

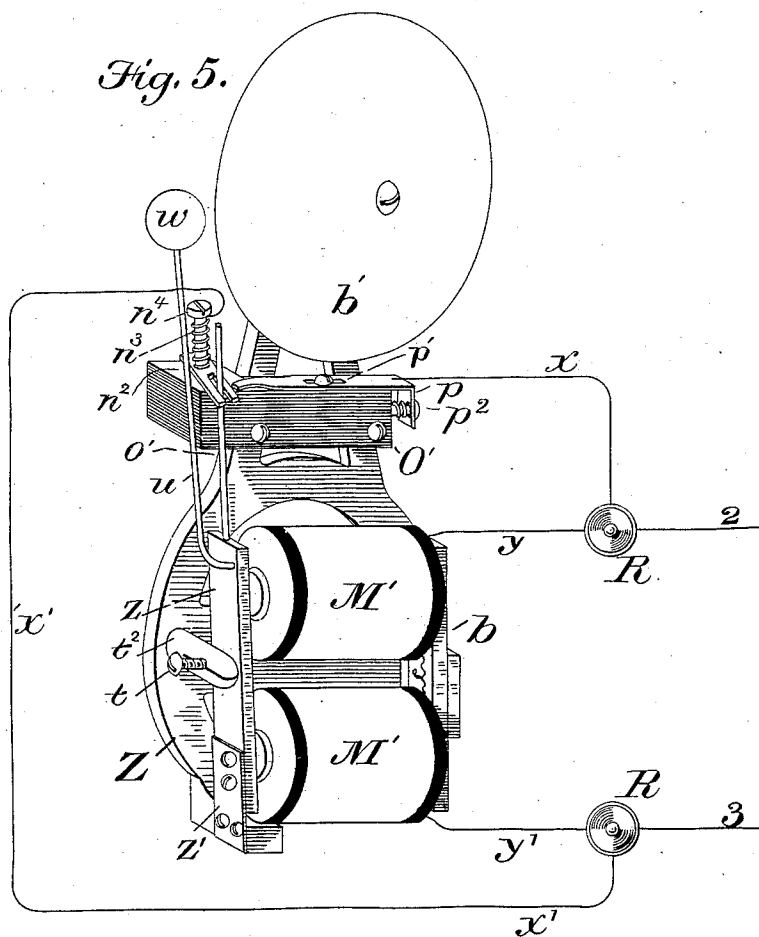
(No Model.)

2 Sheets—Sheet 2.

E. T. GILLILAND.
ELECTRIC SIGNALING APPARATUS.

No. 336,562.

Patented Feb. 23, 1886.



Witnesses.

Geo. Willis Pierce.

Geo. H. C. Trouvelot.

Inventor:

E. T. Gilliland

UNITED STATES PATENT OFFICE.

EZRA T. GILLILAND, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE
AMERICAN BELL TELEPHONE COMPANY; OF SAME PLACE.

ELECTRIC SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 336,562, dated February 23, 1886.

Application filed October 31, 1885. Serial No. 181,524. (No model.)

To all whom it may concern:

Be it known that I, EZRA T. GILLILAND, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Electric Signaling Apparatus, of which the following is a specification.

My present invention relates to electrical signaling apparatus, which, though primarily designed for use in association with telephonic circuits, may readily and without radical change be, if desired, employed in any other system of electrical communication.

The object of the invention, broadly stated, is to provide an economical, yet perfectly efficient electrical signaling mechanism, whereby any one of a number of electro-magnetic signaling-instruments connected in the same circuit may be operated from a distant station, the remaining instruments being at the same time held perfectly quiescent and inert, so that only the station wanted receives the signal.

My invention may very properly be classed with that species of individual signals in which an electro-magnetic call-instrument at each station is normally located in a shunt or branch circuit of the main line, and in which a clock-train, electrically controlled from a distant station, operates at a predetermined moment (differing for each station) to introduce the said signaling-instrument into the main line, where it may then be actuated to give the signal. Heretofore, however, such signaling devices have been subject to certain practical disadvantages, which I aim by my invention to overcome. It has been found, for example, very difficult to maintain synchronism between the several station-clocks, although they have been synchronized at the end of each operation, and for this reason there has existed a considerable degree of uncertainty regarding the ringing of the desired bell, and no other. Furthermore, it has been customary to maintain the clocks in motion from the time they are started until they arrive at the unison-point once more, and thus the moment of time during which each bell is consecutively introduced into the circuit has been extremely brief, and since each several bell has had to be rung during the brief

period during which its magnet is included in the circuit, the result has been that the ringing operator has often failed to attract the attention of the desired station, and has then had to wait until the same point could be reached a second time, thus delaying the call.

To obviate these and other practical defects I have devised the invention which is hereinafter described; and it consists in an arrangement for stopping all the clock mechanisms at a given unison-point a number of times in each complete revolution of the train, thus insuring absolute harmony between the different instruments in circuit.

It also consists in controlling the shunt-circuit-breaking device by an arbor of the clock-train near the source of power, so that when arrested it is easily started again, whereby I am enabled to develop efficient work from a comparatively feeble original power. I am enabled economically to do this by employing as the shunt-circuit breaker a large wheel or disk carrying a number of points at which the said shunt may be broken, in lieu of the small wheel having but one such point, which has heretofore been used, the frequency of the said points on the large and slow-moving wheel compensating for the diminution of speed, caused by placing the said wheel on an arbor near the source of power, which, of course, with the gain of power, involves a corresponding loss of speed.

It consists, further, in providing an automatic short-circuiting device for the calling-generator at each station, which is brought into action by the clock-trains immediately upon the starting of the same, whereby all interference from other stations is prevented during the time when the central or main station is calling any of the sub-stations, or while any of the sub-stations are signaling the central station; also, in combining with the various clock-trains and shunt-circuits a vibrating alarm-bell for each of the latter, which bell vibrates by shunting its own magnet instead of by breaking the circuit, and which is adapted to automatically control the length of time that the magnet is included in or withdrawn from the circuit.

In the drawings which illustrate my invention, Figure 1 is a front elevation of my clock

and circuit-changing apparatus with the front portion removed to show the works. Fig. 2 is a plan view of the same on the line xx of Fig. 1. Fig. 3 is a diagram of the electrical connections of each instrument. Fig. 4 is a diagram of a line-circuit, showing the signal-bells, shunt-circuits, and circuit-breaking disks; and Fig. 5 is a perspective view of the vibrating bell which I prefer to employ, showing its electrical connections.

In the practice of the invention which I am about to describe it will be understood that each of the clock-trains are normally at rest, that they may be all simultaneously released by a single electrical impulse of sufficient strength, that they may be temporarily arrested at certain specified points during their period of motion by other single electrical impulses, that they may be held at rest at such intermediate stop-points as long as may be desired by maintaining the electric current on the circuit, and, finally, that after the conclusion of a definite period of motion (whether that motion be continuous or whether it has been interrupted by stops at intermediate points) the clocks will again come to rest at the unison-stops.

What I shall hereinafter consider and term a "single" or "complete" revolution or motion of the several clock-trains is that which ensues when they are released, and which concludes when, if uncontrolled, they would come naturally to rest at the unison-stop after a certain fixed number of revolutions of the escapement-arbor. During such a revolution each normally short-circuited bell-magnet in the circuit has once for a definite period been included in the main circuit, and it has been in the power of the operator to temporarily arrest the mechanism at any of such periods, and thereupon to ring the desired bell, the magnet of which is so included as long as is considered requisite. The apparatus embodying the present form of my invention is so constructed that such a single or complete revolution involves six revolutions of the escapement-arbor which carries the unison or stop wheel or disk, this being the most rapid arbor of the train. There are two stop-points carried by this disk, one of which is a unison-stop, and the other a ringing-stop, and each of these stops may be engaged by suitable detents once in each revolution of the stop-disk, so that each time the several mechanisms are arrested at the unison-stops they are harmonized with one another, and each time they are brought to rest on a ringing-stop some special one of the bell-magnets is included in the main circuit, which one is determined by the number of revolutions the stop-disk has made prior to stopping on the ringing-point in question. For example, the bell at station No. 1 is brought into circuit by arresting the several clocks at the ringing-stops after permitting one revolution of the stop-wheel, the bell of No. 2 after permitting two similar revolutions, and so on. In my apparatus, more-

over, I have arranged a short-circuiting apparatus which is operated by a slower-moving arbor near the prime mover, so that it moves only one-sixth of a revolution while the escapement-arbor revolves six times. It consists of a metal disk having six spaces cut into its edge at equal distances apart. A contact-spring presses upon the edge of the said disk, and as long as contact is maintained between the substance of the disk and the contact-spring a short circuit is maintained round the bell-magnet. When, however, the disk in its rotation brings one of the spaces under the bearing part of the spring, contact is broken and the bell-magnet is no longer short-circuited. It is, of course, not essential that these precise rates and relations of revolution should be maintained, and, although I have adopted them as being most convenient, I do not thereby restrict myself to them, but may, if I so elect, vary them indefinitely.

I will now describe Figs. 4 and 3, inasmuch as when the electrical connections are understood, it is easy to comprehend the functions of the clock apparatus.

In Fig. 4 the controlling electro-magnets are not shown, as the object of the diagram is simply to make clear the principle upon which the several bells are normally shunted from the circuit, and, when required, are introduced into it. The central or controlling station is represented by the letter H, from which the line 1 passes through a duplicating indicator-clock, W, to the several sub-stations S, terminating at the earth at the last station. At each sub-station is a call-bell, b , normally shunted from the line by a derived circuit of low resistance, and at the central station is a battery, V, of sufficient strength, and a key, K, by which, when required, the battery may be connected to line. Instead of the key, I may use an automatic transmitting device, operating by clock-work, to emit and intermit the electric current in the circuit in the mode required to operate the several signaling devices at the sub-stations. Such a one, for example, is shown and described in the patent issued to Thomas D. Lockwood, April 8, 1884, No. 296,588. The battery V is represented as having one pole connected to the earth at G, the other pole being united by a wire, 4, to the key-anvil V'. The key K is attached to the end of the line-wire, and, when pressed, connects the battery thereto. It is to be noted that in practice the line 1 would not be left open at the key, but would of course be connected with a suitable annunciator, adapted to receive calls from the sub-stations, which, however, forming no part of my invention, I have not regarded as a necessary feature of the drawings. The wire 1, reaching the first sub-station, is represented as being in contact at S with the frame of the calling-instrument there, so that the wheel B is always in connection with the circuit. Normally the current has at each station two

routes, a direct one *via* the wheel B, contact-spring *v*, and wire 5, and one of greater resistance *via* wire 2, call-bell magnet *b*, and wire 3, which two paths subsequently unite into wire 4, which leads to the next station. The same arrangement is provided there, and also at every station in the circuit, the line ultimately terminating, as usual, at the earth at the most distant station, or being brought back by a return-wire to the central station. In the first station S the disk or wheel B is shown as having revolved until one of the notches of its edge has been brought under the spring *v*. In this case, therefore, the short circuit is broken, and the route through the bell-magnet is the only remaining one, and must accordingly be taken by the total current, so that the bell can be rung. The bells at the other station S are, however, shunted by the wheels B, and hence do not ring.

In Fig. 3 the electrical connections of the entire signaling apparatus at each station are faithfully delineated. M is the controlling electro-magnet, which operates to release and detain the clock-work; F, the sub-station calling-generator; *b*, the call-bell; B, the short-circuiting disk therefor; and *m* is a similar disk, which, when the clock-work is in motion, short-circuits the generator. When the apparatus is at rest, the spring *v* rests upon the edge of the disk B, as shown; but the spring *v'* rests over a notch or space on the edge of the disk *m*. The main-line circuit 1 enters and passes, first, through the controlling electro-magnet M, after which it continues by wire 15 through the magneto-generator F, and by wires 16, 17, and 14 to the metal-work of the clock-train, the disk B, spring *v*, wires 5 and 6 and 4, out to line and to the next station. It will be noted, however, that the wire 2, leading from one side of the bell-magnet *b*, is united to the wire 17 at *r*³, and that the wire 3, leading from the other side of the bell-magnet, unites at the point *r*⁴ with the wire 6, thus forming an alternative path in parallel circuit with the wire 14, disk B, spring *v*, and wire 5. The branch through the bell-magnet has, however, a much higher resistance than the branch through the disk B, and the amount of current passing through the bell-magnet, when thus shunted by the disk B and spring *v*, is practically *nil*, and has no effect on the bell. If, however, the disk B is revolved by the clock-work until one of the notches or spaces *n* passes under the contacting part of the spring *v*, the shunt-circuit is broken, and the whole of any current traversing the line passes through the bell-magnet, energizing the same and producing the call. As hereinbefore indicated, the disk B performs but one-sixth of a revolution during one complete trip of the clock-movement. Consequently for each sixth part of a revolution of the said disk the bell-magnet is introduced once into the circuit, there being six spaces on the edge thereof. In like manner the generator F is shunted by

a parallel circuit comprising the wire 1, spring *v'*, metal disk *m*, metal-work of the clock-train, and wire 14, the wire 1 being united to the wire 15 at the junction-point *r* on one side of the generator, and the wire 14 to the wire 17 at the point *r*³ at the other side of the generator. There is, however, this difference, that whereas the bell-magnet is normally shunted, so that it may only be affected when it is desired to call that station, the spring *v'* is normally, when the apparatus is at rest, opposite one of the spaces *n* on the edge of the disk *m*, so that it is not in contact with the edge of the said disk. The object of this arrangement is, that when the line is not in use any sub-station operator may manipulate his generator and send call-signals to the central station, but that as soon as the line is in use and a call is in progress the disk *m* moves the notch away from the spring *v'*, and the generators of all the stations are thus simultaneously shunted, and thus all stations are prevented from interfering with the line during a call, since even though they should operate the generators the electric pulsations developed would not pass to line, but would merely traverse the shunt-circuit. There is, moreover, another difference between the arrangement of the two short-circuiting disks *m* and B. The disks *m* at each station are set alike, so that one of the spaces *n* is uniformly in each instrument under the spring *v'* when the instruments are at rest on the unison-stops, so that any generator F on the circuit may be operated to call the central station, whereas the disks B at each station are adjusted differently, so that the spaces *n* will pass the springs *v* at a time differing for each station; and by this arrangement no two bells can be introduced into the main circuit at the same time, and consequently no two bells can be rung at the same time.

All the necessary movements of the disks are performed by the clock-work A, which in respect to its condition of motion or rest is controlled by the electro-magnet M. The clock train may be actuated either by spring or weight, and terminates in the arbor K, which carries a drag escapement-wheel, N, and the stop or unison disk, *o*. The escapement of course is engaged by the pallets of the escapement-lever E, which thereby acts as a drag, brake, or governor for the train of wheels. On the arbor *k'*, I mount the generator-shunting disk *m*, the bell-magnet-shunting disk B, and a third notched or spaced disk, L, which disk L has a function, which will hereinafter appear. Since the disks *m* and B perform one-sixth of a revolution during one operation of the train, it is obvious that during each of said revolutions one of the notches *n* passes under the contact-springs *v* and *v'*, thus momentarily breaking the electrical connection between the said springs and the metal-work of the clock-train.

The disks B of all the clocks are not rigidly

attached to the arbor, but move therewith by being fastened by the screw j to the companion disk m , as shown in Fig. 2. The disk m has as many threaded holes for the reception of said screws on one segmental portion of its side, limited by two adjacent notches, as there are to be stations in the circuit, and the disk B may be set to introduce the bell-magnet of any station, by changing the screw j from one hole to another of the inner disk, m , there being but one hole through the outer disk, B . Thus, to ring the bell at station No. 1, the screw j will be inserted in the first hole to the right, which will bring the notch n under the spring after the unison-disk o has performed one revolution. As shown in Fig. 1, the disk is set to ring the bell of station 5. The object of this setting device is simply to allow for the interchangeability of the several clocks, so that if a clock which has heretofore served station No. 1 upon a circuit should be transferred to some other station—say No. 5—it is corrected so as to serve the latter simply by changing the screw j from hole No. 1 to hole No. 5 of the disk m .

The contact-springs v and v' are mounted on a non-conducting block, v'' , which is screwed in any preferred way to the frame-work of the machine.

The controlling-magnet M is provided with an armature, a , attached to a side rod, a' , which is hung on the frame brace or rod R . When unattracted, it is supported in position near to the poles of the magnet by the spring-bar q , which is rigidly fixed at the point Q , and which has the height of its free end regulated by the adjusting-screw g . I am thus enabled to regulate the distance of the armature from the poles. A stop-lever, f , is also hung by its arms f^2 and f^3 to the brace-rod R , so as to move freely thereon, and is, moreover, provided with an arm, f' , projecting inwardly at a right angle to the lever and resting lightly upon the armature a . Between the lever f and the armature a is the fourth disk, L , which is mounted on the same arbor, k , that carries the disks m and B . This disk also has six notches upon its edge, although the purpose it subserves is altogether mechanical. When the clock is at rest, the arm f' lies in some one of these notches, and a complete revolution of the clock brings the next notch under the said arm. The free end of the lever f is also bent at a right angle and crosses the edge of the unison-disk o . When at rest, with the arm f' lying in the notch of the disk L , the hook end is sufficiently low to engage with the projection h on the edge of the unison-disk o , and thus to hold the clock mechanism quiescent at its unison-point.

When, by the action of the armature, the lever f is lifted from the stop h , the clock-work moves and the disk L rotates, passing the notch from under the arm f' , which, as the armature once more falls, is compelled to ride upon the edge of the disk until the next notch

reaches it. When this occurs, which is an instant before the unison-stop reaches the hooked end of the lever, the arm f' once more falls into place, the lever f is lowered, and on the arrival of the stop h it is engaged and the motion of the clock-work is arrested. The stop h , it will be seen, projects not only in a radial direction, but also a short distance in a direction vertical to its face. There is also a second stop, i , which may be called the "ringing-stop." Both of these are adapted, under certain circumstances, to be engaged by a second and auxiliary stop-lever, k^2 , which is hung also on the same brace-rod, R , and which is likewise rigidly attached to the side of the armature a , and has its end turned at a right angle toward the disk. By reason of this rigid attachment to the armature it will be seen that the auxiliary stop-lever must partake both of the upward and downward motion of the said armature, and can in no degree be independent thereof, as is the lever f ; hence, when the armature moves upward, under the attraction of the electro-magnet, it is at once brought into the orbit of the side projecting stops, h and i , and the stop which first approaches the bent end of the lever k^2 will be engaged thereby, stopping the movement of the mechanism. The lever can, however, only come into action when the armature is attracted. When the armature rests against its rear limit, the angular end of the lever lies on a horizontal plane below the orbit of the two stops, and is therefore not in position to be engaged by them. It follows, then, that if the apparatus be released by a single pulsation of electricity, which is not succeeded by others, the armature will be attracted for a moment and will instantly fall back. The clock-work, released by the elevation of the lever f , will move. The lever f , once raised, will remain elevated, its arm riding on the edge of the disk L until the next notch on the edge of the said wheel reaches it, when it will fall in the said notch and stop the clock-work at unison after six complete revolutions of the disk o have been made. If, however, after the clock-work has been started by such a single pulsation, the circuit be held closed by a key controlling a battery or otherwise, or if the current be thrown off and instantly thrown on again, the pin i will engage the end of the lever k^2 , and the clock-work at each station will be stopped, but not at the unison-point. It is also evident that if the circuit be held open, or the current withdrawn from the line for a period sufficiently long to allow the stop i to pass the end of the lever k^2 , and then closed or reapplied, the stop h will, on the completion of its first round, engage the bent end of the lever k^2 and stop the mechanism.

The time which the disk o requires to move from a position when stopped on h to the ringing position on i , I designate as the "short interval," and the time required to move from the position when stopped on h to the same

stop on the next revolution I designate as the "long interval." The several shunting-disks B are so adjusted on their arbors that each time the stop i engages with the end of the lever k^2 the notch n of some one station is in the act of passing below the contact-spring v , and therefore as long as the stop i is so engaged the bell-magnet at such station is included within the circuit and the bell may be rung. For example, No. 1 bell may thus be introduced and rung when the stop i passes the end of the lever k^2 the first round of its six revolutions, No. 2 bell on the second revolution, and soon. By operating this mechanism I am enabled not only to ring any desired bell, to the exclusion of the others, but also to bring all the clocks connected with the circuit to unison six times during each continuous motion, or once in each revolution of the disk o , whereby absolute and exact synchronism is fully insured.

I do not restrict myself to any special form of alarm-bell, since it is obvious that any bell which will ring with electric currents of a character to which the controlling-magnet armature will not respond will act efficiently. For instance, I may provide a magneto-bell of the ordinary and well-known form, in which case, after bringing the clock-work of any desired bell to the ringing-point, the battery-current will be retained in connection with the line, and an alternating magneto-electric current from a magneto-machine superposed thereon, in which case it would be essential to provide a controlling electro-magnet, M, with long cores, which would discharge slowly, so that the attraction of the armature would not be interfered with by the ringing-current. I prefer, however, on the score of simplicity in construction and economy in operation, to employ a bell of the character shown in Fig. 5. The said bell b is one of the vibrating or trembling class; but its vibrating feature is effected, not by the alternate and automatic make and break of the circuit, (which in the present case is inadmissible, seeing that a make and break would inevitably affect the controlling-magnets at each station, producing great uncertainty of action,) but by causing the forward stroke of the armature to shunt its own magnet. The electro-magnet M' is—as is likewise the gong b' —supported upon a base, Z, and is provided with an armature, z , hung upon a flexible spring, z' , and having for its back limit the adjustable screw t , held in the post t^2 . The armature z is provided with a hammer-rod, u , carrying the hammer w , and has also projecting in the same direction a second rod, o' , the end of which plays between the tines of the fork n^2 , which fork is loosely attached by means of the screw-pin n^4 to the block O'. To prevent any unsteadiness, a spiral spring, n^3 , gives a certain pressure to the fork, which is adapted to move from side to side when acted upon by the rod o' . The block O' is of some suitable non-con-

ducting material, and supports, also, a contact-plate, p , held firmly, but elastically, in place by the screw and slot p' , and the screw and spring p^2 . R R are the binding-screw terminals of the bell. The main-circuit wire 2, entering, passes by wire y to the electro-magnet, and out by wires y' and 3. A wire, x' , runs from the main wire 3 to the fork n^2 , or its metal connections, and another wire, x , from the incoming main wire 2 to the contact-plate P.

The operation of this bell is obvious. When the ringing-current passes through the magnet, the armature is attracted and advances, ringing the bell. After it has advanced nearly to its full stroke, the rod o' reaches the forward tine of the fork, swinging the said fork round and into contact with the plate P. A shunt-circuit is thereby closed round the bell-magnet, 85 which thereupon parts with its energy, permitting the armature to fall backward; but the arm o' , after traveling back a portion of its stroke, strikes the other tine of the fork n^2 and swings it round, breaking again the shunt-circuit and initiating anew the entire operation. A bell of this class is essential, if a vibrating bell operated by battery-currents is desired, since a bell, vibrating by make and break of the circuit, would necessarily affect 95 the clock-controlling electro-magnets. It is to be noted that the space between the tines of the fork must be wide enough to permit a considerable traverse of the rod o' in either direction before the fork is struck by it, and by the combination, with a shunt-vibrating bell of the said fork, the efficiency of such a bell, is greatly increased, since it permits the armature and hammer to travel nearly the full length of their stroke before the power is cut off. 105

In the operation of the entire system let it be supposed that No. 5 bell is to be rung. The operator at the central station presses his key once, connecting the battery to the line. The magnets M are all simultaneously vitalized and attract their armatures, releasing the clock-trains. The key is, however, instantly released, and the armatures fall back. The clocks do not stop, because the main stop-lever is caused to ride on the edge of the disk L. When the operator sees by his indicator W that the first revolution is about three-quarters made, he presses his key again. The armatures are again attracted and the auxiliary stop-levers k^2 are thrown into the orbit of the stops on the unison-wheels and, as soon as the stops h arrive thereat the clocks are all brought to rest at the complete revolution of the stop-wheel o . This is repeated five times, the circuit being opened by permitting the key to rise each time sufficiently long to allow the ringing-stop to pass. After the clocks have thus been synchronized five times by stopping them all at the close of each of the five completed revolutions of the stop-disk o on the unison-stop h , the key is opened once more, but only for an

instant, and is immediately closed again, having given the stop-wheel only time enough to pass from stop *h* to stop *i*, which now engages with the lever *k*. The clocks in circuit are

5 thus all stopped after an operation in which the circuit has been broken five times for a long interval, denoting the number of the bell to be rung, and one short interval in addition. At this point the notch *n* of bell No. 5 is below the contact-spring *v*, and the bell-magnet shunt is accordingly broken. The bell itself responds to the line-current and rings.

10 It is possible, of course, instead of stopping the clocks at each revolution of the disk *o*, to permit them to run, watching the indicator until the ringing-point of the required bell is nearly reached, when it may be stopped thereat; but by so doing synchronism is imperiled, and I regard the stopping feature and the mechanism whereby it may be accomplished as one of the most valuable features of my invention.

As hereinbefore indicated, the generators are normally included in the main circuit, so that any station can call the central station when the line is not in use; but as soon as the clocks are started by the action of either central or sub station the disks *m* make contact with their springs *v'*, short-circuiting all the generators, which remain cut out until the completion of any ringing operation.

Having now fully described my invention, I claim—

1. The combination, substantially as hereinbefore described, of a series of electrical signal-receiving instruments located at separate stations on a main-line circuit connecting with a central station, a normally-closed shunt-circuit round each of the said signal-receivers, a circuit-breaking disk included in said shunt, a series of electric signal-transmitting instruments also located at the separate stations, a normally-open shunt-circuit round each of the said signal-transmitters, and a circuit-closing disk included therein, said disks being mounted on the arbor of a clock-train, at each station actuated from the central station, whereby any one of the said signal-receivers may be brought into the main-line circuit and operated to give the signal, and whereby the signal-transmitting instruments at all the stations are simultaneously shunted during the entire operation, so that no station may interfere while another is being called.

2. In an electric signaling-circuit, a series of electro-magnetic call-receiving instruments, a series of magneto-electric call-generators, a normally-closed shunt-circuit round each call-receiving instrument, including a circuit-breaking disk, a normally-open shunt-circuit round each generator, including a circuit-closing disk, a clock-train normally at rest, controlling the condition of both of the said shunt-circuits by means of said disks, and an electro-magnet armature and stop-levers adapted to be actuated from a distant central sta-

tion, controlling the said clock-train, substantially as specified, and for the purposes set forth.

3. The combination, in an electrical signaling circuit, of a series of electro-magnetic call-receiving instruments located at different sub-stations on the said circuit, a normally closed shunt-circuit round each of the said instruments, a circuit-breaker in each shunt-circuit, a series of clock-trains—one for each instrument—controlled by electro-magnets in the main-line circuit, and adapted to operate the several shunt-circuit breakers consecutively, each in its own time, and a secondary or auxiliary stop mechanism, also controlled by the said electro-magnets, whereby the several call-receiving instruments may be consecutively introduced into the main-line circuit, and whereby the clock-trains may be arrested when any selected receiving-instrument is so introduced for the purpose of operating the said instrument, and of giving the call-signal as long as may be desired.

4. In an electric signaling system comprising a series of signaling-instruments at different stations, and a series of clock-trains therefor adapted to introduce each of said instruments into the line once during a complete revolution, the combination, with the controlling electro-magnet at each station, of unison-stop mechanism operated from a fast moving wheel of said train, whereby all the clock-trains may be synchronized a number of times during each single or complete revolution thereof, substantially as described.

5. The combination, substantially as hereinbefore specified, of a series of electro-magnetic call-bells, each in a normally-closed shunt or derived circuit of an electric main-line circuit, a circuit-breaker for each bell-shunt circuit, a clock-motor controlling each circuit-breaker and adapted to operate the same each at a time differing from the others, to include the said bells in the main-line circuit, one at a time successively, a unison-stop mechanism for each clock-motor, controlled by an electro-magnet in the main-line and adapted to release the clock-work and to re-engage and arrest the same at its normal point of arrest after a revolution in which the circuit-breakers of each instrument have been once operated, and an independent and auxiliary stop mechanism for each clock, controlled by the same electro-magnet and arranged and adapted to stop the clocks at each complete revolution of the escapement-arbor, and also at the ringing-point of any desired call-bell, whereby the said clocks may be synchronized a number of times during each period of motion, and whereby any desired bell may be independently rung.

6. The combination, in an individual signaling-instrument controlled by a shunt-circuit of the main-line, and a clock-motor to break the said shunt-circuit at the proper time, of the contact-spring *v* and the notched metal

disk B, the latter being mounted on a slow-moving arbor of the clock-work, constituting a circuit-breaker of the said shunt-circuit, the said disk being thus adapted to break the said shunt-circuit a number of times in each revolution thereof, and to perform a portion of a revolution only during a complete period of motion of the clock-motor from unison to unison, as and for the purposes specified.

7. The combination, in an electrical signaling-instrument substantially of the character hereinbefore described, of an electro-magnet call-bell, a normally-closed shunt-circuit, a clock motor, a circuit-breaker for the said shunt-circuit, consisting of a notched metal disk mounted on a slow-moving arbor of the said clock-motor and a contact-spring resting on the edge of the said disk, an electric call-generator, and a normally-open shunt-circuit therefor, a circuit closer therefor consisting of a second disk mounted on the same arbor and a contact-spring normally resting opposite a notch of the said disk, adjusted to trail on the edge thereof and close the shunt-circuit during the motion of the said disk, a unison-stop mechanism adapted to hold the clock-motor normally at rest, and when disengaged therefrom to re-engage the same automatically and stop the clock again at the normal resting-point after the elapse of a predetermined period of time, the said mechanism comprising a disk mounted on the escapement or fast-moving arbor of the train and a stud projecting from the edge thereof, together with a fourth notched disk mounted on the same arbor with the circuit breaking and closing disks, a pivoted lever normally engaging the stud on the edge of the escapement-disk and having a projecting arm controlled in one direction by the armature of an electro-magnet and lying in one of the notches of the fourth disk when the clock is at rest, but elevated by riding on the edge thereof when the clock is in motion, and a synchronizing and ringing auxiliary stop mechanism comprising the escapement-arbor disk, the stops *h* and *i*, carried thereon, and a lever rigidly attached to the electro-magnet armature and adapted to engage the said stops when the armature is operated after long and short intervals, the stop *h* representing the unison-point and the stop *i* the ringing-point of some one bell, substantially as described.

8. An electric signaling-circuit extending from a central station to a series of sub-stations, in combination with a battery, and a key to connect the same in circuit, and at each sub-station an electro-magnetic call-bell adapted to give a continuous ring by shunting its electro-magnet at every stroke, a shunt-circuit normally shunting the said bells, a circuit-breaker for the said shunt-circuit, a clock-work motor normally at rest and adapted, when set in motion, to operate the circuit-breaker at a time different for each bell in the circuit, a normal unison-stop mechanism of the charac-

ter herein described, and a synchronizing and ringing stop mechanism, substantially as and for the purposes specified.

9. The combination, in an electric circuit, of a battery, a key or circuit-closer to connect the same, a series of electro-magnets controlling clock-trains included in the said circuit, and one or more vibrating bells, each operating by shunting its own electro-magnet, whereby the operation of the bells is prevented from interfering with the clock-train-controlling electro-magnets, as herein specified.

10. The combination, in an individual signaling-instrument, of an electrically-controlled clock-train, with the normal unison stopping and starting mechanism, comprising the escapement-disk *o*, the stop *h*, carried thereby, the lever *f*, having an arm, *f'*, projecting therefrom at an angle, the armature *a*, and the retaining-disk *L*, adapted to support the lever *f*, and to prevent its re-engagement during the continuance of a revolution with the stop *h*, and the synchronizing stop mechanism comprising the stop *i* and lever *k*, all arranged as set forth, and in the manner described.

11. The combination of an electro-magnetic signaling device, a short circuit normally surrounding the same, a clock-motor, a disk mounted on the escapement-arbor of said clock-train, carrying unison and ringing stops, and adapted, when the clock-motor is released, to make six complete revolutions before it automatically comes to rest at unison, a disk mounted on an arbor geared so as to make but one-sixth of a revolution during the time required for six revolutions of the escapement-arbor disk, and having on its edge a number of notches equidistant from one another, and a contact-spring adapted to bear normally on the edge of said disk, constituting a circuit-breaker for the shunt-circuit, but to be passed by one of the said notches in the disk in each sixth part of a revolution of the said disk, whereby the shunt-circuit may be broken, for the purposes specified.

12. The combination of two circuit wheels or disks moving together, both of which are provided with conducting-faces, except at certain points, at equal distances apart, the distance between each two points being a sub-multiple of the circumference of said disks, with two contact-springs—one for each disk—and two separate shunt-circuits adapted to short circuit call receiving and transmitting devices, the shunt-circuit round the transmitting device being open when the disks are at rest and closed by the action of one of the said disks and the circuit-spring thereof during the motion of the same, and the shunt-circuit round the receiving device being normally closed and adapted to be opened for a definite period once by the action of the other disk and its contact-spring during each period of motion of the said disk, substantially as hereinbefore described.

13. In an electric signaling apparatus, the

combination of two circuit-controlling disks
on the same slow-moving arbor of a clock-
train, each of which is adapted to close and
open a separate shunt-circuit, with a third
5 disk on a fast moving arbor of the same clock-
train, an electro-magnet-armature, and stop
mechanism controlled thereby, which stop
mechanism is adapted to stop the said third
disk and the clock-train at a common unison-
10 point at the close of each revolution of the

said third disk, or at a ringing-point, as herein
specified.

In testimony whereof I have signed my name
to this specification, in the presence of two sub-
scribing witnesses, this 28th day of October, 15
1885.

EZRA T. GILLILAND.

Witnesses:

GEO. H. E. TROUVELOT,

GEO. WILLIS PIERCE.