(No Model.) 3 Sheets—Sheet 1.

W. CHILDS.

TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM.

No. 528,591. Patented Nov. 6, 1894.

Fig. 2.

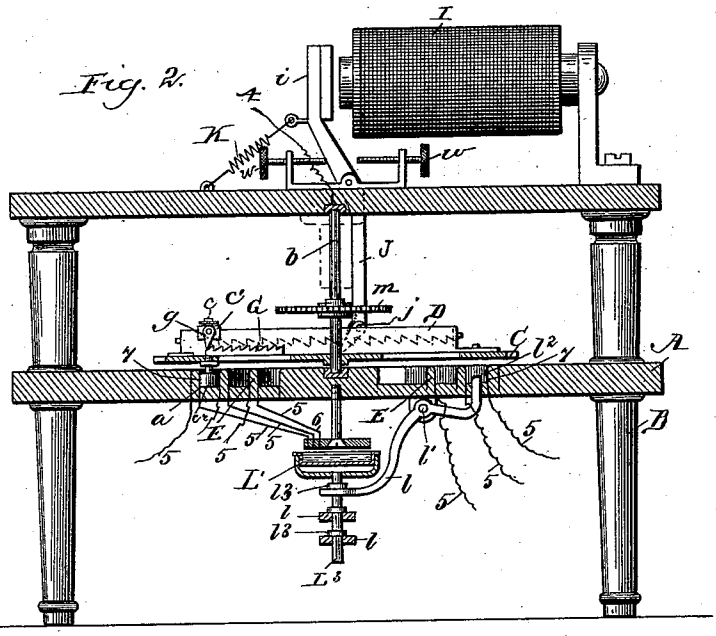


Fig. 1.

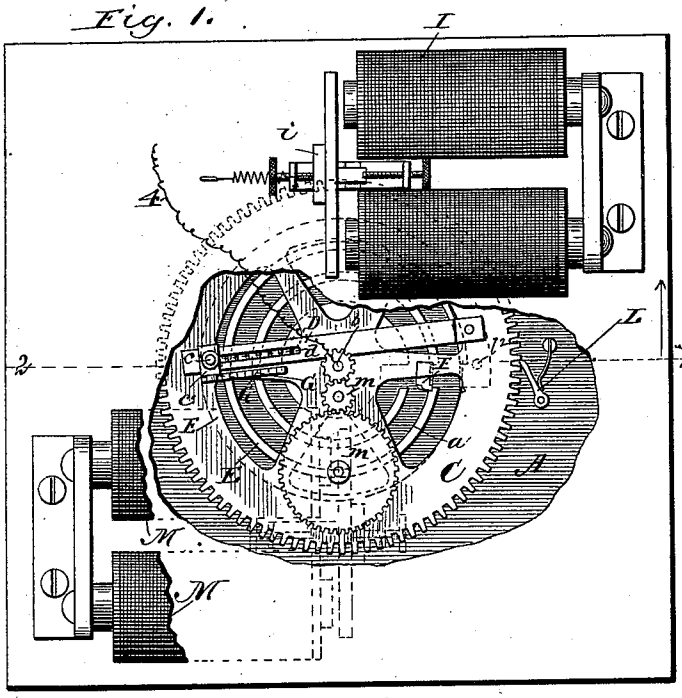


Fig. 3.

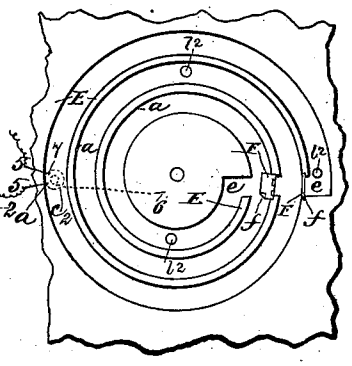
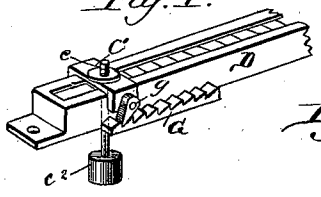


Fig. 4.



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(No Model.) 3 Sheets—Sheet 2.

W. CHILDS.

TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM.

No. 528,591. Patented Nov. 6, 1894.

Fig: 6.

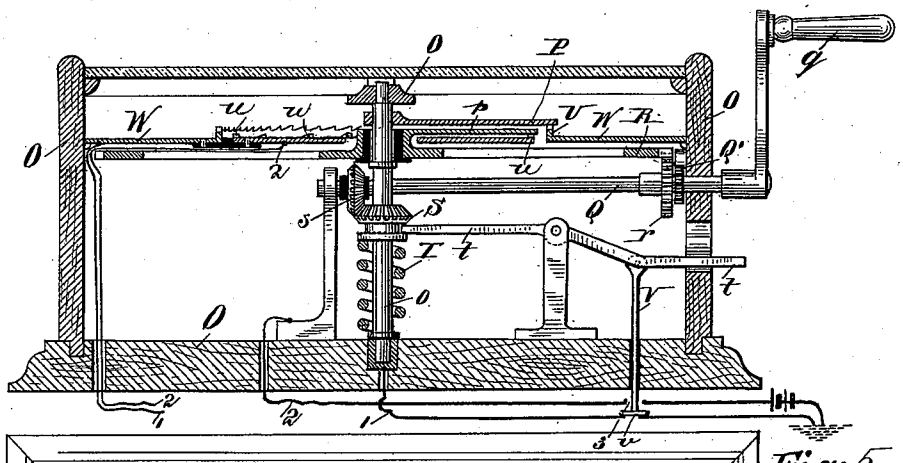
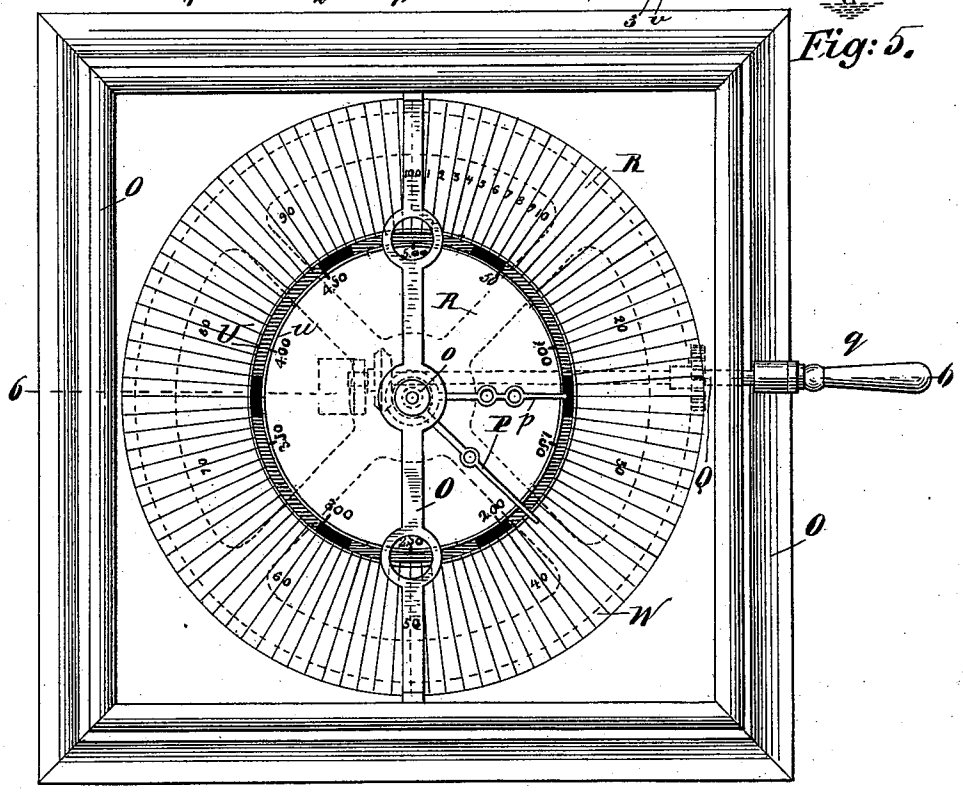


Fig: 5.



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(No Model.) 3 Sheets—Sheet 3.

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TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM.

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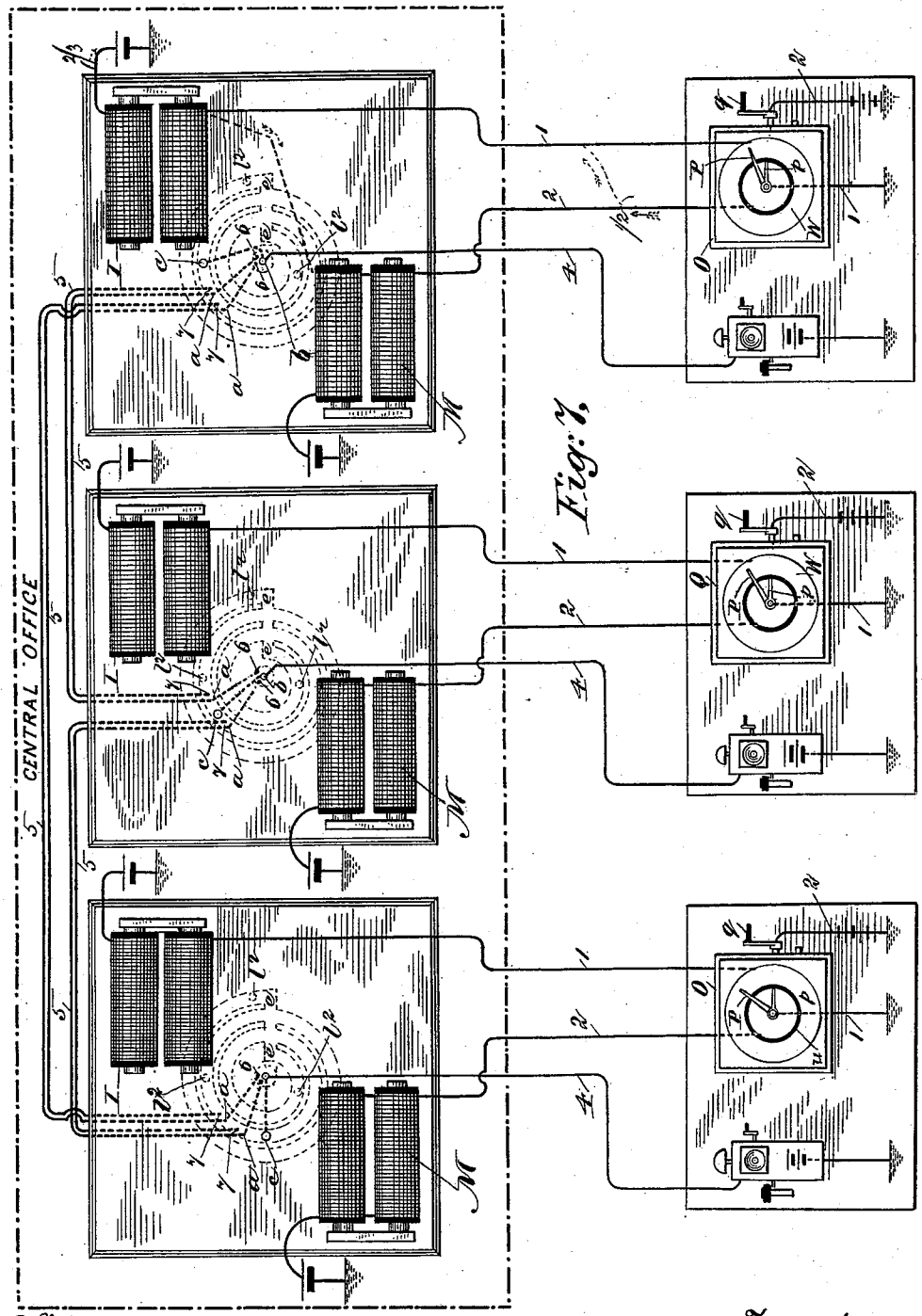

Fig. 1.

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By his Attorney: Jno. N. Whipple

UNITED STATES PATENT OFFICE.

WALLACE CHILDS, OF FORT SMITH, ARKANSAS.

TELEGRAPHIC AND TELEPHONIC EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 528,591, dated November 6, 1894.

Application filed May 27, 1890. Renewed April 21, 1894. Serial No. 508,531. (No model.)

To all whom it may concern:

Be it known that I, WALLACE CHILDS, of Fort Smith, county of Sebastian, State of Arkansas, have invented certain new and useful Improvements in Automatic Telegraphic or Telephonic Exchanges, of which the following is a specification.

My invention relates to telegraphic or telephonic exchange systems in which the subscribers' circuits are all connected with a common central office, where connection is made between any two subscribers' circuits over which telegraphic or telephonic communication is desired to be had by subscribers thereto; and the object of my invention is to provide improved switching means for automatically making connections between the several subscribers' lines and disconnecting the same without the services of operators or attendants, at the central office. This object I attain by the mechanism illustrated in the accompanying drawings, in which—

Figure 1 is a plan or top view of a switching instrument containing my invention and adapted to be used in such systems. Fig. 2 is a central longitudinal section on the line 2—2 of Fig. 1 looking in the direction of the arrow. Fig. 3 is a detail showing in plan view a fragment of the bottom plate on which the switch path is arranged and in dotted lines the traveling switch thereon. Fig. 4 is a detail showing in perspective view a fragment of the support for the traveling switch, and the means for permitting the switch to move transversely to the switch path. Fig. 5 is a plan view of a switch operating instrument containing my invention which is designed to be placed in the subscriber's office and to be electrically connected with the switching instrument of his line at the central office for operating the switch of the latter. Fig. 6 is a transverse vertical section on the line 6—6 of Fig. 5. Fig. 7 is a diagrammatic view showing three switching instruments and three switch operating instruments connected in a system of the class mentioned.

The general plan of my improved switching instrument embraces a switch board having a switch path arranged thereon in the form of a spiral or concentric circular route for the purpose of giving great length of path or a series of paths within a small area. In such path or paths are arranged the terminals of all the subscribers' lines of the system and in connection with such switch path or paths is provided a traveling switch, which is attached to a revolving arm or support for carrying said switch along such path, or paths, the connection of said switch to its support being such as to permit said switch to move along on the support in a direction transversely to said path or paths for keeping the switch in lateral adjustment therewith.

The general plan of the switch operating instrument embraces two contact plates provided with a series of contact points for making and breaking electrical connections, one of said plates being adapted to a revolving pointer for moving, and indicating the movement of, the switch at the central office to bring it into connection with the terminals of the subscribers' lines which are located within certain distances of each other; and the other of said plates being adapted to another revolving pointer, which is adapted to be operated as desired, simultaneously with or independently of the first named pointer, for moving the switch at the central office to bring it into connection with the terminals of the subscribers' lines which are located without the certain distances covered by the first pointer, and indicating the amount of such movement.

Referring to the drawings, A designates the switch board, which is supported by legs B, or in any other convenient manner. The path *a* of the switch board is arranged in the form of a spiral.

Over the switch board, and supported by a shaft *b*, is arranged a wheel C; and upon the wheel, is an arm or support D, upon which is arranged a switch *c*. The switch is carried around in the general direction of the length of the path *a* by the rotation of said wheel. The switch is attached to a slide *c'* and thereby made movable on the support, and it is under the pressure of a spring *d* tending to move it outward. The bottom of the switch is provided with a roller c^2 which moves against a flange E, or projection in or alongside of the path, and adapted to operate on the outside of the roller and thereby compress the spring *d* by moving the slide *c'* inward, as the arm moves around. A radial way *e* is provided through the flange E, which way connects the

inner end of the path with the outer end, whereby the switch on reaching the inner end of the path is permitted under the pressure of the spring to be returned to the outer end through said way. Said way is provided with gates F which are hinged to the bottom of the flange and extended across the way *e* when turned up. These gates are normally down so as to leave said gates open. They are provided with a turned up corner *f* against which the roller c^2 of the switch strikes and turns up the gates temporarily as the switch passes said way, the gates when up operating to close said way and prevent the spring from forcing the switch out through said way.

The gates may be dispensed with and a ratchet G attached to the side of the arm or switch support with which a pawl *g*, on the sliding piece *c'*, to which the switch is attached, engages to hold the switch against the spring *d* when passing the way *e*. When the pawl is carried past the inner end of the ratchet it will drop down into a vertical position and ride back over the teeth of the ratchet, when the switch passes out through the way *e*, until the pawl is carried outward beyond the end of the ratchet bar, as shown in Fig. 2, so that the inward compression of the spring, caused by the rotation of the arm against the flange E, will again bring the pawl into working position on the ratchet.

The wheel C may be operated by electro-mechanism of any ordinary construction. Said mechanism consists, in the present instance, of an electro-magnet I, armature *i* and lever J, the latter being pivoted to the frame and carrying a spring pawl *j* which rides on the teeth, at the periphery of said wheel, in such manner as to propel said wheel by means of electrical pulsations of said eloctro-magnet. A spring K operates to retract the lever and pawl in the usual manner. A pawl L is arranged to hold said wheel from turning backward. The mechanism as thus applied at the periphery of said wheel, is adapted to move the same forward one notch at each pulsation of the electro-magnet I. I also provide similar operating mechanism, located at M to be applied to the shaft *b* of said wheel, through the instrumentality of gearing *m*, in connection with the shaft *b*, and worked by a lever and pawl (not shown but similar to lever and pawl J *j*) connected with the electro-magnet at M, and adapted to operate on the largest of the gears *m* and work it in the same manner that the wheel C is worked. The gearing at *m* is of such construction that each electrical pulsation of the magnet at M will cause the wheel C to move through the same distance as would fifty pulsations of the magnet at I, operating on said wheel C at its periphery.

By means of the first described mechanism the wheel C is operated for moving the switch through short distances, as say within fifty points; and by means of the second or last described mechanism, said wheel is operated by means of gearing for moving the switch through longer distances, as more than fifty points; and the switch in such case is made to travel more rapidly than in the first instance.

To the bottom of the switch board, or other stationary part of the instrument, one or more levers *l* are provided, being pivoted at *l'* and having one end l^2 passed through an opening in the board in the path of the switch and projecting above the bottom of the switch, so that as the switch is rested on the end of any of said levers it will press the lever down. The wires in the path *a* are omitted at the point where the switch rests on the said lever and the numbers corresponding with serial numbers on dial of switch operating instrument are given to the said levers. On the other end of the lever is placed a cup L' for holding mercury or other plastic conductor for making connection with a group of insulated wires suspended above the mercury, so that when the switch is on one of said levers the cup will be raised to bring the mercury into connection with the wires, and when off, the cup and mercury will be lowered and the connection broken. Each of said levers is connected loosely to said cup by means of a pin L^3 which passes through a slot in the end of the lever, and is provided with a shoulder l^3 above the lever whereby each lever will raise the cup independent of the others. Said levers are nearly balanced, the mercury cup slightly overbalancing the other end so that the switch will throw it the other way.

The mechanism at the subscribers' end of the line for producing the electrical pulsations in said above described mechanisms is illustrated in Figs. 5 and 6, in which O designates the frame. *o* is a shaft journaled in the frame and provided with two hands or pointers P, *p*. Q is a shaft provided with a crank *q* for operating the same. A ratchet wheel and pawl Q' are provided to prevent turning said shaft backward. The shaft Q is geared with the shaft *o* and a large wheel R, (placed loosely on shaft *o*) to which the pointer *p* is connected, by a small wheel *r* on shaft Q; and also by pinions S *s*. The pinion S slides on the shaft *o* and is held normally in contact with the pinion *s* by a spring T. By this means the operation of the crank is made to communicate its movement to the pointers P *p;* said pointers moving at different rates of speed for a purpose hereinafter explained.

The lever *t* is provided whereby the pinion S may be thrown and held out of gear with the shaft Q for the purpose of keeping the pointer P at rest while the pointer *p* is in operation. Said pointer P operates in connection with a serrated contact plate U which is in circuit with the wire 1 which connects with the electro-magnet I of the switching instrument in the central office for operating the lever J in the manner before described; and said pointer *p* operates in connection with

another serrated contact plate *u* which is in circuit with the wire 2 which connects with the electro-magnet at M of the switching-instrument in the central office for operating the lever which works the gears *m* in the manner before described.

The circuit formed by the wire 1 is normally closed and the circuit formed by the wire 2 is normally open at 3 and the normal operation of the crank *q* breaks and closes the circuit 1 by means of the pointer P coming in contact with the points of the contact plate U thereby producing electrical pulsations in the electro-magnet I, but produces no effect in the mechanism at M by reason of the break at 3 in the circuit 2. The lever *t* by which the gearing at S *s* is thrown in or out of connection also operates as a switch for alternately breaking and closing the circuits 1 and 2. For this purpose it is provided with an arm or branch V having a contact plate *v* adapted alternately to break and close said circuits at 3, when said lever is vibrated for throwing the gearing in and out of connection.

The contact points on the plate *u* are much farther apart than the contact points on the plate U, being made in the present instance in the proportion of one on the former to ten on the latter; and a graduated dial W is provided whereby the number of pulsations produced on the contact plate U may be read by noting the position of the pointer P on said dial which will correspond to the number of pulsations produced in the electro-magnet I of the switching instrument and determine the distance or number of contacts made by the switch *c* with points or terminals in the path *a* of the switching instrument.

The plate *u* in the present instance has but ten contact points each of which produces a pulsation in the electro-magnet at M of the switching instrument, and each pulsation produces a movement of the switch *c* equal to fifty pulsations or contacts of the pointer P on the plate U as is indicated by the numerals 50, 100, &c., marked on Fig. 6 of the drawings. Adjusting screws *w* are arranged in connection with the lever J for regulating its stroke.

The wiring or connection of the circuits with the various switching instruments of the system is as follows:

Referring to Fig. 7, 1 designates the circuit for operating the switching-instrument through the instrumentality of the mechanism at I, applied to the periphery of the wheel C; and 2, the circuit for operating the said instrument through the instrumentality of the mechanism at M applied to the periphery of the largest of the gears at *m*, as before described. The electro-magnets, at I and M, may be connected in one circuit as indicated by the dotted lines and the arrows at the right side of Fig. 7. To do this the part of the wire 2 beyond the point $\frac{1}{2}$ is omitted and line 2 joined to line 1 as indicated by the dotted arrow line thereat and the ground connection severed at the point marked $\frac{2}{3}$. In such case the battery power should be normally only sufficient to operate the magnet I; and increased power should be applied when the magnet at M is to be worked by switching in the extra battery shown in line 2. This increased power can be switched in through the contact plate *v* when the circuit 2 is closed at 3, Fig. 6, by making proper connection of the wire 2 with the extra battery.

The subscribers' circuits or telephone wires are designated by the numeral 4. They connect individually with the respective switching-instruments at the shaft *b*, and thence through the wheel C, with the traveling switch *c*.

The several switching-instruments of the system are connected together, in the central office, by wires 5; each of which wires starts from some one of said instruments and has, at one end an insulated terminal, at 6, in a group, comprising one end of all of such wires of the system, supported above the mercury cup L′ of such instrument, and runs thence to the path *a* of the same instrument, in which path it has a contact point exposed to the traveling switch *c*, and runs thence to another of such instruments, and terminates at 7 in the path *a* thereof; such other instrument also having a corresponding wire 5 starting from a corresponding group above its mercury cup, and running in like manner to its path *a* alongside of the terminal 7 of the first named wire and thence running to the first mentioned instrument and terminating at 7 in its path alongside of the contact point of the first named wire, so that the switch *c* of each of said instruments in passing along the path *a* thereof will be brought into contact with both of said wires together as shown in Figs. 3 and 7. When the switch *c* of any of said instruments is rested on the end l^2 of any of the levers, it raises the mercury cup and closes the connection between the subscriber's line, of such instrument and all of the other subscribers' lines of the system which are similarly located and puts such subscriber's instrument in connection for "call" by any other subscriber; and when said switch is moved off said lever ends, the connection is broken with all of the other instruments except the one whose wires 5 the switch may be in contact with. Secret communication may be had by any two subscribers of the system, by both severing their connection with the group of wires 5 and placing their respective switches into connection with the two of said wires which connect their respective instruments together.

The operation is as follows: The pointer P of the switch operating instrument in each subscriber's office is set on the dial W to correspond with the position of the switch *c* on the switching-instrument, the position of the switch of each subscriber's instrument, and the relative points of termination of all the wires 5 being indicated by said pointer P and said dial W. Any subscriber desiring con-

nection with any other will move the pointer P on his dial by turning the crank q until said pointer is brought to the desired number. The movement of said pointer over and in contact with the contact points on the plate U causes electrical pulsations of the magnet I and moves the switch into connection with the terminal 7 of the instrument of the party with whom connection is desired, in the manner before described. The said party can now be "rung up." In case the party to be connected with is within fifty points or pulsations of the line of the party operating the switch, the connection will be made by means of the pointer P alone; but if more than fifty points or pulsations as say fifty-five or one hundred and one, the lever t should be raised to throw the gears S s out of connection and close the circuit on the wire 2 and break it on 1 at 3 when a rotation of the crank will bring the pointer p into contact with the plate u and thus bring the magnet at M into operation to make the fifty or one hundred points by one or two pulsations of the magnet M. The lever should then be moved back so as to connect the gears S s, when a continuation of the rotation of the crank q would make the odd five or one by the pointer P. After the communication, the parties will move their respective switches forward to the next nearest lever end l^2 or home station.

It is obvious that in small systems a single coil or circle may accommodate sufficient contact points in the switch-path of the switch-boards thereof for the requisite number of subscribers.

Having now fully described the construction and operation of my invention, I wish it to be understood that I do not limit myself to the precise details of construction and arrangement shown and described, but reserve to myself the right to vary therefrom by using the known equivalents for any or all of the described devices, and generally to avail myself of the existing state of electrical science and practice in carrying out my invention within the true spirit and scope thereof.

What I claim is—

1. A system of telegraphic or telephonic exchange with a switch-board having a pathway formed of a series of convolutions substantially as shown, with wires in open circuit run thereto connecting said switch-board with all the like switch-boards of the system, in combination with a wheel as C, carrying an arm D, with switch-roller c^2, and electro-magnetic propelling devices therefor in line to a local station, to revolve said switch-roller and move it into connection with said wires.

2. A system of telegraphic or telephonic exchange having independent transmitters and receivers connected in open circuits converging in a central office and terminating in switch paths, the combination of an arm D, in electrical connection with each of said circuits and provided with a switch c which has an electrode-roller c^2 and wheels as C, and m, one superimposed upon the other for supporting and operating said roller c^2 over a spiral grooved pathway, and one or more electro-magnetic propelling devices therefor in a line from one of the local stations whereby said roller c^2 may be moved into connection with each of circuits terminating in the said spiral grooved pathways.

3. A system of telegraphic or telephonic exchange having a series of switch-boards in a central office connected together in open circuits by as many single wires for each switch-board as there are switch-boards in the system less one, each of said wires starting from a pathway leaving an uninsulated exposed surface of the wire thereat, thence continues to the pathway of another switch-board leaving a like exposure thereat, and thence extending to and terminating under said last named switch-board, leaving an uninsulated point thereat, in an insulated group of like wires strung in like manner and for like purpose and a lever carrying a mercury cup to connect and operate with said group of wires.

4. A system of telegraphic or telephonic exchange having independent transmitters and receivers connected together in open circuits converging in a central office and terminating in switch-paths, in combination with a switch-board having a spiral pathway, an electrode switch to revolve around said switch-board in said path, and a spring to return said switch automatically from the inner end of the path to the outer end of the path.

5. A telegraph or telephone exchange having independent transmitters and receivers connected together in open circuits converging in a central office and terminating in a revolving switch, the combination of a wheel as C, carrying said switch, a smaller wheel as m, both rigidly attached to a revolving shaft a lever and pawl, one for each of said wheels and electro-mechanical devices to operate said wheels and move said switch into connection with the circuit wires 5.

6. A telegraph or telephone system comprising two or more switching instruments of the character described, connected together in pairs by wires, each of said instruments being connected to every other instrument one end of all of said wires starting in the switch-path of one of said instruments, each wire running to a different instrument from every other wire thence running to the path of another of said switch-instruments and the other end of each of said wires terminating in a group of all of said wires under the switch-board of said last named instrument and a lever having one end provided with a mercury cup arranged under said group of wires and the other end forming a movable contact point in the switch-path of the switching instrument and adapted to operate substantially as set forth.

7. A system of telegraphic or telephonic exchange having independent transmitters and receivers connected in open circuits converg-

ing in a central office terminating in switch-path, comprising a switch-board with convoluted path, an electrode revolving switch to move in said path and a spring to return said switch from the inner end to the outer end of said path and a radial way transverse to said convolutions.

8. An automatic system of telegraphic or telephonic exchange having a switch-board containing an electrode lever, one arm of said lever terminating in the path of a revolving switch and capable of being operated thereby, its other arm carrying a mercury terminal, which is in contact with the ends of all the circuit wires which terminate in a group, under said switch-board.

9. A switch-board having its pathway constructed in the form of a spiral in combination with circuit wires extending from said pathway to the like pathways of all the other switch-boards of the system a revolving switch in line to a local station, to connect with said circuit wires, and electro-magnetic propelling devices to operate said switch.

10. A system of telegraph or telephone exchange having a switch-board and in combination, a lever carrying a mercury cup, circuit wires grouped or bunched together and each wire so grouped extending therefrom to a different switch-board, from every other wire, electro-mechanical propelling devices to operate said lever and bring the mercury cup into contact with the ends of the circuit wires so grouped.

11. A system of telegraphic or telephonic exchange having a switch operating instrument connected in open circuit with a switching instrument in the "central office," which has a dial made in two concentric circular plates joined together but insulated from each other, gearing to connect and operate at different rates of speed two electrode hands alternately or together said hands insulated from each other—and revolve them over the dial and make contact with said plates at points projecting therefrom, and means to revolve said hands.

12. A system of telegraphic or telephonic exchange with a switch-board having the switch path depressed therein, leaving one or more rims standing against which an electrode roller switch is pressed by a spring, into contact with circuit wires which rest in said rims, leaving an insulated segment of said wires exposed for said switch to roll over, and electro-mechanical devices to revolve said switch.

13. A system of telegraphic or telephonic exchange, having a series of switch-boards each switch-board comprising a pathway in which circuit wires terminate, made in the form of a spiral and a pathway running transversely thereto, in combination with an electrode switch as c, electro-magnetic propelling devices to move said switch around said pathway and into connection with said circuit wires.

14. In a telegraphic or telephonic exchange system, a switch-operating instrument comprising two electrode hands and in combination, insulated from each other, a shaft to which one of said hands is rigidly attached, a gear wheel fitting loosely over said shaft carrying the other hand, one hand capable of being independently operated, the other only in conjunction therewith, a dial composed of two plates or rings insulated from each other and in open circuit with a "central office," and means to operate said hands into contact with electrode points on said dial and close said circuit.

15. In a switch operating instrument of the character shown and described—a compound switch having two connecting arms—gearing capable of being operated by one of the said arms—line wires 1 and 2 capable of having their circuits opened or closed by and through the other of the said arms, and means to operate said switch and move said arms simultaneously substantially as set forth.

16. A system of telegraph or telephone exchange having an electrode switch movably connected to a wheel as C, said switch having a spring to move it radially to the wheel and transversely to paths in which it revolves, and electro-mechanical devices to move it into contact with circuit wires 5, resting in said rims located in said paths.

17. In an automatic switching instrument for telegraph or telephone exchange, the combination of a revolving electrode switch, a spring to operate against said switch, a ratchet and pawl controlling said spring and electro-mechanical devices to revolve said switch in a convolute pathway substantially as and for the purpose set forth.

18. A system of telegraphic or telephonic exchange comprising a switch-board having a pathway formed of a series of convolutions substantially as shown, with circuit wires run thereto connecting said switch-board with all the other switch-boards of the system, in combination with a wheel as C, supporting and operating an adjustable electrode as c^3, and electrical propelling devices therefor in a line to a subscriber's office, to move said electrode in connection with said wires.

19. A system of telegraphic or telephonic exchange having independent transmitters and receivers connected together in open circuits converging in a central office and terminating in switch-paths, comprising a circuit making and breaking wheel carrying an electrode switch therefor, radially movable on said wheel, a series of concentric switch-paths, circuit wire contact points located in said paths, and electrical propelling devices to operate said wheel and move said electrode switch into connection with each of said circuit wires substantially as specified.

20. In an automatic switching-instrument for telegraphs, or telephones, the combination of an adjustable electrode switch, one or more deflecting flanges to guide said switch, a

spring to operate against said switch, a pawl and ratchet controlling said spring, and electro-mechanical devices to move said switch in a concentric pathway substantially as shown and described.

21. In an automatic switching-instrument for a system of telegraphic or telephonic exchange, the combination with a single line or circuit of two electro-magnets, two propelling devices, two batteries of ordinary construction, one of said batteries permanently located on said line and adapted to energize one of said electro-magnets and operate but one of said propelling devices, the other battery adapted to be switched on or off said line and capable of energizing both of said electro-magnets and operating both propelling devices simultaneously, and a traveling electrode-switch capable of being operated by such mechanisms substantially as specified.

22. In a system of telegraphic, or telephonic exchange containing switching mechanisms automatically operated by electro-mechanical devices and in combination therewith a concentric circular, or winding switch-path substantially as shown, and an electrode switch, adapted to move along said switch-path into contact with circuit wire terminals located in said switch-path substantially as and for the purpose set forth.

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