(No Model.) 4 Sheets—Sheet 1.

J. W. McDONOUGH.

TELEPHONE SYSTEM.

No. 538,975. Patented May 7, 1895.

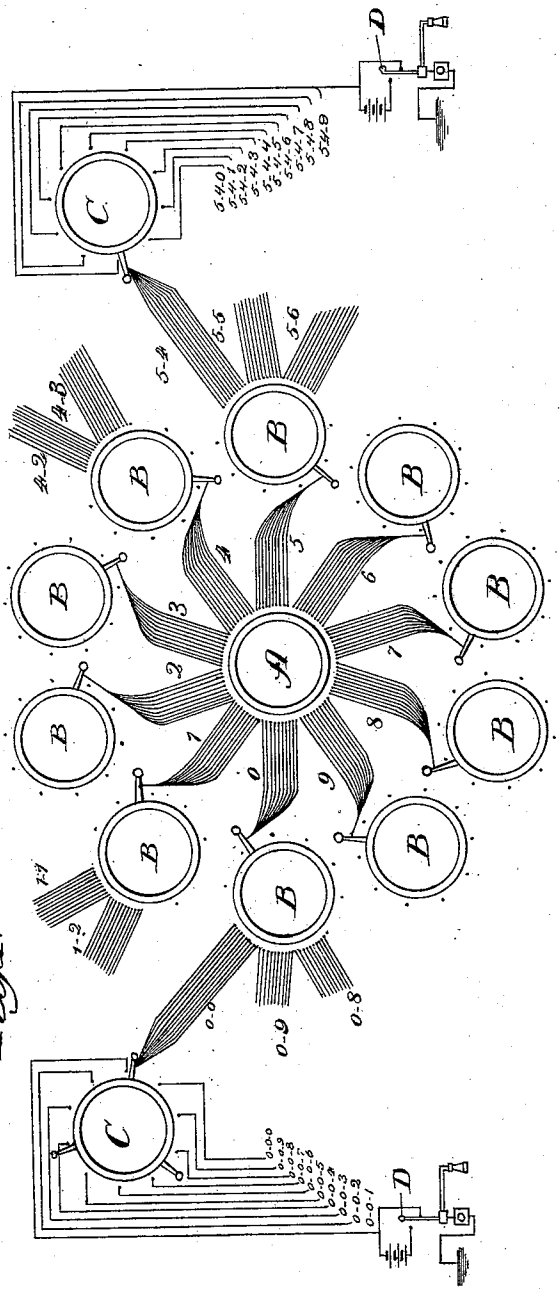

Fig. 1.

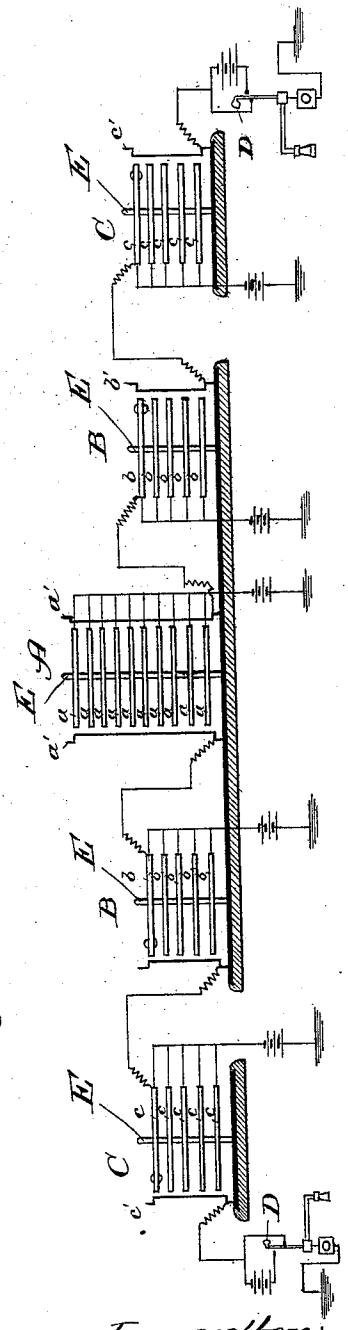

Fig. 2.

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4 Sheets—Sheet 2.

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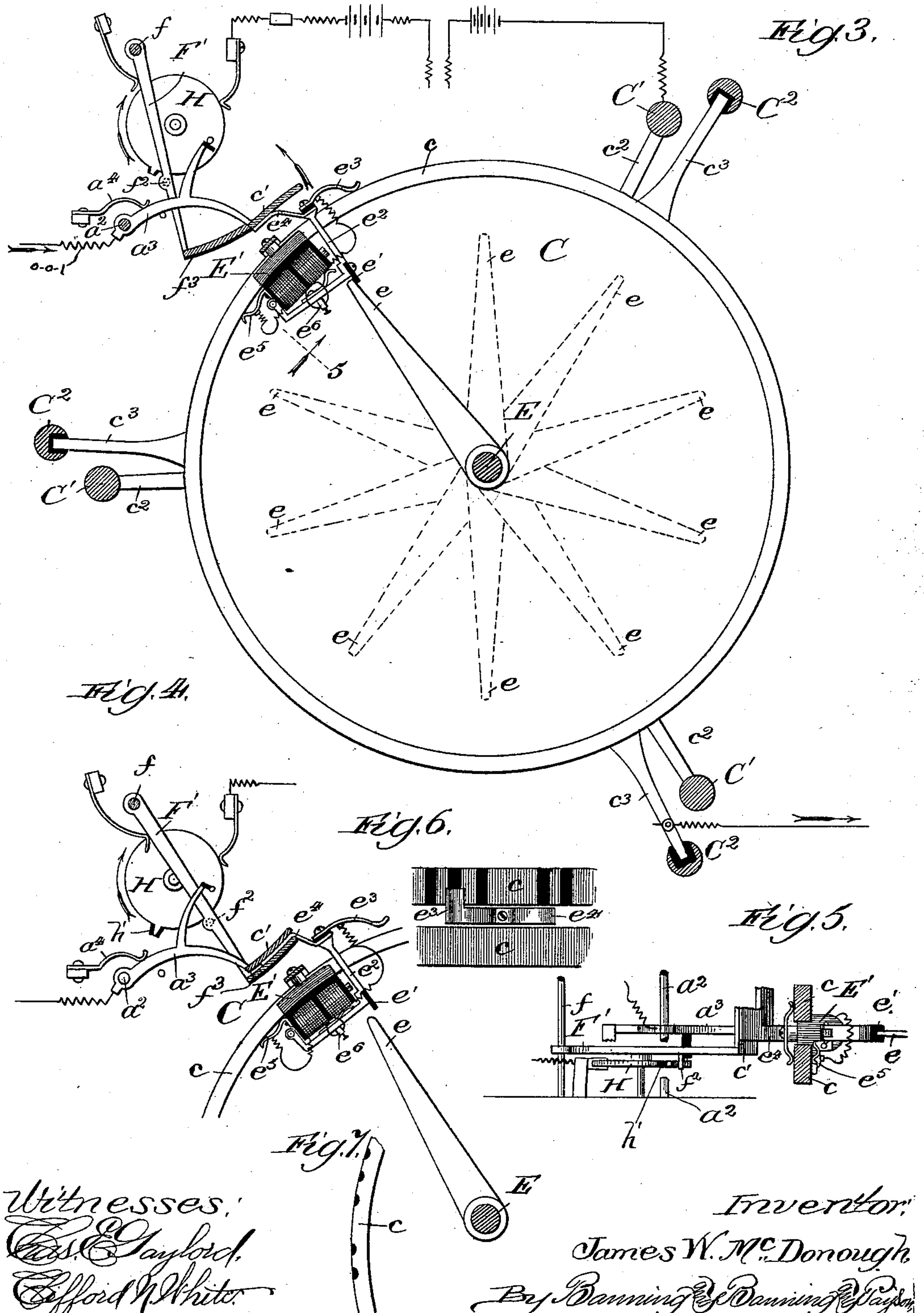
TELEPHONE SYSTEM.

No. 538,975.

Patented May 7, 1895.



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J. W. McDONOUGH.

TELEPHONE SYSTEM.

No. 538,975. Patented May 7, 1895.

Fig. 8.

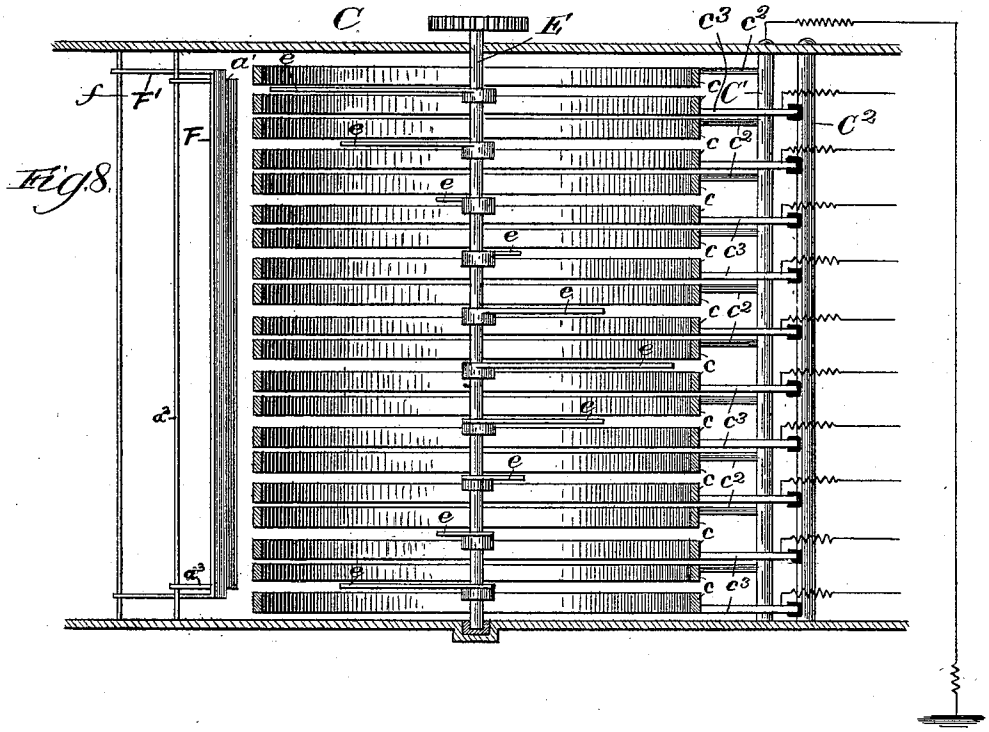
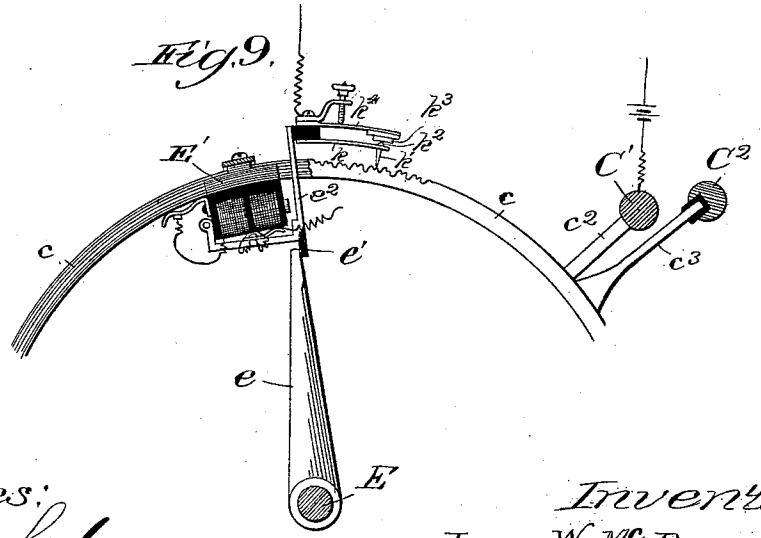


Fig. 9.



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TELEPHONE SYSTEM.

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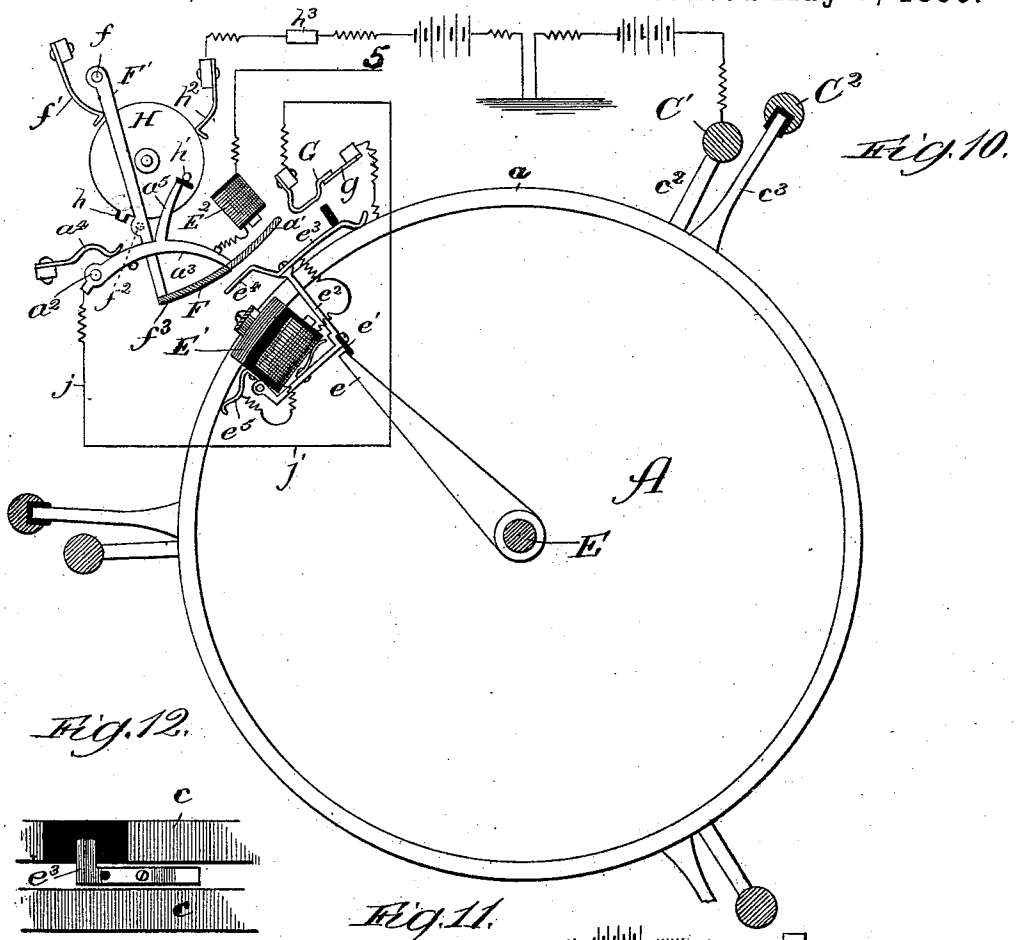
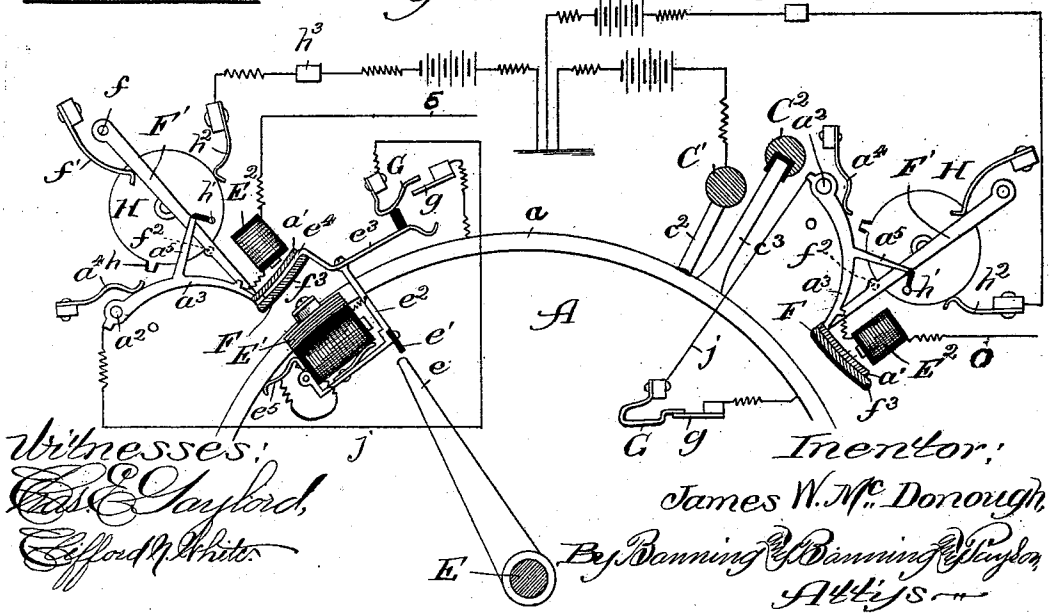


Fig. 10.

Fig. 12.

Fig. 11.



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UNITED STATES PATENT OFFICE.

JAMES W. McDONOUGH, OF CHICAGO, ILLINOIS.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 538,975, dated May 7, 1895.

Application filed May 21, 1891. Serial No. 393,601. (No model.)

To all whom it may concern:

Be it known that I, JAMES W. McDONOUGH, a citizen of the United States, residing at present in Chicago, Illinois, have invented certain new and useful Improvements in Telegraphic or Telephonic Switching and Signaling Systems, of which the following is a specification.

The object of my invention is to provide a switching and signaling system applicable to telegraph and telephone service, in which any subscriber or operator may effect connection with any other subscriber or operator without the intervention of any intermediate operator or attendant at the central station; and the invention consists in the features and details of construction and modes of operation hereinafter described and claimed.

In the drawings, Figure 1 is a plan or diagrammatic view of the circuits employed in my system. Fig. 2 is a vertical section taken through Fig. 1. Fig. 3 is a plan view of any of the apparatus shown in Fig. 1, except the central one. Fig. 4 is a plan view of the magnet and associate parts shown in Fig. 3, but at a different stage in operation. Fig. 5 is a section of the circuit connecting and locking device, taken in line 5 of Fig. 3. Fig. 6 is a side elevation of a portion of the rings shown in plan in Fig. 3. Fig. 7 is plan view of a portion of the upper ring with insulating-sections in place. Fig. 8 is a vertical section taken through any one of the apparatus shown in Fig. 1, except the central one. Fig. 9 is a plan view of one of the rings provided with an automatic telephonic signaling apparatus. Fig. 10 is a plan view of the central apparatus shown in Fig. 1, provided with circuit connecting, locking, and signaling devices. Fig. 11 is a plan or diagrammatic view of a portion of the apparatus shown in Fig. 10, showing the course of the circuits when two subscribers are connected; and Fig. 12 is a side elevation of a portion of the rings shown in Fig. 10, showing a section of insulating material to prevent signaling at a certain time.

In applying my improved telegraphic or telephonic switching and signaling system, I arrange a central apparatus A, containing a series of rings *a*, as they may be termed, at any desired location. These rings are supported preferably in a vertical series, one above the other, but each lying in a horizontal plane, with any desired distance between them. Any desired number of rings may thus be arranged, so as to meet the exigencies or requirements of the particular system of which it is intended they shall form a part.

In Fig. 2 I have shown ten of the rings in the apparatus A, although a hundred or any other desired number may be used.

Around or in proper proximity to what I have termed the central apparatus, I arrange a set of apparatuses B, containing rings *b*, of which apparatuses I have shown ten, and have represented them in Fig. 1 as arranged in a circle around the central apparatus.

As I am treating the central apparatus as containing one hundred rings, so I shall treat the surrounding apparatuses as each containing ten rings.

I shall hereafter in the specification and claims speak of the central apparatus and the surrounding apparatuses, but I wish it to be understood that I use these terms merely as a convenience in description, and that it is immaterial whether the various apparatuses be actually arranged in a circular position, as shown in Fig. 1, or not.

I next arrange outer apparatuses C, each preferably containing ten rings *c*. I call these outer apparatuses because their operation is still further removed from the central apparatus than the surrounding apparatuses. I do not mean, however, by this designation that they are either the last that can be used in the series, or that they are located at an outside position. They may be located in any desired place, either together or separate. When my system is applied to more than one thousand subscribers, another series of apparatuses will be employed, to which the outer apparatuses C will occupy the same relation as the surrounding apparatuses B now occupy to the apparatuses C. The entire ramifications and possibilities of my system will therefore be understood when I describe it in connection with one thousand subscribers, as well as if I carry out the description to apply to a system in which there were ten thousand. I shall, therefore, for the purposes of my description, confine myself to the central, the surrounding, and the outer apparatuses used in a system to accommodate one thousand subscribers.

Around the apparatus A, I arrange upright,

movable bars a', which extend from the bottom to the top of the apparatus, so as to pass each of the rings. For convenience I shall term this bar a gate, as it is hung or pivoted on a rod, shown in Fig. 8, so that it may swing when struck. Each one of these gates forms the terminus of a wire, so that as there are one hundred of them arranged around the central apparatus, one hundred circuit wires can be accommodated by the central apparatus. These are divided into divisions consisting of ten wires each. Each division is carried to one of the surrounding apparatuses, where each several wire is connected to one of the ten rings contained respectively in the surrounding apparatuses. Around each of the surrounding apparatuses B are arranged one hundred gates b', which are mounted and hung as are the gates a'. Each of these gates b' forms the terminus of a circuit wire, so that each of the surrounding apparatuses B accommodates one hundred wires, making one thousand in all. These wires are likewise divided into divisions of ten each, and each division carried to one of the outer apparatuses C, where each several wire is connected to one of the ten rings c contained in each of the outer apparatuses. This requires, as above said, one hundred of these outer apparatuses C. If preferred, however, the rings of the hundred apparatus may be arranged around a single central shaft, instead of around one hundred shafts, so long as the rings are maintained in one hundred divisions of ten each. These outer rings are each surrounded or provided with ten gates c', making one thousand gates in all, which are mounted or hung like the gates a' and b' before described. I may say here, however, that in describing the mounting or hanging of these gates, as shown in the drawings, I do not mean to limit myself to that way only of mounting them, as they may be otherwise hung or arranged if desired. Each of these gates c' forms the terminus of a circuit wire leading to the office of a subscriber, so that with the one hundred outer apparatuses one thousand subscribers can be accommodated.

The ten divisions of the wires leading from the one hundred gates around the central apparatus are numbered respectively 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9, or by letters A, B, C, &c. Each of the surrounding apparatuses will be known or recognized by the number of the division leading from the central apparatus to it. Each of the ten divisions of wires leading from each of the surrounding apparatuses is likewise also numbered from 0 to 9 with the number of the particular division of wires leading from the central apparatus to such surrounding apparatus as a prefix. This number could also, if preferred, be used as an affix, but for convenience and simplicity of description I shall in the application and claims speak of it as a prefix, but in using this word I mean for it to comprehend and include the arrangement of the number as an affix as well. To illustrate this, I shall particularly follow the division of wires numbered 5 leading from the central apparatus.

As above said, each of the divisions of wires leading from the surrounding apparatuses will also be numbered from 0 to 9, but as only three of the divisions are represented in the drawings, they bear the numbers of 4, 5 and 6. As division 5 of the wires from the central apparatus leads to this particular surrounding apparatus, the sections of wires, shown in the drawings, and numbered respectively 4, 5 and 6, would have the 5 designating the division of wires from the central apparatus added to them as a prefix, so they they would be 5—4, 5—5, 5—6. If, to illustrate further, I took the surrounding apparatus to which the division of wires leading from the central apparatus numbered 0 were connected, I would have for the three divisions illustrated in the drawings in connection with this surrounding apparatus 0—0, 0—9 and 0—8. The numbers of the divisions of wires leading from each one of the surrounding apparatuses would be numbered in like manner from 0 to 9 with the number of the division of wires leading from the central apparatus to it added as a prefix. This will be readily understood from the illustrations already given, and need not be further described or enlarged upon.

The outer apparatus C, of which but two are shown in Fig. 1, would in like manner have the ten wires leading from each of them numbered from 0 to 9, with the numbers of the division of wires leading from the surrounding apparatus to the outer apparatus used as a prefix in connection with them. Thus in the two outer apparatuses shown in Fig. 1, I would have the numbers in the apparatus at the left hand of the figure numbered 0—0—1 to 0—0—0, and in the apparatus represented at the right hand of the figure, I would have the numbers running from 5—4—0 to 5—4—9. As illustrated in Fig. 1, the system is represented as showing complete circuit wires for the numbers 0—0—1 and 5—4—9. Fig. 1 also shows a diagram of the connection at the subscriber's box, in which the knob D affords the means employed by the subscriber in effecting connection with any of the other subscribers desired. It operates as a push button and switch, by which a battery is thrown in and out of circuit. The other devices represented in connection with the push buttons are the ordinary telephone devices commonly used. In Fig. 2 is also represented the connection of each ring with an earth circuit.

The outer apparatus C and the surrounding apparatuses B are provided with means for connecting the respective rings with the gates, as I will now explain. These means are particularly represented in Figs. 3 to 8, and I will specially refer to these figures in my description of them. I shall, however, treat the parts described as being arranged in the outer apparatus C, the parts in

an insulated surface on each side, as shown, and a stud h'. The arm or lever a^3 of the gate is provided with an extension a^5 that passes up by the side of the wheel, and which is provided at its end with a piece of insulating material. The end of this extension falls in the path of the stud h' as the wheel is rotated, and holds the wheel from further rotation. When, however, the gate is moved back and the arm or lever a^3 moved back with it, the extension a^5 is also pushed back until the end of the insulating material slips past the stud h', as shown in Fig. 11. This permits the wheel H to rotate until the tooth h has made almost a revolution, when it comes into contact with the lever F' through means of a stud f^2 projecting from it into the path of the tooth h. When the tooth comes into contact with this stud, it pushes the lever, and with it the lock F, back until the end of the lock has been moved past the end of the gate, when the spring a^4, bearing on the arm or lever a^3, moves the spring back into its normal position, and the extension a^5, falling into place, engages the stud h' and stops the rotation of the wheel.

As above explained, the circuit is completed when the spring e^4 is held by the lock in contact with the gate a', and the circuit is broken as soon as the tooth h has moved the lever of the lock back, so that the lock ceases to hold the spring and gate in contact with each other and the gate in its back position. As soon as the lock is moved back, and the spring and gate resume their normal position, the circuit is broken. To notify the subscriber that this is about to take place, and thus warn him to again press the button if he desires longer time, the tooth h is not insulated at its end, although it is at its sides. As it moves past the pin f^2 on the lever of the lock, it will be for a short time in metallic contact with it. This completes a circuit through the wheel H, through the spring h^2, and through the signal box h^3 and on to the earth. It is to be understood, of course, that in operation the tooth h comes into metallic contact with the pin f^2, before the lever F' has been moved back far enough to carry the lock F away from the spring e^4, so as to release it and break the circuit. This causes a signal to be given to the subscriber, so that he can by pressing on the button prevent the gate from being unlocked and the circuit broken. This signal box h^3 may be made to convey any signal desired, as a buzzing noise, or the words "time up," or any other predetermined signal to notify the subscriber. Where it is desired to give a signal in words, they may be formed as hereinafter explained.

A lock and signaling box h^3, like that above described, may be attached to and used in connection with each and every gate through the apparatus, if desired.

I will now describe the course of the circuits in the outer apparatus C. Shown in Figs. 3 to 8. From some subscriber's office a line 0—0—1, shown in Figs. 1 and 3, runs to the gate c shown in detail in Fig. 3, and through the spring e^4 down through the piece e^2 to the binding post e^6, where the circuit divides. One part of the circuit passes through the right hand coil of the magnet and through the wire up to the spring e^3, whence it passes into the upper portion of the ring, and through the arm c^2 to the post C', whence it passes through a wire to a battery and thence to the ground. The other portion of the circuit, beginning at the binding post e^6, passes through the left hand coil of the magnet and through a wire into the spring e^5, whence it passes into the lower portion of the ring and through the arm c^3 to the line connecting with it and on through the line 0—0 to the apparatus B.

The circuit for the central apparatus A is brought in from apparatus B through the line 0, shown in Figs. 1, 10 and 11, on the right hand of the figures whence it passes to the magnet E^2, and through the lever or arm a^3 of the gate a', and through the wire j connecting with such lever around to the spring switch G and g, and on to the lower portion of one of the rings of the apparatus. It will be understood that each gate a' is electrically connected with a separate ring of the apparatus through a separate circuit making and breaking device G and g. From this ring the circuit passes through the spring e^5 into the magnet E' which in the central apparatus is made of a single coil, and through the wire leading from such magnet to the springs e^3 and e^4; and from the spring e^3 it passes to the upper portion of the ring and through the arm c^2 to the post C', whence it passes through the wire to the battery and on to the ground. It is preferred that the upper section of the ring shall be used for signaling purposes, and to that end it is provided with sections or portions of insulating material, as shown in Fig. 6, or forms a part of another signaling device shown in Fig. 9. When sections of insulating material are used, as shown in Fig. 6, the spring e^3 alternately passes from a metallic to an insulated surface. Whenever it is in contact with the metallic surface, a current passes through the circuit, and the alternate making and breaking of the circuit, as the spring moves alternately over the one surface or the other, causes signals to be transmitted to the subscriber. The battery that sends the current for such signaling purposes is intended to be strong enough for that, but not strong enough to affect or operate the armatures of the magnets as hereinbefore described. The alternate making and breaking of the circuit, which occurs when the arrangement is as shown in Fig. 6, is one way of sending the signals; but in Fig. 9 I have shown another way by which I am enabled to transmit words to the subscriber, giving him the desired notice. In this arrangement, instead of having springs arranged at the top of the piece e^2 extending from the armature, I have a telephonic device. The surface of the ring, instead of be-

the surrounding apparatuses B being the same. I arrange a shaft E in the center of each of these apparatuses, so that it stands properly supported in a vertical position in the center of the surrounding rings. By referring to Fig. 8, it will be seen that the rings stand a slight distance apart from each other. The ten rings are made up of twenty parts, and each ring has its two parts divided with a wider space between them than that which separates the rings proper from each other. The two parts of each ring are supported and held in their position or horizontal plane by means of posts C′ provided with a wire to the earth, to which the upper section or portion of each ring is attached by a bar c'' and by posts C″, to which the lower section or portion of each ring is attached by a bar c^3, insulated from the posts C^2, and provided with a circuit wire leading away from it to the next station. The vertical shaft E is adapted to be rotated by any convenient motor, and I need not describe in detail the means for imparting rotation to it. It is provided with ten arms *e*, rigidly connected with it, so as to be carried around with its rotation. These arms are, of course, in different horizontal planes, corresponding to the different horizontal planes of the spaces between the rings in which they rotate; and instead of being located on the shaft directly one above another, they are arranged in a spiral around the shaft, so that the ends are equidistant from each other in plan view, though in a different horizontal plane. Each ring composed of its two parts or sections is intended to support and form a way or track for a carriage E′. These carriages are adapted to slide along, round and round the rings. They each contain an electro magnet, which need not be described in detail. The armature of each magnet, when the current is off, is held by a spring in a position where the ends of the arms *e* may engage with a piece of insulating material e' arranged on the armature, as shown in Fig. 3. The rotation of the arms *e* will therefore carry the carriages round and round the various rings of the apparatus C, one following another though in different rings, until affected by the current, as hereinafter described. The armature on the electro magnet carries an angle arm e^2, that extends out between the two parts or sections forming a ring, and is provided at its end outside of the rings with two springs e^3 and e^4 insulated from each other. The spring e^3, in its normal position, rests on the outside of the upper section of the ring, as shown in Fig. 6. The spring e^4 extends out far enough to come into contact with and bear against each of the gates as the carriage is moved round and round the ring. Another spring e^5 is attached to the end of the magnet, and rests upon and bears against the lower one of the sections composing the ring, but on the inside instead of the outside, as does the spring e^3. In Fig. 5 this spring is shown as bearing against the lower section of the ring.

The surrounding apparatuses B are all intended to be provided with rotating shafts, arms, rings, electro-magnets, armatures and springs, as in the case of the outer rings C, which I have more particularly been describing, and I need not repeat the description as to them. In the central apparatus A, however, the arrangement of the central mechanism is slightly different, as I will explain. This mechanism is particularly shown in Figs. 10, 11 and 12. In the case of the central apparatus, there is a central, vertical, rotatable shaft E, provided with arms *e*, which are carried round with it. Carriages with electro magnets are also employed, and are arranged to be carried round by the rotation of the arms, as before described. The springs e^3 and e^4 are not, however, insulated from each other. It is to be understood, however, that the spring e^4 does not make connection with the gates a' while the carriage is moving past such gates in the apparatus A as it makes connection with the gates in the apparatuses B and C. In addition to the magnet that forms a part of the carriage E′ another magnet E^2 is employed in connection with each gate arranged around the central apparatus, and movable contact springs G and *g* are also provided for each gate to make and break a circuit as hereinafter described.

When the current caused by pressing the button D is on, the armature of the magnet shown in Fig. 10 is lifted, and the spring e^3 moved away from contact with the surface of the ring. The spring e^4 then bears against the gate a' and makes a contact with it for the current. As the armatures and springs are thus moved, the gate a' is pushed back enough to permit the lock F to slip past the edge of the gate and clasp the spring e^4 between it and the gate a', as shown in Fig. 11. While this operation has taken place, the piece of insulating material on the spring e^3 lifts the spring G from its contact piece *g*, so as to break the circuit between them. The magnet E^2 aids in moving the gate toward it and assists the spring e^4 in moving it back, so that the lock may fall into place. The lock is mounted on a lever F′ that is fulcrumed on the rod *f*, as shown in Fig. 8. To positively push or move the lock forward into its locking position, a spring f' bears against the lever of the lock and forces it forward, as soon as the gate a' is moved back enough to permit it to fall into place. To hold the gate down in its normal position, so that it can be struck by the spring e^4 as it passes round the track and when it is operated on by the current from the button D, the gate a' is mounted on a rod a^2 by means of an arm or lever a^3, which is held down by the spring a^4. In order to unlock the lock, I mount a wheel H on a shaft that may be moved or rotated in any convenient way. This wheel is provided with a tooth *h*, having

ing provided with alternate metallic and insulated surfaces, is provided with indentations corresponding to the sound waves necessary to be produced in making the sounds of any desired word which may be used. For instance, if it be desired to transmit the word "engaged" to the subscriber, the indentations will be such as to produce the sounds forming this word. In like manner, the words "time up," or numbers or letters, or other word signals may be provided for and transmitted. The telephonic device that is used in transmitting these sounds consists of a spring k carrying a point k', which, in its normal condition, bears upon the surface of the ring and follows the indentations over which it passes. Immediately above the upper contact point k^2 on the upper surface of the spring is arranged a carbon piece k^3, attached to a spring k^4, held in proper adjustment by means of the screw shown. In this case the circuit passes through the wire, and through the springs and contact points into the ring, whence it passes to the ground. I wish to say, however, that while I have described this telephonic device with some particularity, I do not mean to be confined to the details of its construction, and other means can be used if desired to transmit the mechanical, electrical telephonic sounds of the signal words.

In illustrating the operation of my telegraphic and telephonic switch and signaling system, I will describe the operations that take place as a subscriber calls up and secures connection with another in a system of more than one hundred subscribers. We will suppose that a subscriber at 0—0—1 desires to call up a subscriber at 5—4—9. It will be understood, of course, that each subscriber is provided with the usual telephone receiver and signaling apparatus. The subscriber at 0—0—1 places the telephone receiver to his ear and listens to the signals as they are furnished him over the circuit. The first thing that he will hear in this particular arrangement of circuits will be the signal of his own number, caused by the passage of the spring e^3 of the apparatus C as it passes over and forms connection between the signaling section of the ring which, as above stated, may consist of alternate sections of metallic and of insulated surfaces, or of any indented surface and telephonic device. This signal of his own number is carried to him every time one of the carriages and magnets passes the gate of the apparatus C to which his wire is connected, as they are carried around the rings by the rotation of the shaft E and the movement of the arms e. When he hears the signal of his own telephone 0—0—1, he presses the button D into place, which brings the battery at his station into circuit causing a current to flow through the wire 0—0—1 into the magnet and on through the ring to the earth, after it passes from the post C', as heretofore explained. As before explained, the armature is drawn up by the magnet, and the spring e^3 removed from contact with the ring, breaking the earth circuit. The gate c' is moved back and the lock F pushed into place clasping the spring e^4 between it and the gate. As soon as the armature has been drawn up by the magnet, the carriage and magnet stop, because they are no longer pushed forward by the arm e, and the parts remain as described until the gate is again unlocked. This effects a permanent connection between the wire 0—0—1 from the subscriber's station and the ring c for a predetermined time. The circuit wire, connected with the ring with which the subscriber has thus secured connection leads to one of the gates at one of the apparatuses B. While the signaling and making of the circuit to this point has been going on, the circuit between the gates in the apparatus B and the carriage and magnets in such apparatus, has been opened.

I should say here that the carriages in the apparatuses A, B and C, are so timed in their movements that as one magnet has been passing a gate, the magnet in the next apparatus has been passing a space between the gates. Now, as the current comes into one of the gates of the apparatus B, the subscriber hears a signal as each carriage and magnet on the different rings of the apparatus pass his gate. The signals that are carried to him from the apparatus B in this case are constantly 0—0, 0—1, 0—2, &c., instead of 0—0—1, 0—0—2, &c., as they were when he commenced. When he hears this signal, he again presses the button D and there is the same operation effected as explained with reference to the apparatus C. Illustrated in Fig. 3. He brings one of the rings of the apparatus B into his circuit and the circuit is further established through the wire marked 0 connected with such ring to one of the gates at the apparatus A. The signals that are now transmitted to him, as the carriage and magnet shown in Fig. 10 pass around the ring connected with his gates, are those which correspond to the particular gates that they are passing. As these gates are divided into ten divisions, as before explained, and as the same signal is transmitted for each of the wires of a division, he hears the signal 0, then 1, then 2, then 3, then 4, then 5, each ten times if no gate is engaged. When he hears any signal 5, he again pushes the button D. When the subscriber presses the button this time, the current passes through the wire 0, at the right hand of Fig. 11, into the magnet E^2, and on through the arm a^2 and the wire j, through the spring switch G and g into the ring, and on through the arm c^2 to the signaling battery and thence to the ground. This current causes the magnet on the carriage, E', at the left hand of Fig. 11 to lift the armature, e^3, and the spring, e^3, breaking the circuit between such spring and the ring a, and between the spring switch G g. This makes a circuit through the line 0, the magnet, E^2, the gate, a^2, the wire j, the switch G g on the right hand of

Fig. 11, the lower ring a, to the left hand spring e^5, the magnet E′, armature e^2, spring e^4, gate a^3, magnet E^2, line 5, as these parts are shown at the left hand of Fig. 11. While the current is passing through these parts, the magnet E′, at the right hand of Fig. 11, draws the gate, a', toward itself, and the magnet, E^2, draws the armature, e^2, to itself, so that the lock may be pushed by its spring, f', into position to lock and hold the circuit completed until time of unlocking and prevent any interference with the circuit as this is established on through the line 5 beyond the apparatus, A, to the subscriber wanted. The magnet E^2, as shown in the left hand portion of Fig. 11, pulls the gate back, allowing the lock to be moved in, so as to lock it and prevent connection with any other carriage as it is being moved around the different rings in the apparatus A. The insulating surface f^2 on the lock F may be replaced by a surface containing indentations, as explained in reference to Fig. 9, so that as any other carriage passes it, it may signal back the word "engaged." The current passing through the ring causes the armature of the magnet at the right hand of Fig. 11 to be attracted, so as to move the spring e^3 away from the ring, open the spring switch G and g and push the gate a' back, to permit the lock F to move into place and lock the gate. This effects the connection between the gate at the left hand and the gate at the right hand of Fig. 11, or, in other words, a connection between two gates at opposite sides of the central apparatus A. This establishes a circuit through the wire 5 to one of the rings in the opposite apparatus B, with which the wire leading from the last gate, brought into circuit by the apparatus A, is connected. The subscriber now hears in succession the signals 5—1, 5—2, 5—3 and 5—4. When he hears the signal 5—4, he again pushes the button, and, as in the cases already described, the carriage and magnet are stopped in contact with one of the gates in the division marked 5—4, so as to bring such gate into the circuit. This establishes the circuit through the wire connection with such gate to the ring in the opposite apparatus C, with which the subscriber 5—4—9 is connected. The signals are now transmitted back to him through the numbers from 5—4—0 up to 5—4—9, and when he hears the number of the subscriber that he desires to bring into the circuit, in the case supposed 5—4—9, he again pushes the button. This causes the carriage and magnet to stop in contact with the gate to which the wire 5—4—9 is connected. The circuit is now established clear through from 0—0—1 to 5—4—9, and locked for a predetermined time, before the expiration of which the unlocking cannot take place. I have thus traced the subscriber at the station 0—0—1 through its connection with the station at 5—4—9. It may happen, however, that he desires to communicate with a subscriber in his own division; as for instance, with the subscriber at the station 0—0—2. In order to establish a circuit to the station 0—0—2, the subscriber picks his way into the central station A, as I have already described. In order to establish the circuit back to the station 0—0—2, as soon after he has established the circuit to the station A that he hears the signal announcing the wires in the division 0, he presses his button and makes connection with one of the gates a to which one of the wires 0 is attached. This establishes a circuit back to the apparatus B, and after this has been done, he listens to the signals as they are announced, until he hears one of the wires in the division 0—0 announced. He then presses his button again and makes connection with one of the gates b to which one of the wires in the division 0—0 is attached. This establishes a circuit back to the apparatus C. He again listens at the signals, as they announce the different wires connected to the different gates in the apparatus C, until he hears the wire 0—0—2 announced. He then presses the button again, and makes connection with the gate to which such wire is attached. This establishes a circuit to the wire leading to the station 0—0—2, with which he desires to communicate. He can then ring his bell and cause the bell at the station 0—0—2 to be rung, so that he may communicate with the subscriber at such station. It will be understood of course, because already explained, that each division contains ten wires, so that after a subscriber has picked his way into the central station, he has nine wires, or such of them as are not engaged, to pick his way back to any station of the ten in his division. The operation of returning to a subscriber in his own division is the same as advancing from the central station to subscribers in their divisions, except that he has but nine lines in such case, besides his own, on which to operate, while in advancing he has ten.

In order to enable the subscriber to pick his way through, as above described, from his own station to that of any other subscriber with whom he may desire to communicate, the gates of each division are all numbered with the number of such division, and the rings immediately opposite such gates are provided with insultations or corrugations necesary to signal such number to the subscriber. As the circuit is established, for instance, to the central apparatus A, the subscriber hears the number 1 signaled to him ten times as the carriage passes that division. He next hears 2, then 3, then 4, each repeated ten times as the carriage passes these divisions. He then hears the number 5, when he immediately pushes his button and establishes the circuit to the next point, as already described. In order, however, to prevent his own number from being signaled back to him, and to prevent him from locking his own apparatus to his own station, a strip of insula-

tion, as shown in Fig. 12, in front of his own gate, takes the plate of the corrugations or other devices upon the ring in the central apparatus to which his gate is electrically connected.

What I regard as new, and desire to secure by Letters Patent, is—

1. A telegraphic or telephonic automatic central exchange system comprising an apparatus containing circuit wires, means at the will of the subscriber for connecting any two of them together at a central station, a locking apparatus for maintaining such connection unlocking of itself at a pre-determined time independently of the subscriber or operator, signaling apparatus for notifying the subscriber or operator of the approach of such unlocking, and means in the control of the subscriber for continuing the locking for successive pre-determined periods of time, substantially as described.

2. A telegraphic or telephonic automatic central exchange system comprising an apparatus containing circuit wires, means at the will of the subscriber for connecting any two of them together at a central station, a locking apparatus under the control of the subscriber for maintaining such connection unlocking of itself at a pre-determined time independently of the subscriber or operator, and means in the control of the subscriber for continuing the locking for successive pre-determined periods of time, substantially as described.

3. A telegraphic or telephonic automatic central exchange system comprising a main central station, branch central stations, lines connecting the main and branch central stations, a series of subscribers' stations connected to the branch central stations by circuit lines, means at a central station for connecting any two such stations together at the will of the subscriber, locking apparatus under the control of the subscriber for maintaining such connections unlocking of itself at a pre-determined time independently of the subscriber or operator, and means in the control of the subscriber for continuing the locking for successive pre-determined periods of time, substantially as described.

4. A telegraphic or telephonic automatic central exchange system comprising a series of switching and distributing apparatuses, circuit wires whose terminals are normally alternately open in relation to immediately surrounding apparatuses and alternately brought into position for connection, means at a central station for locking such circuits under the control of the subscriber, but unlocking of themselves at a pre-determined time independently of the subscriber, and means in the control of the subscriber for continuing the locking for successive predetermined periods of time, substantially as described.

5. A telegraphic or telephonic automatic central exchange system comprising an apparatus containing circuit wires, means at the will of the subscriber for connecting any two of them together at a central station, a locking apparatus for maintaining such connection, and mechanism comprising a rotatable wheel provided with a projection set in rotation by the act of locking and in a pre-determined time by means of the projection unlocking and causing the breaking of the connections of the circuit wires, substantially as described.

6. A telegraphic or telephonic automatic central exchange system comprising an apparatus containing circuit wires, means at the will of the subscriber for connecting any two of them together, a locking apparatus for maintaining such connections unlocking in itself at a predetermined time independently of the subscriber or operator, a switch at the subscriber's station, an electric battery, and a magnet arranged to hold the locking apparatus locked while passing a period of unlocking and until a new period of locking has arrived, substantially as described.

7. A telegraphic or telephonic automatic central exchange system comprising an apparatus provided with circuit wires, means for connecting any two of them together, telephonic receivers, a spring connected with the electric circuit passing through a space allotted to a subscriber and moving over a surface corrugated to correspond with the undulations of a spoken word, and a telephonic transmitting device operated by the same for throwing a signal to a subscriber's station when the spring is moving over the space allotted to such subscriber, substantially as described.

8. In a telegraphic or telephonic switching or signaling system, an apparatus containing circuit wires, means for connecting any two of them together, a locking apparatus for maintaining such connection, a movable piece provided with a projection for unlocking at a pre-determined time and with an electrical connection coming into contact with a subscriber's line before the unlocking, an electric generator, a corrugated surface corresponding with the undulations of a spoken signal, a sliding spring connection with such corrugated surface, and a telephonic transmitting device for notifying a subscriber of the approaching unlocking and breaking of his circuit, substantially as described.

9. An automatic telegraphic or telephonic exchange system comprising subscribers' circuit wires, means at the will of the subscriber for connecting any two of them together, a locking apparatus for maintaining such connection, and a time limit apparatus for unlocking the locking mechanism at a predetermined time independently of the subscriber or operator, substantially as described.

JAMES W. McDONOUGH.

Witnesses:
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