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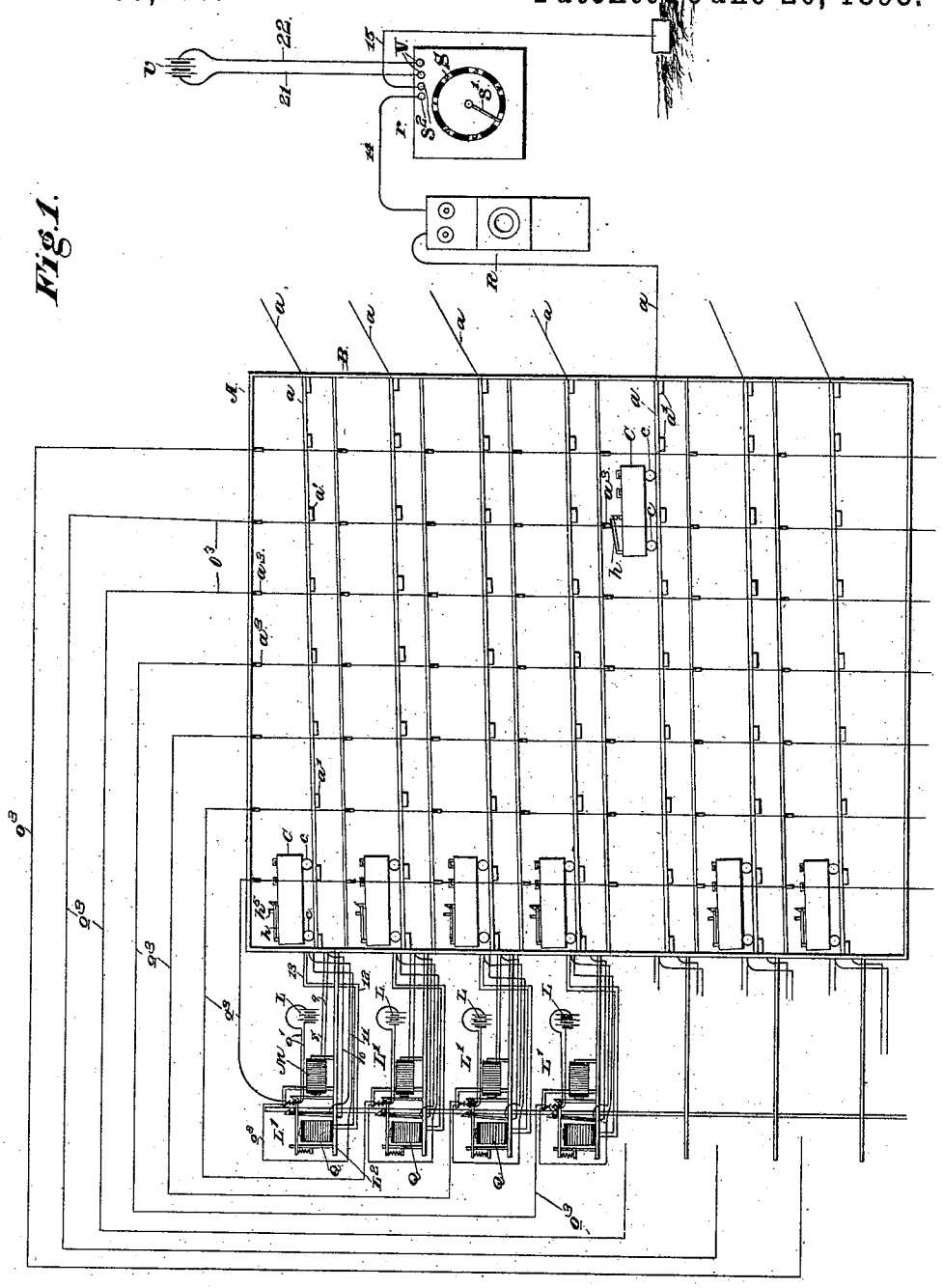
A. E. McCLAREN.

TELEPHONE EXCHANGE.

No. 499,748. Patented June 20, 1893.

Fig. 1.



Witnesses

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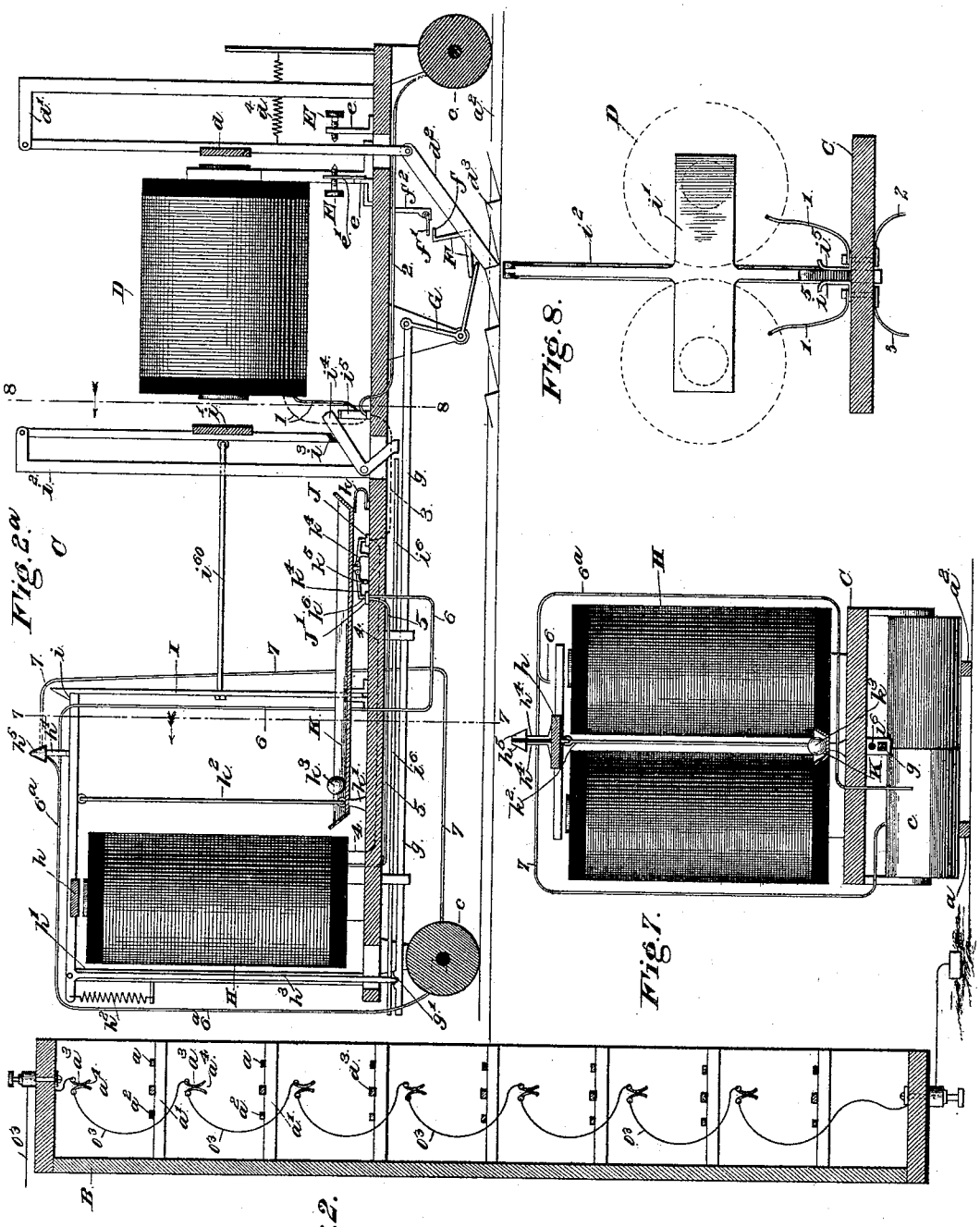

Fig. 2.

Fig. 8.

Fig. 7.

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Fig. 3.

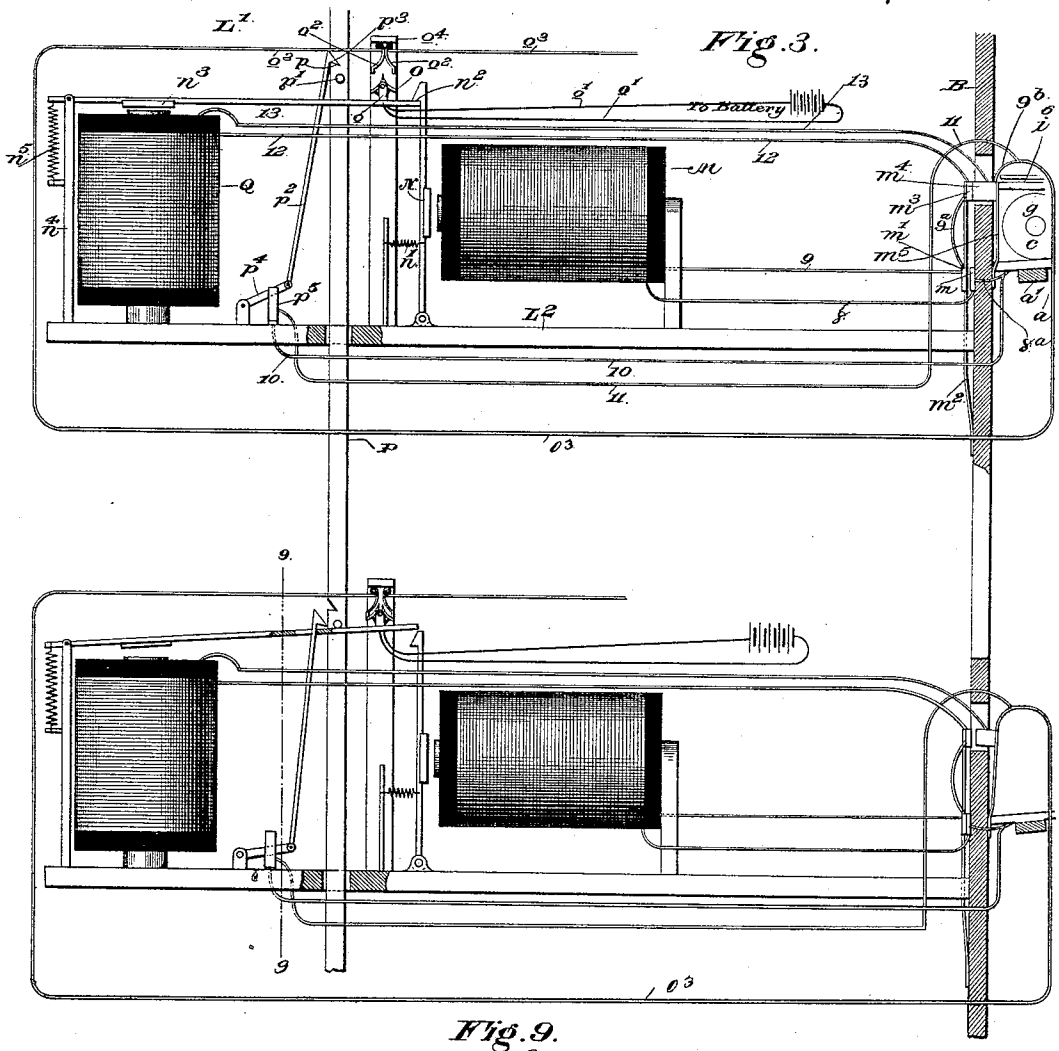
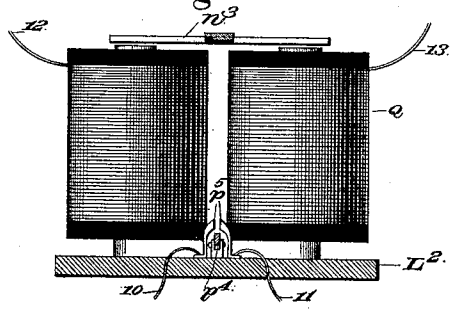


Fig. 9.



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TELEPHONE EXCHANGE.

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Fig. 4.

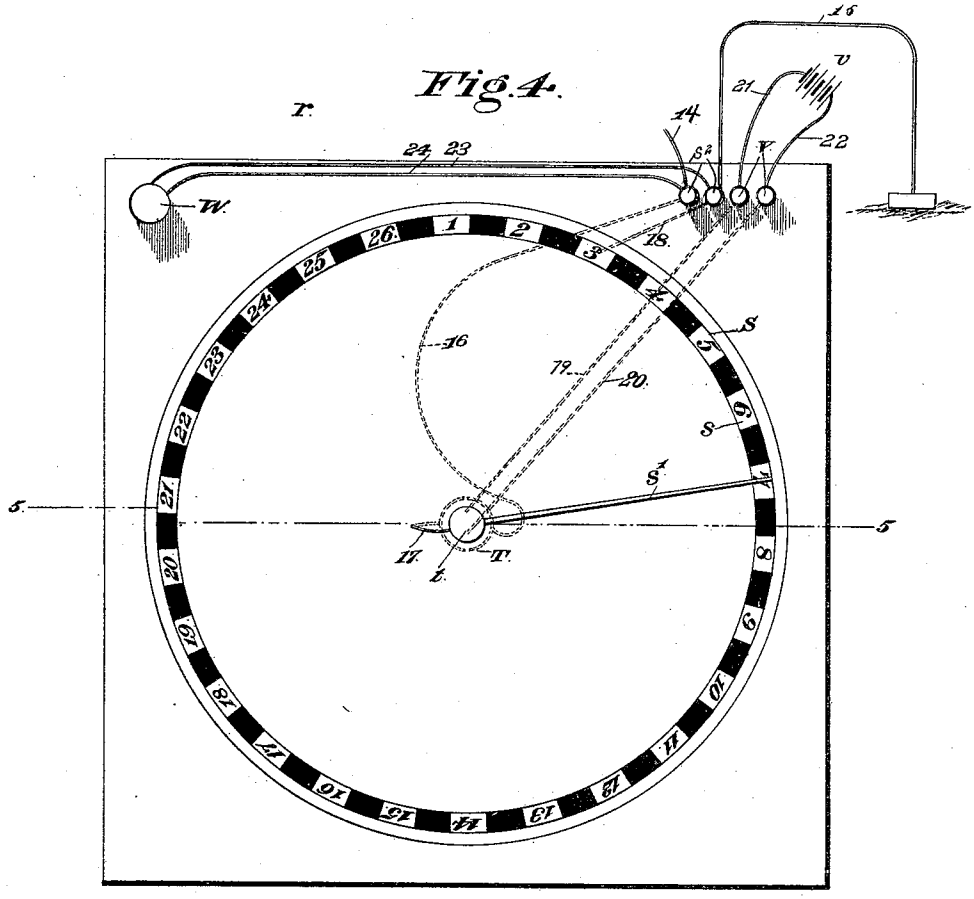
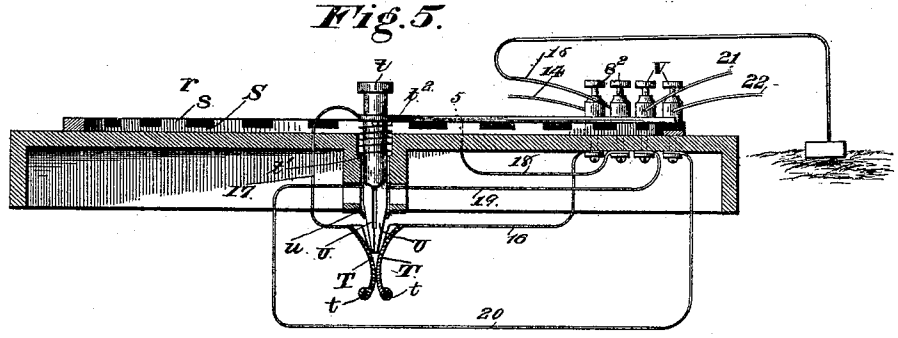


Fig. 5.



Witnesses

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(No Model.) 6 Sheets—Sheet 5.

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TELEPHONE EXCHANGE.

No. 499,748. Patented June 20, 1893.

Fig. 6.

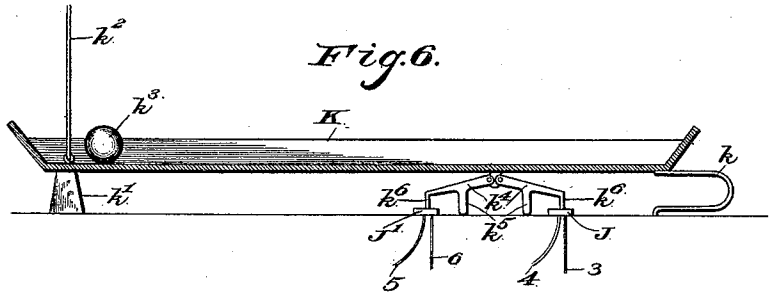


Fig. 6a.

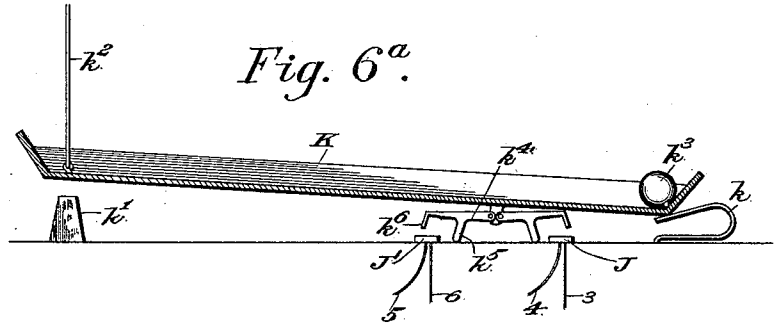


Fig. 10.

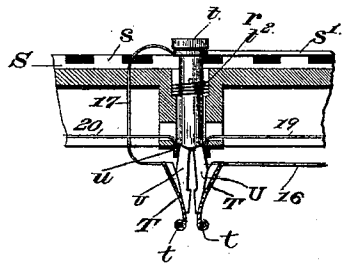
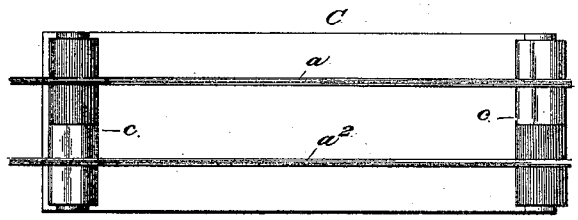


Fig. 11.



Witnesses

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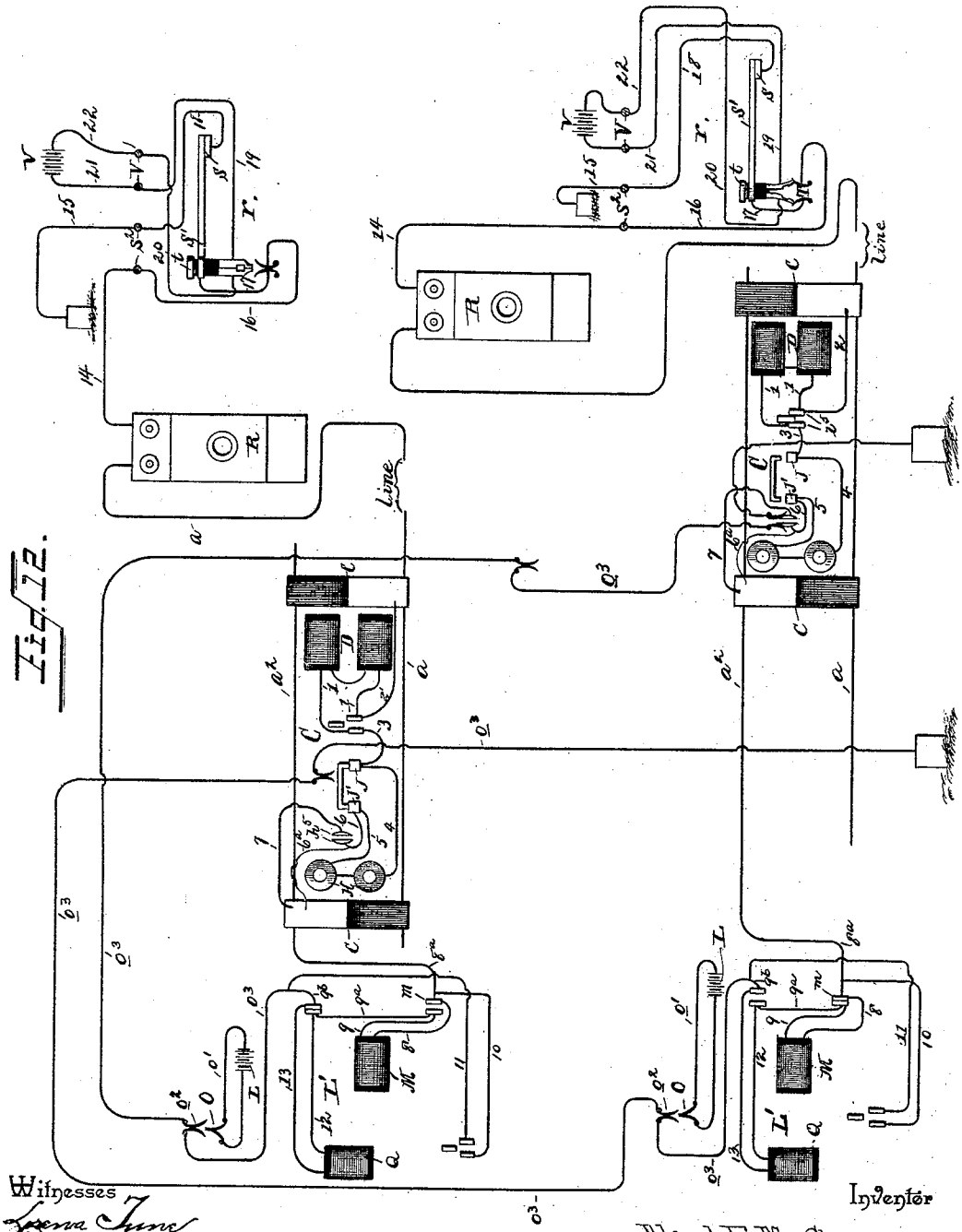

Fig. 12.

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UNITED STATES PATENT OFFICE.

ALFRED E. McCLAREN, OF JOPLIN, MISSOURI.

TELEPHONE-EXCHANGE.

SPECIFICATION forming part of Letters Patent No. 499,748, dated June 20, 1893.

Application filed June 13, 1892. Serial No. 436,564. (No model.)

To all whom it may concern:

Be it known that I, ALFRED E. McCLAREN, a citizen of the United States, residing at Joplin, in the county of Jasper and State of Missouri, have invented a new and useful Telephone-Exchange, of which the following is a specification.

This invention relates to automatic telephone exchange systems; and it has for its object to provide an improved automatic telephone exchange used in connection and connected with the ordinary telephone, being designed to provide means where one subscriber can automatically connect his line with that of any other party in the same exchange, and therefore avoid the delay and disadvantages attending the ordinary central office.

With these and many other objects in view which will readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

The system to secure the automatic connection of telephone lines consists essentially, in general plan, of the following features:—At the central office is arranged a box or frame in which terminate the main telephone wires. The single wires leading from each telephone or series of telephones, are arranged one above the other at the exchange to form one rail of a parallel series of tracks, the other rail of the track being parallel with the terminals of the main telephone wires. Upon the several tracks are placed electrically propelled connecting cars which are designed to travel from one end of the frame to the other, and have metallic contacts and intermediate connections between such contacts so that the circuit is closed from the main wires, forming one of the rails, with the adjacent parallel wire forming the other rail, the latter wire being termed the ground wire of the circuit for convenience of identification. This ground wire of each track is connected in circuit at one end of the exchange frame with a battery connecting instrument which is itself connected to a separate and independent working battery, which is employed for propelling the cars. After following the various connections in the battery connecting instrument, the said ground wire leads to the top of the frame and passes vertically through the same over each track, having at such point over each track, connecting terminals whereby cars can be connected therewith. The said cars of course carry suitable devices for connection with such terminals, and when connected with any one particular line the current from one telephone to the other traverses back and forth as the speaking alternates from one telephone to the other, bringing into play the ordinary telephone speaking battery over the circuit generally outlined. Connected with the telephone of each subscriber is a scale transmitter to which is connected a strong operating battery, which by means of suitable cut-out devices is cut onto the subscriber's wire for the purpose of bringing the working battery of that particular wire or line into play. By means of this transmitter the subscriber is enabled not only to bring the working battery at the exchange end of his line into play, but is also enabled to move out his connecting car in the exchange directly under the terminal, over his track of, the line or wire with which he desires to connect himself, as well as disconnect himself. With this general plan in view the detailed description of the operation of the system and the several circuit connections following the general description will be clearer.

In the accompanying drawings:—Figure 1 is a general plan view of a telephone exchange system constructed in accordance with the present invention. Fig. 2 is a detail sectional view, of the central exchange. Fig. 2^a is an enlarged vertical longitudinal sectional view of one of the connecting cars. Fig. 3 is a similar view through a portion of one end of the exchange frame and the battery connecting instruments adjacent thereto. Fig. 4 is a detail plan view of the indicator. Fig. 5 is a detail sectional view of the same on the line 5—5 of Fig. 4. Figs. 6 and 6^a are detail sectional views of the cut-out trough used in connection with the connecting car, showing both positions. Fig. 7 is a detail sectional view on the line 7—7 of Fig. 2^a. Fig. 8 is a similar view on line 8—8 of Fig. 2^a. Fig. 9 is a similar view on line 9—9 of Fig. 3. Fig. 10 is a similar view of the central cut-out of the indicator. Fig. 11 is a detail view of a car and portion of track. Fig. 12 is a diagram-

matic plan view, illustrating two telephone lines connected with each other, and illustrating one of the batteries *v*, cut onto one line to show the circuit connections with such battery on the line.

Referring to the accompanying drawings:—A represents the central office of the exchange system where the different telephone line wires *a* center and are designed to be arranged so as to be connected in circuit with each other when desired. At the central office is located the exchange frame or box B into one side of which enter the several telephone line wires *a* arranged parallel with and one above the other from the bottom to the top of the frame. The main wires *a* incline from their points of entrance in one side of the frame or box B to the opposite side and are connected in circuit with the battery connecting instruments to be presently described. The said wires *a* are suitably supported upon the supporting blocks *a'* extending transversely of the box or frame and which also support the parallel ground wires a^2 arranged parallel with said main wires inside of said box or frame so as to form an inclined track for the connecting cars herein described of the exchange, and said ground wires pass through one side or end of the frame or box and are led indirectly as described to the top of the same, and by continuations are led vertically through the entire frame between and above the several tracks to their ground connection, thus completing the circuit when the connectors traveling over the wire tracks are thereon and in operation.

The circuit or continuation wires of the several ground wires a^2, are each provided over each track within the frame or box with the spring connecting points a^3, normally contacting with each other to continuously close the circuit of the wires, and are provided with the flared ends a^4 between which are automatically inserted the connecting devices of the connectors traveling over the tracks, in order to connect the line on which the connectors are traveling with the line whose ground wire contact points lie above the said line. The said spring contact points are so arranged that when the connecting points of the connecting cars are forced between them to force the same apart, all the portion of the ground wire above the car will be a line wire connected with the main wire of the line, while all below the car will be grounded.

Traveling upon the several tracks formed by the main telephone wires and the ground wires running parallel with the same, are the automatically controlled connecting cars C, said cars closing the circuit between wires *a* and a^2. The said connecting cars C are mounted upon the connecting wheels or rollers *c*, suitably journaled at each end of the car and adapted to travel over the wire rails which are preferably flattened throughout the frame or box B. The said rollers *c* at each end of the connecting cars are one-half metal while the other half thereof is of a suitable insulating material, as clearly illustrated in the drawings, and are so arranged with respect to each other that the metallic portion of one roller, which may be designated as the front roller, contacts with the main telephone line wire *a*, while the metal portion of the other roller contacts with the ground wire a^2 of the track upon which the car travels, thus establishing, when the proper connections are made, a complete circuit through the car.

Arranged upon one end of the car from one track to the other and near the front roller thereof are the motor magnets D, suitably supported upon the car and having the cores thereof at each end exposed, and the same are designed to control at one end thereof the swinging propelling armature *d*. The said armature *d* is pivotally suspended at its upper end from the supporting bracket *d'*, and projecting through the bottom of the car is pivotally connected with the propelling pawl d^2. The said propelling pawl d^2 carried by said armature engages the toothed track d^3, arranged centrally between the telephone and ground wires forming the tracks, and having the teeth thereof so arranged that when the swinging armature is attracted by the motor magnets, the lower engaging end of the pawl engaging the teeth of the bar, will cause the connecting car to move under one pair of connecting points a^3 at a time. It will be readily seen that as the armature *d* is attracted by the magnets the swinging pawl d^2, will be alternately pulled out one tooth and cause the car to be propelled up the inclined track one point, the same being carried to the desired connecting points by closing and breaking the circuit through said magnets as many number of times, as the number of the connecting points to be connected with are away from the side of the box or frame A. The swinging armature *d* is normally held away from the motor magnets D by means of the retractile spring d^4, connected therewith and a suitable point of attachment, and the same is further designed to play between the regulating screws E mounted in the brackets *e*, projecting from the bottom of the car upon each side of the swinging armature, and one of which is mounted upon the spring *e'*, which when the current in the magnets is sufficiently strong allows the screw or post to give under the pressure of the swinging armature and thus allows the propelling pawl d^2 to be released from its catch when the car is at its starting point, which will be hereinafter fully explained. The said pawl d^2 is provided with the arms F projecting at right angles to each other from the top of the pawl near its lower end, and one of which is provided at its upper end with the supporting plate *f*, which when the pawl is lifted, is designed to lift the latch *f'*, until it passes over the same and then drops upon the latch to support the pawl above the toothed track d^3, until it is desired to employ the car. The said latch *f'* is pivoted to the

lower end of the arm f^2, projecting from the bottom of the car, and is designed to stand in such a position and be overlapped sufficiently by the supporting plate f, as to prevent the latch dropping, until a sufficiently strong current causes the swinging propelling armature to press back the spring-actuated regulating screw E. At the proper time the propelling pawl d^2, in engagement with the rack, is lifted therefrom to allow the car of its own weight to roll back to one end of the frame after using. To effect this the other arm F of the said pawl is engaged by one arm of the bell crank lever G, pivotally supported beneath the bottom of the car and having the other end thereof connected with the sliding rod g, projecting beyond the rear end of the car and provided near such rear end with the engaging notch g', which is engaged by a suitable device for simultaneously lifting the pawl from the track when the connecting car is disconnected from the contact points.

Supported upon the car near the rear end thereof opposite to the motor magnets is the vertical connecting magnet H, over which plays the horizontal spring drawn connecting armature h. The said armature h is pivoted at one end to the standard h', arising from the car and is also connected at such end with the spring h^2, which normally tends to throw the free end of the armature up so as to connect the lines as will be presently apparent, and said connecting armature h carries in its up and down movement, the swinging spring bar h^3, working through the bottom of the car and designed to engage the notch g', in the sliding rod g when the armature h is raised, and being in engagement with such notch, when the armature is drawn to the magnet, the said bar draws the sliding rod g and causes the swinging pawl d^2 to be raised and supported beneath the car.

Carried by the armature h near the swinging end thereof is the connecting post h^4, to the upper end of which are secured the opposite rounded connecting points h^5, which are insulated from each other and, when the armature h is released, are designed to be thrown into engagement with and between the spring connecting points a^3 of the line to be connected with, and inasmuch as the said points h^5 are in connection with the telephone wires of the track upon which the car is traveling, and the spring connecting points a^3 are in the circuit of the line to be connected with, the proper connections between the two lines are effected by propelling the car automatically to the point of connection and then releasing its connecting armature. The connecting armature h is normally locked in a horizontal position above the connecting magnet and below the spring connecting points by means of the swinging lock lever I. The said locking lever I is provided at its upper end with the shoulder i, behind which the swinging end of the armature h engages, and is connected by the connecting rod i^{60} to the swinging operating armature i'. The said swinging armature i' is pivotally suspended at its upper end from the bracket i^2, supported above the car and has a lower beveled end i^3, which when the same is drawn toward the motor magnet engages one arm of the bell crank cut-out lever i^4, which is struck and operated by the operating armature i' at the same time that the said armature draws the lock lever I away from the armature h, and allows the same to spring up between the spring connecting points a^3. The said cut out lever i^4 is designed to have the arm thereof forced between the cut out plates i^5, arising from the car each of which is connected with the motor magnet wires 1; and the main conducting wire 2 is connected with one of said plates and with the metallic portion of the front contact roller receiving the current from the main telephone line wire a. The other cut out plate is connected with the wire 3 leading to the other devices of the connecting armature hereinafter described. It will be seen that when the lever i^4 is raised out of the space normally intervening between said cut out plates, the current through the wire 2 necessarily passes from one of said plates to the motor magnets to magnetize the same, and back through the other plate and out through the wire 3. But when the motor magnets have attracted the armature i' and closed the cut out, the motor magnets are shunted and the current naturally passes directly over the wire 3 to the connecting magnet H as will be readily apparent. When the car has been returned to its starting point at the lower end of its track, it is necessary to restore the magnets D to the normal connection with the line wire. To effect this I employ the lever lifting rod i^6, sliding beneath the car and having one end thereof projecting beyond the rear end of the car while the other end thereof is designed to engage one arm of the bell crank lever i^4, so that when the car of its own weight rolls back to the side of the frame or box A, the said rod i^6, raises the lever i^4, from between the plates i^5 and thereby restores the motor magnets to a normal connection with the circuit wire 2, so that the car is ready for another trip. It may be observed at this point that the rod i^6, while in contact with the side or end of the frame after the car has rolled back, holds the cut out lever i^4 in such a position as to prevent the motor magnets D, from attracting the armature i', until the car has passed up to its point of connection, and has been connected with the proper line.

Until the motor magnets have ceased to perform their functions, it is necessary to exclude the connecting magnet, H, from the circuit, in order to allow the motor magnets to propel the car and make the proper connections, and in order to accomplish this, cut out devices used in connection with and controlled by the connecting armature are employed. The wire 3 carrying the current from

the motor magnets or directly from the wire 2, is connected with the metallic contact plate J and from there passes over the wire 4 to the connecting magnet H from which the current returns through the wire 5 to an adjacent and similar contact plate J'. From this contact plate a wire 6 leads to one of the metal contact points h^5 and when such point is not connected the current passes through said wire and over the auxiliary wire 6^a connected therewith to the ground wire a^2 of the track through the metal portion of the rear contact roller, it being illustrated in the diagram of Fig. 12 that the wire 6^a, is finer and of greater resistance than the wire 6, so that when the contact point to which the wire 6 is connected, is in the circuit of the line with which it is connected, the current will pass from the wire 6 and over said line, as being the path of least resistance, as will be readily understood. It may be observed right here, that the other metal contact point h^5 is connected with the ground wire 7 also leading to the rear contact roller just mentioned.

Arranged above the bottom of the car and the metallic contact plates J and J', is the cut out gutter K supported at one end adjacent to said plates upon the spring k, and having the other end thereof normally resting upon the rest k', and connected with the connecting armature h by means of the connecting or lifting rod k^2, which when the armature h is in its lowered position and in engagement with the lever I, allows the said end of the gutter K to rest upon the rest k', while the spring supporting the other end of the gutter holds the same at an incline so that the ball k^3, is at the lowest end of the gutter and its point of connection with the lifting rod k^2.

Pivotally suspended from a common point beneath the gutter near the spring supported end thereof, are the pivoted cut out plates k^4, provided with the depending lugs k^5, and the contact ends k^6. When the armature h is in its horizontal locked position and the spring supported end of the gutter, therefore higher than the other end, the contact ends of said pivoted plates k^4 of their own weight contact with the plates J and J' thereby shunting the connecting magnet and allowing the current from the wire 3 to take the shorter route of least resistance through said pivoted plates and the wire 6 to the ground through 6^a until the connecting armature h is released from the lever I through the medium of the operating armature i'. When the connecting armature h is thus released, the lifting rod k^2 lifts one end of the gutter K and causes the ball or weight k^3, to roll to the other spring supported end of the gutter. The weight of the ball depresses this end of the gutter and forces the lugs k^5, against the top of the car, which thereby raises the said plates k^4 out of contact with the plates J and J', and cuts in the connecting magnet H through which the current is designed to flow directly from the wires 3 and 4 and back through the wires 5 and 6 to one of the contact points h^5 which has just been thrown into connection with one of the spring connecting points a^3, and thus while cutting the magnet H in for subsequent use, at the same time connects the telephone line wires together as will be readily apparent. The connected telephone wires being grounded through the wire 7, the connecting magnet remains cut in until a sufficient charge is sent through the same to attract the connecting armature back to its place. This again lowers one end of the trough and the ball rolls back to its original position, allowing the connecting magnet to be shunted from the circuit as already described.

It has been before noted that when the connecting armature returns to its place the operating bar h^3, carried thereby carries the sliding rod g out to raise the operating pawl d^2. When the car rolls back to the end of the frame the sliding rod g strikes the frame and releases itself from the bar h^3, and leaves the pawl suspended to be subsequently dropped by the armature d as will be described.

In order to propel the connecting cars and provide means for connecting the same with the line wires it is necessary to employ devices for bringing the ordinary line working battery L, stationed at the central office, into play, and to effect this each circuit line is provided at the central exchange with a battery L, and connector L', by means of which the battery is thrown onto the line for a purpose hereinafter shown. Each of the battery connectors L' is mounted upon a suitable base L^2, and supported upon one side or end of the box or frame A from which the connecting cars begin their travel.

Upon one end of the bases L^2 adjacent to the side of the frame or box, is the connecting magnet M which is designed to connect the battery L onto the telephone circuit when a strong current is passed therethrough, said magnet being connected with the main track line a^2 by the wire 8 connected with the fixed cut out plate m secured at one end of the frame and having the wire 8^a connected directly therewith and the telephone line track wire a^2, the circuit of the telephone line being closed by the car on said track. When the circuit is thus closed the current travels through the wires 8^a and 8 from the wire a^2, to the magnet M and returns through the wire 9 to the opposing moving contact plate m', working opposite to the contact plate m and forming a cut out, said moving contact plate m', being carried by the cut out spring m^2, secured at one end of the frame and tending to normally press the contact plate m', against the opposing contact plate m to cut out the magnet M from the circuit. But when said cut out is not closed the current from 9 passes from the contact plate m' through the wire 9^a to the upper movable contact plate m^3, carried by the upper end of the spring m^2, and working opposite the opposing upper contact

plate m^4, carried upon the upper end of the supplemental cut out spring m^5, secured to the inside of the box or frame, and being designed to be controlled by one end of the car bearing thereagainst when at its starting point. When the cars are at their starting points, their rear ends force the spring plates m^4 against the upper plates m^3 which thus closes the upper cut out and holds the movable plate m', away from its opposite fixed plate so as to provide a closed circuit through the magnet M. When the cut outs are thus disposed the return current from the magnet M, passes through the wire 9^a, the upper cut out, and through the wire 9^b suitably connected with the main ground connections. The wire 9^b is connected directly to the line wire o^3, as clearly shown in the diagram of Fig. 12. The magnet M being thus closed to the current, when the current passes therethrough, the same attracts the swinging locking armature N. The said armature N is pivoted at its lower end to the base of the instrument and is held away from the magnet M by a suitably located retractile spring n', while the upper end of the armature M is provided with a tapered locking shoulder n^2, which receives the outer end of the horizontal battery connecting armature n^3 and holds the same in its unconnected position. The said armature n^3 is pivoted at its other end to the upper end of the upright n^4 arising from one end of the base of the instrument, and is designed to be sprung up or forced into connection with the telephone circuit by means of the spring n^5, secured to said pivoted end and the supporting upright n^4. The said armature n^3 carries upon the outer end thereof the connecting points O mounted upon the stud o and connected with the wires o', leading from and to the battery L. The said connecting points O are suitably sprung together, normally, to close the battery circuit when the instrument is not in use, but are designed to be forced apart and be connected with the spring circuit terminals o^2, connected by the auxiliary wires o^3, with the main telephone circuit in order to saturate the circuit with the current of said battery, it being further observed at this point that the wires o^3, are auxiliary or continuation wires of the ground wires a^2, and lead to the top of and through the frame as and for the purpose described. The circuit terminals o^2, are suspended from the bracket o^4, above the swinging end of the armature n^3, and are normally sprung together to close the telephone circuit, over the wire a, the connecting car, a^2 and o^3, but when the connecting points O are forced therebetween, the same spring apart, together with said connecting points, to cut in the ordinary battery onto the telephone circuit, the current direction being still assumed in the same direction for the purpose of simplification. It will be now readily seen that when a current is passed through the magnet M, the same attracts its locking armature which releases the battery connecting armature and connects the battery L onto the circuit. The battery connecting instruments L' are arranged in groups one above the other at the end of the frame or box A opposite the line tracks and each receives the single cut out rod P passing through the entire group of connecting instruments, and provided above each instrument with the notches p and lifting pins p', arranged below said notches, said rod preferably working through the slots in the several battery connecting armatures n^3. Engaging the notches p in the said rod P, are the cut-out operating arms p^2, which arms are provided with the upper pointed engaging ends p^3, normally engaging the notches in said rods, while their ends are pivotally connected to the outer swinging ends of the cut out levers p^4, working between the opposing cut out plates p^5, completing the main cut out of each instrument, which provides for cutting out every instrument from the circuit except that one in use on the main line carrying the moving car. Each of the opposing cut out plates is connected with a wire from the main circuit, one cut out plate being connected by the wire 10 with the wire 8^a, while the other plate is connected by the wire 11, with the wire 9^b, connected to one of the cut-out plates of the uppermost cut-out at the end of the exchange box or frame, in order to complete the circuit from the wire 11, through the ground wire continuation o^3, when the circuit is closed between the main cut-out plate, which is the case when that particular instrument is cut-out by the rod P, actuated by the instrument cut into use. It will be readily seen that when the magnet M attracts its armature and thereby releases the connecting armature n^3, the rising connecting armature will force the cut out arm p^2 of that instrument out of the notch of the rod P. It is of course seen that the cut out arms P work through the connecting armatures. Now the rising armature of the instrument brought in play bears under the lifting pins p', adjacent thereto, which thus raises the single rod P carrying the cut-out arms p^2 therewith, thus drawing up the several cut out levers p^4, into contact with the opposing contact plates p^5, to close the cut outs of these other instruments and thus shunt the same from the working battery, so that only one line can make connection with another line at one time.

At the proper time when it is desired to take the battery L off the circuit, the disconnecting magnet Q is employed for that purpose. The said magnet Q when brought into play draws down the armature n^3, and takes off the battery L from the telephone circuit. A wire 12 carries the current from one of the upper cut-out plates m^3, to the magnet Q, from which the current returns through the wire 13 to the other opposing upper cut out plate m^4, thence through the ground connecting wire 9^b. This disconnecting magnet Q is only brought into play after the car has left its starting point or is at least away from said

starting point and in use, for when the car is at the end of the frame the same forces the plates m^3 and m^4 into contact and the plate m' of the lower cut out away from the plate m opposite the same, thus opening the circuit through M and shunting the same off of Q as described. But when the car is away from the end of the frame the lower cut out is closed, and the current therefore is shunted around M, and passes through the upper cut out plates and the magnet Q inasmuch as the same are out of contact. The battery connecting instruments not in use have their main cut outs p' closed as already described and allow the circuit to be completed over the wires already referred to.

In order to operate the several devices described and bring the several magnets into play at the proper time, I employ with each telephone R, the operating transmitter r. The telephone R is of the usual construction and is connected with the line wires and is provided with its ordinary ground connection and working battery, all of the usual type and operated in the usual manner. The transmitters r connected with each telephone by the wires 14 and 15, are provided with the continuous metallic rings S having a series of exposed contact faces s over which travels the operating and transmitting hand s', said faces s being numbered to correspond to the number of the line terminals at the main central office. The telephone wires 14 and 15 are connected with the binding posts s^2 upon the transmitter, said wires 14 and 15 being parts of the ground connection for the telephone, so that the transmitter can be included in said ground connection as clearly shown in Figs. 1 and 12 of the drawings. The current is led from one of the binding posts s^2 over the wire 16 to the spring closed cut out plates T, suitably located back of the transmitter and normally sprung together so as to close the telephone circuit over the wire 17 leading from one of said plates.

As clearly illustrated in Figs. 5 and 10 of the drawings the spring closed cut-out plates T, are securely fastened at one end as at t, apart from each other, but being of spring metal are so fastened at t, that they normally spring together so as to normally close the circuit over the wires 16 and 17. The said plates T diverge from each other so as to be forced apart or separated and connected with the transmitter button t, around which the hand s' revolves, and the button t, is constructed of a suitable insulating material so that the current through the wire 17 may pass through said hand to the contact faces of the ring S, thence through the wire 18 connected with said ring, and out through the other binding post of the telephone ground connection. The transmitter button t works through the central perforation t', in the bottom of the transmitter and is normally held out of contact with the normally contacting plates T by means of the spring t^2 interposed between the top of the same and the front of the transmitter. Opposite metallic spring connecting points U are carried upon the inner end of the transmitter button, and are normally held in contact with each other by means of the elastic collar u pressing around the same and secured to the rear side of the transmitter around the central perforation therein.

As will be apparent from the illustration of Figs. 5, 10 and 12, the spring connecting points U, are securely fastened at one end to the body of the button t, so that the tendency thereof is to normally spread apart or away from each other so as not to be in contact, and the tension of the spring points U, which separate the same from each other is greater than the tension which holds the spring plates T together, so that when the points U, are free to yield to their tendency to separate, and come in contact with the plates T, the latter are also separated so as to be thrown out of contact with each other, as is clearly shown in Figs. 10 and 12 of the drawings. This contact provides means for the cutting in and out of a separate battery on to the telephone circuit as will be presently described. The said metallic points U are connected with the wires 19 and 20, which wires lead to the battery binding posts V connected by the wires 21 and 22 with the strong auxiliary battery v, forming what may be termed the main operating battery circuit in contradistinction to the weaker ordinary battery L. Now it will be seen that by pushing the button in the center of the transmitter down the points U are forced beyond the contracting pressure of the collar u, and between the metallic plates T thus separating the plates, while at the same time themselves spreading apart as previously described thus making a continuous circuit of the telephone and main battery circuit, thereby causing the current from the battery v to flow over the telephone circuit. This operation is very clearly shown in diagrammatic view in Fig. 12 of the drawings. When the transmitter is not in use, the telephone circuit may be if so desired short circuited over the wires 23 and 24 through an ordinary auxiliary cut out W mounted upon the transmitter and of any suitable type. Now the various devices of the exchange system have been described and are connected with each other in such a manner that from the transmitter under the control of the subscriber, the said subscriber may connect himself with any line with which he desires to be connected.

Before detailing the connection and disconnection of two lines it may be well to recall the general circuit of the telephone line, which may be traced from the ground at the subscriber's house or office. Starting at the ground it runs up to the transmitter as described, then through the telephone instrument to the central office, through the connecting car to the battery connecting instrument at one end of the frame, and thence to the frame where the car takes the current

from the wire track, and then from the top to the bottom of the frame, having spring connecting terminals or points over each and every track on the frame, and finally leading to the ground at the central office. First assuming that the wires 14 and 15 are on the circuit of the line a, the subscriber is ready to connect his line with any other line terminating at the exchange. In the first place the subscriber presses his central transmitter button t, whereby the strong battery v, is cut onto the telephone circuit wires 14 and 15 and consequently on the wire a, through the wires 21, 22, 19 and 20,—16, 17 and 18, as has just been described in the last paragraph. Now as long as the transmitter button is pressed in, the current from the battery v, passes over the subscriber's wire a, to the exchange. At this point his connecting car, which is at the lowest end of the track, takes the current from the metallic portion of the front roller and leads the same over the wire 2, to one of the cut-out plates i^5. This cut-out being open the current passes through the motor magnets D, and out through the wire 3, to one of the contact plates of the gutter cut-out. It will be observed at this point that the current passing through the wires will not release the armature d, sufficiently to drop the pawl d^2, nor will it operate the armature i', on account of the rods i^6, holding the lever i^4, there-against, the car being at one end of the frame. Taking up the current again from the wire 3, we find that inasmuch as the gutter cut-out is closed, the same shunts over the wires 6, 6^a, to the metallic portion of the rear contact roller, thence to the ground wire a^2 of the track, on which the car moves. Now the current passes from a^2, over 8^a, 8, to the magnet M, of the battery connecting instrument, which magnet is operated by the current, and the current returns and passes through the wires 9, 9^a, 9^b, and through the wires o^3, to the ground at the central exchange. The telephone circuit is thus completed with the battery v, cut onto the same, and now the function of the magnet M, will be clear. As the current passes through this magnet its armature N, is attracted and thereby releases the working battery connecting armature n^3, of the instrument. This connects onto the telephone circuit, the working battery L, and the current from this battery combines with that of the battery v, to saturate the telephone circuit with a current produced from two batteries in series, namely, the batteries v, and L. Bearing in mind that the subscriber's finger is still on his transmitter button, it will now be clear that the increased strength of the current traveling the circuit just outlined, will produce sufficient magnetism in the motor magnets D, to draw the propelling armature d, against the spring e', sufficiently strong, as to allow the pawl d^2, to drop into engagement with the toothed track, by being released from its supporting catch. Now the subscriber removes his finger from his transmitter button and thus takes the battery v, off of the circuit, while the working battery L, still remains onto the circuit just described. The subscriber's next move is to turn the transmitter hand s', over the several contact faces of the transmitter until the same has reached the number of the line he desires to be connected with, the circuit with the hand being completed through the wires 16, 17 and 18 with the wires 14 and 15. As the transmitter hand moves over the several contact faces, the circuit is alternately opened and closed just as many times as there are notches in the track for the car to travel over, and therefore this alternate make and break in the current or series of impulses causes the motor magnets of the car to attract and release the propelling armature just that many times. This attraction and releasing causes the propelling pawl to successively engage notch after notch, and draw the car along until the connecting points thereof have been brought directly under the line terminals to be connected with. As the subscriber's car moves away from its starting point from end of the exchange box or frame, the upper and lower cut-outs of the battery connecting instrument assume the position shown in the lower instrument of Fig. 3, and particularly in the diagram of Fig. 12, and therefore cut out the magnet M, just noted, and cut in the disconnecting magnets Q, of the same instrument. This magnet is designed to draw the connecting armature n^3, to its place, at the time the connecting car is connected with a certain line, and therefore allows all the connecting instruments to resume their normal position, as described. Owing to the adjustments of the armature n^3, and its catches, the magnet Q, therefore will not completely return the same to its locked position until the two batteries are again combined. Now the subscriber has carried his car to a point directly under the line with which he desires to be connected. He therefore again presses the button in the center of his transmitter to combine the currents of the battery v, and L, for a moment. Now bearing in mind that the car is out of contact with one end of the exchange frame or box, and therefore the lever i^4, does not hold the armature i', from being acted on, it will be clear that this second combination of currents will cause the magnets D, to operate said armature i'. It will be observed that the direction and course of the current are still the same as previously mapped out. Immediately as the armature i', is attracted, the connecting armature h, of the subscriber's car springs up and throws its connecting points between the spring connecting points or terminals of the line under which the car stands and with which the subscriber desires to connect himself as shown in the diagram of Fig. 12. Simultaneously with the releasement of the armature h, this last combined current, at the same time, passes through the magnets Q, over the wires 8^a, 9^a, 12 and 13, owing to

the fact that the disconnecting magnets are cut into the circuit as the car leaves the end of the frame as clearly illustrated in Fig. 3 of the drawings. The magnets Q, therefore return the connecting armature n^3, to its place, thereby taking the battery L, off of the line. The subscriber takes his finger off of his push-button at his indicator and takes the battery v, off of the circuit. Therefore, both of the batteries v, and L, are off of the circuit, and the connected lines are free from any current except the pulsating currents from the ordinary speaking battery of each telephone, which are brought into play as the subscribers speak. It will be observed that as the armature h, is connected with a line, the gutter cut-out is opened and the motor magnet cut-out is closed, so that a speaking circuit is established through the wires 2, 3, 4, 5, 6, skipping 6^a, of the first subscriber's line and the wires o^3, 9^b, 9^a, 9, 8, 8^a, a^2, 6^a, 6, the gutter cut-outs, 3, 1, 2, and a, of the second subscriber, with whom the first subscriber has connected himself, ground connections of course being at both ends of the line. Therefore, when the first subscriber wishes to disconnect himself after he has finished speaking and "rung off," he simply presses the button in the center of his transmitter and causes the battery current v, to bring the magnet H, into operation, through the wires 4 and 5, this magnet being of such a resistance as not to be affected by the ordinary speaking current of the connected telephones. The magnet H, therefore draws the armature h, to its place, which movement, through the rod g, herein described, also lifts the propelling pawl d^2, from the track and into engagement with its supporting catch. The car being thus released from its engagement with the toothed track, and disconnected from the line rolls back of its own weight, to the end of the frame. It then causes the frame-cut-outs to assume the position illustrated in the upper battery connecting instrument in Fig. 3, and also through the rod i^6 again opens the motor magnets onto the circuit and establishes the circuit we originally started out with. It is now thought that the operation of connecting and disconnecting two lines will be apparent to those skilled in the art.

For the purpose of a clear understanding of the circuits, it may be added at this point, that at the moment the battery L, of one line, is brought into play, so as to cause the ends of the wires 10 and 11 to be connected at the plates p^5, of the other battery connecting instruments, any current led to the battery connecting instruments of such other lines which are thus cut out, would be short circuited in either direction over the wires 8^a, 10, 11 and o^3, or over o^3, 11, 10 and 8^a. This is clearly seen in diagram Fig. 12, but when the rod P, lowers, the cut-outs p^4, p^5, of all the instruments throw the wires 10 and 11 out of use as is clearly shown in Fig. 12.

Another point to be observed is, that when one connecting car has been carried out under the terminals of a line, so that the high resistance wire 6^a, is practically out of use, any current from any other line passing through the battery connecting instrument onto the wire a^2, and such connected car will be grounded over the wire 7, and the continuation of the wire o^3, below the connected car. This provides means for cutting the connected car out of communication with any other line except that with which it is connected.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a telephone exchange system, the central exchange having a series of line tracks included in the telephone circuits and provided with line continuation having connecting terminals over each track, and electrically controlled connecting cars traveling over the said tracks and closing the circuit between the rails thereof, substantially as set forth.

2. In a telephone exchange system, the central exchange having a series of conductor tracks arranged one above the other and included in the telephone circuits, an automatic wheeled connecting car traveling over each track and closing the circuit between the rails thereof, and means for connecting the car of one line in circuit with any other line, substantially as set forth.

3. In a telephone exchange system, the central exchange receiving the line wires, said wires having separated rail portions at the exchange, automatic electrically controlled connecting cars traveling over said line wires at the exchange and closing the circuit between the rail portions thereof, and means for propelling said cars and connecting the same with any line of the exchange, substantially as set forth.

4. In a telephone exchange system, the central office having a series of inclined conductor tracks arranged one above the other and in the telephone circuits, electrically controlled connecting cars traveling up said inclined tracks, and closing the circuit between the separated rail portions thereof, and means for automatically propelling the cars up the tracks, connecting the same with any line of the exchange, and then releasing the car to roll back to its starting point, substantially as set forth.

5. In a telephone exchange system, the central exchange receiving the line wires, automatic electrically controlled connecting cars traveling over said line wires at the exchange, transmitting devices connected with the line wires and adapted to control said connecting cars, substantially as set forth.

6. In a telephone exchange, the combination with the telephones; of the exchange having a series of line tracks in the telephone circuit and provided with spring connecting terminals over every other track, electrically controlled connecting cars traveling over said

tracks and provided with connecting points in the circuit of its own track, and means for controlling said cars to bring the same beneath the terminals of any desired line, substantially as set forth.

7. In a telephone exchange system, the central exchange frame receiving the line wires arranged parallel one above the other and extending from one side of the frame at an incline to the other side, the parallel ground wires arranged alongside of the main wires and passing vertically through the frame to the ground, and provided over each track with the normally contacting spring connecting points, and electrically controlled connecting cars traveling over said tracks and provided with connecting points in the circuit of its own track adapted to be placed in connection with the spring connecting points of any other line, substantially as set forth.

8. In a telephone exchange system, the central exchange frame receiving the line wires arranged parallel one above the other and extending from one side of the frame at an incline to the other side, parallel ground wires arranged parallel with the main wires to form a track and passing vertically through the top of the frame to the ground, the same being provided over each track with normally contacting spring connecting points, electrically controlled connecting cars traveling over said tracks and completing the circuit therethrough and provided with connecting points in the circuit of its own track, and means for propelling the cars upon the tracks and throwing said connecting points in contact with the connecting points of the other circuits, substantially as set forth.

9. In a telephone exchange system, the central exchange having the line tracks in the telephone circuit and connecting terminals for each circuit above each track, the connecting cars traveling over said tracks and provided with propelling devices and connecting devices in the same circuit as the line track upon which the same travels, and means for independently controlling said propelling devices and connecting devices of the car, substantially as set forth.

10. In a telephone exchange system, the central exchange receiving the line wires having connecting terminals over every other circuit, of wires forming tracks, connecting cars traveling over said line of tracks and provided with propelling devices, a connecting device having connecting points in the circuit of its own track adapted to connect with the line terminals, and cut outs for directing the current from the propelling devices and connecting devices independently of each other to the connecting points, and means for controlling said cars, substantially as set forth.

11. In a telephone exchange system, the combination of the centered line tracks having connecting terminals over every other track, and the electrically controlled connecting cars traveling over said tracks, said connecting cars having contact wheels at each end receiving and grounding the current, motor magnets mounted upon one end, propelling devices controlled by said magnets, a connecting magnet at the other end of the car, an armature lock controlled by said motor magnets and a connecting armature released by said armature lock and returned into position by said connecting magnet, substantially as set forth.

12. In a telephone exchange, the centered line wires, parallel ground wires forming tracks with the line wires and provided with connecting terminals over every other track, and the connecting cars traveling over said tracks, said connecting cars being provided with contact rollers or wheels of one half conducting and the other half non-conducting material and alternately disposed to each other to close the circuit from the line to ground wires, propelling devices located at one end of the cars, connecting devices upon the opposite end of the cars and carrying connecting points in the circuit of the line tracks, electrical connections between said devices and the rollers and means for independently controlling said propelling devices, substantially as set forth.

13. The combination of the centered telephone line tracks having connecting terminals over every other track, electrically controlled connecting cars traveling over and in circuit with said tracks, a ratchet or rack bar arranged between the wires of each track, motor magnets mounted upon one end of the car, a swinging propelling armature controlled by said magnets and provided with a propelling pawl engaging said rack, a connecting magnet arranged upon the other end of the cars, an armature lock controlled by said motor magnets, and a connecting armature released by said armature lock and returned in position by said connecting magnet, substantially as set forth.

14. The combination of the centered telephone line tracks having connecting terminals over every other track, a ratchet or rack bar arranged between the wires of each track, electrically controlled connecting cars traveling over and in circuit with the tracks, and provided with motor magnets upon one end, spring released propelling armatures controlled by said magnets, swinging propelling pawls carried upon the lower ends of said armatures and engaging said racks, locking devices for holding said pawls above the racks, means for lifting the pawls into engagement with said locking devices, and connecting devices carried over the other ends of the cars and controlled independently of said propelling devices in the same circuit therewith, substantially as set forth.

15. The combination of the centered telephone line tracks having connecting terminals, the connecting cars traveling over and in circuit with said tracks, the rack or ratchet bars arranged between each track, motor mag-

nets upon one end of said cars, swinging propelling pawls controlled by said magnets and provided with right angularly disposed arms one of which is provided with a supporting plate at its upper end, horizontal latches suspended beneath the cars and adapted to be lifted by and engaged with said supporting plates to hold the pawls above the track, a bell crank lifting lever engaging the other arm of the pawls, a notched sliding rod connected with said bell crank, a swinging operating bar connected with said rod, a connecting armature carrying said bar, and means for operating said armature, substantially as set forth.

16. The centered telephone line tracks having connecting terminals over every other track, the connecting cars traveling over and in circuit with said tracks, said connecting cars each having motor magnets at one end, propelling devices controlled by said magnets, a swinging operating armature controlled by said magnets, a swinging lock lever provided with a locking shoulder and connected with said swinging operating armature, a horizontal connecting armature pivotally connected above the car and normally engaging the shoulder of said lock lever, a spring connected with said connecting armature and normally forcing the same upward, and electrical connections, substantially as set forth.

17. The centered telephone line tracks having connecting terminals, the connecting cars traveling over and in circuit with said tracks, each car having motor magnets, propelling devices controlled by said magnets, a swinging operating armature controlled by said motor magnets, a cut out arranged below and controlled by said armature, a swinging lock lever provided with a locking shoulder and connected with said operating armature, a spring released connecting armature normally engaging the shoulder of said lock lever and provided with connecting points in the circuit of the car track, a connecting magnet arranged beneath said connecting armature, and electrical connections between the cut-out, said magnets, and the line, substantially as set forth.

18. The combination of the centered telephone line tracks, having connecting terminals over every other track, the connecting cars traveling over and in circuit with said tracks, each car having motor and connecting magnets at opposite ends, propelling and connecting devices controlled by said magnets, parallel cut-out plates arranged near the motor magnets and in circuit therewith, a swinging bell crank cut-out lever working between said cut-out plates and controlled by said connecting devices, a sliding rod arranged beneath the car and adapted to raise the cut-out lever from between said plates when the car reaches its starting point, and electrical connections, substantially as set forth.

19. The combination of the centered telephone line tracks having connecting terminals connecting cars traveling upon said tracks, and each provided with motor and connecting magnets propelling devices controlled by said motor magnets, a connecting armature controlled by the connecting motor magnets and provided with contact points, a motor magnet cut-out controlled by the connecting armature devices, metallic cut-out contact plates secured to the top of the car, a cut out gutter supported at one end by a spring and provided with pivoted cut out plates having depending lugs and contact ends normally contacting with said contact plates when the gutter is in its normal position, a lifting rod connected with the other end of the gutter and said connecting armature, a weight ball traveling in said gutter to depress the spring supported end thereof and raise the pivoted plates out of contact with the fixed plates, and electrical connections between the cut-outs, the magnets, and contact points, substantially as described.

20. In a telephone exchange system, the central exchange having a series of line tracks in the telephone circuit and provided with connecting terminals over every other track, electrically controlled connecting cars traveling over said tracks and in circuit therewith, and battery connecting instruments located at the central exchange and adapted to connect a battery circuit onto and disconnect the same off of each telephone circuit, substantially as set forth.

21. The combination with the electrical conducting wires, of the fixed cut-out contact plates connected in circuit with said wires, a cut-out gutter arranged over said plates and supported at one end by a spring, opposite cut-out plates pivotally suspended from a common point near the spring supported end of the gutter and provided with depending lugs and outer contact ends normally contacting with said fixed contact plates, when the gutter is in its normal position, means for lifting the free end of the gutter, and a weight ball traveling in said gutter to depress the spring supported end thereof, to close and open the cut-out, substantially as set forth.

22. In a telephone exchange system, the central exchange having a series of line tracks in the telephone circuit and provided with connecting terminals for each track over each track, electrically controlled connecting cars traveling over said tracks and in circuit therewith, battery connecting instruments located at the central exchange and in circuit with each track, and a transmitting device connected with the telephone lines and adapted to control said battery connecting instruments, and in conjunction therewith, the connecting cars, substantially as set forth.

23. In a telephone exchange system, the central exchange having a series of line tracks in the telephone circuit and provided with connecting terminals, electrically controlled connecting cars, battery connecting instru-

ments connected with a line battery and the telephone circuit, and means for connecting the battery circuit onto the telephone circuit and disconnecting the same therefrom for the purposes herein described and set forth.

24. In a telephone exchange system, the combination with the central telephone line tracks, the electrically controlled connecting cars traveling over said tracks, the battery connecting instruments connected with an ordinary battery circuit and the telephone circuits, and the transmitter connected with an auxiliary battery circuit and the telephone circuit to control said battery connecting instrument and said cars in the manner described.

25. The combination with the central telephone line tracks having connecting terminals, the connecting cars traveling over and in circuit with said tracks, the battery connecting instruments located adjacent to the centered tracks and in circuit therewith, said instruments each having a battery connecting magnet, a spring controlled locking armature released by said magnet, a battery connecting armature connected with an ordinary battery and held inoperative by said locking armature, a disconnecting magnet arranged beneath said connecting armature line terminals arranged above said armature, and electrical connections, substantially as set forth.

26. In a telephone exchange system, a central exchange having the line tracks in the telephone circuit and provided with connecting terminals, motor connecting cars traveling over said tracks, battery connecting instruments located at the exchange and connected by auxiliary connections with the telephone circuit, said connections having connecting terminals, each of said connecting instruments having a connecting magnet, a locking armature controlled by said armature, a horizontal spring released connecting armature having connecting points in an ordinary battery circuit, the disconnecting magnet arranged beneath said connecting armature and means for independently controlling the connecting and disconnecting magnets, substantially as set forth.

27. In a telephone exchange system, the combination with the central exchange telephone circuit tracks and the motor connecting cars traveling over said tracks; of the battery connecting instruments located at the exchange and connected with each track, each of said connecting instruments having a connecting magnet, a spring locked armature controlled by said magnet, a horizontal spring released connecting armature engaging said locking armature and connected in circuit with an ordinary battery, the disconnecting magnet arranged beneath said connecting armature, cut-outs arranged upon each instrument and a single cut out controlling rod passing through the several instruments and connected with said cut-outs, said rod closing the cut-out of each instrument except the instrument having the released connecting armature raising said rod, substantially as set forth.

28. In a telephone exchange system, the combination with the central exchange telephone circuit tracks, and the motor connecting cars traveling over said tracks; of the battery connecting instruments located at the exchange and connected with the telephone circuits opposite the same by auxiliary connections, said connections having connecting terminals, a spring released connecting armature having contact points connected with a battery and adapted to be connected with said auxiliary terminals, independently controlled magnets controlling said armature, opposing cut-out plates arranged upon each instrument, cut-out levers working between said plates, lifting arms, connected with said levers, having upper pointed engaging ends and working in slots in said connecting armature, a single lifting rod passing through the several instruments and their connecting armatures, and provided with notches engaged by the pointed ends of said arms and lifting pins below said notches engaged by the released armature of the instrument in use, and electrical connections between said magnet, and the cut out, and the telephone circuit, substantially as set forth.

29. In a telephone exchange system, the combination with the central exchange having a series of line tracks in the telephone circuit and provided with connecting terminals, electrically controlled connecting cars, battery connecting instruments connected with an ordinary battery and adapted to be connected with the telephone circuit, cut-outs arranged at the end of each track and adapted to be controlled by the position of the car at the end of the track and the car leaving such end, and electrical connections between said cut-outs, the telephone circuits, and said battery connecting instruments, substantially as set forth.

30. In a telephone exchange system, a central exchange having a series of line tracks in the telephone circuits and provided with connecting terminals, electrically controlled connecting cars, battery connecting instruments connected with each circuit and an ordinary battery, and transmitters connected with the telephone circuits or lines of each subscriber and an auxiliary battery, said transmitters being adapted to control said battery connecting instruments and in connection therewith, the connecting cars, substantially as set forth.

31. In a telephone exchange system, the combination with the centered circuits and the automatic wheeled motor connecting devices; of the transmitters connected with each circuit and provided with conducting rings having a series of exposed contact faces and a transmitting and operating hand moving over said faces and in the telephone circuit, and

an auxiliary battery connected with each transmitter and adapted to be cut onto the telephone circuit at the proper moment, substantially as set forth.

32. In a telephone exchange system, a central exchange having a series of line tracks in the telephone circuit and provided with connecting terminals, electrically controlled connecting cars, battery connecting instruments connected with each circuit, the transmitters each having a continuous conducting ring having numbered exposed contact faces in circuit with one of the telephone circuit wires, a rotating transmitting and operating hand moving over said exposed faces and connected with the other telephone circuit wire, a cut-out located at the center of the transmitter, an auxiliary battery, and wires leading from said battery to said central cut out, for the purposes set forth.

33. In a telephone exchange system, the combination with the centered telephone circuits, the battery and line connecting devices; of the transmitters each provided with the conducting rings having numbered exposed contact faces in circuit with one of the telephone wires, a central spring actuated cut out button, having opposite contact points in circuit with an auxiliary battery, a transmitting and operating hand mounted over said button and moving over said exposed faces, and normally contacting cut-out plates located back of the contact ends of the cut out button and connected with the other wire of the telephone circuit and said transmitter hand, substantially as and for the purpose set forth.

34. In a telephone exchange system, the combination with the centered telephone circuits, the battery and line connecting devices; of the transmitters, each having the continuous conducting rings provided with numbered exposed contact faces connected with one of the telephone circuit wires, a central spring actuated cut-out button having opposite normally contacting metallic points in circuit with an auxiliary battery, a transmitting hand mounted over said button and moving over the said exposed faces, normally contacting cut out plates located back of the contact ends of the contact button and connected in circuit with the other wire of the telephone circuit and the transmitting hand, and an auxiliary cut out connected with the telephone circuit, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

ALFRED E. McCLAREN.

Witnesses:
W. R. FLETCHER,
J. A. BECKER.