upstanding arms f and g (Figs. 2, 8, 9 and 11) located at the respective ends of the bars F and G, which arms f and g are pivotally mounted at their lower ends upon the main frame, as indicated at f' and g' . H designates a magnet suspended from a cross-bar b' (Figs. 9 and 11) of the main frame in position to overhang an arm f^2 rigidly connected with one of the arms f of the bar F and carrying an armature k adapted to be acted upon by the magnet H, the lifting of the arm f^2 by the magnet serving to oscillate the arms f forwardly, and with them the cross-bar F supported at their upper ends. I (Fig. 2) designates a series of thrust-levers, one for each selector-bar, adapted for engagement by the thrustbars F and G to force the selector-bar forwardly. Each thrust-lever I is pivoted at its forward end, as indicated at i , to the body of the selector-bar, so as to be capable of oscillating in a vertical plane parallel with the plane of said selector-bar, and is normally held uplifted and in engagement with a stop i' by means of a suitable spring, as indicated at i'' . At its rear end the thrust-lever I is provided with two contact devices i^3 and i^4 , respectively, adapted for engagement with the respective thrust-bars F and G. In the normal position of the parts the contact device i^3 is located directly above an engaging notch or shoulder f^3 (Fig. 2) so formed in the upper part of the bar that when the thrust-lever is drawn downwardly, as hereinafter described, the contact device i^3 and said notch will be brought into operative engagement and electrical contact to thrust the selector-bar forward by the subsequent energizing of the magnet H and consequent thrusting forward of the bar F. In order to thus draw down the thrust-lever a magnet J is mounted upon the selector-bar immediately beneath said thrust-lever, and an armature I' is mounted upon the thrust-lever in position to be attracted by the magnet J. Preferably, in order to economize in space, the magnet J will be made of flattened form and set within a recess formed in the body of the selector-bar, as indicated in the several figures of the drawings. The drawing down of the thrust-lever closes a circuit through the magnet H which thereupon thrusts forward the selector-bar a certain distance against the tension of a coiled expansion spring K interposed between the forward end frame member b^2 and the front end of the selector-bar. In order to hold the selector-bar temporarily in this position, and against the tension of the spring K, after the magnet H has been deenergized,

a mechanical detent is provided comprising a pivoted detent l (Figs. 2 and 7) mounted upon an upstanding plate-like support L' arranged to extend vertically adjacent to the side of the selector-bar, which detent is adapted to engage a notched latch member l' pivotally mounted upon the upper edge of the selector-bar, so as to be capable of lifting upwardly and permitting the engaging end of the detent to slide under it upon the return movement of the bar, as hereinafter to be described. The engaging end of the detent l is in the form of a right-angled projection l^2 (see detail Fig. 7) which, when the selector-bar is in its normal position, registers with the lies within an opening l^1 formed through the latch member l' . The engaging notch l' of the latch member is located in rear of the opening l^1 , that part of the latch between the opening and the notch being in the form of a rearwardly and upwardly extending inclined portion l^3 covered with insulation. From the engaging face or shoulder l^4 of the latch the rear end portion of the latch is also inclined upwardly, and is located a sufficient distance above the upper edge of the selector-bar to enable the angular portion l^2 of the detent to pass under the latch member cam fashion, and lift the latch upon the return movement of the selector-bar. The first forward step of the selector-bar, under the action of the bar F, carries it into position for the detent l to engage the notch l' . The second forward step is imparted to the selector-bar by means of the thrust-bar G which is provided with an arm g^2 carrying an armature g^3 and acted upon by a magnet M (Fig. 2) constructed and arranged substantially like the magnet H and supported from a cross-bar b^3 . The upper portion of the thrust-bar G is provided with a shoulder or notched portion g^4 , adapted for engagement with the contact device i^4 of the thrust-lever in substantially the same manner as described in connection with the thrust-bar F. The contact device i^4 is shorter than the contact device i^3 whereby, when the contact device i^3 engages the thrust-bar F, the contact device i^4 will clear the top of the thrust-bar G. However, after the thrust-bar F returns to normal position, the thrust-lever I having been advanced to a position with the contact device i^4 just above the engaging notch g^4 , the magnet J, upon energizing a second time, may then attract the thrust-lever I so as to cause the contact i^4 to engage the thrust-bar G. It will be evident, however, that this particular construction is not absolutely necessary. It is obvious that the contact device i^4 may be in the nature of a ratchet, in which case both contacts i^3 and i^4 may be of the same length. The part i^4 will then give way each time it engages the edge of the thrust-bar G on the side of the thrust-bar F. Of

course, in that event it will be necessary, however, to insulate either the curved portion of the contact device i' that engages the thrust-bar G or the front part of the thrust-bar G. The two forward steps of the selector-bar bring the engaging ends of its several contact fingers e into positions substantially vertically above the axes of the several trunk elements, and in position to be engaged by the contact studs a' thereof, as hereinbefore described. At the end of the forward movement of each of the thrust-bars F and G a switch operates to open the electric circuit extending through magnets H and M, and as a convenient construction for accomplishing this end, and at the same time providing a switch which will not re-establish the circuit until the thrust-bar has completely returned to its normal position, I provide a construction as follows: f^4 (Figs. 3 and 10) designates a contact block mounted upon the frame member b' at a point in rear of the thrust-bar F, and provided on one of its side faces with an obliquely upward and forwardly-extending guide-groove f^5 . (See detail Fig. 3). f^6 designates a spring contact strip secured to the thrust-bar F and extending backwardly therefrom and provided at its end with an angular portion or stud f^7 adapted to engage the groove f^5 . The spring strip f^6 is so shaped as to tend to assume a horizontal position intersecting the central portion of the length of the groove, so that when the thrust-bar F is in its normal backward position the spring strip will be flexed downwardly by engagement with the guide-groove, and will tend to spring upwardly, and vice versa, when the thrust-bar F approaches its forward limit of movement the guide-groove will force the spring strip upwardly so that it will tend to spring downwardly when it passes out of the groove at the end of such forward movement. That portion f^8 which forms the lower side of the guide-groove is insulated upon its under surface, as indicated at f^9 , (see detail Fig. 3) and is inclined or made shoe-shape at its front end so as to direct the engaging end f^7 of the spring strip downwardly beneath the said portion f^8 upon the return movement of the thrust-bar, while at the rear end of the portion f^8 a slot f^{10} is provided through which the engaging end of the spring strip may pass upwardly into the slot f^5 . A similar switch device, designated as a whole g^2 (Figs. 2 and 10), has its respective parts mounted upon the frame member b^3 and the thrust-bar G, and operates in substantially the same manner to open and close a circuit when the thrust-bar G is operated.

N and N', respectively, (Figs. 2 and 9) designate a pair of longitudinal reciprocating contact devices mounted upon the

forward end of the selector-bar and adapted to engage at their forward ends with contact plates n and n' , respectively, when the selector-bar is moved forward. The contact devices N and N' are maintained in their normal forward positions by means of coiled expansion springs n^3 interposed between fixed guides n^4 and n^5 , which guides are rigidly connected to the selector-bar. The contact devices are adapted to slide through the collars n^3 and n^5 , but the collars n^4 being rigid with the respective contact devices N and N' serve as stops by engaging the collars n^5 to limit the forward movement of the contact devices under the influence of their springs, thereby holding said contact devices free from engagement with the contact plates n and n' when the selector-bar is in its normal or rearmost position. The several selector-bars are supported to slide endwise by resting at their forward ends upon a supporting ledge b^4 , and at their rear ends upon the upper edge of the cross-bar b' , said bars being spaced apart at their forward ends by means of upper and lower space-blocks b^5 and b^6 , while at their rear ends they are similarly guided by resting within notches formed in the upper edge of said member b' . (See Fig. 11). At the end of the forward movement of each selector-bar it is necessary that two electrical circuits be opened, and, as a convenient means of accomplishing this end, I provide upon the selector-bar a pair of spring-closed contact devices respectively designated as a whole O and O' (Fig. 2), said contact devices being located in position to be opened by the engagement therewith of the rear ends of the sliding plunger-like contact devices N and N'. Conveniently, each contact device comprises a fixed member o against which is forced a movable member o' mounted upon a V-shaped spring o^2 which is rigidly secured to the side of the selector-bar by means of a stud o^3 . The movable contact device o' is located in alignment with the end n^6 of the sliding contact device, the engaging end portion of the latter being of insulating material so as to prevent interference with the circuits of the contact devices engaged thereby. It is also necessary that a certain other circuit be opened and closed during the movement of the selector-bar, and to this end I provide a spring contact designated as a whole O² which is mounted upon the fixed standard L' (Fig. 2) and is adapted to be engaged by a laterally-projecting stud o^5 mounted upon and carried by the selector-bar. Said contact device O² embraces a V-shaped spring rigidly secured to the standard by means of a stud o^7 and normally resting in engagement at its free end with a fixed contact o^8 . The projecting

end portion o^b of the contact spring is adapted to be engaged by the stud o^a and forced back when the selector-bar approaches the limit of its second forward step under action of magnet M to open the circuit of magnet J. A spring contact device p^{10} mounted upon the support L' is also provided which is adapted to be engaged by a contact p^{21} mounted upon the top edge of the selector-bar for the purpose hereinafter described. The main lines R and L terminate in the selector instrument at a bar E individual to the line, but the operating circuits by which the selector instrument is operated are controlled by a cut-off relay P. The object of the said relay P is to automatically cut off the operating circuits from a subscriber's line when the said subscriber is called, and to provide a busy-test at all test rings allotted to the line called. To briefly describe this part of the system P' designates the relay coil, P, the armature, which is in the usual form of an angular metal plate pivotally supported at its angle and operating when attracted by the magnet P' to simultaneously lift three contact strips p , p' and p'' , respectively, the contact strips p and p'' normally resting in contact with lower fixed contacts p^3 and p^4 , respectively. The main lines R and L leading from the subscriber's instrument are respectively connected with the contact strips p_2 and p , and are thus normally closed with conductors p^6 and p^5 both of which lead to and through the selector instrument. The contacts p^7 , p^8 and p^9 are the three upper contacts which, when the relay energizes, are engaged by springs p , p' and p'' . The contacts p^7 and p^8 are, as shown, connected through conductors p^{10} and p^{11} with conductors p^{12} and p^{13} common to the several connecting jacks designated as a whole P³ and P⁴. The upper contact p^9 of the relay is connected with ground through a conductor p^{14} , while the cooperating lower contact strip p' is connected through a conductor p^{15} with a conductor p^{16} common to the branch conductors p^{17} leading to the several test rings p^{18} . The conductor p^{16} , which is connected with the test circuit, is likewise connected through a conductor p^{19} with a contact p^{20} which is engaged by a cooperating contact p^{21} carried by the selector-bar whenever said bar is shifted forwardly. The insertion of the operator's plug in any one of the connecting jacks P³, etc., closes a local circuit from a conductor p^{22} through the contacts p^{23} and p^{24} of the jacks, from the latter contact through a conductor p^{25} to a conductor p^{26} common to each of the jacks, and from this latter conductor through a conductor p^{27} to and through the relay and back by way of a conductor p^{28} to battery P', the end of con-

ductor p^{22} being connected with the opposite side of the battery by a conductor s^{22} , as clearly shown in the diagram.

Describing now the several circuits from the subscriber's set through the selector, it will be remembered that the first operation of the selector is to draw down the thrust-lever I to close a circuit which energizes the magnet H and thrusts forward the selector-bar to a position where it is engaged and held temporarily by the mechanical detent. Pointing out the circuit through the magnet J which operates to draw down the thrust-lever (see Figs. 8 and 8^a) it extends from the grounded terminal of battery P' through conductor o^{14} , thrust-lever I, conductor e^6 to the contact e^7 , conductor p^6 , through the cut-off relay springs p^3 and p to the left line L, thence through the subscriber's station passing through the receiver and transmitter thereof to the right line R, to the contact spring p^2 of the cut-off relay P, thence to the contact p^4 , conductor p^8 to the fixed contact o^7 mounted upon the standard L', as hereinbefore described, thence to the spring contact O^2 normally resting in engagement with the fixed contact o^8 , conductor o^{12} , and through the magnet J, thence by way of the conductor o^{13} to the non-grounded terminal of battery P'. The energizing of said magnet J draws down the thrust-lever and closes a circuit through the magnet H which may be traced as follows: from the thrust-lever I which, as hereinbefore described, is in connection through the conductor o^{14} with one side of the battery, current passing to the thrust-bar F and from the latter through contact strip f^6 to the contact f^4 , thence by conductor f^{11} to and through the magnet H, and by conductor f^{12} to conductor o^{13} which, as hereinbefore described, is connected with the opposite side of the battery, thus completing the circuit. The energizing of the magnet H thrusts forward the selector-bar to a position where the latter is engaged by the mechanical detent I and simultaneously opens the circuit between the contact strip f^6 carried by the thrust-bar and fixed contact f^4 . The inclined part I^5 of the latch I' (see detail Fig. 7) of the mechanical detent is covered with insulating material which prevents the closing of a circuit between the latch-member and detent member until the latter drops into the notch I⁶ thereof. The dropping of the detent into the notch serves to close at this point a second circuit through the magnet J, which circuit, however, is not completed until the subscriber completes it by pressing one of his signal buttons x or y which ground the line L. The completion of the circuit by pressing either of said signal buttons x or y draws down the thrust-lever a second time, and thereby closes a circuit which energizes magnet M, which magnet M operates to move

the selector-bar forward a second step in substantially the same manner described in connection with magnet H. The second circuit through the magnet J may be traced as follows: from ground at the subscriber's station to the left main line, to a conductor q which is connected at its opposite end with a conductor strip e^8 mounted upon the upper edge of the selector-bar, and with which the latch member l' is electrically connected, from the latch member to the detent, and thence through the conductor q' to and through the magnet J, thence by way of conductor o^{13} to battery, and from battery to ground through a conductor o^{15} . When, however, one of the signal buttons w or z is operated a different circuit is closed through the magnet J which may be traced as follows: from ground at the subscriber's station to the right-hand main line to and through contacts p^2 and p^4 of the relay P, thence by way of conductor p^6 through contact device O^2 , contact o^8 , conductor o^{12} to the magnet, thence by conductor o^{13} from magnet to battery, and from battery to ground, as before. Inasmuch as the second forward movement of the selector-bar under the action of the magnet M opens the circuit at the switch g^5 which energizes said magnet M, it is necessary to provide a retaining circuit through the magnet M to maintain the latter energized after the circuit there-through is opened at switch g^5 . This circuit is hereinafter described. The pulling down of the thrust-lever this second time closes a circuit from the thrust-lever through contact device i^4 to thrust-bar G, thence to switch contact g^8 , to conductor q^2 and to magnet M. From the magnet M a conductor q^3 leads to conductor o^{13} , and through the latter to battery. From the battery the return circuit is by way of conductor o^{14} to the thrust-lever, as in the case of the circuit through the magnet H. The second forward step of the selector-bar closes the circuit between N and N' and the contacts n and n' , whereby the trunk-selecting operations are performed at the same time, brings its several contact fingers e in position for engagement by the trunk elements, and closes a circuit which selects one of the trunk elements of the particular exchange desired (depending upon which signal button the subscriber has operated) and operates the exchange system. As shown, the subscriber's set is capable of sending out four different kinds of signals, since the number of exchanges interconnected in this particular case is four, each signal corresponding to a different exchange. The four different kinds of signals employed in the present instance comprise two sent over the right and left lines, respectively, without resistance, and two sent over the right and left lines with resistance interposed in each, thus giving the four sig-

nals of different character necessary to operate the relays responding to such signals. In Figs. 8, 8* and 15 the arrangement of the subscriber's set is shown diagrammatically by which the four different signals or impulses are accomplished. In said figures, R and L designate the right and left main lines, respectively, r the transmitter, r' the receiver or ear telephone, and r^2 the switch lever which serves as a hook upon which the ear telephone is ordinarily hung when not in use. r^1 designates a conductor provided with a plurality of contact devices r^4 , r^5 , r^6 and r^7 adapted to be severally engaged by moving contacts r^8 , r^9 , r^{10} and r^{11} operable respectively by four signal buttons x , y , w and z which severally correspond to the magnets X, Y, W and Z of the selector system. One end of the conductor r^3 is placed to ground at the subscriber's station, as indicated in the diagram. The operation of signal button w operates to send an impulse through the right main line to a directing relay S without interposed resistance and to thus operate a magnet W, as hereinafter described, the circuit through the button being traced as follows: Upon depressing the button w the contact r^{10} is brought into circuit with contact device r^6 , and the circuit is then from ground at the subscriber's station through conductor r^3 , through contacts r^8 and r^{10} , through a conductor r^{12} connected with the contact r^{10} , and thence to the right main line and to the selector. After reaching the selector it will be seen that the impulse passes from the line R to the conductor s , thence to the conductor e^9 , through the contact device O' to the conductor N', thence to the contact n' through the relay S, and through the magnet W, thence to the non-grounded terminal of battery P', passing first through the relay V² (Fig. 8*). Since the impulse is transmitted to these relays S and W without any interposed resistance at the telephone, both of the relays will operate, but the relay S operates with no result of consequence at this time. It will be understood, of course, that the impulse cannot reach the magnets S and W until after the magnet M has operated to close the circuit at the point between the conductor N' and the contact n' . The depression of the signal button w operates to open a contact r^{14} to separate the right line from the left line through the telephone instrument and by way of conductor r^{15} . If the signal button z is depressed an impulse is first sent over the right line with resistance included, thereby operating the magnet S of the selector system, the circuit being traced as follows: from ground at the subscriber's station through conductor r^3 to and through a resistance coil R², thence over a conductor r^{16} to a movable contact member r^{17} interposed between the contact r^{18} and the contact device

r^7 , from the contact device r^{17} to the contact device r^{11} , and thence out over the main line R. After reaching the main line R, of course, the impulse passes through the magnets S and W, as before, with the exception that in this instance only the magnet S operates for the purpose of operating the switch S' , whereby the left line L is placed, in connection with the relay Z. The button z is further depressed so as to close a second circuit from ground direct to the left line, which second circuit may be traced as follows: from ground at the subscriber's station through conductor r^8 to contact r^7 , thence to the contact r^{11} moving with but insulated from the contact r^{17} , thence through a conductor r^{19} to contact r^9 mounted upon a conductor r^{20} , which latter carries a contact device r^{21} operable by signal button x , and from conductor r^{20} to the main left line L. The armature of the relay S having been shifted by the first impulse now directs the second impulse through a magnet Z, which impulse, of course, passes from the left line L through the conductor q to the conductor e^8 , thence through conductor N, contact point n , conductors t , t' and t^2 to the magnet Z, thence through the magnet Z to the non-grounded terminal of battery P' by way of the relay V^2 (Fig. 8^a). The depression of the button z , it will be seen, opens the contact device r^{12} , which opens the circuit through the subscriber's instrument, as in the case of the operation of the button w .

The arrangement of the circuit of buttons x and y is precisely similar to those described in connection with the buttons w and z , except that when the button x is pressed ground is first put on the left line L through resistance and ground is put on the right line R direct. Also, when the button y is pressed ground is put direct on the left line L. As stated, the second forward step of the selector-bar carries the plunger-like contact devices N and N' into engagement with the contact plates n and n' , thereby closing both right and left lines through a set of relays which operate to select the proper trunk, depending upon which line or lines the trunk-selecting impulse or impulses are sent over, and also upon whether or not these impulses are sent direct or through resistance. It will first be assumed that the calling subscriber wishes to call another subscriber at a distant exchange W and that he (the calling subscriber) belongs to exchange Z. He therefore presses button w , whereby an impulse is sent from the subscriber's set through the right line direct, and the circuit and operations will be as follows: from the main line R through a conductor s to a contact strip e^9 mounted to extend along the lower edge of the selector-bar, and from this contact strip through a conductor o to the fixed contact o' of the contact device O', from the latter contact through the contact device o^2 , and thence through a conductor s^2 to the contact device N' and the contact plate n' . From the plate n' a conductor s^3 leads to and through a directing relay S which operates a vibrating switch member S' , and thence through a conductor s^4 to the vibrating switch armature S^3 of a second relay S^2 to a back or normally-closed contact s^5 , and thence through a conductor s^6 to a magnet W. The opposite side of the magnet W is connected by means of a conductor s^7 with a conductor s^8 common to three other similar magnets designated X, Y and Z, respectively, and severally corresponding to the different exchanges connected with the system. From the conductor s^8 a common return conductor s^9 leads back to and is connected with conductor o^{13} and then to battery, and from battery to ground, thus completing the circuit. The energizing of the magnet W draws down its armature w' and closes a circuit from conductor s^8 through a contact device s^{10} to the contact device s^{11} carried by said armature w' , and from thence through a conductor s^{12} to a contact device s^{13} which constitutes a back stop against which the armature arm e^2 of the magnet C normally rests, said armature arm being provided with a contact plate s^{14} adapted for engagement with the contact s^{13} . From the contact plate s^{14} a permanently attached conductor s^{15} leads to a similar back contact s^{16} of the next switch C belonging to the same series of trunk elements, namely those extending between the same exchange stations, and these connections are repeated throughout this entire system. From the conductor s^{12} a branch conductor s^{16} leads through the coil of the first magnet C, a conductor s^{17} from the opposite side of said magnet leading to a contact device s^9 (see the second magnet C of group belonging to magnet W) mounted upon the answering trunk jack hereinafter described, which contact is opened by the insertion of the operator's plug. A return conductor leads back to stop e^3 against which the armature arm normally rests, as hereinafter described. Upon the armature arm is mounted a contact e^4 adapted for contact with the stud e^3 , and this plate is connected by a permanently attached conductor s^{18} with a back stop contact device s^{19} normally engaged by a contact plate s^{20} upon the armature of the second magnet C of the series. From the contact plate s^{20} a conductor s^{18} leads to a similar back contact s^{19} of the third magnet of the series, and so on throughout the series. Likewise, a conductor s^{16} extends from the back contact s^{13} of the second magnet C of the series, through the coil of said magnet, and thence to its particular trunk jack and back to the stud e^3 thereof, the same as in the first instance; and these connections are

repeated throughout the train or series of magnets, the conductor s^{21} of the last magnet of the series being extended to and connected with a conductor s^{22} common to all of the different series or trains of magnets. From the conductor s^{22} a common return wire s^{23} leads to the ground side of the battery. It will be seen that if the signal button z which sends a first impulse over the right-hand line through resistance had been pressed, the circuit would have been the same so far as actuating the directing relay S is concerned, but by reason of the interposition of resistance in the line the magnet W does not in that case respond it being understood that this magnet is so wound as to require a stronger current to operate it than will pass over the line when the resistance is interposed. The operation of the directing relay S, however, closes a circuit from the left-hand line to magnet Z, which line, it will be noted, is likewise placed to ground by the same movement of the signal button z , as hereinbefore described. The shifting of the armature S' of the directing relay S, as above stated, closes a circuit from the subscriber's left-hand main line, without interposed resistance, when contacts r^{11} and r^7 engage through the magnet Z, and thereby through the series or train of trunk-operating magnets controlled by said magnet Z, which may be traced as follows: from ground at the subscriber's station the circuit is over the left main line to the conductor q , through the conductor strip e^8 of the selector-bar to the contact device N and the contact plate n , and from contact plate n a conductor t extends to the side of the armature S' which, when the directing relay S is energized, is drawn into contact with a fixed contact t' . A conductor t^2 leads to and through the coil of the magnet Z and thence to the conductor s^8 common to each one of the four magnets W, X, Y and Z, from whence the circuit is back to battery and ground over the conductor s^9 , as hereinbefore described. The energizing of the magnet Z closes a circuit through a conductor t^8 coöperating with the armature contact t^4 of the magnet, whereby a circuit is established through the series of magnets C belonging to the Z exchange group of trunks controlled by the magnet Z, in the same manner as described in connection with the series controlled by magnet W, this series of magnets being connected with the common conductor s^{22} . The circuits involved when the signaling buttons x and y are pressed are the same as those involved when the buttons w and z are pressed, but the difference is that where the operating of button w causes the operation of the magnet W the operating of the button y causes the operation of the magnet Y, for the reason that where button w presses the R line di-

rect to ground, the button y presses the L line direct to ground. Putting direct ground on the L line, of course, energizes the magnets S^2 and Y in series, but in this instance the operation of the magnet S^2 has no significance. Similarly, where pressing the button z first puts ground through resistance on the R line, and then puts ground direct on the L line after first operating magnet S and then operating magnet Z, by pressing button x the conditions are reversed, so that ground through a resistance is put on the L line and subsequently direct ground is put on the R line. The result is that by thus operating the button x the relay S^2 is energized, which then closes a circuit through the magnet X, which magnet is then operated by the direct ground that is put on the R line. It will be evident, of course, that the said magnets X and Y, upon being energized, operate to energize one of the C magnets under their control for automatically selecting one of the trunk lines going in one case to the X exchange and in the other case to the Y exchange. It has been mentioned hereinbefore that a retaining circuit is provided for maintaining the magnet M energized during the interval between the time when the first circuit through said magnet M is interrupted at the switch q^5 and the time when the trunk elements have actuated and engaged the selector-bar. This circuit will now be described and may be traced as follows: As hereinbefore described, whenever any one of the subscribers' signal buttons is actuated current will be directed to and through the common conductor s^8 pertaining to the several magnets W, X, Y and Z which in turn connects with the common return conductor s^9 . I therefore interpose in said common return s^9 a switch-closing magnet V^3 provided with an armature v^{14} which is electrically connected by means of a conductor v^{15} with the common return conductor s^{23} pertaining to the groups of magnets C, and in position to be engaged by said armature v^{14} is a contact v^{16} which is connected by means of a conductor v^{17} with the conductor q^2 leading to and through the said magnet M. It follows, therefore, that this last-described circuit will be closed by the energizing of the magnet V^3 at the time the circuit is interrupted at the switch q^5 , and the magnet M will, therefore, remain energized until that movement of the instrument which opens the circuit extending through the conductor s^9 . From the foregoing it will be apparent how a subscriber is enabled to select a trunk of either one of the four different exchanges at will, and it now remains to be described how his individual selector is caused to engage and form connection with one of the trunks of the particular exchange wanted (exchange W), and at the same time pre-

vent interference with this trunk while leaving all of the other trunks leading to the same exchange W accessible to other subscribers of either the W or Z exchange. It will be remembered that the first two forward steps of the selector-bar hereinbefore described left the selector-bar in position for the engagement of its contact fingers *e* by any one of the trunk elements which should be operated. Inasmuch as all of the magnets C' belonging to any given series or train are connected in multiple circuit, and the operation of one serves to open the circuit of the others of the train, it will be obvious that only one magnet of the train will be fully energized, and the trunk element corresponding thereto actuated, the remaining magnets of the train, although momentarily energized, dropping back as soon as the most advanced one moves forward enough to interrupt the circuit. Without any special provision, it will generally be found that no two magnets of a train, such as the magnets C', will operate with exactly the same speed, and this natural inequality may be depended upon to cause the selection of the trunk. There are, however, several well-known means for causing a magnet to operate sluggishly, which may be employed to increase this inequality if desired. Also, in order to secure uniformity of operation, the magnets of a train may be arranged in the order of their sensitiveness—that is, the fastest magnet may be allotted to the first trunk, the next fastest to the second trunk, etc. This, however, is not essential to the successful operation of the system. The movement of the trunk element operates to close the circuit through the contact finger *e* at the point of intersection of the selector-bar with this particular trunk element and through the two contacts carried by said finger *e* and the corresponding contact plates upon the trunk element. In other words, three circuits are closed at this point practically simultaneously. The closing of the contact finger *e* with the contact stud *a'* of the trunk element closes a circuit through the magnet D at the opposite end of the trunk-selector to energize the latter, which circuit may be traced as follows: from the non-grounded side of the battery P' through conductor *o*¹³ and conductor *s*⁹ to a conductor *u*, and thence to the member *u'* of a switch U which is normally closed. From the opposite or movable member *u*² a conductor *u*³ extends to and through the magnet D, conductor *u*⁴, contact strip *d*³ of the arm *d*⁰, contact *u*⁵ to the contact strip on the upper side of the armature of the magnet D, thence through conductor *u*⁶, conducting strip *u*⁷, stud *a'*, contact finger *e*, conductor *u*⁸, self-restoring drop U' and conductors *u*¹⁰ and *s*²³, and thence to the grounded terminal of battery P'. The completion of this circuit ener-

gizes the magnet D, drawing down the armature thereof and oscillating the trunk element forwardly to its most forward limit, and through the medium of the contact finger *e* thrusting the selector-bar to its foremost limit, in which position none of the other trunk elements can interfere with its several contact fingers *e*. When the trunk element is thus advanced to its forward limit by the magnet D the circuit of its particular magnet C' is opened between the contact points *c*² and *c*⁴, thus protecting the seized trunk from interference by another call. Although the drop U is included in the above circuit of the magnet D, it receives only a momentary impulse, so that its operation at this time could only be momentary at the most and, therefore, not objectionable. If desired, the drop could be so adjusted and wound as not to operate at all in series with the magnet D. As the armature of the magnet D is drawn down the contact strip *d*² thereof engages a fixed contact *a*¹, opening the circuit between said strip and the contact *a*², and shunting the circuit through a conductor *a*³ which, it will be seen, retains a holding circuit through the magnet D and thus retains the trunk element and selector-bar in proper position. The apparatus is now in talking position and the talking circuit may be traced from the subscriber's instrument through the selector to the distant exchange and back as follows: from the subscriber's instrument over the right line to the conductor *s*, over conductor *s* to the contact strip *e*⁹ upon the lower edge of the selector-bar, and from the latter through contact strip *e*⁴ (see detail Fig. 5) to contact plate *a*² of the trunk element which is connected with a conductor bar *a*⁴ common to each of the similar contact plates *a*², throughout the length of the trunk element, and from said conductor strip *a*⁴ through a conductor *v* to the right-hand or sleeve side of the answering jack V. The return circuit may be traced from the left-hand or tip side of the answering trunk jack V through a conductor *v*¹ to a conductor bar *a*⁶ similar to the conductor strip *a*⁴ and similarly connected to each one of the contact plates *a*². From the contact plate *a*² the spring finger or strip *e*⁵ engaged therewith connects through a conductor *v*² with the contact strip *e*⁸ upon the upper edge of the selector-bar, which latter is connected with the subscriber's left-hand line through the flexible conductor *q*, thus completing the circuit. It will be remembered that the ends of the trunk-lines R' and L' connected with the answering trunk jack V and terminating in the distant exchange are connected with a selector-bar in precisely the same manner as in the exchange now being described. (See Fig. 17). The circuit over which the distant W exchange operator is

signaled is as follows: Assuming that the impulse or signal in question comes in over the right-hand line R connected with said trunk-jack (in this connection it is to be noted that of the four calls of different character, two will come in over the right line and two over the left, the drops being inserted in the respective lines accordingly), the circuit will be from ground at the calling subscriber's station through his selector-bar at his station and over the right-hand side of the trunk-line to exchange W (see Fig. 17), to the conductor v , through the drop V' interposed in conductor v^{10} and to contact d^{11} ; thence the circuit is to a back contact v^{11} and by conductor v^{12} to conductor u , and thence to battery, as hereinbefore traced, the operation of drop V' indicating to the operator at the exchange W being called that a connection is wanted. The operator having noted the call simply plugs into the answering trunk jack with her cord plug, which may be of any suitable type, in the usual manner, thereby cutting off the terminals v and v' of the selector of her exchange and at the same time opening the circuit in the line s^{17} to prevent interference. Having inquired of the party who is calling what number is wanted she simply makes the connection with the jack of that particular subscriber by plugging in with the opposite end of the cord in the usual manner. The hanging up of the subscriber's receiver grounds the circuit and thus operates a signal in the exchange operator's cord, indicating that the subscriber has completed the conversation and that the line should be cleared, this signal in the operator's cord being of any usual type. The clearing or restoring of connections to their normal positions is accomplished by the operator at the exchange which has been called by putting on the line a current of higher power, sufficient to operate a magnet in circuit with a conductor bridged across the main lines and operating to open a switch in the holding circuit which controls the magnet D. The clearing is effected by opening the circuit at the switch U, hereinbefore described, the operation of this switch being accomplished by means of a magnet U^2 included in a conductor extending across the lines v and v' and acting upon an armature lever the end of which carries the switch member u^2 when the magnet is sufficiently energized and opens the circuit. The opening of the circuit at the switch U deenergizes the magnet D which holds the trunk element, and thereupon both the trunk element and the particular selector-bar held thereby return to their normal positions, the mechanical detent member Z passing beneath the latch member Z' . In this connection it is to be noted that the upper surface of the detent is covered with insulating material, so

that a circuit is not established at this point during the return movement of the selector-bar.

The foregoing description refers to a call to a distant exchange W. In the case, however, where the calling subscriber desires a local connection—that is, a connection with a subscriber at his own exchange Z—the arrangement may be substantially the same. In other words, the calling subscriber will throw a drop at the local board, thereby signaling the operator, which operator (by plugging into the jack V of the trunk automatically selected by the calling subscriber) inquires the number desired and completes the connection, as in exchange W. But I will now describe a different method of taking care of such local calls with the apparatus as shown in the drawings. The calling subscriber wishing connection with the local subscriber will, of course, press his button z , which will cause the instrument at the exchange to select one of the trunks controlled by the magnet Z, which trunks terminate in the local board. It will be obvious that since these trunks are common, it is impossible for the operator to tell merely by the operation of the trunk drop V' which particular local subscriber is the one calling. I therefore provide means for ascertaining the number of said calling subscriber, whereby the operator may complete the connection by plugging into the particular multiple jacks of the calling and called subscribers, and also means whereby the trunk connection may be broken without disturbing said connection, thereby restoring the trunks to common use and thus increasing the efficiency of the trunking apparatus by retaining the trunks in use only for signaling the operator and not during conversation. For this purpose each selector-bar is provided with an individual self-restoring drop U' connected in the circuit which is normally open at an operator's key designated U^4 (see Fig. 17), said drops adapted to be energized by the operation of said key. This key may also conveniently control an operator's listening key, the contacts v^8 and v^8 being indicated for this purpose. The closure of the identifying key establishes a circuit through the particular drop belonging to the subscriber who is calling, and thus discloses to the operator which subscriber is asking for the connection, whereupon she gives him the particular connection by connecting the jacks of the two subscribers, for example, the jack P^2 of the calling subscriber and the similar jack of the called subscriber. It is very evident that it is necessary for the operator to discover the number of the calling subscriber, as explained, or else it would be impossible for her to complete this connection as described. The arrangement of the cir-

5 cuit by which this is accomplished—that is, by which the operation of the identifying drop is made possible—is as follows: When the operator notices the signal by the operation of the trunk drop V' she knows that some subscriber has obtained connection with the trunk to which the said drop V' is allotted, and she at once presses the button U^1 allotted to said trunk, which closes the circuit through the subscriber's self-restoring drop U' (see Fig. 19) as follows: from ground through the conductors s^{23} and a^{10} to and through the drop U' , thence over conductor w^7 , contact finger c , stud a' , conducting strip w^7 , thence to the key U^1 , and through contact point r^7 to the non-grounded terminal of battery P^7 . It will be evident that the connection from battery to the drop U' is not completed until the contact finger c engages the stud a' . As long as the operator presses the button U^1 the drop U' discloses the number of the calling subscriber, and after giving the connection the operator may release in the usual way by plugging the releasing current in the jack V allotted to the trunk and permanently attached thereto. (See Fig. 17.) The operator thus sends releasing current from the jack to the conductors c and c' , thereby operating the release magnet U^2 and restoring the trunk A . It will be obvious that the drop V' for the trunks that terminate in the local exchange will not be connected to the non-grounded terminal of the battery through such contacts as d''' and d'' . There being no use for such a trunk element A at the other end of the local trunks the drop V' will, of course, be connected directly to the non-grounded terminal of the battery. As already stated, this method of connecting local subscribers is not essential, and the same apparatus and the same method may be used as in calling a distant exchange, with the difference that the other terminals of the trunks are deprived of the trunk elements A and, therefore, the drop V' of each local trunk is connected directly to the non-grounded terminal of battery. (See Fig. 17.) Although I have described a method of automatically obtaining the number of the subscriber for increasing the efficiency of the trunks, it will be evident that the efficiency of the trunks may be increased in substantially the same manner by inquiring of the subscriber himself what his number is, and then the operator can complete the connection between the subscribers' jacks and release the trunk connection. For example, the subscribers can be instructed that when calling their own exchange they should first give their own number and then the number of the line desired, as is customary in a great many places—that is, as soon as the operator answers, the subscriber instead of just giving

the number 5221, for example, of the desired line will say 351 on 5221, meaning that he wants his own line 351 connected with the line 5221. Of course, with this later mode of operation the button U^1 may be omitted from the trunk lines and the drop U' from the subscribers' lines.

As a matter of further improvement I have provided for the contingency of a subscriber taking down his receiver and thus partially operating the selector and then restoring the receiver without completing the operation of calling. For this purpose I have connected the left line L normally to ground through the subscriber's bell, as indicated in Fig. 15. Obviously, in the absence of such special provision, and in case the subscriber did not actuate one of the signal buttons, the operator at central would not know that his particular selector-bar had been operated, and the selector would, therefore, remain disabled so far as that particular subscriber was concerned until he at some subsequent time called again. It will be remembered that the operation of taking down the receiver closed a circuit through the magnet H and stepped the selector-bar forward one step, in which position it was engaged and held by the mechanical detent. If, now, the receiver is again hung up the second circuit is closed through the magnet J , which closes the circuit through magnet M , which magnet M in turn steps the selector-bar forward a second step and thereby carries the detent member Z past the latch member, so that it is in position to slide under the latch and will not hold the selector-bar when the latter is released. The circuit last referred to through magnet J does not affect the trunk element magnets and, therefore, when the selector-bar has been stepped forward the second time, and the circuit interrupted through the magnet M by the switch g^5 at the end of this forward step, it simply flies back to its normal position under the tension of the spring K . This circuit which accomplishes the second step forward of the selector-bar when the receiver is hung up is the same as that which accomplishes the same movement of said bar in its ordinary operation, excepting that in the present case the line is grounded through the subscriber's bell instead of through one of the signal buttons. The subscriber's bell is so wound as to constitute sufficient resistance to prevent the operation of either of the relay-operated magnets Z and Y , which latter are alone normally connected directly with the left line, so that none of the trunk elements will be operated. The magnet J will, however, be operated, and consequently the magnet M thus shifting the selector-bar forward through its second step; but inasmuch as none of the trunk ele-

ments is operated there will be nothing to hold the selector-bar in its advanced position, and upon the breaking of the circuit at the switch g^3 the selector-bar will fly back to its normal position, the mechanical detent passing under the latch, as in other cases.

It will be seen that I accomplish the several objects of my invention in a comparatively simple manner and by the use of comparatively simple apparatus; that the system is capable of very wide application and adaptation either in whole or in part; that it is not limited to the use of a central energy system, but may be readily adapted to other systems; that by its use the operation of securing connections is rendered automatic to a much greater extent than is the case with the systems now in general use which employ exchange operators for making connections, while at the same time the general method of handling calls at present in vogue is not so widely departed from as to involve serious objection; that by the use of my invention it is possible to accomplish the same results of dividing the work of large exchanges between groups of operators, substantially as has heretofore been accomplished, by the use of divided switchboards; and that owing to the fact that the work of the exchange operator is greatly lessened and facilitated, and that all trunk-lines are instantly available to every subscriber when not in actual use, the capacity of a given equipment is very materially increased over that attainable with heretofore known systems.

While I have illustrated and described a preferred embodiment of my invention I do not, for the broader purposes of my invention, wish to be understood as limiting myself to the details thereof as set forth. It will be seen that Fig. 18 is a simplified view of the system in which the four exchanges W, X, Y and Z are shown. Each of these exchanges has allotted to it a group of subscribers, the subscribers of exchange X being indicated at 2, of the exchange W at 3, of the exchange Z at 4, and of the exchange Y at 5. In each of these exchanges the cut-off relays P are indicated between the subscriber's station and his individual bar E. At right angles to the bars E of the exchange X are shown the trunk bars Z', Y' and W', the lines from each running to the exchanges Z, Y and W, respectively. As indicated, the line from the trunk bars X' for local calls terminate in the operator's board 6. The same arrangement is followed out in the other exchanges W, Y and Z. It will also be seen that the trunks leading from the Z' bars of the exchange X terminate in the X' bars of the Z exchange. The Y' bars are, in a similar manner, connected with the X' bars of the Y exchange, and the W' bars are

connected with the X' bars of the W exchange. It will, therefore, be seen that the trunks 7, 8, 9, 10, 11 and 12 are two-way trunks terminating at each end in one of the bars A. As indicated, it will further be seen that each of the trunk-lines passes through a jack at each one of the exchanges which it connects. For example, the trunks 7 have included in their circuits the jacks 13 at the X exchange and the jacks 14 at the Z exchange. As explained in the specification, the jacks 13 are only used when calls are made from the Z exchange to the X exchange, and the jacks 14 are only used when calls are made from the X exchange to the Z exchange; and, as explained, when the operator plugs into a jack it disconnects the local bars A from the line 7. Obviously, then, the jacks 15 for the local trunk at exchange X must differ from the jacks 13 in that when the operator plugs into any one of them the trunk bars A of the group X' are not disconnected from the trunks. The same is, of course, true with regard to the local jacks 17, 18 and 19, and the other respective local trunks 20, 21 and 22. By referring to Fig. 18 it will be seen how, if a call comes in from the Z exchange over one of the trunks 7 to the exchange X for one of the subscribers 2, the operator inserts one of the plugs of her cord circuit into one of the jacks 13 of the trunk which is calling, and then inserts the other plug of her cord into the jack P' of the desired line. In each of these exchanges the manual apparatus is located in the board 6, as shown by dotted lines in Fig. 18. It will be seen that Figs. 15 and 16 disclose substantially what is disclosed by Figs. 8 and 8', but they show more in detail the arrangement of the circuits, especially those relating to the trunking operations. These two figures show diagrammatically three subscribers' individual bars E in the exchange Z. Across these individual bars E there is shown only one of the trunk bars A of the local group X' and four of the trunk bars A of the group W. In Fig. 15 the off-normal contacts e^1 , p^{21} , etc., are indicated by springs, and it will be seen that e^{12} has been consolidated with p^{21} , both of which are connected to the grounded thrust-lever I shown in Fig. 8. In Fig. 17, to the left of the dotted line 23—23, is shown the manual apparatus individual to the calling line and to a local trunk. To the right of the line 24—24 is shown a section of the W exchange, and between the lines 23—23 and 24—24 is shown the trunk drops of the exchange Z and the trunk-lines 10 running to the exchange W. (See Fig. 18.)

From the foregoing it will be seen that I provide an arrangement by which a calling subscriber may automatically extend his line into connection with a trunk-line leading to a manual switchboard. It will be seen that

this is accomplished through the medium of
 the subscribers' line bars E and the trunk-
 line bars A, in the manner previously ex-
 plained. As herein disclosed, the trunk-
 5 lines extending between the different ex-
 changes, or between the different divisions
 of the same exchange, are each two-way in
 character—that is to say, are each adapted
 for trunking in either direction, each trunk-
 10 line being equipped at each end with as many
 multiple terminals as there are subscribers
 of that exchange, or of that particular divi-
 sion of the same exchange, and each trunk-
 line being provided with a jack at each end
 15 thereof. In this way each long-distance
 trunk, or each trunk between different divi-
 sions of the same exchange, can be seized
 automatically at either end thereof, and can
 also be extended manually at either end
 20 thereof. In other words, each two-way
 trunk terminates at each end in both manual
 and automatic switchboard apparatus, and
 with this arrangement one end of a two-way
 trunk can be seized automatically by a call-
 25 ing subscriber, and the manual switchboard
 at the other end of said trunk can then be
 relied upon to complete the connection from
 the trunk to the line of the called subscriber.
 For local calls—that is to say, for calls be-
 30 tween subscribers of the same exchange, or
 between subscribers whose lines terminate at
 the same division of a certain exchange—the
 trunk over which the calling subscriber
 obtains connection with the manual switch-
 35 board, and over which the call-signal is
 transmitted for attracting the attention of
 the operator, can be cut out of the connec-
 tion and returned to normal condition, leav-
 ing the two subscribers' lines connected sim-
 40 ply through the medium of any ordinary or
 suitable cord circuit. With the arrange-
 ment disclosed, the operator can use the auto-
 matically-selected trunk for answering the
 calling subscriber by plugging into the jack
 45 of such trunk, and can then release the call-
 ing subscriber from such trunk while she is
 waiting for the called subscriber to answer.
 In such case the operator would then trans-
 fer the cord plug from the jack of the
 50 trunk-line to the multiple jack of the call-
 ing line, restoring the automatic trunking
 machinery and apparatus to condition for
 use by other subscribers, and leaving the two
 subscribers' lines connected through the
 55 medium of the cord circuit. On the other
 hand, as explained, the operator may re-
 lease the calling subscriber's line from the
 trunk which he automatically selected in
 making the call, having first automatically
 60 ascertained the number of the calling line,
 and may then ascertain the number of the
 called line after plugging into the multiple
 jack of the calling line. Either arrangement
 can be employed, depending upon the cir-
 65 cumstances and requirements of different

cases. As to the long-distance trunks, how-
 ever, it will be seen that these must always
 remain in the talking connection, inasmuch
 as the operator at the exchange of the
 called subscriber will not have on her board 70
 any multiple jack of the calling line. With
 the arrangement shown a calling subscriber
 operates one push-button if he is calling a
 subscriber of the same exchange, or of the
 same division of a large exchange, but pushes 75
 another button if he desires to extend his
 line into connection with the line of a sub-
 scriber of some other exchange, or with a
 called line terminating in a different divi-
 sion of the same exchange, there being as 80
 many push-buttons or equivalent devices as
 there are different exchanges, or as there
 are divisions of the same exchange. In this
 way the trunking from one exchange to
 another, or from one division of a large ex- 85
 change to another, is automatic and under
 the control of the subscribers, and the op-
 erators are in any case only necessary for
 completing connection with the called line.
 No trunk-line can be seized at a time when 90
 it is already in use, and thus no interference
 occurs in the selection and use of the local
 and long-distance trunks—that is, not under
 ordinary conditions. By a local trunk I
 mean one which enables the calling sub- 95
 scriber to signal the operator at the board
 on which his line terminates, and by long-
 distance trunks I mean those which are em-
 ployed by calling subscribers to extend their
 lines into connection with another exchange, 100
 or with another division of the same ex-
 change. By a two-way trunk I mean a
 trunk which can be employed for extending
 a call in either direction, and which can be
 105 seized at either end thereof, and connection
 extended from either end thereof. It will
 be seen that the two-way trunks, or long-
 distance trunks as I have called them, are
 each composed of end and intermediate sec-
 110 tions, the intermediate or body portion of
 the trunk terminating at its opposite ends
 in spring jacks, and the end sections of the
 trunk being connected with the said main or
 body portion through the medium of series
 115 contacts in the jacks. With this arrange-
 ment the operator who plugs into the trunk
 jack in order to respond to a call thereby
 automatically disconnects the end section
 from the trunk, thus cutting off all of the
 120 multiple switch terminals which are con-
 nected with that section, and precluding
 seizure of that end of the trunk by any call-
 ing subscriber. At the other end of the two-
 way trunk the end section thereof is neces-
 125 sarily retained connected therewith, inas-
 much as it is through the medium of this
 end section that the calling subscriber auto-
 matically selects and seizes the trunk and ex-
 tends the call to the other exchange—that is
 to say, to the exchange where the operator 130

in answering the call automatically disconnects from her end of the line the end section thereof and all multiple switch terminals connected therewith. At the calling subscriber's end of the two-way or long-distance trunk the same is made busy in the manner already explained, so that after the operator has answered at the called subscriber's end of the trunk, then no other calling subscriber can seize either end of said trunk. It will also be seen that when an operator plugs into the jack of the calling line in order to complete a local call, she thereby automatically energizes a cut-off relay, which cut-off relay renders inoperative the trunk-selecting mechanism, or that portion thereof, which is individual to the calling line. With this arrangement, and after the operator has plugged into the individual jack of that line, the calling subscriber can not then operate or in any way disturb the automatic trunk-selecting mechanism. As shown, the subscribers' lines receive battery current for talking purposes, and this can be furnished through the cord circuits or in any other suitable, known or approved manner. Furthermore, it will be seen that each subscriber's line has a double-wound line relay which is individual thereto, and which is responsive to all of the acts of the calling subscriber which are necessary to accomplish the automatic selection of an idle trunk, in the manner explained. The operator can release the automatic trunk-selecting switch mechanism of the calling subscriber by a suitable current, and by means of a suitable key in the cord circuit of the answering plug—that is to say, the plug by which the operator answers the call. The system can, however, be used or operated in various ways, the novel construction and arrangement affording opportunity for various methods of operation.

I claim as my invention:

1. In a telephone system, the combination with a plurality of exchange stations interconnected by one or more trunk lines and a plurality of subscribers' stations connected with each exchange, of means for automatically selecting and establishing connections between said subscribers and any given one of said exchange stations comprising independently moving trunk elements forming trunk terminals, independently movable selector elements individual to and forming terminals of the subscribers' lines, a plurality of normally disconnected directing relays, and means controlled by said directing relays for automatically establishing circuit connections between the selector elements and the trunk elements.

2. In a telephone system, the combination with a plurality of exchange stations interconnected by one or more trunk lines and a plurality of subscribers' stations connected

with each exchange, of means for automatically establishing connections between said subscribers and any given one of said exchange stations comprising independently movable trunk elements forming trunk terminals of the several exchanges, each said element consisting of a bar with insulated contacts thereon, independently movable selector elements forming terminals of the subscribers' lines, said trunk elements extending at right angles to said selector elements, and means operable electrically from the subscribers' stations for sending selective current to control said trunk elements for automatically establishing circuit connections between the selector elements and a trunk element of a desired exchange.

3. In a telephone system, the combination with a plurality of exchange stations interconnected by one or more trunk lines, and a plurality of subscribers' stations connected with each exchange, of means for automatically establishing circuit connections between said subscribers and any given one of said exchange stations, comprising normally stationary trunk elements forming terminals of the trunks, normally stationary selector elements forming terminals of the subscribers' lines, said trunk and selector elements being arranged in intersecting relation with each other, magnets operable from the several subscribers' stations for initially operating the corresponding selector element, and other magnets for moving the trunk elements and establishing circuit connections between said trunk and selector elements, said magnets being operable sequentially.

4. In a telephone system, the combination with a plurality of exchange stations interconnected by one or more trunk lines and a plurality of subscribers' stations connected with each exchange, of means for automatically establishing circuit connections between said subscribers and any given exchange station, comprising trunk elements forming trunk terminals, independent selector elements respectively forming terminals of the subscribers' lines, a series of directing relays, means controlled by said directing relays for automatically and independently actuating selected ones of said cooperating elements to establish circuit connections therebetween, means for operating and controlling said directing relays from the subscribers' stations, and automatic means operating to prevent interference with a connected pair of said elements during the time they are in operative engagement with each other.

5. In a telephone system, the combination with a plurality of exchange stations interconnected by one or more trunk lines and a plurality of subscribers' stations connected with each exchange, of means for automatically establishing circuit connections between

said exchanges, comprising trunk elements forming trunk terminals, selector elements forming terminals of the subscribers' lines, a series of directing relays, means controlled by said directing relays for automatically actuating selected ones of said cooperating elements to establish circuit connections therebetween, means for operating and controlling said directing relays from the subscribers' stations, and automatic means cooperating to prevent interference with a connected pair of said elements during the time they are in operative engagement with each other, comprising means for moving said cooperating elements together out of the path of movement of the remaining elements.

6. In a circuit selector, a series of trunk elements and a series of selector elements arranged in intersecting relation therewith, the individual members of one of said series being capable of movement relatively to the other, electric contact devices located at intersecting points upon said elements, means for imparting an initial movement to each member of said movable elements to establish circuit connection between the same and individual ones of the cooperating elements, and means for imparting a subsequent movement of said connected elements together, whereby they are carried into a position which prevents interference by the other elements.

7. In a telephone system, the combination of a subscriber's set adapted to send out electric impulses of different character, a set of directing relays responsive to said impulses, a set of magnets controlled by and individually operable through said directing relays, and a circuit selector operable by said magnets.

8. In a telephone system, the combination with the right and left main lines, of a signaling button set, comprising a plurality of contact devices, interconnections including resistance between said contact devices whereby impulses may be sent over the lines of different power, a pair of directing relays respectively in circuit with said main lines, a pair of magnets in circuit with each main line and between which and the button set said directing relays are interposed, and interconnections between said relays whereby an impulse may be sent over either main line directly through its corresponding directing relay to one of said magnets, and whereby also an impulse may be sent over either main line to its relay to shunt the circuit of the opposite main line, and an impulse thereafter sent through said shunted circuit to the other of said pair of magnets, for the purpose set forth.

9. In a telephone system, the combination with the right and left main lines, of a signaling button set comprising a plurality of

contact devices whereby impulses may be sent over the lines of different power, interconnections between said contact devices, a pair of directing relays respectively in circuit with said main lines, and each operable to shunt the opposite main line, comprising interconnections between said relays whereby an impulse may be sent over either main line directly through its corresponding directing relay to a magnet to be operated, and whereby also a first impulse may be sent through either relay to shunt the circuit of the opposite main line, and an impulse subsequently sent through said shunted circuit to a device to be operated, resistance in each relay circuit whereby current may be sent therethrough without operating the relay, and magnets controlled by said relays, for the purpose set forth.

10. In a system for transmitting intelligence electrically, the combination with main circuit lines, of a train of circuit-controlling magnets connected in multiple and responsive in common to a normal current, and interconnections whereby the operation of either of the magnets of the train serves to cut out of the train the remaining magnets.

11. In a system for transmitting intelligence electrically, the combination with main circuit lines, of a train of circuit-controlling magnets connected in multiple and responsive in common to a normal current, and interconnections between said several magnets whereby the operation of either one of the train serves to cut out of the train the remaining magnets, a selector element movable step by step, mechanical connections whereby one of the steps of the selector element is affected by means of one of said magnets of the train, and means effecting the release of said operating magnet when said selector element is moved a further step, whereby said magnet returns and restores the train to operative condition independently of the return of the selector element.

12. In a telephone system, the combination with a subscriber's main line and means for sending electrical impulses of different character over said main line, of a plurality of trains of magnets connected in multiple, means responsive to the different impulses for operating different trains at will, and interconnections between the magnets of each train whereby the operation of any one operates to cut out the remainder of the train, as and for the purposes set forth.

13. In a telephone system, the combination with a talking circuit, means for sending electrical impulses over said circuit of different character, and a set of directing relays severally responsive to the different impulses, of a plurality of trains of magnets controlled by said directing relays, and interconnections between the magnets of each

train, whereby the operation of any one serves to cut out the remaining ones of the train.

14. In a telephone system, the combination with the right and left lines of a talking circuit, of a signaling set comprising means for sending impulses over each line of different power, and interconnections whereby such impulses may be sent alternately over either wire, a set of directing relays interconnected to respond to said impulses, a series of relay-operated magnets, one for each of the several circuits controlled by said directing relays, a plurality of trains of magnets controlled by said relay-operated magnets, and interconnections between the members of each train of magnets whereby the operation of any one serves to cut out the remainder of the train.

15. In a telephone system, the combination with the right and left lines of a talking circuit, of a signaling set comprising means for sending impulses over each line of different power, and interconnections whereby such impulses may be sent alternately over either wire, a set of directing relays interconnected to respond to said impulses, of series of relay-operated magnets, one for each of the several circuits controlled by said directing relays, a plurality of trains of magnets controlled by said relay-operated magnets, and interconnections between the members of each train of magnets whereby the operation of any one serves to cut out the remainder of the train, and a circuit selector having a plurality of selector elements controlled by the several magnets of said trains of magnets.

16. In a directing relay set, the combination with a pair of main circuit lines, of a magnet in direct circuit in each line, a circuit switching armature for each magnet, a pair of opposed contact devices for each armature between which the latter vibrates, a branch conductor leading from each main line to the contact of the armature of the opposed relay which is closed when the magnet thereof is energized, and a continuation of each main line which extends through the coil of its relay extending to that contact of the armature of the opposite relay which is closed when the armature is in normal or retracted position, substantially as described.

17. In a circuit selector, the combination with a series of selector elements and a series of cooperating elements between which circuit connections may be established, of electrically operated means for imparting an initial movement to individual ones of one of said series, a mechanical detent operating to engage and hold each initially moved element at the end of its initial movement, means for imparting movement to one of

said cooperating elements to bring a pair together and for moving the two together, and means for restoring said parts to their normal positions as and for the purposes set forth.

18. In a telephone system including a circuit selector, the combination with a selector element and means for moving said element successively forward step by step, and means for restoring the element to its normal position, controllable over a line circuit, of a mechanical detent comprising a pawl-like latch member and a cooperating latch member provided with a stop shoulder, and a switch cam whereby the pawl-like member is shifted out of the path of the shoulder upon the return movement of the selector element, together with a line circuit over which the said selector element is controlled.

19. In a telephone system including a circuit selector, the combination with a series of oscillatable trunk elements and a series of endwise shiftable selector bars cooperating therewith, means for imparting an initial endwise movement to each selector bar controllable over a line circuit, a mechanical detent operating to engage and hold the selector bar at the end of its initial movement, and means operable electrically for releasing said detent to permit the selector bar to return to its normal position, as and for the purposes set forth.

20. In a telephone system including a circuit selector, the combination of two series of independently movable contact elements, controllable over a line circuit, the elements of one series arranged in intersecting relation to those of the other series, means for initially and independently moving the members of one series, other means for moving the second series of contact elements, and means for effecting circuit connections between said cooperating elements comprising contact devices upon each at the points of intersection, the contact devices of one series being yieldable and adapted to retain engagement of those of the other series and constituting the mechanical moving connections whereby movement is imparted from the element of one series to a corresponding element of the other series, for the purpose set forth.

21. In a telephone system including a circuit selector, the combination of an oscillatory selector element and an endwise shiftable selector element arranged in intersecting relation thereto, controllable over a line circuit, of a contact stud upon the oscillatory member and a yieldable contact device upon the shiftable member, said contact device of the shiftable member being so located that in the shifting movement of the latter member it passes into and out of the arc-

shaped path of movement of the contact of the oscillatory member, whereby said contacts may be caused to engage when the shiftable member is in an intermediate position by movement of the oscillatory member, and the latter member is free to move without engagement of the contacts when the shiftable member is shifted in either direction beyond its intermediate position.

22. In a telephone system including a circuit selector, the combination of an oscillatory selector element and an endwise shiftable selector element arranged in intersecting relation thereto, controllable over a line circuit, of a contact stud upon the oscillatory member and a yieldable contact device upon the shiftable member, said yieldable contact device of the shiftable member being so located that in the shifting movement of the latter member it passes into and out of the arc-shaped path of movement of the contact stud of the oscillatory member, whereby said contact device may be caused to engage when the shiftable member is in an intermediate position by movement of the oscillatory member, and the latter member is free to move without engagement of the contacts when the shiftable member is shifted in either direction beyond its intermediate position, the engaging part of said contact stud being under-cut or recessed to receive and form a holding engagement with the end of the yielding contact, for the purpose set forth.

23. In a telephone system including a circuit selector, the combination of an oscillatory selector element and an endwise shiftable selector element arranged in intersecting relation thereto, magnets for imparting a step-by-step movement to each of said selector elements, controllable over a line circuit, a contact stud upon the oscillatory member, and a yieldable contact device upon the shiftable member, said yieldable contact device of the shiftable member being so located that in the shifting movement of the latter member it passes into and out of the arc-shaped path of movement of the contact stud of the oscillatory member, whereby an initial movement of the shiftable member brings it into position for engagement of the contacts upon the subsequent movement of the oscillatory member, and a further movement of the oscillatory member carries with it the shiftable member by reason of the interengagement of said contacts.

24. In a telephone system, the combination of a subscriber's telephone, a line circuit terminating at the exchange in a manually-operated spring jack and in automatic switch mechanism, a relay connected with the subscriber's line at said exchange, a source of electrical energy, motor mechanism controlled by said relay, switch mechanism operable by said motor, a series of

trunk lines selectable by said switch mechanism, and cooperative non-interfering mechanism operating to prevent the selection of busy trunks by said switch mechanism.

25. In a telephone system, the combination of a subscriber's telephone, a line circuit terminating at the exchange in a manually-operated spring jack and in automatic switch mechanism, a relay connected in circuit with said subscriber's line at said exchange, a source of electrical energy, a motor mechanism controlled by said relay, a switch mechanism operable by said motor, a plurality of trunk lines leading to different stations and selectable by said switch mechanism, and means for restoring the several instrumentalities to normal.

26. In a telephone system, the combination of a subscriber's telephone line, a relay connected with said subscriber's line, a source of electrical energy, motor mechanism, means controlled by said line relay for controlling the initial operation of said motor mechanism, switch mechanism operable by said motor mechanism, trunk lines selectable by said switch mechanism, manually-operated connection terminals in which said trunks terminate, and cooperative means operating to prevent the selection of busy trunks by said switch mechanism, substantially as described.

27. In a telephone system, a subscriber's telephone line, a line relay for said line; an automatic switch for telephone circuits, a plurality of trunks leading from said automatic switch to spring jacks before a telephone operator, signals and manual switching means before the operator and associated with said trunks, terminals in said switching device associated with said telephone line and adapting said telephone line to connect with any of said trunks, means for effecting a connection between said telephone line and an idle one of said trunks and other means for energizing said line relay for initiating the operation of said last means.

28. In a telephone system, a subscriber's telephone line, an automatic switch for telephone circuits, a plurality of trunks leading from said automatic switch to spring jacks before a telephone operator, signals and manual switching means before the operator and associated with said trunks, terminals in said switching device associated with said telephone line and adapting said telephone line to connect with any of said trunks, and means for effecting a connection between said telephone line and the first in predetermined order of said idle trunks.

29. In a telephone system, an exchange with subscribers' lines terminating thereat, another exchange with subscribers' lines terminating thereat, a trunk line extending

between said exchanges, as many multiple terminals movable to close a circuit for each end of said trunk line as there are subscribers' lines terminating in each exchange, and means for moving said terminals and connecting them with a subscriber's line.

30. In a telephone system, an exchange, another exchange, a trunk line extending between the said exchanges, as many multiple terminals movable to close a circuit for each end of said trunk line as there are subscribers of each exchange, and means for automatically moving said terminals and for extending calls to them to give trunking connection from either exchange to the other.

31. In a telephone system, a two-way trunk line for extending a trunking call, automatic means for seizing one end of said line to extend connection thereover in one direction, automatic means for seizing the other end of said line to extend connection thereover in the other direction, either of said automatic means responsive also for establishing a local connection.

32. In a telephone system, a two-way trunk for extending a trunking call, automatic devices by which either end of said trunk can be seized, manual switchboards at which the opposite ends of said trunk terminate, either of said automatic means responsive also for establishing a local connection.

33. In a telephone system, a plurality of exchanges, trunk lines between the same, as many push buttons for each subscriber as there are exchanges, and devices responsive to said push buttons for automatically selecting idle trunk lines leading to the different exchanges.

34. In a telephone system, a plurality of groups of subscribers' lines, an exchange equipment for each group; two-way trunks between said groups, each equipment comprising means for automatically selecting idle trunks, each trunk thereby serving to extend a call thereover in either direction, and means responsive to the subscribers for selecting the desired group ahead of the automatic selection of the trunk leading thereto.

35. In a telephone system, subscribers' lines, a common battery manual switchboard, trunks leading thereto, relay coils for each subscriber's line, and means controlled by said relay coils for automatically selecting idle trunks for calling subscribers, the coils for each line being less in number than said trunks.

36. In a telephone system, subscribers' lines, a manual switchboard, trunks terminating thereat, relay mechanism for each subscriber's line and means controlled by said relay for automatically selecting idle trunks for calling subscribers, said trunks

being greater in number than the relay coil or coils for any one line.

37. In a telephone system, subscribers' lines, endwise-shiftable terminal bars for said lines, arranged parallel, means for operating said bars responsive to calling subscribers, trunk lines, and movable trunk terminals cooperating with said bars to automatically connect calling subscribers' lines with idle trunk lines.

38. In a telephone system, a manual switchboard, trunks leading thereto, subscribers' lines, a line relay for each subscriber's line, and means initially controlled by said relays for automatically connecting calling lines to idle trunks.

39. In a telephone system, a signal common to a number of subscribers, means by which a calling subscriber operates said signal, a group of signals individual to the different subscribers, and means by which the operator controls said individual signals to automatically indicate which subscriber is calling.

40. In a telephone system, a group of signals common to a plurality of subscribers, means by which a calling subscriber automatically selects an idle signal, a group of signals individual to the different lines, and means by which the operator controls said individual signal to automatically indicate which subscriber is calling.

41. In a telephone system, a subscriber's line, a relay normally in bridge of the line, groups of trunks, a combined trunk group, elector and selector controlled by said relay, a jack, and a bridge-cut-off relay and means for operating it by the insertion of a plug in said jack.

42. In a telephone system, a visual call signal common to a number of subscribers, means by which a calling subscriber automatically extends connection to said signal to attract the attention of the operator when a connection is desired, and means by which the operator restores said signal to condition for use by other subscribers and a centralized source of current for operating and talking purposes.

43. In a telephone system, a plurality of subscribers' lines, a visual signal common to said lines, means by which a calling subscriber automatically extends connection to said signal to attract the attention of the operator when a connection is desired, and means by which the operator restores said signal to condition for use by other subscribers and a centralized source of current for operating and talking purposes.

44. In a telephone system, trunks, a trunk selector, a subscriber's line, and a double-wound line relay individual to the said subscriber's line and controlling the said trunk selector.

45. In a telephone system, a trunk, a jack

for said trunk, multiple switch terminals for said trunk, and means for cutting off or disconnecting the said terminals by the insertion of a plug in said jack.

46. In a telephone system, a subscriber's line, a jack for said line, groups of trunks, group electing and trunk-selecting means for said line, and means for cutting off or disconnecting the said trunk-selecting means by the insertion of a plug in said jack.

47. In a telephone system, a common battery manual switchboard, trunks terminating thereat, subscribers' lines, and means for automatically selecting idle trunks and for connecting calling subscribers' lines thereto, each trunk having only as many multiple terminals for automatic connection as there are subscribers' lines, and each subscriber having a line relay for initiating the operation of said means.

48. In a telephone system, a common battery manual switchboard, trunks terminating at said board, subscribers' lines, a line relay for each subscriber's line, means for automatically selecting idle trunks, and circuits closed by the energizing of said relays for controlling the initial operation of the automatic selecting means.

49. In a telephone system, a common battery manual switchboard, trunks terminating thereat, subscribers' lines, a line relay for each line, and means for automatically selecting idle trunks for calling subscribers, said line relays controlling the initial operation of said means.

50. In a telephone system, a common battery manual switchboard, trunks terminating thereat, a magnet for each line, and means for automatically selecting idle trunks for calling subscribers, said magnets controlling the initial operation of said means.

51. In a telephone system, subscribers' lines, a common battery manual switchboard, trunks terminating at said board, movable terminal bars for said lines, movable terminal bars for said trunks, means for moving the bar of a calling line endwise, and means for rocking the terminal bar of an idle trunk into engagement with the bar of the calling line.

52. In a telephone system, subscribers' lines, a common battery manual switchboard, trunks terminating at said board in spring jacks, means for automatically connecting calling lines with idle trunks, and signals operated over the trunks to attract the attention of the operator.

53. In a telephone system, subscribers' lines, a common battery manual switchboard, trunks terminating at said board, movable trunk terminals, and means for automatically moving the terminal of an idle trunk into connection with a calling line.

54. In a telephone system, subscribers'

lines, a manual switchboard, trunks terminating at said board, movable terminals for the lines, movable terminals for the trunks, means for moving the terminal of a calling line, and means for automatically moving the terminal of an idle trunk into engagement with the terminal of the calling line.

55. In a telephone system, a manual switchboard, trunks on said board, means associated with one end of said trunks for automatically selecting idle trunks, and means associated with the other end of said trunks for preventing seizure of a selected trunk.

56. In a telephone system, a manual switchboard, trunks on said board, jacks for said trunks, means for automatically selecting idle trunks and jacks, and means for preventing seizure of busy jacks.

57. In a telephone system in which the subscribers' lines are divided into groups, means normally connected with the subscriber's line by which a calling subscriber selects the desired group, and means by which an operator completes the connection to the called line in that group.

58. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control, normally connected with the subscriber's line, to connect a calling line with the desired group, and means by which an operator completes the connection to the called line in that group.

59. In a telephone system in which the subscribers' lines are divided into groups, means by which a calling subscriber selects the desired group, means by which an operator completes the connection to the called line in that group, and a central source for supplying current to the subscribers' lines for talking and switching purposes.

60. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control to connect a calling line with the desired group, means by which an operator completes the connection to the called line in that group, and a central source for supplying current to the subscribers' lines for talking and switching purposes.

61. In a telephone system in which the subscribers' lines are divided into groups, means normally connected with the subscriber's line by which a calling subscriber selects the desired group, means by which an operator completes the connection to the called line in that group, and means associated with the operator's cord circuit by which the subscribers signal for a disconnection.

62. In a telephone system in which the subscribers' lines are divided into groups,

automatic trunking apparatus operative under substation control, normally connected with the subscriber's line, to connect a calling line with the desired group, means by which an operator completes the connection to the called line in that group, and means associated with the operator's cord circuit by which the subscribers signal for a disconnection.

63. In a telephone system in which the subscribers' lines are divided into groups, means normally connected with the subscriber's line by which a calling subscriber selects the desired group, means by which an operator completes the connection to the called line in that group, and jacks and line signals for said lines.

64. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control, normally connected with the subscriber's line, to connect a calling line with the desired group, means by which an operator completes the connection to the called line in that group, and jacks and line signals for said lines.

65. In a telephone system, subscribers' lines divided into groups, automatic means normally connected with the subscriber's line for trunking between the different groups, and means at each group for connecting together the lines of the same group.

66. In a telephone system, subscribers' lines divided into groups, automatic means normally connected with the subscriber's line for trunking between the different groups, and switchboard apparatus at each group for manually connecting together lines of the same group.

67. In a telephone system, a calling line, a called line, and a semi-automatic connection between the two lines, which connection includes an automatic switch which is normally connected to the subscriber's line, a trunk line, an operator's cord circuit, supervisory signal apparatus for said connection, and jacks and line signals for said lines.

68. In a telephone system, a calling line, a called line, and a semi-automatic connection between the two lines, which connection includes a trunk line, an automatic switch, which is normally connected to the subscriber's line, by which the trunk line is automatically selected, a manual switchboard connecting cord, supervisory signal apparatus for said connection, and jacks and line signals for said lines.

69. In a telephone system, a trunk line terminating at either end in a manual switchboard, and automatic selective devices for seizing either end of said trunk line to extend a connection to the manual switchboard at the other end.

70. In a telephone system, a two-way trunk line, a call signal device at either end of said trunk, automatic selective devices for seizing either end of said trunk, and means for causing the operation of the call signal upon one end of the trunk upon the seizure of the opposite end thereof.

71. In a telephone system, a group of subscribers' lines terminating in manually operated spring jacks and in contacts of automatic switches, a line relay for each line, trunk lines terminating in automatic switches and in spring jacks, said automatic switches each provided with means controlled by said line relay for selecting any one of said trunk lines when idle, and for connecting a calling subscriber's line with the selected trunk, said line relay controlled initially over the line circuit, and manual switching means for completing the connection.

72. In a telephone system, a group of subscribers' lines, a group of trunks, a plurality of automatic switches for said lines, a relay for each line, manually operated connective devices, each of said switches comprising means for selecting any one of said trunks when idle through the medium of said line relay controllable over the line, the selected trunk terminating in an automatic switch at one end and in one of said connective devices at the other for completing a connection.

73. In a telephone system, a subscriber's line, automatic means comprising an automatic switch associated with said line, manually operated switching terminals, trunk lines leading from said automatic switch to said manually operated switching terminals, and a signal at the manually operated switching terminal of each of said trunk lines, said automatic switch comprising means controllable over the line circuit for effecting a connection between said telephone line and an idle one of said trunks, and for operating the signal of the selected trunk, said automatic switch having a single line relay controllable over said line for operating said switch to establish connection with any one of said trunks.

74. In a telephone system, a subscriber's line, other subscribers' lines, a line relay for said line, movable terminals for said line under the control of said line relay, trunks, multiple terminals for each of said trunks, the different multiple terminals of each trunk being accessible to the different lines, an automatic switch comprising said movable terminals for said subscriber's line having means controllable by the line relay for selecting any idle one of said trunks and for connecting said line with said selected trunk via its multiple terminals, an automatic switch for each one of the other

lines, and a line relay for controlling each switch to select an idle trunk.

75. In a telephone system, a telephone line, other telephone lines, a line relay associated with said telephone line, movable terminals for said line under the control of said line relay, trunks, multiple terminals for said trunks, different multiples of each trunk being accessible to different ones of said lines, manual switching terminals for said trunks, signals for said trunks, manual switching terminals for said line, an automatic switch comprising said movable terminals for said subscriber's line having means controllable by the line relay for selecting any idle one of said trunks and for connecting said line with said selected trunk via its multiple terminals, an automatic switch for each one of the other lines, and a line relay for controlling each switch to select any idle one of said trunks, and means for connecting the selected one of said trunks through its manual switching terminal to a desired line through the manual switching terminal of the desired line.

76. In a telephone system, a manual switchboard provided with jacks, subscribers' lines terminating in said jacks, a line relay for each line, signals on said board less in number than said lines, automatic switches for said lines, means in said switches operable to automatically select any one of said signals when idle, said selected signal operating under the control of said means to signal the operator to extend a call to another line, said means controlled by said line relay to cause such selection and operation of one of said signals, other lines terminating in said board, and means for manually connecting the calling line with one of said last named lines.

77. In a telephone system, a plurality of subscribers' lines, automatic switches for said lines, trunk lines, a manual switchboard, each of said trunk lines having terminals in said automatic switches and in said board, a line relay individual to each line, each of said automatic switches provided with means for automatically selecting any one of said trunks when idle through the medium of said line relay.

78. In a telephone system, a plurality of subscribers' lines, an automatic switch for each line, a line relay for each switch, a plurality of trunks, an operator's switchboard, said trunk lines having terminals in said switches and in said manual switch board, means in each of said automatic switches for automatically selecting any one of the trunks when idle controllable through the line relay of the switch, manual means at the manual switchboard for extending a

connection from the selected trunk for talking purposes, a centralized source of current and means for supplying current therefrom to the talking circuit via the selected trunk.

79. In a telephone system, a plurality of subscribers' lines, automatic switches for said lines, trunk lines, a manual switchboard, each of said trunk lines having terminals in said automatic switches and in said board, a line relay individual to each of said lines, each of said automatic switches provided with means initially controlled by said relay for automatically selecting any one of said trunks when idle, and a centralized source of current for operating and talking purposes, and means for supplying said source of current through the selected trunk.

80. In a telephone system, a plurality of subscribers' lines, an automatic switch for each line, a line relay for each switch, a plurality of trunks, an operator's switchboard, said trunk lines having terminals in said switches and in said manual switchboard, means in each of said automatic switches for automatically selecting any one of the trunks when idle controllable through the line relay of the switch, means at the switchboard for extending a connection from the selected trunk for talking purposes, a centralized source of current, and means for supplying current therefrom to the talking circuit via the selected trunk.

81. In a telephone system, a plurality of calling subscribers' lines, a manual switchboard provided with a set of answering jacks, trunks leading to said jacks, a plurality of automatic switches, each having a relay, individual to one of said lines, and means initially controlled by each relay for automatically selecting any one of said answering jacks when idle for calling subscribers.

82. In a telephone system, a manual switchboard, trunks terminating in said board, a subscriber's line, a line relay for said line, means for selecting an idle one of said trunks, means for energizing said relay, and means controlled by the energization of said relay for controlling the initial operation of said automatic trunk-selecting means.

83. In a telephone system, a manual switchboard, trunks terminating in said board, a signal, a subscriber's line, a line relay for the subscriber's line, automatic trunk-selecting means associated with said trunks, means for energizing said line relay to control the initial operation of said trunk-selecting means, and means for operating said signal when an idle trunk is found.

84. In a telephone system, a manual switchboard, trunks terminating in said

board, a signal, a subscriber's line, a line relay for the subscriber's line, automatic trunk-selecting means associated with said trunks, means for energizing said line relay to control the initial operation of said trunk-selecting means, and means for operating said signal when an idle trunk is found, and a centralized source of current for operating purposes.

85. In a telephone system, a manual switchboard, trunks terminating in said board, a signal, a subscriber's line, a line relay for the subscriber's line, automatic trunk-selecting means associated with said trunks, means for energizing said line relay to control the initial operation of said trunk-selecting means, means for operating said signal when an idle trunk is found, and a centralized source of current for talking and operating purposes.

86. In a telephone system, a plurality of trunks, automatic means associated therewith for automatically selecting an idle trunk, and manual means for setting up connection with a trunk and for preventing the seizure of the said trunk by the said automatic means.

87. In a telephone system, a couple of lines, an automatic switch for each line and automatic trunk selecting means associated therewith, trunk lines having terminals in said trunk selecting means, a line relay for each switch for controlling the operation of the switch, means for extending connection from either line to the other comprising the switch of the calling line and any one of said trunks, and means for rendering the line relay of the called line inoperative when the connection is established.

88. In a telephone system, a couple of lines, means comprising an operator's trunking equipment for extending connection from either line to the other, said means also comprising an automatic switch for each line, means in said switches whereby when either line calls the other switch of the called line is rendered inoperative.

89. In a telephone system, a couple of lines, an automatic switch for each line, a line relay for each switch for controlling the operation of the switch, means comprising an operator's trunking equipment for extending connection from either line to the other, said means also comprising the switch of the calling line, and means for rendering the line relay of the called line inoperative when the connection is established.

90. In a telephone system in which the subscribers' lines are divided into groups, corresponding groups of trunk lines, an automatic trunk selecting switch by which a calling subscriber selects an idle trunk in the desired group, and means by which an

operator completes the connection to the called line in the corresponding group, and a centralized source of current for operating and talking purposes.

91. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control to connect a calling line with the desired group, and means by which an operator completes the connection to the called line in that group, and a centralized source of current for operating and talking purposes.

92. In a telephone system in which the subscribers' lines are divided into groups, trunk lines, an automatic trunk selecting switch by which a calling subscriber selects an idle trunk line to the desired group, means by which an operator completes the connection to the called line in that group, and means associated with the operator's cord circuit by which the subscribers signal for a disconnection, and a centralized source of current for operating and talking purposes.

93. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control to connect a calling line with the desired group, means by which an operator completes the connection to the called line in that group, and means associated with the operator's cord circuit by which the subscribers signal for a disconnection, and a centralized source of current for operating and talking purposes.

94. In a telephone system in which the subscribers' lines are divided into groups, trunk lines, an automatic trunk selecting switch by which a calling subscriber selects an idle trunk line to the desired group, means by which an operator completes the connection to the called line in that group, and jacks and line signals for said lines, and a centralized source of current for operating and talking purposes.

95. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control to connect a calling line with the desired group, means by which an operator completes the connection to the called line in that group, and jacks and line signals for said lines, and a centralized source of current for operating and talking purposes.

96. In a telephone system, subscribers' lines divided into groups, automatic means for trunking between the different groups, and switchboard apparatus at each group for manually connecting together lines of the same group, line relays individual to each line, said automatic means initially

controlled by said relays for performing said trunking operations, and a centralized source of current for operating and talking purposes.

97. In a telephone system, a calling line, a called line, and a semi-automatic connection between the two lines, which connection includes a trunk line, an automatic switch by which the trunk line is automatically selected, a relay individual to the calling line for initially controlling the automatic selecting of said trunk, a manual switchboard connecting cord, and devices by which the subscribers signal the operator to indicate the necessity for disconnection, and a centralized source of current for operating and talking purposes.

98. In a telephone system, a calling line, a called line, and a semi-automatic connection between the two lines, which connection includes an automatic trunk selector, a trunk line, an operator's cord circuit, supervisory signal apparatus for said connection, and jacks and line signals for said lines, and a centralized source of current for operating and talking purposes.

99. In a telephone system, a calling line, a called line, and a semi-automatic connection between the two lines, which connection includes a trunk line, an automatic switch by which the trunk line is automatically selected, a manual switchboard connecting cord, supervisory signal apparatus for said connection, and jacks and line signals for said lines, and a centralized source of current for operating and talking purposes.

100. In a telephone system in which the subscribers' lines are divided into groups, trunk lines, an automatic trunk selecting switch by which a calling subscriber selects an idle trunk line to the desired group, and semi-automatic means for completing the connection to the called line in that group, and a centralized source of current for operating and talking purposes.

101. In a telephone system in which the subscribers' lines are divided into groups, trunk lines for each group, automatic trunk selecting and trunk selecting apparatus operative under substation control to elect a group of trunks and to automatically select an idle trunk in that group to connect a calling line with the desired group, and manual trunking means for completing the connection to the called line if the called line is in the same group with the calling line, and a centralized source of current for operating and talking purposes.

102. In a telephone system in which the subscribers' lines are divided into groups, trunk lines, an automatic trunk selecting switch by which a calling subscriber selects an idle trunk line to the desired group, semi-automatic means for completing the con-

nection to the called line in that group, and means associated with the operator's cord circuit by which the subscribers signal for a disconnection, and a centralized source of current for operating and talking purposes.

103. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control to connect a calling line with the desired group, semi-automatic means for completing the connection to the called line in that group comprising an operator's cord circuit, and means associated with the operator's cord circuit by which the subscribers signal for a disconnection, and a centralized source of current for operating and talking purposes.

104. In a telephone system in which the subscribers' lines are divided into groups, trunk lines, an automatic trunk selecting switch by which a calling subscriber selects an idle trunk line to the desired group, semi-automatic means for completing the connection to the called line in that group, jacks and line signals for said lines, and a centralized source of current for operating and talking purposes.

105. In a telephone system in which the subscribers' lines are divided into groups, automatic trunking apparatus operative under substation control to connect a calling line with the desired group, semi-automatic means for completing the connection to the called line in that group, jacks and line signals for said lines, and a centralized source of current for operating and talking purposes.

106. In a telephone system, a subscriber's line, an automatic trunk selecting switch associated with said line, trunks terminating in said switch, said switch provided with a line relay, means for closing a circuit through said line relay over the two sides of the line in series to initiate the operation of said switch to select an idle one of said trunks, and a centralized source of current for operating and talking purposes.

107. In a telephone system, a line, a switch associated with said line, a plurality of groups of trunks associated with said switch, means for operating said switch to elect one of said groups, and means in said switch for automatically selecting an idle trunk in said group, a central source of battery, and means associated with the selected trunk for supplying current for talking purposes to the line.

108. In a telephone system, a subscriber's line, an automatic switch for said line, a relay individual to the line and a battery in series across said line at the automatic switch, a called subscriber's line, and semi-automatic means comprising said automatic

switch for establishing connection between the two lines, said relay initially operating said switch, and means for breaking said connection across the calling line during talking.

109. In a telephone system, a line, an automatic switch associated with said line, a line relay individual to said line and battery in series across said line, a trunk line, automatic means in said switch initially controlled by said relay for selecting said trunk line from other trunk lines, another subscriber's line, semi-automatic means comprising said switch and trunk line for connecting the two subscribers' lines, and means for breaking the said relay and battery connection across the first line, and a centralized battery for supplying talking current to the talking circuit.

110. In a telephone system, a line, an automatic switch associated with said line, a line relay individual to said line and battery in series across said line, a trunk line, automatic means in said switch initially controlled by said relay for selecting said trunk line from other trunk lines, another subscriber's line, semi-automatic means comprising said switch and trunk line for connecting the two subscribers' lines, and means for breaking the said relay and battery connection across the first line, a centralized battery, and means for supplying current to the talking circuit via said trunk.

111. In a telephone system, a trunk line, automatic and manual equipment associated with each end of the trunk line, means in each of said automatic equipments for seizing the corresponding end of the trunk line, and means in each of said manual equipments for extending connection from the trunk line after it has been seized by the automatic equipment at the opposite end.

112. In a telephone system, a trunk line, automatic and manual equipment associated with each end of the trunk line and having trunk terminals in which the line terminates, means in each of said automatic equipments for seizing the corresponding end of the trunk line, and means in each of said manual equipments for extending connection from the trunk line after it has been seized by the automatic equipment at the opposite end, whereby two subscribers' lines may be connected in a talking circuit, and a central battery for supplying talking current to the talking circuit.

113. In a telephone system, a subscriber's line, an automatic switch associated with said line, a plurality of groups of trunks accessible via said switch, a manual board, means for electing a group of trunks and for then selecting a trunk in the group terminating in said board, a signal associated with the trunk, and means for operating the

same when the trunk is seized for signaling an operator at the board.

114. In a telephone system, a calling and a called line, a manual board equipment, an automatic switch for each line operable thereover to extend connection to either subscriber's line through the medium of manual equipment, means allotted to the called line whereby the connection from the calling to the called line may be completed manually, and means allotted to the switch of the called line for rendering the switch of the called line inoperative when connection is completed therewith.

115. In a telephone system, a calling and a called line, a manual board equipment, an automatic switch for each line operable thereover to extend connection to either subscriber's line through the medium of manual equipment, means allotted to the called line whereby the connection from the calling to the called line may be completed manually, and means allotted to the switch of the called line for rendering the switch of the called line inoperative when connection is completed therewith, and a centralized battery for supplying talking current to the circuit.

116. In a telephone system, a couple of lines, an automatic trunk selecting switch for each line, trunks terminating in said switch means for establishing connection from either line to the other comprising the switch of the calling line and any one of said trunks, means in each switch operable when the line to which the switch belongs is called for rendering the switch of the called line inoperative, said means controlled over a circuit separate from the talking circuit connecting the calling and called lines.

117. In a telephone system, a line, automatic means for extending connection from said line, manual trunking means for extending connection to said line, means for making said line busy at the second means when the line is calling comprising a private circuit, a magnet in said circuit, and means for energizing said magnet over said private circuit when the line is called to render the automatic means for extending connection from the line inoperative.

118. In a telephone system, groups of trunk lines, said trunk lines provided at each end with a movable contact, the contact at one end of each trunk being individual to a single subscriber's line and movable to close connection therefrom to the subscriber's line, and an automatic group elector and trunk selector for connecting with any one of said trunk lines.

119. In a telephone system, a subscriber's line, an individual switch comprising a plurality of trunk line terminals, means for moving each terminal independently of the

other, a trunk line connected with each terminal and subscriber's line terminals adapted to cooperate with said trunk terminals in establishing connection between the line and
5 any one of said trunk lines, each trunk having a terminal in a manual trunk board.

120. In a telephone system, the combination of a subscriber's line, a plurality of multiple line terminals for said subscriber's
10 line, a plurality of trunk line terminals individual to the subscriber's line and each adapted for movement independently of the others, means under the control of the subscriber for operating the trunk line terminals, and means under the control of the subscriber for operating the multiple line terminals each trunk having a terminal in a manual trunk board.

121. In a telephone system, the combination of a subscriber's line, a movable line terminal connected with said subscriber's line, an automatic trunk selector, a trunk line, a movable trunk line terminal connected with the trunk line, and means under the control of the subscriber for moving said terminals toward each other and into contact and for operating said selector to select the trunk independently of the subscriber.

122. In a telephone system, the combination of a plurality of trunk lines, trunk line terminals, a plurality of subscribers' shiftable line banks, each provided with multiple terminals adapted to cooperate with said trunk line terminals in establishing connection between any subscriber's line and any
35 trunk line, subscribers' individual line relays for operating said line banks, and auxiliary switches adapted to be operated by the shifting movements of said line banks.

123. A telephone system comprising a plurality of subscribers' shiftable line-banks, subscribers' individual line relays for operating said line banks, spring means for restoring said line banks to their normal positions, and trunk line terminals adapted to cooperate with said line banks, each line bank being provided with a plurality of multiple terminals of its allotted line.

124. In a telephone system, the combination of a subscriber's line, a plurality of multiple terminals of said subscriber's line, a subscriber's individual line relay means for shifting said multiple line terminals in unison, and spring means for returning said
55 group of multiple line terminals to its normal position.

125. In a telephone system, the combination of a plurality of trunk lines, a plurality of metal plates connected with each trunk line, the plates allotted to any trunk line being rigidly connected together but insulated from each other, each plate being provided with a plurality of electrical contacts, means whereby the metal contact plates connected with any one line may be and are

shifted independently of the plates connected with the other trunk lines, subscribers' lines, and automatic trunk selecting means operable over said lines and adapted to cooperate with the said electrical contacts
70 formed on the said metal plates connected with the trunk lines, whereby any subscriber's line can be connected with any idle trunk line.

126. In a telephone system, the combination of a subscriber's line, a plurality of movable line terminals, said terminals connected in multiple and adapted for use in calling out over said line, and a plurality of line terminals, said line terminals connected
80 in multiple and adapted for use in calling in over said line and means for moving said first terminals.

127. In a telephone system, a central exchange, three groups of lines, each line connected with the exchange over a pair of conductors, means for connecting calling and called lines over a talking circuit, said talking circuit including said pair of conductors of the connected lines, said means including in combination a plurality of trunk lines extending between the first and second groups and the first and third groups, an automatic trunk selector in the first group having terminals of said trunk lines, means
95 for connecting a calling line in the first group with a particular line in the second group, said means comprising said selector and any one of the trunk lines for the second group, means for connecting the said
100 calling line with a particular line in the third group, said means comprising said selector and any one of the trunk lines for the third group, and a line relay operated by closing said pair of conductors at the
105 calling substation for controlling said selector whereby it may operate to select the trunk line for either connection.

128. In a telephone system, three groups of lines, a plurality of trunk lines extending
110 between the first and second groups and the first and third groups, an automatic trunk selector in the first group having terminals of said trunk lines, means for connecting a calling line in the first group with a particular line in the second group, said means comprising said selector and any one of the trunk lines for the second group, means for connecting said calling line with a particular line in the third group, said means comprising said selector and any one of the trunk lines for the third group, a line relay for the calling line for controlling said selector whereby it may operate to select the trunk line for either connection, and means
125 in the second group associated with the trunk lines for the second group for establishing a connection from a calling line in the second group over the said trunk lines for the second group to the first group.

129. In a telephone system, three groups of lines, a plurality of trunk lines extending between the first and second groups and the first and third groups, an automatic trunk selector in the first group having terminals of said trunk lines, means for connecting a calling line in the first group with a particular line in the second group, said means comprising said selector and any one of the trunk lines for the second group, means for connecting the said calling line with a particular line in the third group, said means comprising said selector and any one of the trunk lines for the third group, and means in the second group associated with the trunk lines for the second group for establishing a connection from a calling line in the second group over the said trunk lines for the second group to the first group.

130. In a telephone system, three groups of lines, a plurality of trunk lines extending between the first and second groups and the first and third groups, an automatic trunk selector in the first group having terminals of said trunk lines, means for connecting a calling line in the first group with a particular line in the second group, said means comprising said selector and any one of the trunk lines for the second group, means for connecting the said calling line with a particular line in the third group, said means comprising said selector and any one of the trunk lines for the third group, a line relay for the calling line for controlling said selector whereby it may operate to select the trunk line for either connection, and a centralized battery for supplying current for operating and talking purposes.

131. In a telephone system, three groups of lines, a plurality of trunk lines extending between the first and second groups and the first and third groups, an automatic trunk selector in the first group having terminals of said trunk lines, means for connecting a calling line in the first group with a particular line in the second group, said means comprising said selector and any one of the trunk lines for the second group, means for connecting said calling line with a particular line in the third group, said means comprising said selector and any one of the trunk lines for the third group, a line relay for the calling line for controlling said selector whereby it may operate to select the trunk line for either connection, means in the second group associated with the trunk lines for the second group for establishing a connection from a calling line in the second group over the said trunk lines for the second group to the first group, and a centralized battery for supplying current for operating and talking purposes.

132. In a telephone system, a central exchange, a line, an automatic trunk selecting switch associated with said line, trunk lines,

terminating in said switch, another line, both lines connected with the exchange over a pair of conductors, means for connecting said first and second lines over a talking circuit, said talking circuit including said pair of conductors of both lines, said means comprising said switch and any one of said trunk lines, a line relay operated by closing said pair of conductors of said first line for initially controlling the operation of said switch whereby it may operate to select a trunk for the connection.

133. In a telephone system, three groups of lines, a plurality of trunk lines extending between the first and second groups and the first and third groups, an automatic trunk selector in the first group having terminals of said trunk lines, means for connecting a calling line in the first group with a particular line in the second group, said means comprising said selector and any one of the trunk lines for the second group, means for connecting the said calling line with a particular line in the third group, said means comprising said selector and any one of the trunk lines for the third group, and a central battery for supplying current for talking purposes.

134. In a telephone system, a line, an automatic trunk selecting switch associated with said line, trunk lines, a terminal for each of said trunks and for said line in said switch, another line, means for connecting the two lines, said means comprising said switch and any one of said trunk lines, said switch having also means for moving the terminals of the selected trunk into connection with the terminals of the first line.

135. In a telephone system, a line, an automatic trunk selecting switch associated with said line, trunk lines, a terminal for each of said trunks and for said line in said switch, another line, means for connecting the two lines, said means comprising said switch, and any one of said trunk lines, said switch having also means for moving the terminals of the selected trunk into connection with the terminals of the first line, and a central battery for supplying current for operating and talking purposes.

136. In a telephone system, a line, an automatic trunk selecting switch associated with said line, trunk lines terminating in said switch, another line, means for connecting the two lines, said means comprising said switch and any one of said trunk lines, a line relay individual to said first line for controlling the operation of said switch whereby it may operate to select a trunk for the connection, said relay normally bridged across said line, circuits controlled by said relay, a circuit for said line relay comprising the line, and a second relay for controlling the circuit of the first relay.

137. In a telephone system, a plurality of

lines, an automatic switch common to said lines and normally disconnected therefrom, means for connecting any one of said lines with said switch, a plurality of groups of trunks associated with said switch, means in said switch operable to elect a group of said trunks and for automatically selecting an idle trunk in the elected group, means for connecting said one line with the selected trunk and for then automatically releasing said switch and maintaining the connection between the line and selected trunk.

138. In a telephone system, calling subscribers' lines, a line relay individual to each line, a numerical switch common to said lines, groups of trunks accessible to said switch, means in said switch responsive to an operation at the calling subscriber's station to elect a group of trunks and to select an idle trunk in the group, means by which a calling subscriber connects his line with said numerical switch before the operation of said switch, said means comprising said relay.

139. A telephone system comprising telephone lines, operator controlled link circuits automatic traveling switches adapted for operation for interconnecting said lines and link circuits, and operator actuated release controlling switches for releasing said automatic switches when operated.

140. A telephone system including telephone lines, normally passive selective switches adapted for use in establishing connections, means responsive to calls for starting said switches, said switches including automatic traveling mechanisms, and means at the exchange whereby the operators thereat restore the switches.

141. In a telephone system, a telephone line, link circuits for extending the circuits of said line, a source of current, an automatic switch having an electromagnet connected with said line and said source of current adapted to initiate travel of said switch to select an idle link-circuit, a second electromagnet associated with said switch and adapted to be energized from said same source of current, armature controlled mechanism therefor and means for shifting said armature controlled mechanism on final selecting movement of said switch to disconnect said first mentioned electromagnet from the telephone line.

142. In a telephone system, the combination with a telephone line of a busy trunk circuit and an idle trunk circuit, a central source of current, and selector means controlled by current from said source over the limbs of the telephone line in series, adapted to move over the contacts of said busy trunk and connect said line with said idle trunk circuit, and means for supplying talking cur-

rent from said source through the connected idle trunk circuit to said line, substantially as described.

143. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines, an automatic switch individual to each subscriber's line for selecting an idle trunk, and means for operating said switch by an initial impulse transmitted upon the removal of the receiver from the hook by the calling subscriber.

144. In a telephone system, a plurality of subscribers' lines, a plurality of trunk lines, a non-numerical switch individual to each subscriber's line for selecting an idle trunk, and means for operating said switch by an initial impulse transmitted upon the removal of the receiver from the hook by the calling subscriber.

145. In a telephone system, the combination with a telephone line of a busy trunk circuit, and an idle trunk circuit and selector means controlled by current over the limbs of the telephone line in series, adapted to move over the contacts of said busy trunk and connect said line with said idle trunk circuit, substantially as described.

146. In a switch, the combination of sets of intersecting bars, contact sets at the intersections of said bars, means effective upon conjoint displacement of two intersecting bars for operating a contact set, and means dependent upon the continued displacement of one, but independent of the continued displacement of the other of said bars for maintaining the said contact set operated.

147. A telephone exchange system including an electrical circuit, selective switches, multiple terminals pertaining to said circuit at said switches, normally unselectable in character, a magnet individual to said circuit for operation to render said terminals selectable in character, means for operating said magnet, and apparatus for starting a switch responsive to said magnet to select said circuit.

148. A telephone exchange system including an electrical circuit, selective switches, multiple terminals pertaining to said circuit at said switches, normally unselectable in character, a magnet individual to said circuit for operation to render said terminals selectable in character, means for operating said magnet, apparatus for starting a switch responsive to said magnet to select said line, and circuit connections effective on selection made to render said terminals unselectable.

149. The combination with an electrical circuit, of a selective switch, a terminal of said circuit at said switch normally unselectable in character, a magnet and switch contacts controlled thereby associated with said terminals and individual to said circuit for

operation to render said terminal selectable, mechanism responsive to said magnet for starting said switch, and means for operating said magnet.

- 5 150. A telephone exchange system comprising a plurality of subscribers' lines, a plurality of associated link-circuits, a plurality of switch mechanism individually operative to establish connection between a calling line and an idle link-circuit, operator's
10 means for extending the circuit of a selected link-circuit to a called line, and means under the absolute control of the operator for

rendering the selected link-circuit selectable by other switch mechanisms.

- 15 151. In a telephone system, a series of relays, means for energizing any one of said relays initially, and an interference circuit pertaining to all said relays and operating to prevent the operation of two of said relays
20 simultaneously.

HOMER J. ROBERTS.

Witnesses:

ALBERT H. GRAVES,
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