4 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.

Auxiliary Telephone-Exchange.

No. 223,201. Patented Dec. 30, 1879.

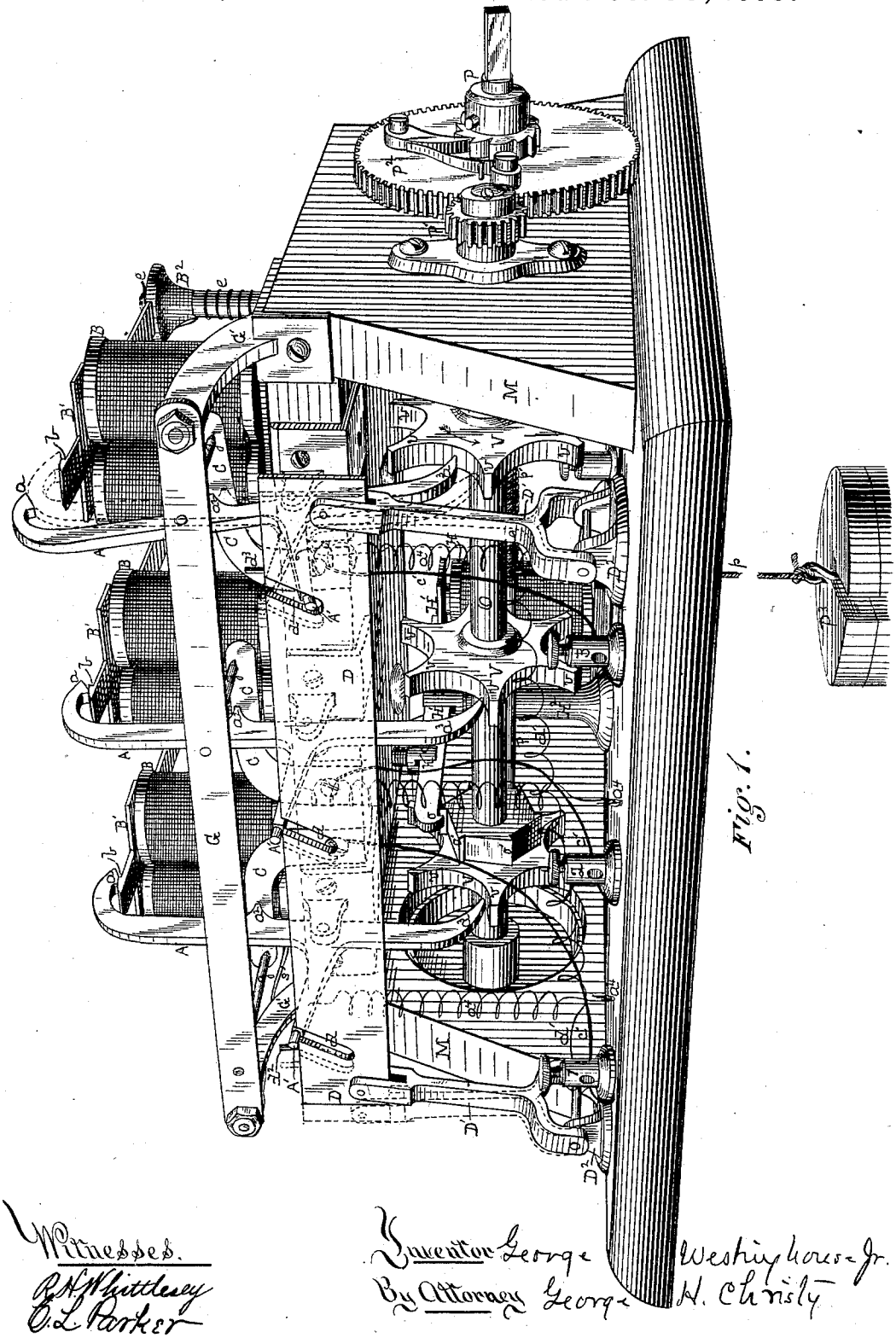

Fig. 1.

Witnesses.
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Inventor George Westinghouse Jr.
By Attorney George H. Christy

4 Sheets—Sheet 2.

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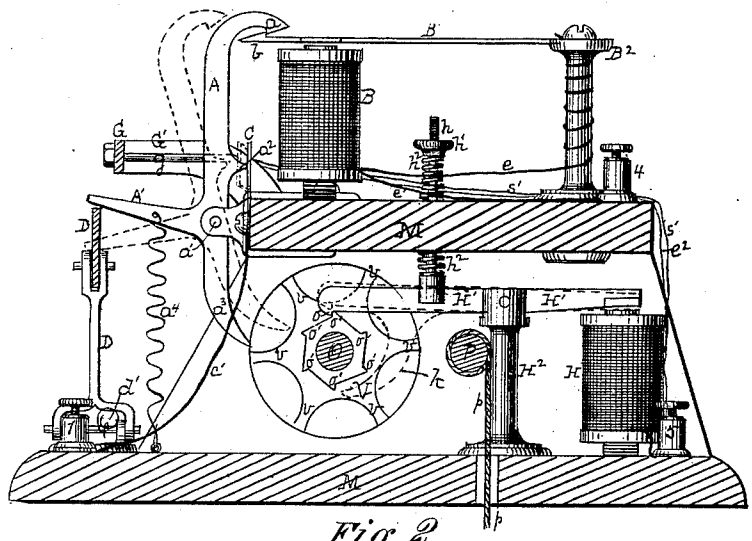

Fig. 2.

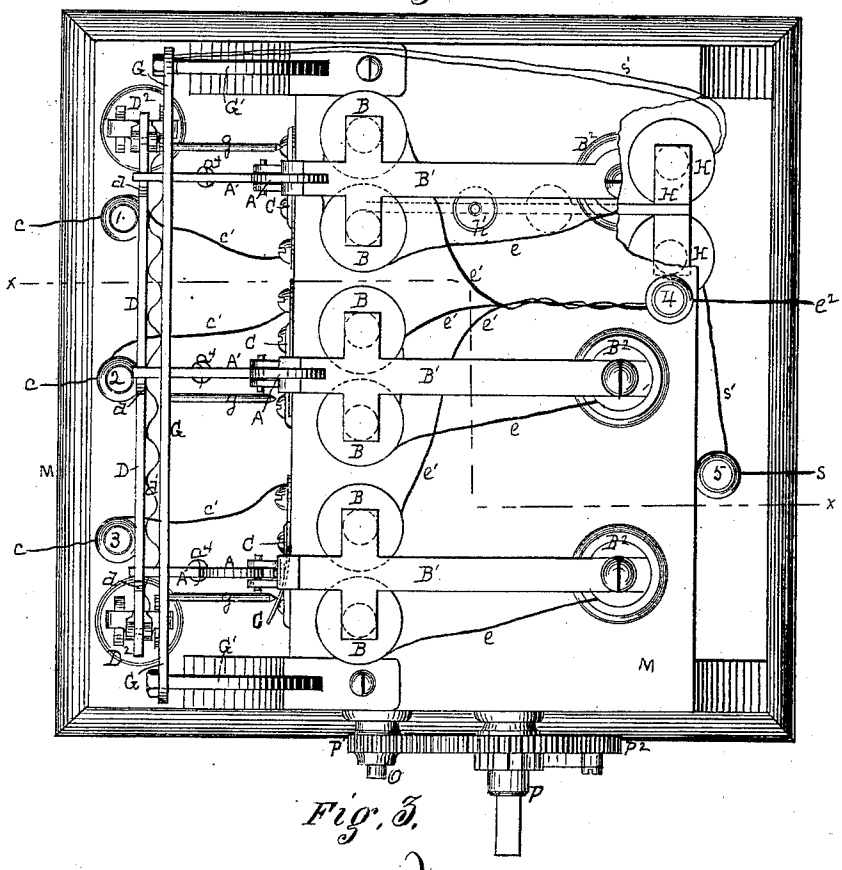

Fig. 3.

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4 Sheets—Sheet 3.

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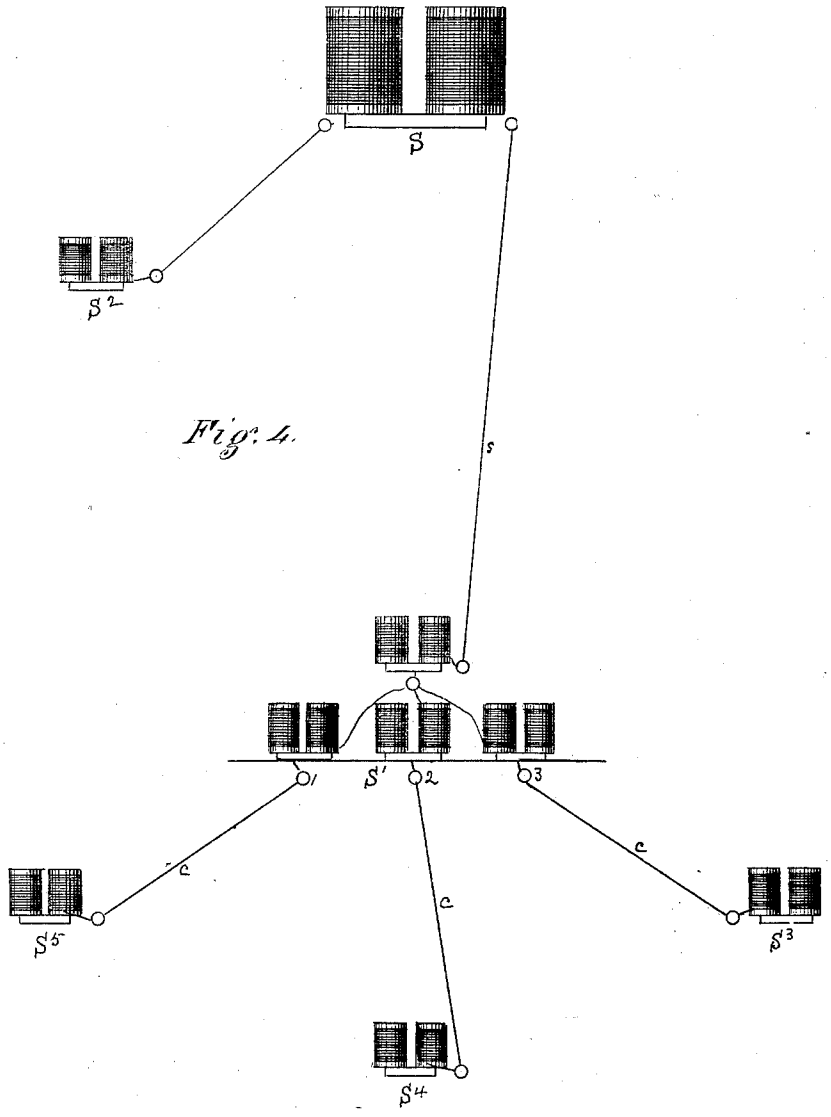

Fig. 4.

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4 Sheets—Sheet 4.

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Fig. 5.

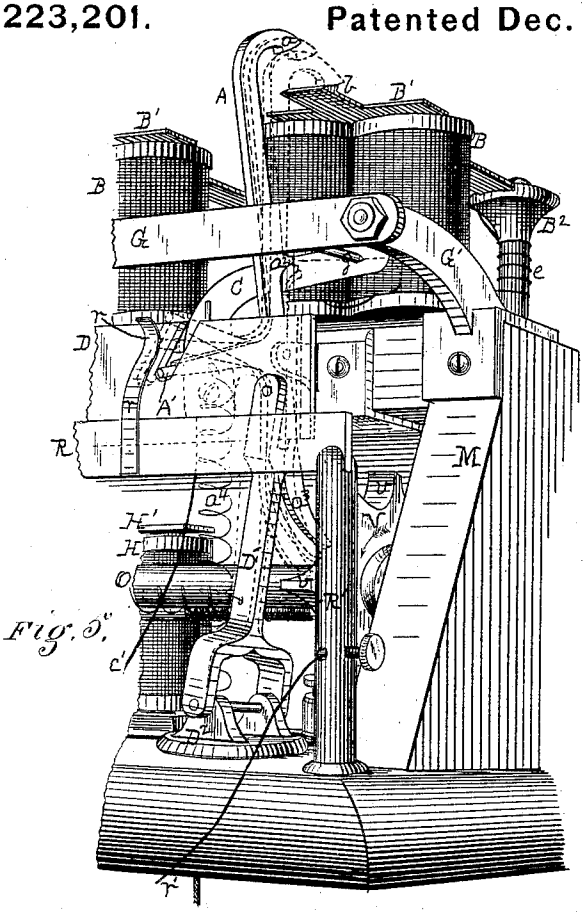
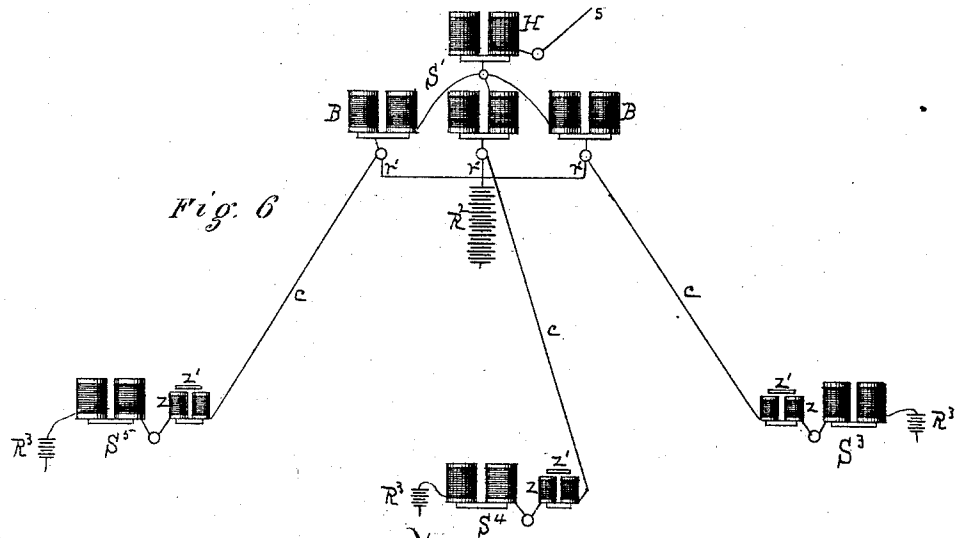


Fig. 6



Witnesses
R. H. Whittlesey
E. L. Parker

Inventor George Westinghouse Jr.
By Attorney George H. Christy

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., OF PITTSBURG, PENNSYLVANIA.

IMPROVEMENT IN AUXILIARY TELEPHONE-EXCHANGES.

Specification forming part of Letters Patent No. **223,201**, dated December 30, 1879; application filed October 11, 1879.

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful Improvement in Auxiliary Telephone-Exchanges; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

Figure 1, Sheet 1, is a perspective view of a machine illustrative of my invention. Fig. 2, Sheet 2, is a transverse vertical section thereof in the plane of the line *x x* of Fig. 3. Fig. 3 is a top or plan view thereof; and Fig. 4, Sheet 3, is an outline or plan view of stations and connections.

In the ordinary use of the telephone in our large cities, each user is connected by an independent wire with a main central office or station, sometimes called an "exchange." At this exchange the wires of the different users are switched into or out of communication, as may become necessary.

It has also been found that in suburban or outlying villages, boroughs, &c., a few miles distant from the central exchange, a few persons frequently reside who desire to be in telephonic communication at their residences with one or more of the users of telephones in the city; but the number of such suburban residents in any one locality is frequently so small that it does not pay commercially to maintain a separate local exchange for them, and the distance is so great that the cost of a separate wire for each, leading to the main city exchange, prevents them from enjoying the desired advantages and conveniences of a home telephone.

Apparatus embodying my present invention, while applicable to other purposes, is particularly designed for use at such local exchanges, which, for convenience, I will term herein "auxiliary exchanges," or "auxiliary stations," since they are in a sense auxiliary to the main or city exchange or station, and are connected with it by at least one wire. Each local or suburban user has an independent wire connected with such auxiliary exchange.

By my present invention I enable each such suburban user to call and open telephonic communication through the auxiliary exchange with the main or city exchange, and through it with any desired city user without the necessary intervention of an operator at the auxiliary exchange. In doing this he automatically locks the opening or closing connections of the other suburban users having connections with the same auxiliary exchange, so that they cannot call or interfere with his use of the line until he is through.

The invention also includes provision by which, when such user is through, the operator at the main or city exchange can restore the apparatus at the auxiliary exchange to its normal condition, so that any other suburban user can call and hold telephonic communication in like manner with a city user, and also in so doing lock out his suburban co-users as before. In this way any number of wires may be led to the auxiliary exchange, and the user of any one of them may use the main wire to the city exchange, and through it communicate with city users, at the same time locking out all others. When he is done the apparatus is put into condition for use by any other suburban user.

In Fig. 4, Sheet 3, S represents the main or city exchange; S′, a local or suburban auxiliary exchange; S^2, the office or residence of a city user, and S^3 S^4 S^5 the offices or residences of suburban users.

The intermediate wire-connections will be readily understood from the following description.

The apparatus shown in the drawings, Figs. 1 to 3, is to be put up at the auxiliary station or exchange S′; and while I have for convenience represented it as adapted for but three suburban users, it will be obvious from the following description that the number may be indefinitely extended from two upward.

The frame-work M is of any suitable form or construction, preferably of hard wood or other material of little or no conducting power; or the independently-working parts may be insulated in any convenient way.

Each suburban-line wire has an independent magnet, B, and spring-armature B′, secured to a post, B^2.

The forward end of each armature B′ has a slight hook or catch, as shown at *b*, which is engaged and disengaged, as presently explained, by a counter hook, detent, or catch,

a, on the upper end of a lever, A, which is pivoted at a to a bracket on the frame M. This lever A has a projecting arm, A′, for purposes presently to be explained, also a projecting point, a^2, and at its lower end, a^3, it is suitably shaped for a tripping function.

Across the front of the apparatus is a longitudinally-moving locking-bar, D, made of non-conducting material, or having an insulated working-face carried by pivot or sliding joints in posts D′, which latter, if a pivoting motion is desired, are pivoted in supports D^2. In this locking-bar D is a series of inclined slots, d, which, when the apparatus is in its normal condition or adjustment, come at their open ends directly under the ends of the arms A′. This locking-bar is held in this position by a spring, d', and is provided with stops d^2 d^3, for purposes which will presently appear.

Each lever A is held in its normal position by its hook a engaging the hook b on the corresponding armature, and when released from such engagement is thrown back at its upper end by a spring, a^4, connected at one end to A′ and at the other end to the frame; but an equivalent weight may be substituted therefor. Also, across the front of the apparatus is a fixed metallic bar, G, supported by metallic brackets G′ at one or both ends, but otherwise insulated. From this bar a series of metallic pins, g, project back a sufficient distance for making and breaking electrical connection, as presently to be explained.

Opposite each magnet B, I attach an insulated spring-plate, C, having a slight range of lateral or forward-and-back motion, due to its flexibility and elasticity. Its elastic portion or free end passes back of and in line with the projecting point a^2 of the corresponding lever A, and also in line with and back of the end of the corresponding pin g, and the contact points or ends of a^2 and g are so arranged that when the levers A are in their normal position, with the hooks a engaging the hooks b of the armatures, the contact-points a^2 will press the spring-plates C back out of engagement with the contact points or ends of g; but when the engagement of any one lever, A, with its armature is broken and the lever turns back, as shown at the right-hand end of Fig. 1 and by dotted lines in Fig. 2, the contact-points a^2 will go back clear of C, and the latter, by its elasticity, will come against and bear on the end or contact-point of g, except, as hereinafter stated, the lower ends, a^3, of the levers A are free.

The wires c, which lead from the residences or offices of suburban users, are secured to binding-posts 1 2 3, and a wire-connection, c', is made from each binding-post to the corresponding spring-plate C.

Each magnet B has a wire-connection, e, through its post B^2, with its armature B′, and the opposite wire, e', leads to a binding-post, 4, from which the ground-connection e^2 is made.

The main-line wire s, from the main or city station or exchange, is secured to a binding-post, 5. From this post a heavy wire-connection, s', (composed of two or more light wires, if so preferred,) leads through a heavy or strong magnet, H, to one end of the bar G, so as to be in electrical connection therewith. The function of this magnet will be passed for the present; but it will be seen that the electrical connection of the main or central exchange with the auxiliary exchange is broken when the apparatus is in its normal position—that is, with the hooks a b engaging each other. This results from the fact that such connection is made through the bar G, and the contact-points g of this bar cannot come in contact with the spring-plates C, since the latter are held clear of such contact by means of the contact-points a^2 of the levers A pressing them forward, as already stated. Hence communication from the central exchange is broken at the contact points or ends of the pins g; but the same adjustment gives an open local circuit from the wires c, through wire c', spring-plate C, contact-point a^2, lever A, armature B′, post B^2, wire e, magnet B, and wire e', to the ground-connection e^2.

Assume now, for the purposes of illustration, that each local suburban user at S^3 S^4 S^5 is provided with telephone, circuit-breaker or call-button, battery, and other appliances usual to such apparatus, and that the apparatus described is in its normal position, and that a user at S^3, Sheet 3, wishes to communicate by telephone with a party at S^2. To do this he operates his call-button or circuit-breaker. Electrical action then following the line last described depresses the corresponding armature B′, and the corresponding lever A is released from its hook, catch, or detent engagement therewith, and falls back to the position shown at the right-hand end of Fig. 1 and by dotted lines in Fig. 2. This motion results in the breaking of the contact between the contact-point a^2 and the plate C, and leaves the latter free to come by its flexibility and elasticity against the contact-point of the pin g. The magnet B of that circuit is thus cut out, and electrical action then takes place from the spring-plate C through the contact-point of the pin g, thence, through the bar G, wires s', magnet H, and main-line wire s, to the central or main city exchange, and the user at S^3, Fig. 4, is in telephonic communication with the operator at the latter station. On making known his wishes, the wire of S^2 is switched on and the parties can converse in the usual way.

It is an important feature of the present apparatus that the user at S^3, Fig. 4, at the same time that he thus puts himself in communication with the central exchange, also, by the automatic action of the apparatus, locks out the other suburban users at S^4 and S^5, so that while he is using the main-line wire in the manner described no one of them can break his connections or otherwise interfere with him.

To this end the backward motion of the lever A, as described, results in the outer end

of the corresponding arm A′ entering the underlying slot *d* of the locking-bar D, and, moving down the incline of such slot, causes the bar to travel or move to the right, to the position shown in Fig. 1. This motion of the locking-bar is sufficient in extent or range to bring the edge of the bar under or into locking engagement with the other arms A′ of the apparatus, so that so long as such bar remains in that position the other levers A will be held up and with their hooks in engagement with the hooks *b* of the corresponding armatures; and as such hooks *a* cannot then be disengaged from the armature-hooks *b*, it will be impossible for any of the other suburban users at S^4 or S^5, or other similarly-connected local points, to either put themselves into connection with the main or city exchange, or to interfere with the user at S^3 during the limited time that he is entitled to the exclusive use of the apparatus. They are effectually locked out, and must remain locked out until the apparatus is restored to its normal condition by the breaking of the main-line connection and the restoration of the local circuit of S^3 through its magnet B, and this is done by means which I will next describe.

The magnets B and the batteries connected therewith are merely sufficient in power to operate with certainty and precision the local circuits to which they belong. The magnet H is much larger and requires much more power to operate it, so that the batteries employed in the local circuits are insufficient to operate it. Hence it is not affected by any of the operations thus far described; but the operator at the main or city exchange, on learning, by inquiry, signal, or otherwise, that the user at S^3 is through, or when the limited time during which any one suburban user is entitled to the exclusive use of the apparatus has expired, switches off the wire leading to S^2, brings a powerful battery into the circuit of the main-line wire *s*, and thereby causes the magnet H to bring down the armature H′. This latter armature is pivoted to a post, H^2, Fig. 2, and its rear end has a hook detent or escapement, *o*, which has until then engaged one of a series of teeth, *o′*, on a shaft, O. This shaft O has a gear-wheel connection, P′ P^2, Fig. 1, with a counter-shaft, P, on which is wound a rope, cord, or chain, *p*, which latter carries a weight, P^3, and the weight acts in such direction as to cause the teeth *o′* in rotating to move toward, and when in engagement to press against, the hook or detent *o*.

On the same shaft O is a series of wheels, V, one opposite to each lever A, and the periphery of each wheel has a series of tappet-arms, *v*, of suitable length and arrangement, such that as each tooth *o′* passes the detent *o* a tappet-arm of each wheel will pass the lower end, a^3, of the corresponding lever A; and if any lever A is out of engagement with its proper armature, such passing tappet *v*, striking its free lower end, a^3, will tilt the lever forward at its upper end, and thereby cause the contact-point a^2 to engage the spring-plate C, clear the latter from the contact-point *g*, and cause the hook *a* to engage the armature-catch *b*. Thus the movement of the armature H′ in the manner described releases one of the teeth *o′*, and allows the movements last described, but, engaging the next tooth *o′*, permits but a single motion of the tappet-wheels V. These, however, perform their work, or, rather, the one in line with the lever A of the circuit from S^3 performs its work, as described, so that the main-line circuit through *s s′* is broken, but the local circuit, previously broken by the user at S^3, is restored, and the apparatus is again in its normal condition for further use in like manner by any person who has a wire-connection, as described, with the apparatus.

To regulate the tension and motion of the armature H′ it is hung to a vertically-moving stem, *h*, properly adjusted in position by means of a nut, *h′*, and spring h^2, each of which has a bearing on the main frame, or other suitable arrangement of adjustable spring may be employed; and to prevent the wheel V from turning too far in case the armature H′ remains too long in contact with its magnet H, I add to the armature an arm, *k*, (shown in dotted lines, Fig. 2,) in suitable position to catch a lower tooth, *o′*, in the manner of an ordinary clock-escapement, and thereby arrest the revolution of the wheel V until the armature is released from its magnets and rises, and its hook or detent *o* engages the next tooth *o′*, as already described.

It should be noted that as the apparatus is thus restored to its normal condition the end of the arm A′ which was at the base of the slot *d*, moving up against the inclined side of said slot, shifts the locking-bar D to the left, to the position shown by dotted lines in Fig. 1, in which position all the local circuits through the magnets B are unlocked and in condition for use, as already stated.

The stops d^2 d^3 simply limit the length of motion of the locking-bar.

The ratchet and pawl shown on the gear-wheel P^2, in connection with the square stem of the shaft, afford a means for winding up the weight after it runs down.

With a view to greater clearness both in drawings and description, I have omitted thus far an additional feature, which may be used or not at pleasure. Its purpose when used is to give a return-signal whenever a call is sent from a local station, as S^3 S^4 S^5, &c.

Using only such apparatus as is thus far described, a person calling at S^3 would have no means of knowing whether or not he had effected a connection by the main-line wire with the central or city exchange until the operator at the latter point (in case such connection was made) should call or signal back.

In order that a person, say at S^4, might be able to know, in case he called, whether the line was already in use from S^3 or elsewhere, and his connection locked out, I add to the

apparatus already described certain features which I have shown in Sheet 4, wherein Fig. 5 is a view, in perspective, of a portion of the apparatus of Fig. 1, with devices added for giving a return-signal, and Fig. 6 is an outline or plan view illustrative of its use.

At each front corner of the apparatus of Fig. 1 I add a metal post, such as is shown at R′, and in such posts support a metal bar, R, in such position across the front of the apparatus that a metal spring, *r*, secured thereto may come sufficiently near the pathway of the end of the arm A′ as to be touched by or have an electrical contact therewith as such an arm comes down, in the manner already described.

One of these metal springs is thus arranged opposite each arm A′. A wire, *r*′, extends from one post, R′, (or other point of electrical connection,) to a battery, R^2, at a suitable point in or near the auxiliary exchange S′, so that immediately on the breaking of one local circuit from S^3 to S′, by the disconnecting of hook *a* and catch *b*, a new circuit is for an instant formed between the same points through A′, *r*, R, R′, *r*′, R^2, and its ground-connection.

By the use of known devices suitable for the purpose at the local stations S^3 S^4, &c., this new local circuit, thus formed, may be employed to ring a bell, drop a number, or give other desired signal at such local station.

As one suitable means for effecting this purpose, I add in the line of connection from each station S^3 S^4, &c., an additional magnet, *z*, and armature *z*, with the usual connections; and it may here be stated that the batteries R^3 of these local stations are comparatively weak, and R^2 is comparatively heavy. Hence in sending a call from S^4, as supposed, in case the arms A′ are all unlocked, the armature *z*′ is not affected; but the return-circuit made on the dropping of A′ through the battery R^2, as described, acts back with such power as to depress the armature *z*′, and thereby ring the bell, drop a number, or give other signal connected therewith; but, in lieu of this means, a fixed or permanent magnet may take the place of the magnet *z*, and the positive and negative poles of the batteries R^3 R^2 be so connected that the return-current through R^2 shall temporarily demagnetize such fixed magnet and release its armature, which till then was held in contact with it. The like signaling apparatus as before described, being connected therewith, will announce at the calling-station that the main-line connection is made. As this new circuit cannot be formed except by the motion of A′, it will readily be seen that no return-signal can be given, say, to the user at S^4 until the lever A is so disengaged as to throw him into communication with the main line and main exchange. In the absence of such return-signal he may know for a certainty that he is locked out by some other user on a parallel local circuit, and that he must wait his turn.

The same return-signal devices may with like utility be used on the ordinary telephonic lines from all users to the central exchange, so that each user may know that his call has been effective at such central or main exchange. In such use it will only be necessary that the connections at the main exchange be such that a metallic piece at the central exchange be dropped or shifted in position by the making of the call so as in its motion to make an electrical contact with a suitable spring, *r*, through which, by an independent battery, to establish a return-circuit, as already described.

The invention herein described contains no separate provision, such as to enable the operator at the main or city exchange to effect a connection at the auxiliary exchange of the main-line wire with any desired wire leading to any one of the several local suburban instruments S^3 S^4 S^5, &c., and at the same time lock out the other local suburban wires or circuit-connections. An apparatus adapted to this purpose will form the subject-matter of a separate application.

In the above description I have described this apparatus as adapted for use at suburban auxiliary exchanges; but it may be used with advantage, particularly in our larger cities, at auxiliary exchanges or stations in outlying city districts, so as materially to lessen the number of main-line wires; and, in fact, at almost any point a little out of the immediate vicinity of the main or city exchange, where the wires of a number of telephones can readily be brought together so as to constitute an auxiliary exchange, apparatus of the kind described may be used with great saving and advantage.

Instead of a thousand wires from the main exchange, one to each of a thousand users, the telephone-wires of the users may be brought together in convenient groups of five, ten, or twenty (more or less) to form an auxiliary exchange, and if such auxiliary exchange be properly fitted with such apparatus as I have above described, a single main-line wire therefrom to the main exchange will suffice; and in this use of my invention it will be found practicable to group together into an auxiliary exchange the wires of the telephones used in a single building, or in a single block or square, or in two or more adjoining buildings, blocks, or squares, and thereby save the cost and expense of a separate main-line wire from the main exchange to the residence or office of each user.

I expressly include herein the mechanical equivalents of and proper substitutes for the devices described, both severally and collectively, and in particular it may be stated that any suitable connection of a pivoted lever and armature may be substituted for the hook and catch described, that any suitable movable metallic connection having two points of electrical contact in different planes may be substituted for the spring-plate C, and that any locking device which may be put in motion directly or indirectly by the closing of one circuit, so as to lock other devices, which, when

locked, will prevent the like action on a like or parallel circuit, may be substituted for the locking-bar D; and in this respect such locking-bar may be made to rotate or move spirally without any change of function, or may be moved by a separate magnet brought into action by the establishment of a connection between the main exchange and any local user, and generally the shapes and forms of all these devices, as described, may be varied at pleasure without any substantial departure from the scope of my invention.

Having now described my apparatus in detail, I would state that, with reference to the functions employed and with reference to the claims following, I would term the circuits illustrated by those from S^3 S^4 S^5, &c., through magnet B as "local" and "parallel" circuits, that the device marked A (with its mechanical equivalents) may be termed properly in such local circuits as "circuit-escapement," and that the shafts O and P, connecting gearing, &c., constitute a clock-work by which to operate the tappet-arms *v* in restoring the escapement A to its connection with its armature and reversing the locking device; but a battery-power may be employed to effect such restoration.

I am aware that in a telephonic fire-alarm repeater it is not new, broadly, to introduce a locking device which, while a signal is being transmitted over one circuit, will lock out one or more parallel circuits for a short limited time, the restoration of the mechanism to an unlocked position being effected by the running down of an auxiliary train, and not being effected at the pleasure of the operators. Hence, while such device is suitable for use in the sending of a fire-signal, which requires but a short time, it is not suitable for a telephonic system, where the length of time during which a user may desire to talk with a co-user varies considerably.

I claim herein as my invention—

1. In an auxiliary telephonic exchange having two or more local-circuit connections, a main-line connection, a ground-connection, a magnet and armature for each local circuit, a magnet of greater resistance in the main-line circuit, a series of two or more circuit-escapements adapted to break and make the local-circuit connections, and by so doing to change the contact-points from the local to the main-line circuit, in combination with a locking device which, on the breaking of any one local circuit, shall automatically be thrown or shifted into a locking engagement with the circuit engagement of the other local circuit or circuits, and on the restoration of the local-circuit connection shall automatically reverse such locking arrangement, substantially as set forth.

2. In an auxiliary telephone-exchange having two or more parallel local circuits and an escapement in each, a locking device shifted by one motion of one escapement into a locking position with reference to the other escapements, and by its other motion shifting such locking device into an open or unlocked position with reference to all the escapements, the latter motion being independent of the former, and effected at, and only at, the pleasure of the operator, substantially as set forth.

3. Two or more escapements in parallel circuits, in combination with a locking device arranged to be operated by any one of such escapements, so as to lock the others and retain them in a locked position for any desired time, and by a positive reverse action, at the pleasure of the operator, unlock them, substantially as set forth.

4. The combination of locking-bar D, having slots *d*, escapements A, (two or more in number,) having arms A′ and contact-points a^2, spring-plates C, and contact-points *g*, connected with the main line, substantially as set forth.

5. The magnet H and escapement-armature H′, engaging and releasing a clock-work mechanism, and thereby operating through a tappet mechanism to restore the engagement of escapement A with its armature, in combination with a locking device actuated from such escapement A, whereby other parallel local-circuit escapements are automatically unlocked, substantially as set forth.

6. The fixed bar G, having pins *g*, which give fixed and permanent main-line contact-points, and a magnet, H, of comparatively great resistance, in such main line, in combination with two or more magnets, B, of less resistance, arranged in parallel local circuits, a corresponding number of escapements, A, having movable contact-points a^2, and spring-plates C, arranged to make a contact with a^2 or *g*, according to the position of the escapement A, substantially as set forth.

7. A moving metallic connection at a telephonic exchange, arranged to be moved by the making of a call, and thereby brought into electrical contact with an independent battery-connection, whereby to send a reverse current over the same wire back to the caller with reference to giving automatically a return-signal at the calling-station, substantially as set forth.

8. In combination with a main line, a series of two or more parallel local circuits, a locking-bar operated from any one calling-station, and an escapement for each local circuit, a series of springs, *r*, each adapted to make an electrical contact with the corresponding escapement on the movement of the latter, and thereby, through an independent battery, send back a return-signal to the calling-station, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:
R. H. WHITTLESEY,
C. L. PARKER.