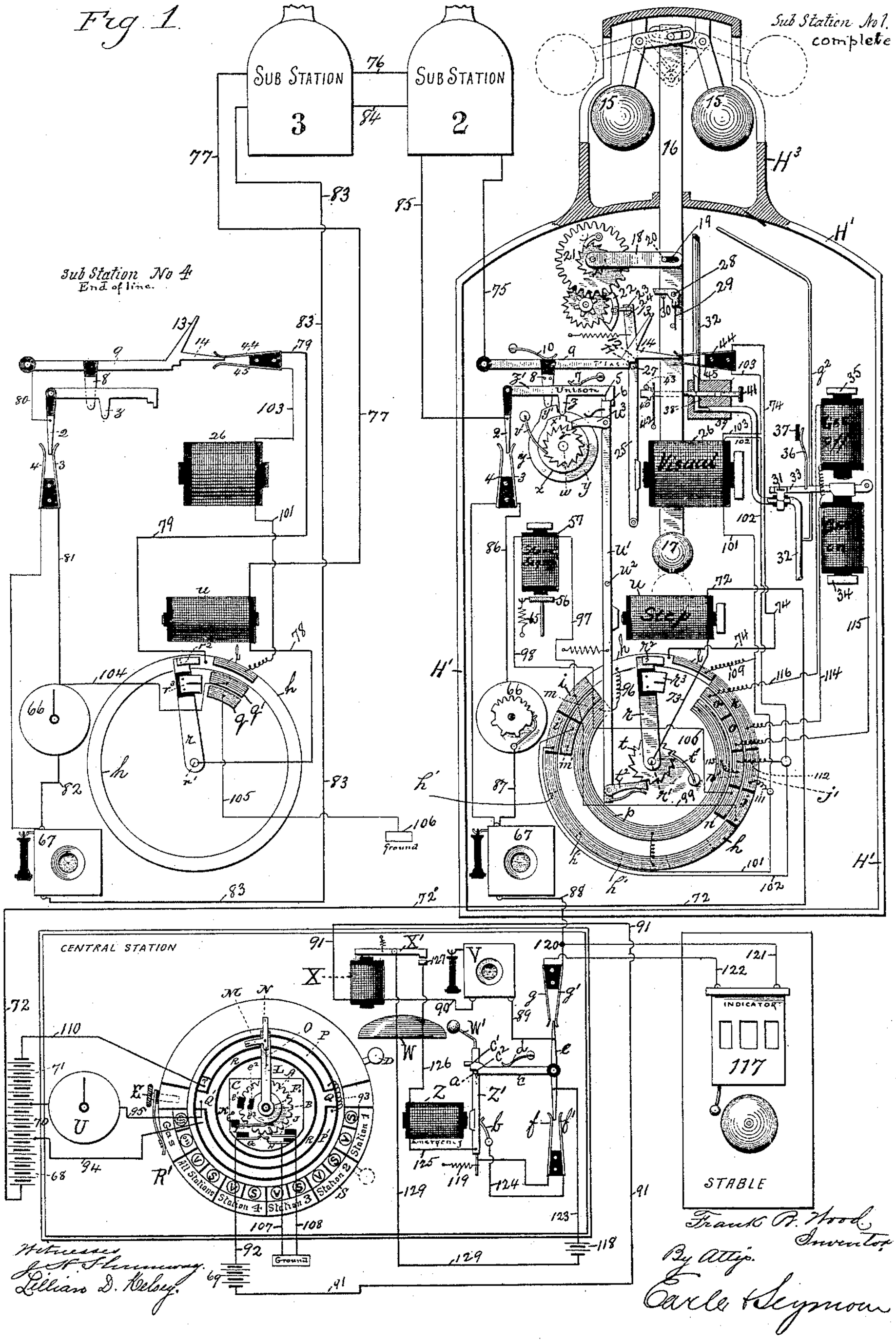
(No Model.) 2 Sheets—Sheet 1.

F. B. WOOD.

ELECTRIC SIGNALING SYSTEM.

No. 462,345. Patented Nov. 3, 1891.

Fig. 1.



Witnesses
J. H. Flannery.
Lillian D. Kelley.

Frank B. Wood.
Inventor
By Attys.
Earle & Seymour

(No Model.) 2 Sheets—Sheet 2.

F. B. WOOD.

ELECTRIC SIGNALING SYSTEM.

No. 462,345. Patented Nov. 3, 1891.

Fig. 4

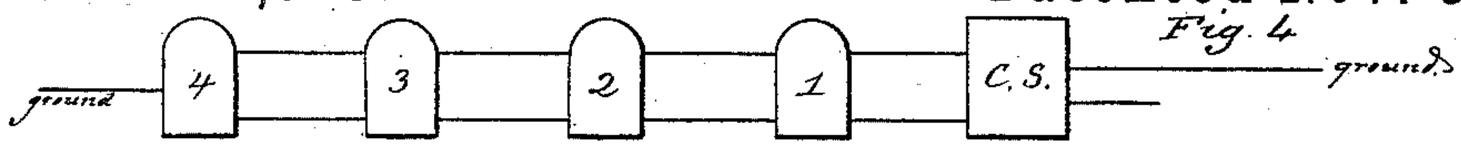


Fig. 2.

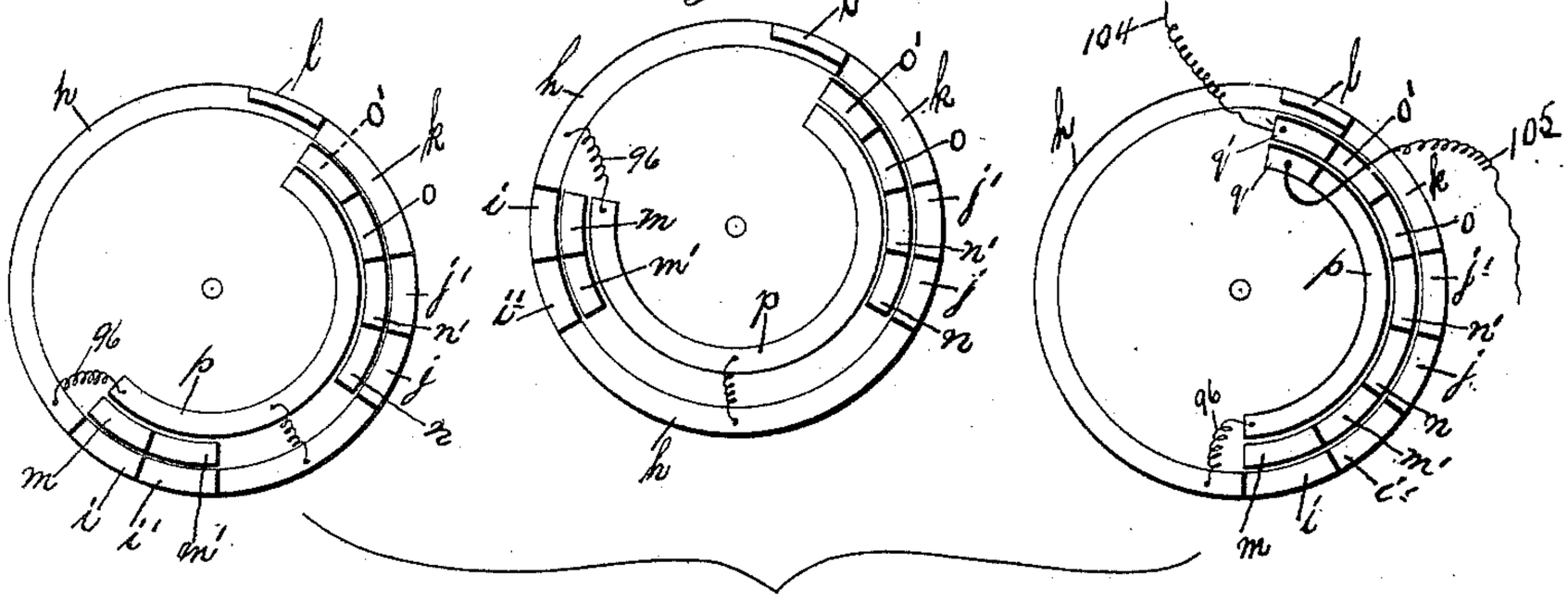
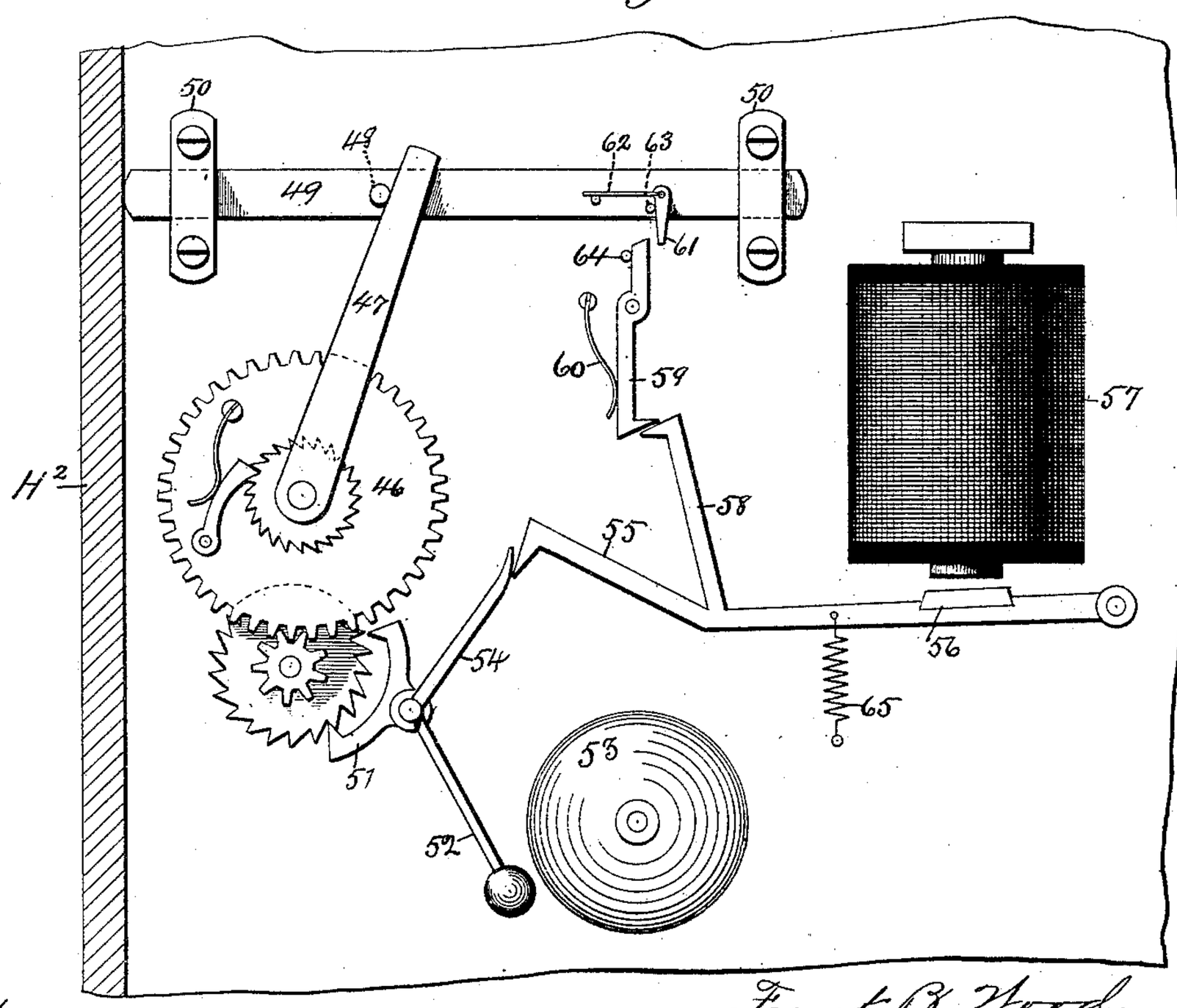


Fig. 3.



Witnesses
J. H. Shumway.
Lillian D. Kelsey.

Frank B. Wood.
Inventor
By attys.
Earle & Seymour

UNITED STATES PATENT OFFICE.

FRANK B. WOOD, OF NEW YORK, N. Y., ASSIGNOR TO THE BREWER & SMITH VISUAL SIGNAL COMPANY, OF NEW HAVEN, CONNECTICUT.

ELECTRIC SIGNALING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 462,345, dated November 3, 1891.

Application filed January 6, 1890. Serial No. 336,083. (No model.)

To all whom it may concern:

Be it known that I, FRANK B. WOOD, of New York, in the county of New York and State of New York, have invented new Improvements in Electric Signaling Systems; and I do hereby declare the following, when taken in connection with accompanying drawings and the letters and figures of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification.

My invention relates to an improvement in electric signaling apparatus of the type designed to provide for intercommunication between a central station and a series of sub-stations, the object being to provide for operating the sub-stations individually or collectively from the central station, to provide for sending in calls from the sub-stations at the same time a sub-station is being operated from the central station, to provide for the storing of a signal at any or all of the sub-stations, to provide for turning the gas on or off in all of the sub-stations, to provide for flashing the gas-jet in any or all of the sub-stations, to provide for automatically transmitting emergency calls from the sub-stations through the central cention to another point, and to promote the general efficiency of a signal service by furnishing a simple, convenient, and effective apparatus.

With these ends in view my invention consists in a central station and a series of sub-stations located on a single-wire metallic circuit; in a single-wire metallic circuit passing through a series of sub-stations and means located at the central station and at the end sub-station of the series for splitting the said circuit into two ground metallic circuits; in a single-wire metallic circuit passing through a series of sub-stations, means located at the central station and at the end sub-station of the series for splitting the circuit into two ground metallic circuits, the multiple call-boxes, the telephones, and the apparatus of the sub-stations being located in the circuit, so that when the same is split the call-box and the telephone will be on one of the ground circuits and the apparatus on the other ground circuit; in a stored signal mechanism located at each sub-station and adapted to be set from the central station and to be released at the sub-station when the door of the same is opened in flash-light mechanism; in means for automatically transmitting an emergency call through the central station to a stable in the precinct in which the apparatus is placed, and in certain details of construction and combinations of parts, as will be hereinafter described, and pointed out in the claims.

In the accompanying drawings I have chosen to show my improved apparatus in its adaptation to police service, for which it is primarily designed, although not limited for use in that capacity.

In the said drawings, Figure 1 is a view, partly in the nature of a diagram, showing four sub-stations, a central-station apparatus, and a stable apparatus, one of the sub-stations being shown complete, two in outline, and one in part. Fig. 2 is a view embracing the switches of sub-stations 2, 3, and 4 to show the progressive arrangement of the individual calling-segments therein. Fig. 3 is a detached view in side elevation of one of the stored signal mechanisms, and Fig. 4 is a simple diagram showing the location of four sub-stations on one metallic circuit leading from a central station and returning thereto.

For facilitating the tracing of the circuits I have represented wires leading into and out of the central station and the sub-stations by heavy lines and the wires of all branch circuits in the central station and in the sub-stations by light lines.

DEFINITIONS.

Before proceeding to the detailed description of the apparatus at the central and sub stations it may be well to state that the former contains a peculiar transmitter, including a novel switching mechanism, a circuit-interrupter, an audible alarm-signal, and a telephone, and that each sub-station contains a switch having calling-segments which are differently placed in each sub-station, a step-by-step mechanism co-operating with the said switch and including a magnet which, from its part in this function, will be called the "step-magnet," one or more semaphores, and a flash-light mechanism connected with a magnet which controls their operation and

will therefore be called the "visual magnet," mechanism for turning on and cutting off the gas-supply, including magnets which, from their part in this function, will be called the "gas-magnets," a stored-signal mechanism, including a magnet, which will henceforth be called the "stored-signal magnet," and unison mechanism co-operating with the step-by-step mechanism to restore the sub-station signaling mechanism to its normal condition after it has been operated.

Central-station transmitter.—The transmitter of the central station contains a transmitting-wheel A, mounted in insulation upon an arbor B of a mechanism C, corresponding to the mechanism of an ordinary call-box, and provided with an operating-crank D and geared to the arbor, so that when the crank is pulled down to the position in which it is indicated by broken lines in Fig. 1 the arbor, and hence the wheel, will be caused to move one revolution. The said wheel is provided with twenty-four teeth, including a broad insulated tooth e', and with a hub F, having two insulated teeth e^2 and e^3 set into its periphery and projecting therefrom at a point adjacent to the said insulated tooth e'. The teeth of the said wheel engage with a spring-finger G, normally disengaged from a contact-point H, while the periphery of the hub and the insulated teeth therein engage with a spring-finger I, normally disengaged from a contact-point J, the said spring-fingers and contact-points being attached to the front plate of the mechanism C, from which they are insulated, except the finger I, which is connected therewith by a short wire K. The connections of the said fingers and points will not now be described, but left for description with the circuits of the apparatus. An arm L, secured to the arbor B, is provided at its outer end with a pivotal switch M, having an outwardly-projecting shifting-finger N and normally held by a spring O in engagement with an insulated sectional contact-ring made in two corresponding parts P and P', the ends of which are separated by projecting lugs Q and Q', extending outward from an insulated contact-ring R, located inside of and concentric with the said sectional ring, and engaged by the switch when the same is shifted by its shifting-finger. The transmitter is also provided with a dial R', having its lower portion virtually divided into a series of radial compartment arranged from right to left. These begin with a compartment virtually including the shoulder Q and forming the starting compartment of the device. Then follow the compartments of the several sub-stations considered individually. These are succeeded by two compartments, respectively representing the stored and visual signal and gas controlling features of all of the sub-stations considered collectively. Then follows a compartment virtually including the stopping-lug Q'' and forming the stopping-compartment of the device. This is succeeded by the last compartment of the line, which includes an insulated reserve-battery plate T, attached to the inner end of the upper part P of the sectional contact-ring. Each individual and collective sub-station compartment is provided with two plug-holes adapted to receive a shifting-plug (not shown) for engagement by the shifting-finger of the said switch. The holes, as herein shown, are distinguished from each other by the letters "S" and "V," respectively, signifying that they are for use in connection with the stored-signal and visual-signal mechanisms of the sub-stations. The holes of the gas-controlling compartment are designated by the words "On" and "Off," of obvious signification. As herein represented, the dial has the form of a ring, through the opening of which the mechanism of the device is shown. Practically, however, it will be a disk and located above the arm L, so that the shifting-finger of the switch will engage with the inner end of the plug. Ordinarily the dial will contain more than four individual sub-station compartments; but four suffice for illustration. The dial is also provided with a stop-pin E, arranged opposite the shoulder Q' and provided for arresting the arm L for permanently splitting the circuit of the apparatus.

The central station also contains a circuit-interrupter U, which may be of any approved construction, a telephone outfit V, and an audible-alarm signal mechanism, including a bell W, a relay-magnet X, having an armature X', a switching-magnet Z, situated in a local circuit and having an armature Z', provided with a bell-hammer W' and with a pin a, a vibrating spring b, engaging with the said armature Z', a lever c, having two notches c' and c^2 to receive a pin a, a spring d for mechanically operating the lever c, a double circuit changer e, the two ends of which are insulated from each other, and insulated following fingers f and f' and g and g'. The electric connections of these parts will be described farther on.

Sub-station apparatus.—The apparatus at each sub-station is inclosed in a suitable case H', having a door H^2, (see Fig. 3,) and is alike in all of the stations, except for their switches, and these are alike in construction, although not in the arrangement of their segments, with the exception of the switch of the sub-station at the end of the line and corresponding to sub-station No. 4 of the apparatus herein shown. Description of one sub-station will therefore describe them all, with the exception above noted.

Sub-station switch-board.—Each sub-station contains a circular switch having an insulated ring h, carrying a series of insulated segments arranged from right to left and corresponding to the compartments on the dial of the transmitter. For convenience of description the ring may be supposed to be divided into a series of compartments arranged from right to left and corresponding to the

compartments upcn the dial of the transmitter, these compartments, which exist only for convenience of description, being indicated by dotted lines h' on Fig. 1 of the drawings. The first compartment in all of the switches is left unoccupied and corresponds to the starting-compartment of the transmitter. The next compartment contains two individual calling-segments i and i', respectively corresponding to the plug-holes designated by the letters S and V in the second compartment upon the dial of the transmitter. In the switch for sub-station No. 2 the segments are moved one compartment along the line, and so on, as shown in Fig. 2 of the drawings, from which it will be seen that the individual calling-segments of the switches are progressively arranged in them in the order of the succession of the sub-stations upon the line. Each switch is also provided with two collective calling-segments j and j', located in the compartment of its ring corresponding to the compartment on the dial through which the sub-stations are collectively called, and a gas-controlling segment k, located in the last compartment but one on the ring h and corresponding to the comparment on the dial through which the gas is turned on and off in all of the sub-stations. The ring h of each switch also contains in its last compartment an insulated half-segment l, corresponding to the stopping-lug Q' of the transmitter and called the "retaining-segment." Each switch also contains two segments m and m', located within the segments i and i', two segments n and n', located within the segments j and j', two segments o and o', located within the segment k, and with a contact-ring p', located within the supplemental segments just named. The switch of the sub-station at the end of the line also contains in the last compartment of its ring h two circuit-splitting segments q and q'.

Sub-station unison device.—Each sub-station contains a step-by-step movement operated by the interruptions of the main line at the central station and employed for stepping an arm r, mounted on an arbor r' and carrying two brushes r^2 and r^3 around over the segments and the contact-rings of the switches, the said brush r^2 being applied directly to the arm and the brush r^3 being insulated therefrom and located inside of the other brush. The said movement consists of a ratchet-wheel t, held against reverse rotation by a spring t' and stepped forward by a spring-pressed pawl t^2, pivoted to the lower end of a long armature u', fulcrumed about midway of its length on a pivot u^2, standing in the presence of the poles of the step-magnet u, which, when energized, operates to step the rotatable arm r around over the segments of the switch. The said armature u' is provided at its upper end with a spring-pressed pawl u^3, engaging with the teeth of a ratchet-wheel v, held against reverse rotation by a spring v', mounted upon an arbor w, carrying a disk x, having a cam-shoulder x', and the said arbor also carrying a larger disk y, having a cam-shoulder y'. The said cam-shoulder x' normally supports a finger z, depending from a horizontal unison-lever z', fulcrumed at its outer end, where it is provided with a depending circuit-changer 2, which extends between two following fingers 3 and 4 and shaped at its inner end to form two notches 5 and 6. The small spring 7, engaging with the upper edge of this lever z', exerts a constant tendency to push it downward. The mechanism just above described constitutes the unison mechanism of the sub-station, as will appear later on. It will be noticed that in the adjustment in which the parts of the mechanism of sub-station No. 1 are shown in the drawings the end of the pawl t^2 stands away from the teeth of the ratchet-wheel t, with which it is engaged, and the end of the pawl u^3 in a corresponding manner stands away from the teeth of the ratchet-wheel v, with which it is engaged. This distance between the ends of the pawls and the teeth of the ratchet-wheels with which they are engaged represents the distance that the armature u' is out of the field of magnetism, as will be more fully described later on. It may be stated here that in the practical construction of my improved apparatus the ratchet-wheels t and v and the disks x and y will all be mounted upon the same center, their separation here being merely for convenience and clearness of illustration.

Flash.—The cam-shoulder y' of the disk y normally supports a finger 8, secured in insulation to a horizontal locking-lever 9, normally held down by a spring 10, engaging with its upper edge, fulcrumed at its outer end, and provided at its inner end with two notches 11 and 12 and with two diverging fingers 13 and 14, the latter having circuit-changing functions. This lever 9 has its primary function in connection with flashing the gas-jet in signaling at night, and will be fully described hereinafter in connection with that feature of my improved apparatus.

Semaphores.—The visual signal of my apparatus for use during the day-time consists of two semaphores 15, normally retired within a dome H^3 and flexibly connected with a vertically-movable rod 16, extending down into the case H' of the sub-station, provided at its lower end with a counter-weight 17 and normally sustained in its elevated position in which the semaphores are retired by means of a crank 18, with which it is connected through a slot 19 and a pin 20, the said crank being rigidly secured to the arbor of a train 21, having a spring-motor (not shown) corresponding to the ordinary train of a call-box and normally locked against movement by its escapement-pallet 22, which is provided with an outwardly-projecting pin 23, normally engaged by a corresponding pin 24, located in the upper end of the armature 25 of the visual magnet 26, the said armature be-

ing fulcrumed at its lower end and provided with a pin 27, which enters the notches 11 and 12, formed in the inner end of the horizontal locking-lever 9, before referred to. The said rod 16 is also provided with a dog 28, held in place by a spring 29 and a pin 30, and having its free end beveled and arranged to be engaged with the finger 13 of the said lever 9 for lifting the same when the rod is raised to retire the semaphores, so as to permit the pin 27 to fall into the notch 11 of the lever 9, and thus allow the armature 25 to fall out of the field of the visual magnet 26 when the current is of normal strength.

Gas.—The mechanism for turning on and turning off the gas at the sub-station consists of a valve 31, extending into the gas-supply pipe 32 and mounted in the outer end of an armature 33, located between the poles of two gas-magnets 34 and 35, the said armature being held in the open or closed position of the valve by means of a spring 36, having frictional engagement with a plate 37, as shown. A small permanent gas-feed pipe g^2 leads from the gas-supply pipe 32 at a point outside of the valve 31 to the gas-burner, which is not shown. The mechanism for flashing the gas-jet for signaling during the nighttime consists in part of a valve 38, extending transversely through the gas-supply pipe 32, mounted in a block 39, and provided at its outer end with a shouldered head 40, which is normally engaged with the inner edge of the armature 25 when the same is in the field of the visual magnet 26, which will be when the magnetic force is of normal strength. At this time the pin 27 is entered into the notch 12 of the lever 9. When the said armature 25, being in the described position, is attracted by the visual magnet 26, the valve 38 is moved inward and cuts off the gas from the upper end of the gas-supply pipe 32, its inward movement being regulated by the adjusting-screw 41, mounted in the block 39. As soon, however, as the magnet 26 is demagnetized and the armature 25 allowed to fall back a small spring 42 pulls the valve back to its normally-open position, its outward movement being arrested by a pin 43, which is engaged by the head 40. It will be readily seen that every time the visual magnet 26 is energized with the armature 25 in the field of magnetism the valve 38 will be operated in momentarily cutting off the gas, which may thus be employed in giving a flash-signal. The lever 9, before referred to, has the twofold function, in connection with the flash-signal mechanism of my apparatus, of holding the armature 25 in the field of the said magnet and of cutting the same permanently into the line, which it does by means of its circuit-changing finger 14, which extends between two following fingers 44 and 45.

Stored signal.—The stored-signal mechanism of my apparatus is best shown in Fig. 3 of the drawings, and consists in part of a movement 46, virtually corresponding to an ordinary alarm movement and provided with a crank 47, the outer end of which is engaged with the inner face of a pin 48, located in a slide 49, mounted for horizontal reciprocation in bearings 50 50, secured to the case H′ of the instrument, the outer end of the said slide 49 being normally engaged with the door H^2 of the case H′, inclosing the sub-station mechanism. The said movement 46 is normally locked by means of its escapement-pallet 51, the arbor of which carries a bell-hammer 52, arranged to strike a bell 53, and a locking-arm 54, the outer end of which is engaged, when the movement 46 is locked, with the hooked end of a finger 55, located at the outer end of the armature 56 of the stored-signal magnet 57. The said armature is also provided with a beveled hooked finger 58, adapted to be engaged with a beveled hook formed at the lower end of a pivoted tripping-finger 59, normally thrown toward the finger 58 by a spring 60, and having its upper end beveled for engagement by a tripping-dog 61, pivoted to the slide 49 toward the rear end thereof and provided with a spring 62 and a check-pin 63. A check-pin 64 is located in front of the upper end of the tripping-finger 59 for preventing the same from being moved by the dog 61 when the slide 49 is moved forward, at which time the spring 62 permits the dog 61 to yield and clear the upper end of the finger 59. When, however, the slide 49 is pushed inward by the closing of the door H^2, the dog 61, being held against forward movement by the pin 63, engages with the upper end of the finger 59 and trips the same, its lower end being then disengaged from the hooked finger 58 of the armature 56. The spring 65, connected with the armature 56, is employed for keeping the same normally out of the field of the magnet 57 when the magnetic force is of normal strength. Fig. 3 of the drawings shows the parts of the stored-signal mechanism in their normal position, in which the train is prevented from running down when the door is opened and the bell from being sounded by the engagement of the arm 54 with the hooked finger 55 of the armature 56. When, however, a circuit is closed through the magnet 57, the armature 56 will be attracted and lifted, whereby its hooked finger 58 is carried above and engaged with the hooked lower end of the tripping-finger 59 and the arm 55 lifted above and cleared from the stop-arm 54. The movement is now prevented from actuation only by the slide 49, which is restrained from moving outward by the closed door H^2 of the case H′; but as soon as the door is opened by an officer the slide 49 will be released and moved outward under the action of the crank 47, which is rotated by the train-movement, which in its operation will ring the bell 52, thus giving a signal. When the door is closed, the slide 49 will be pushed back, with the effect of rewinding the movement and bringing the parts into the position in which they are

shown by the drawings, and therefore in readiness to be set for giving a signal by the energization of the magnet 57. It will thus be seen that my improved stored-signal mechanism is always in readiness to be set from the central office, and that once set the stored signal is retained for any length of time to wait the opening of the door of the case.

Call-box and telephone.—I also employ at each sub-station a multiple call-box 66. This may be of any approved construction. I prefer, however, to employ a novel call-box invented by me, for which an application, Serial No. 336,084, for Letters Patent of the United States is filed January 6, 1890, herewith. However constructed this call-box should be adapted to make long and short breaks of the circuit. I also provide each sub-station with a telephone-outfit 67 of any approved construction.

Stable-indicator.—When my improved apparatus is adapted for police-service, it preferably includes an indicator 68, located in the stable of the precinct in which the apparatus is placed. This indicator, which may be of any approved construction, is adapted to indicate the several sub-stations by their numbers and to sound an audible alarm whenever the multiple call-boxes located at the sub-stations are operated, so as to make long breaks in the circuit, these long breaks forming what are known as "emergency" calls.

Having now described my improved apparatus in detail in its application to an electric police system, I will proceed to set forth the wiring of the apparatus, to trace the circuits thereof, and to describe its operation under the various conditions of its use.

Wiring.—At the outset it may be well to state that all of the magnets at the central station and in the sub-stations are normally and dead out of the field of magnetism, with the exception of the relay-magnet X, located in the central station, and that all of the magnets in the entire apparatus are normally and dead out of circuit, with the exception of the said relay and step magnets of the sub-stations. I may also remark that the stored-signal and the gas magnets of the sub-stations are dead out of the circuit and not legged into the same, as will be hereinafter more fully described.

The apparatus is provided with a normal battery consisting of the parts 68 and 69, with an extra battery 70 and with a reserve battery 71.

Normal circuit.—Now when all of the parts of the central-station and sub-station mechanisms are in their normal adjustments, as shown by Fig. 1 of the drawings, the normal circuit of the apparatus, beginning at the section 68 of the normal battery, will be through the line 72 to the step-magnet u, the wire 73, the arm r, the brush r^2, ring h, wire 74, spring-finger 44, circuit-changing finger 14, lever 9, wire 75, sub-station No. 2, the wire 76, the sub-station No. 3, the wire 77, the step-magnet u of the sub-station No. 4, the wire 78, the arm r in the said sub-station No. 4, the brush r^2, attached to the said arm, the ring h, the wire 79, the spring-finger 44 of the sub-station No. 4, the circuit-changing finger 14, the lever 9 in said sub-station No. 4, the wire 80, the circuit-changer 2, the following spring 3, the wire 81, the multiple call-box 66, the wire 82, the telephone 67, the return-wire 83, thence through the call-box and telephone of sub-station No. 3, thence through wire 84 to the sub-station No. 2 and through the multiple call-box and telephone thereof to the wire 85, thence to the circuit-changer 2 of the sub-station No. 1, the following spring 3, wire 86, the multiple call-box 66 of the sub-station No. 1, wire 87, telephone 67 of the said station, wire 88, the following spring g' at the central station, the upper end of the double circuit-changer in the central station, wire 89, the telephone V, wire 90, the relay-magnet X, wire 91, the section 69 of the normal battery, wire 92, insulated contact-finger G, the transmitting-wheel A of the transmitter, the hub F, connected with the said wheel, the contact-finger I, engaged with the hub, the wire K, the mechanism C of the transmitter, the arm L, the switch M, the upper section P of the sectional contact-ring, the wire 93, connecting the inner ends of the upper and lower sections of the sectional ring, the section P′ of the said ring, and the wire 94 to the section 68 of the normal battery.

To set the stored signal.—Let it be supposed that it is desired to set the stored signal of the sub-station No. 1. To do this the plug of the transmitter is plugged in the hole designated S, located in the second compartment of the dial of the transmitter, the said compartment containing the words "Station 1" for identifying it with the said sub-station. The plug having been inserted into the said hole, the crank D is pulled down from the position in which it is shown by full lines to the position in which it is shown by dotted lines. This winds up the movement of the mechanism C, so that when the crank is released and allowed to return to its normal position the said mechanism operates to impart one complete revolution to the wheel A and the arm L. The makes and breaks caused by the said wheel and its contact-finger G while the arm is traveling from its normal position to the lug Q of the extra-battery contact-ring R will not have any effect upon the apparatus, the armatures u' of the step-magnets u of the sub-stations being normally out of the field of magnetism when the apparatus is at unison, at which time the arms r at the sub-stations are in their normal positions, as shown by Fig. 1 of the drawings, and the fingers z of the levers z' are lifted upon the cam-shoulders x' of the disks x, the upper ends of the long armatures u' being at this time entered into the notches 6 of the said levers z'. In case, however, any of the sub-stations are not in unison and their arms

r have not been brought around to their normal positions, the makes and breaks of the circuit, occurring when the arm L at the central station is traveling around to the lug Q_2, will operate to bring the arms of any stations that are not in unison into unison. In case all of the sub-stations are in unison, these makes and breaks will have no effect on the apparatus whatever. When the switch M is caused to leave the upper section P of the sectional contact-ring and pass onto the lug Q of the extra battery-ring R, the circuit will be switched through the wire 95 and the circuit-interrupter U to the extra battery 70, then through the section 68 of the normal battery, and thence onto the line, as before described. The extra battery now being added to the normal battery, the closing of the circuit will put a sufficiently-powerful current on the line to start the step-magnets u of all of the sub-stations. The armatures u' of all of the said magnets being operated, the pawls t^2 and u^2 are brought into engagement with the teeth of their respective ratchet-wheels t and v, which are then advanced one step. The advancement of the ratchet-wheel v through the distance represented by one tooth causes the cam-shoulder x' of the disk x to be cleared from under the depending finger z of the lever z', which is now pressed down by its spring 7 and its notch 5 caught over the upper end of the armature u', the lower end of which is therefore moved closer to the step-magnet u and into the field of magnetic force. This result having been accomplished by means of the extra battery, the same is now cut out by the transference of the switch M from the shoulder Q of the extra-battery contact-ring to the lower section P′ of the sectional contact-ring, which represents the normal battery. The described energization of the step-magnet u also causes the arm r to be stepped one point to the left. It may be mentioned here, also, that the same movement that releases the finger z from the cam-shoulder x' of the disk x releases the finger 8 from the cam-shoulder y' of the disk y; but inasmuch as the lever 9 from which the finger 8 depends, is at this time, supported by the engagement of its notch 11 with the pin 27 of the armature of the visual magnet the spring 10 does not press the lever 9 down, although the same is no longer supported in any way by the cam-shoulder y' of the disk y. It will be understood, also, that the action above described for sub-station No. 1 is repeated in all the sub-stations. The shoulder Q corresponds to one tooth of the wheel A, so that the circuit will be broken once while the switch M is passing across the said shoulder, whereby when the circuit is again closed by the engagement of the switch with the inner end of the lower section P′ of the sectional contact-ring the circuit will be again closed through the line and the normal battery, which is strong enough to actuate the long armatures u' of the sub-stations, inasmuch as they have by the previous cutting in of the extra battery into the line been brought into the field of magnetic force. This second energization of the step-magnets u steps the arms r of all of the sub-stations still another point to the left, the arm of the sub-station No. 1 being then brought into engagement with the individual calling-segment i of the said sub-station; but the arms r of the other sub-stations will not in being moved another point to the left be engaged with their calling-segments, owing to the progressive arrangement of the said segments in the several switches of the different sub-stations, as shown by Fig. 2 of the drawings. Directly after the switch M passes onto the inner end of the lower section P′ of the sectional contact-ring the shifting-finger N of the said switch engages with the plug which is located in the first hole in the series of plug-holes, whereby the switch will be moved and transferred from the sectional contact-ring to the extra-battery contact-ring R. The circuit will then be shifted from its normal path and transferred to the line 95 and the circuit-interrupter U to the section 70 of the battery. The brush r^2 of the sub-station No. 1 will now be engaged with the segment i of the sub-station No. 1, and the double brush r^3 of the arm will be in contact with the segment m and with the contact-ring p of the sub-station mechanism, the said ring p being connected by a wire 96 with the ring h. The circuit will now be shifted from its normal path and flow from the brush r^2 to the segment i, thence to the wire 97, the stored-signal magnet 57, the wire 98, the segment m, brush r^3, ring p, wire 96, ring h, wire 74, and thence, as before, to the battery. This energization of the stored-signal magnet 57 attracts the armature 56 thereof and unlocks and so sets the movement of the said stored signal, as hereinbefore fully described. In the rotation of the wheel A and the arm L the arms r of all the sub-stations are stepped still farther to the left, leaving the segments i and m of sub-station No. 1 entirely out of the circuit, and thus cutting the stored-signal magnet 57 of the said station dead out of the circuit, and therefore protecting it from possibly being burned out by any excess of current transmitted to the line by the accidental crossing of the wires of the apparatus with those of electric light or power or other currents. It will be noticed that the segment i is connected by a wire 99 with the collective calling-segment j of the sub-station No. 1 and that the segment m is connected by a wire 100 with the segment n of the said station. The corresponding individual calling-segments of the other stations are also connected in a similar manner with the collective calling-segments of the other stations corresponding to the collective calling segments j and n of sub-station No. 1. The purpose of this arrangement will be referred to later on. The switch M having been shifted with the effect described, the plug is drawn out from the first hole in

the series of holes, when the switch will be caused by the spring O to resume its normal position upon the lower section P′ of the sectional contact-ring, which connects with the normal battery. The plug being removed, as described, the arm L is left free to continue its movement under the action of the mechanism of the transmitter, the circuit being alternately made and broken, with the effect of stepping the arms r of all the sub-stations one step forward for each interruption of it, but without any other effect on the apparatus. When the arm L gets around to the pin E, the same is withdrawn to permit the arm to complete its revolution and stand again in its normal position, at which time the arms r of all the sub-stations will be restored to their normal positions. Furthermore, the disks x and y of all the sub-stations will have made one complete revolution, with the effect of lifting the levers z' of all the sub-stations and permitting the upper ends of all the long armatures u' to fall into the notches 6 in the levers z', whereby all the said armatures are retired from the field of magnetic force.

To Operate visual signal.—Let it now be supposed that it is desired to operate a visual signal at sub-station No. 1. With this end in view the plug is inserted in the second hole of the series and in the compartment alloted to station No. 1. The effect of this action will be the same as before described for the operation of the stored signal, until the arm r of the sub-station No. 1 engages with the segment i' of that station, when the normal circuit will be shifted from its usual path and flow from the brush r^2 through the said segment i', the wire 101, the visual magnet 26, the wire 102, the segment m', the double brush r^3, attached to the arm r, the contact-ring p, wire 96, ring h, wire 74, and, as before, to the battery. The visual magnet 26 is thus cut into the circuit. Directly after this occurs the shifting-arm N of the switch M will engage with the plug in the said plug-hole, whereby the arm L will be stopped and the switch shifted onto the extra-battery contact-ring R, the normal circuit in the transmitter being shifted through the line 95 and the circuit-interrupter U to the section 70 of the battery, as before described. The visual magnet 26 is now energized by the extra battery and attracts its armature 25 and so changes the relations of the stop-pins 23 and 24 that the movement 21 is released, with the effect of permitting the vertically-sliding rod 16 to descend under the control of the said movement and display the semaphores 15. This same energization of the magnet 26 by attracting its armature 25 to it permits the pin 27 of the armature to be shifted into the notch 12 of the lever 9, which is pressed down by the spring 10, whereby the armature 25 of the visual magnet is now locked into the field of magnetism when the current is of normal strength. The described depression of the lever 9 disengages the finger 14 from the following spring 44 and engages it with the following spring 45. The visual magnet is now cut into the circuit through the said finger 45, the path of the current being from the brush r^3 to the segment i, thence through the wire 101, the magnet 26, the wire 103, the following finger 45, the finger 14, and lever 9, and thence, as before, to the battery. The semaphores having been displayed, the plug is withdrawn from the dial of the transmitter, whereby the switch M is restored to its normal position and the arm L allowed to travel around to the stop E, which is removed from its path, whereby it is permitted to go on to its normal position, leaving all the parts of the apparatus in their normal positions and the same as they were left in at the conclusion of the operation of storing a signal. The restoration of the parts of the sub-station No. 1 to unison will have in that station the effect of lifting the lever 9 and permitting the pin 27 of the visual-magnet armature to fall back into the notch 11 of the lever 9, whereby the armature is left out of the field of magnetic force at this time of the normal strength. The lifting of the lever 9 also carries the finger 14 from the following spring 45 back to the following spring 44, leaving the circuit of the apparatus through its normal path.

To flash light.—In case it is desired to give a signal by flashing the light at the sub-station the same steps as have been just described are gone through, with the exception that the stop-pir E is not removed from the path of the arm L, which is therefore stopped by it. At this time all of the arms r of the several sub-stations are engaged with the segments l of the sub-stations, while in the fourth or end station the double brush r^3 is engaged with the circuit-splitting segments q q', the said segment q' being connected by a wire 104 with the line-wire 81 and the segment q being connected by a wire 105 with the ground-plate 106. Before tracing the split circuits it will be well to call attention to the fact that the shoulder x' of the disk x is longer than the shoulder y' of the disk y, so that the lever z' will be raised by the disk x, which co-operates with it, before the lever 9 is raised into its normal position by the disk y, which co-operates with it, the difference in the length of the two cam-shoulders x' and y' being such that the shoulder x' will be brought into its normal position when the arm r lacks but one point of a complete revolution, while the shoulder y' is not brought into its normal position until a full revolution of the arm r has been effected. When the arm x' is raised, the long armature u' falls into the notch 6 of the said lever and is thus retired from the field of magnetic force. The step-magnet is therefore cut out of operation and cannot operate the step-by-step mechanism in moving the arm r from the last point but one in its move-

ment to the last point therein, so that the step-magnet will be cut out with the lever 9 in its depressed position, in which the armature 25 of the visual signal remains in the field of magnetic force. The visual magnet 26 may now be operated as desired by the normal battery without energizing the step-magnet *u*, and therefore without stepping the arms *r* at the several stations to unison. When the arm L is stopped by the stop-pin E, the insulated block *e'* of the wheel A has pressed down the contact-finger G into engagement with the contact-point H, which grounds the circuit through wire 107. At the same time the tooth e^2, mounted in the periphery of the hub F, has pressed the spring-finger I into engagement with the contact-finger J and grounded the circuit through wire 108.

Split ground circuits—The single metallic circuit of the apparatus is now divided into two ground metallic circuits, respectively leading from the central station through all of the stations to the end station of the series. I will now trace these split circuits, beginning with the circuit through the telephones and call-boxes. This circuit will be from the ground through wire 107, contact-point H, spring-finger G, wire 92, section 69 of the battery, wire 91, relay-magnet X, wire 90, telephone V, wire 89, the upper end of the double circuit-changer *e*, following spring *g'*, wire 88, telephone 67 of sub-station No. 1, wire 87, multiple call-box 66, wire 86, following spring 3, circuit-changer 2, wire 85, the telephone and multiple call-box of sub-station No. 2, thence to sub-station No. 3 through wire 84, through the telephone and multiple call-box of the sub-station No. 3, thence through wire 83 to the telephone 67 of sub-station No. 4, thence through wire 82 to the multiple call-box 66 of the said station, thence through wire 104 to the circuit-splitting segment *q'*, thence through the brush r^3, carried by the arm *r* of the mechanism of sub-station No. 4, which is the end station of the series, thence to circuit-splitting segment *q*, and thence through wire 105 to the ground-plate 106. Beginning with the ground the path of the other circuit is through wire 108, contact-point J, spring-finger I, wire K, the mechanism of the transmitter C, the arm L, the switch M, the shoulder Q', with which the switch is now engaged, the wire 95, the circuit-interrupter U, the extra section 70 of the battery, (which now takes the place of battery-section 69, which is on the other circuit,) the section 68 thereof, wire 72, the step-magnet *u* of the sub-station No. 1, wire 73, arm *r*, brush r^2, ring *h*, wire 74, following spring 44, finger 14, lever 9, wire 75, sub-station No. 2, wire 76, sub-station No. 3, wire 77, the step-magnet *u* of the sub-station No. 4, wire 78, arm *r*, the brush r^2, attached to the said arm, ring *h*, wire 79, following spring 44 of sub-station No. 4, finger 14, lever 9, wire 80, circuit-changer 2, following spring 3, wire 81, wire 104, circuit-splitting segment *q'*, brush r^3, circuit-splitting segment *q*, wire 105, and ground-plate 106, as described. I have described the path of the circuit last traced as being through the ring *h* of the sub-stations. When, however, the visual magnets 26 have been permanently cut into the circuit, as heretofore described, the path of the circuit last traced will not be through the rings *h* of the sub-stations, but through the half-segments *l* thereof. In this case the circuit will be shifted from the rings *h* through the brushes r^2, thence through the plates *l*, the wire 109, the wire 101, the visual magnet 26, the wire 103, following spring 45, finger 14, lever 9, and so on. It will thus be seen that two paths are provided for the circuit from the brushes r^2 of the sub-stations when the arms *r* lack but one point of a complete revolution. This is necessary, because all of the visual magnets 26 may not be permanently cut into circuit, and when this is not the case the normal path must be left open for the circuit. It will thus be seen that in splitting the single metallic circuit into two ground metallic circuits the battery-sections 68 and 69 are separated and that section 70 of the battery has been brought into one circuit to replace section 69 thereof, which is now in the other split circuit. On account of the resistance of the step-magnets it is necessary that the split circuit which passes through them should have more battery than the split circuit which passes through the telephones and call-boxes, where the resistance is comparatively slight. The visual magnet of sub-station No. 1, when it is proposed to make a flash-signal, having been permanently cut into the circuit, as described, may be operated by the normal battery, which now consists of sections 70 and 68. It has also been explained that by reason of making the cam-shoulders *x'* and *y'* different in length the visual magnet must be left permanently cut into the circuit with the long armatures of the step-magnets out of the field of magnetism, and consequently beyond the influence of the now normal battery, so that the making and breaking of the split circuit through the step-magnets will not affect them. In order to produce a flash-signal at sub-station No. 1, a wheel having notches corresponding to the character of the signals which it is desired to make is inserted into the circuit-interrupter U at the central station, after which the said circuit-interrupter is operated to make and break the circuit. These interruptions of the circuit will cause intermittent energizations of the visual magnet 26 at the sub-station No. 1 and in any other stations in which the visual magnets are permanently cut into the circuit. Then when the visual-magnet armature is attracted it will operate to slide the valve 38 of the gas-pipe 32, thereby temporarily cutting off the supply of gas. Just as soon as the magnet is demagnetized the spring 45 will pull the valve back again and allow the gas to flow through the pipe, as before, the permanent feed g^2, connecting with the gas-sup-

ply pipe 32, feeding sufficient gas to the burner to keep a flame there for relighting the body of the gas when it is allowed to flow through the pipe again. By changing the signal-wheel put into the circuit-interrupter at the central station a great variety of code-signals may be flashed at the sub-stations. As an illustration of the use of these flashed signals, it may be stated that by flashing at sub-station No. 1 a signal representing the number of sub-station No. 2 any officer observing the signal flashed at sub-station No. 1 would at once understand that he was to report to sub-station No. 2, where assistance was required. The central office will be provided for this purpose with a set of signal-wheels, so that the number of any sub-station may be reproduced at any other sub-station. A suitable wheel for making a continuous flashing of the light will be employed to indicate at any sub-station that the officer of that sub-station is wanted at it. After the flash-signals have been made, as above described, the stop-pin E is pulled out to let the arm L return to its zero position. The first movement of the said arm brings the tooth e^3 in the hub F under the spring-finger I and the contact-point J, putting a ground on the line-circuit again. At the same time the switch M engages with the reserve-battery plate T, which, as before described, is secured in insulation to the outer end of the upper section P of the sectional contact-ring. The ground circuit through the step-magnets will now be through the switch M, the plate T, the wire 110, the reserve battery 71, the extra battery 70, which is now acting as a portion of the normal battery, section 68 of the normal battery, and thence as before. By cutting in the reserve battery, as described, the current through this ground circuit is made strong enough to energize the step-magnets at the sub-stations and impart one movement to the step-by-step mechanism, whereby the apparatus at the sub-stations is brought into unison with the long armatures out of the field of magnetic force. It will be remembered that when the mechanisms at the sub-stations were brought into position for flash-signaling the arms r lacked but one point of making a complete revolution, and likewise the disks x and y. This single actuation of the sub-stations by the use of the reserve battery 71 completes the revolutions of the arms r of the disks x and y, whereby the long cam-shoulders x' of the disks x are moved under the depending fingers z of the levers z', which have already been lifted, so as to bring the said fingers z in position to drop off from the said shoulders x' the next time the long armatures of the step-magnets are operated, and also whereby the shoulders y are operated in lifting the levers 9 through their depending fingers 8, so as to permit the armatures 25 of the visual magnets to fall back into their normal positions, in which they are out of the field of magnetic force. The lifting of the levers 9 also cuts the visual magnets out of the circuit by reason of the finger 14 leaving the contact-spring 45 and re-engaging with the contact-spring 44, through which the normal circuit passes, the normal circuit being thus restored. When the levers z' of the sub-stations are allowed to drop down by the action of the step-by-step movements in the sub-stations, the circuit-changer 2 is shifted in position from the following spring 3 to the following spring 4, whereby the call-boxes are short-circuited, so that they will not operate during the operation of the step-by-step movements. Otherwise they might conflict with the action of the transmitter in breaking the circuit and interfere with the perfect operation of the step-by-step movements. When, however, the single metallic circuit is split into two ground metallic circuits, as has been described, which will occur when the arms r of the step-by-step movements lack but one point of a complete revolution, and when also the disks x and y also lack but one point of a complete revolution, the levers z' will be lifted by the long cam-shoulder x' and the circuit-changer 2 shifted from the following spring 4 back to the following spring 3, whereby the multiple call-boxes will be cut into circuit again, so that during the operation of the flash-light from the central office the call-boxes may be used from the sub-stations in sending signals into the central office, the mechanism for flashing the light being located on one of the ground circuits and the call-boxes being located on the other ground circuit.

Simultaneously-operating signals.—I have already described the operation of the apparatus in storing signals at the particular stations and in displaying a visual signal at particular stations, and will now describe its use for storing a signal at all of the stations and displaying a visual signal at all the stations simultaneously.

Stored signals.—To simultaneously store signals in all of the sub-stations, the plug of the transmitter is inserted in the plug-hole designated by S in the compartment on the dial of the transmitter marked "All stations." The transmitter is then operated in the usual manner, and as soon as the shifting-arm N of the switch strikes the plug the switch will be shifted from the sectional contact-ring onto the extra-battery contact-ring R. The makes and breaks of the main circuit that have occurred while the arm L has been traveling from its normal position around to the plug have operated the arms r of all the sub-stations and brought them around in position for the engagement of their brushes r^2 with the collective stored-signal segments j, which are located in the same position in all of the sub-station switches, as indicated by Fig. 2 of the drawings. At the same time the double brushes r^3 of the said arms will be engaged with corresponding segments n and with the contact-rings p of the switches. All of the

stored-signal magnets 57 will now be cut into the circuit through the wires 99 and 100 and all of the stored signals will be set. The plug is now removed from the disk and the stop-pin E pulled out of the path of the arm L, which is then allowed to return to its normal position.

Semaphores.—In case it is desired to display the semaphore-arms simultaneously in all of the sub-stations the plug is put into the plug-hole designated by the letter V in the compartment on the dial marked "All stations." The action of the apparatus will now be the same as just before described, except that the brushes r^2 and r^3 of the arms r of all of the sub-stations will be stopped in engagement with the collective visual-signal segments j' and the segment n' and the ring p. The circuit in each sub-station will now be from the step-magnet u to the arm r, the brush r^2, segment j', wire 111, wire 101, visual magnet 26, wire 102, wire 112, segment n', brush r^3, ring p, wire 96, ring h, wire 74, thence to the battery in the path of the normal circuit, as before described. All of the visual magnets will therefore be permanently cut into the circuit and all of the semaphores displayed in the manner hereinbefore described. The plug is now removed from the dial of the transmitter to permit the arm L to return to its normal position.

Flash-lights.—In case it is desired to simultaneously give a flash-signal at all of the sub-stations at night, the arm L is allowed to be stopped by the plug E and the light flashed, as before described, before the arm is permitted to return to its normal position, thus providing a flash-signal for night and a semaphore-signal for day. As has been before mentioned, the display of the semaphores or the flashing of the light necessitates locking the visual magnets permanently into the circuit, at which time the finger 14 of the lever 9 will be engaged with the following spring 45. When the plug is removed, as before mentioned, and the arm r is stepped forward one point and into engagement with the segment k, the normal circuit of the apparatus is broken at the following spring 44. It is therefore necessary to provide means for the path of the circuit through the following spring 45, with which the finger 14 is now connected. This is done by a small wire 113, connecting the contact-ring p with the segment n'. The circuit will then be from the contact-ring p to the segment n' through the wire 112, wire 102, wire 103, and following spring 45.

Gas.—To turn the gas on in all of the sub-stations, the plug is inserted in the plug-hole in the dial of the transmitter marked "On" of the compartment marked "Gas" on the dial. The transmitter is now wound up by its crank, causing the arm L to travel around to the plug, the ensuing interruptions of the circuit operating to step all of the arms r in the sub-stations around to the segments k and o. The circuits in all of the sub-stations are now from the step-by-step magnet through the wire 73, the arm r, the brush r^2, the segment k, the wire 114, magnet 34, wire 115, segment o, brush r^3, contact-ring p, wire 96, contact-ring h, wire 74, and thence to the battery, as before, in the path of the normal circuit. The magnet 34 being thus energized, the armature 33 is pulled down, with the effect of bringing the valve 31 in the position in which it is shown at sub-station No. 1 in Fig. 1 of the drawings, the valve being held in this position by the frictional contact of the spring 36 with the friction-plate 37. The plug is now pulled out of the plug-hole and the arm L allowed to return to its normal position, the stop-pin E being temporarily pulled out of the way. To turn off the gas, the plug is inserted in the hole marked "Off" in the compartment marked "Gas" on the dial. The transmitter is then wound up, whereby the arm L is caused to sweep around until it engages with the plug, the interruptions of the circuit so caused operating to step the arms r of all the sub-stations around into engagement with the segments k and the plates o' thereof. The circuits in each of the sub-stations will now be through the step-by-step magnet u, the wire 73, the arm r, the brush r^2, the segment k, wire 114, to gas-magnet 35, wire 116, plate o', brush r^3, contact-ring p, wire 96, plate h, wire 74, and thence to the battery in the normal path of the circuit. The magnet 35 being thus energized, the armature 33 is drawn thereto and the valve operated in shutting off the gas from the gas-pipe 32, the valve being held so closed by the spring 36 and friction-plate 37. The plug is now removed from the hole, the stop-pin pulled out of the way, and the arm L allowed to return to its normal position.

To transmit emergency calls to stable.—The automatic transmission of emergency calls and those only from any one of the sub-stations through the central station to the stable will now be described. It has already been explained how the path of the normal circuit of the apparatus lies through the relay X, located in the central station, this relay responding to all interruptions of the normal circuit. It may be here explained that the ordinary calls sent in from the sub-stations are made by quick interruptions of the circuit and that long interruptions thereof in combination with quick interruptions thereof are employed in making emergency calls, the number of the long interruptions denoting the nature of the emergency call. At the central station there is located a local circuit operated by the relay X in the well-known manner, the armature Z′ of the magnet Z of this circuit being placed under so much tension, as well as being normally out of the field of magnetism, that a quick closing of the local circuit will not give the local battery 118 enough time to energize the magnet Z in overcoming the strong tension of the spring 119. When, however, a long or emergency

break is made in the main circuit, such a break being, for instance, of four times the duration of one of the quick or short breaks thereof, the battery 118 of the local circuit will be given an opportunity of energizing the magnet Z, thus enabling it to attract its armature Z'. The attraction of the said armature Z' into the field of magnetism permits the spring *d* to press down the lever *c* and engage its notches *c'* with the pin *a*, whereby the armature Z' is permanently locked into the field of the magnet Z. The described movement of the lever *c* moves the double circuit-changer *e*, so as to shift its upper end from engagement with the following spring *g'* to engagement with the corresponding following spring *g* and to shift its lower end from its normal engagement with the following spring *f* into engagement with the corresponding spring *f'*. Now the circuit will be, beginning with the multiple call-box 66, through the wire 87, telephone 67, wire 88, binding-post 120, wire 121, indicator 117, wire 122, following spring *g*, circuit-changer *e*, wire 89, telephone V, wire 90, relay-magnet X, wire 91, and thence to the battery, as before described. The closing of the circuit through the indicator, which is located at the stable of the precinct in which the apparatus is situated, will then operate to designate the sub-station from which the call is sent and to ring a bell, calling attention to the operation of the indicator, and this without any manual interference with the apparatus at the central station, through which this emergency call is therefore automatically transmitted. The described movement of the circuit-changer *e* shifts the local circuit to the vibrating spring *b*, whereby a vibrating signal is sounded in the central station upon the bell W simultaneously with the operation of the indicator at the stable. When the circuit-changer *e* is in position for sounding the vibrating signal in the central station, the path of the local circuit will be from the battery 118 through the wire 123, the lower end of the circuit-changer, following spring *f'*, wire 124, vibrating spring *b*, armature Z', wire 125, magnet Z, wire 126, contact-point 127, relay-armature X', wire 129, thence to the battery 118, completing the circuit. When the emergency call has had attention, the officer at the central station manually lifts the lever *c* and permits the spring 119 to throw the armature Z' out of the field and to enter the pin *a* into the notch c^2 of the lever *c*, throwing the double circuit-changer *e* back into its normal position, in which the indicator 117 is cut out and left in its normally-open branch of the main circuit. If desired, instead of locating the indicator in an open branch of the main circuit it may be located in a local circuit.

It is apparent that in carrying out my invention some changes from the construction herein shown and described may be made. I would therefore have it understood that I do not limit myself to the exact construction shown and described, but hold myself at liberty to make such changes and alterations as fairly fall within the spirit and scope of my invention.

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

1. In a signaling system, the combination, with a single metallic circuit, of a series of sub-stations located in the said circuit and each containing a signaling mechanism, and a switch having an individual segment located in a different position in each sub-station, and a collective segment connected with the said individual segment and having the same position in all of the sub-stations, and a central station having segments corresponding to the individual and collective segments of the sub-stations, substantially as described, and whereby the sub-stations may be called either individually or collectively.

2. In a signaling system, the combination, with a single metallic circuit, of a series of sub-stations located on the said circuit and each containing two or more signaling mechanisms for producing signals of different character and an individual and a collective segment for each of its different signals, the individual segments being differently located in each sub-station and the collective segments being correspondingly located in each of the sub-stations and connected with the corresponding individual segments, and a central station having segments corresponding to the individual and collective segments of the sub-stations, substantially as described, and whereby any or all of the corresponding signaling mechanisms may be selected for operation, substantially as described.

3. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon, and a central station also located on the said circuit and containing apparatus adapted to select any of the sub-stations for operation, the end sub-station of the series, and the central station, including means for splitting the line at those points into two ground metallic circuits, substantially as described.

4. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon, a central station also located on the said circuit, and means located at the end sub-station and at the central station for splitting the circuit into two ground circuits, the operating-magnets of the sub-stations being located on one of the ground circuits and the call-boxes and telephones on the other, so that when the circuit is split any sub-station may be operated from the central station and a call sent into the central station from any sub-station at the same time, substantially as described.

5. In a signaling system, the combination, with a single metallic electric circuit, of a series of sub-stations located thereon and each containing signal and step-by-step magnets,

the armatures whereof are normally located out of the field of magnetic force when the current is of normal strength, and a switch constructed to select any or all of the said signal-magnets, a central station also located on the said circuit and containing apparatus adapted to select any or all of the sub-stations for operation, an extra battery located at the central station, and automatic mechanism also located at the central station for automatically switching in the said extra battery for use in conjunction with the normal battery of the line to bring the said armatures at the sub-stations into the field of magnetic force, substantially as set forth.

6. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a signaling mechanism, a multiple call-box, and a circuit-changer for short-circuiting the said call-box from the main line to prevent interference with the operation of the mechanism of the sub-station through the call-box while said mechanism is being operated in regular order from the central station, and a central station also located on the circuit and containing apparatus adapted to select and operate the signal mechanism in any of the sub-stations, substantially as described.

7. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a signal-magnet placed in a dead-open branch of the main line and means for cutting the said magnet into line when it is desired to operate the signal which it controls, and a central station also located on the said circuit and containing apparatus adapted to select any of the sub-stations for operation, substantially as described, and whereby the burning out of the signal-magnets is obviated.

8. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a stored-signal magnet and gas-magnets, all of the said magnets being located in dead-open branches of the main line, and means for cutting the said magnets into the circuit when it is desired to operate the mechanisms controlled by them, and a central station also located on the said circuit and containing apparatus adapted to select and operate any of the said magnets in any of the sub-stations, substantially as described.

9. In a signaling system, the combination, with a single metallic electric circuit, of a series of sub-stations located thereon and each containing two or more signal-magnets, including a visual-signal magnet, and a switch adapted to select for operation any or all of the said magnets, the armatures whereof are normally located without the field of magnetic force when the current is of normal strength, an extra battery for bringing any or all of the said armatures of each sub-station into the said field, and a central station also located on the said circuit and containing a transmitter adapted to select any or all of the sub-stations for operation and to automatically cut the extra battery into the line, substantially as described.

10. In a signaling system, the combination, with a metallic circuit, of a series of sub-stations located thereon and each containing two or more signal-magnets and a step-by-step magnet, the signal-magnets being normally located in open and dead-open branches of the main line, and the step-by-step magnet being always in line, and all of the said magnets being normally out of the field of magnetic force when the current is of normal strength, and a switch also located at each sub-station and constructed to select any or all of the signal-magnets thereat, and a central station also located on the said circuit and containing apparatus adapted to select any of the sub-stations for operation, and also containing an extra battery, which is automatically cut into the line to energize the said magnets at the sub-stations and bring their armatures into the field of magnetic force.

11. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a selecting step-by-step mechanism, a step-magnet for operating the same, and means for locking the armatures of the said magnets out of the field of magnetism when the current is of normal strength, an extra battery, and a central station containing apparatus for selecting any of the sub-stations for operation and adapted to automatically cut the said extra battery into the main line, whereby the step-magnets at the sub-stations are energized in bringing their armatures into the field of magnetism, in which they are locked, substantially as described.

12. In a signaling system, the combination, with a metallic electric circuit, of a sub-station located thereon and containing a selecting step-by-step mechanism, a step-magnet for actuating the same, means for normally locking the armature of the said magnet out of the field of magnetic force when the current is of normal strength and for retaining the armature in the said field during the operation of the sub-station and for automatically unlocking the armature, so that it may fall out of the field of magnetic force at the completion of its work, an extra battery, and a central station also located on the said circuit and adapted to select any sub-station for operation and to automatically cut the extra battery into the main line for energizing the step-magnet in bringing its armature into the field of magnetic force, substantially as described.

13. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a selecting-switch and mechanism for producing a visual signal by the flashing of a light, and a central station having a trans-

mitter adapted to select any of the sub-stations for operation and to hold their switching mechanism in the adjustment required for the operation of the flashing mechanism, substantially as described.

14. In a signaling system, the combination, with a metallic circuit, of a series of sub-stations located thereon, and a central station also located on the said circuit and containing a transmitter having a rotatable arm, a pivotal switch carried thereby and having a shifting-arm, and a series of plug-holes located in the path of the switch to receive a plug, which is engaged by the shifting-arm of the switch when the rotatable arm is moved over the transmitter, the rotatable arm being arrested by the plug, substantially as described.

15. In a transmitter for a signaling system, the combination, with a rotatable arm, of a pivotal switch carried thereby and having a shifting-arm, two concentric contact-rings located in the range of the switch, and a series of plug-holes located in the path of the shifting-arm of the switch, whereby the same may be shifted from one ring to the other by the insertion of a plug in any one of the plug-holes, substantially as described.

16. In a transmitter for a signaling system, the combination, with a rotatable arm, of a pivotal switch carried thereby and having a shifting-arm, two concentric contact-rings located in the path of the switch and one of them having extensions which break into the path that the switch takes in traveling over the other ring, an extra battery connected with the ring having the said extensions, whereby when the switch is traveling over the sectional ring the extra battery will be momentarily switched onto the line by the engagement of the switch with the extensions of the other ring, a series of plug-holes located in the path of the pivotal switch, and a plug for insertion into the said holes to shift the switch and stop the rotatable arm, substantially as set forth, and whereby the extra battery is cut into the circuit of the sub-station represented by the plug-hole.

17. In a transmitter for a signaling system, the combination, with a rotatable arm, of a pivotal switch having a shifting-arm carried thereby, two concentric contact-rings located in the path of the switch and one of them having extensions which break into the path that the switch takes in traveling over the other ring, an extra battery connected with the ring having the said extensions, and a reserve-battery plate located in insulation upon the broken ring for engagement by the switch for throwing a reserve battery onto the line, substantially as described.

18. In a signaling system, the combination, with an electric circuit, of a series of sub-stations, each having a step-magnet, the armature whereof is normally out of the field of magnetic force when the current is of normal strength, and each sub-station normally being at unison with every other sub-station, a transmitter located at the central station and having a rotatable arm, a pivotal switch carried by the said rotatable arm and having a shifting-arm, two concentric contact-rings located in the path of the said switch, a series of plug-holes for the reception of a plug for engagement by the said shifting-arm, which is operated thereby, and means for stopping the said rotatable arm before it returns to its zero position, whereby the sub-stations on the line are prevented from being restored to unison and the armatures of the step-magnets cut out of the field of magnetism, substantially as described.

19. In a signaling system, the combination, with a single metallic circuit, of a series of sub-stations, each having a circular switch provided with individual signaling-segments, which have a different position in each sub-station, whereby any one sub-station may be selected for operation independently of the others, an extra battery, and a transmitter located at the central station and containing a segment for each sub-station, a rotatable arm for sweeping over the said segments, which are circularly disposed, and a pivotal switch mounted on the said rotatable arm and automatically shifted to switch in the extra battery by plugs placed in a circular series of holes arranged concentric with the path of the arm, substantially as described.

20. In a signaling system, the combination, with a single metallic circuit, of a series of sub-stations, each having a circular switch provided with collective signaling-segments, which have the same position in all of the switches, so that all of the sub-stations may be called collectively, and a transmitter located at the central station and containing a segment for each sub-station and a rotatable arm for sweeping over the said segments, which are circularly disposed, substantially as described.

21. In a signaling system, the combination of a series of sub-stations, each having a circular switch provided with independent signaling-segments and collective signaling-segments, the former having a different location in each switch and the latter having the same location in each switch, whereby the sub-stations may be called independently or collectively, substantially as described.

22. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and a central station also located thereon, a switch located in each of the sub-stations and containing a retaining-segment, two additional circuit-splitting segments located in the switch of the end sub-station, and a transmitter located at the central station and adapted to split the said circuit thereat at the same time that the circuit is split at the said end station by means of the two circuit-splitting segments,

whereby the metallic electric circuit is split into two ground circuits, substantially as described.

23. In a signaling system, a transmitter located at the central station and provided with a transmitting-wheel having a broad insulated tooth and provided with a hub having two insulated teeth, in combination with contact fingers and springs for splitting the circuit of the system into two ground circuits, substantially as described.

24. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon, a central station also located thereon, means located at the central station and at the end sub-station for splitting the metallic circuit into two ground circuits, a normal battery arranged in two parts which operate together when the system is operating on the single metallic circuit and independently when the said circuit is split into two ground metallic circuits, an extra battery for operating in conjunction with the normal battery when the circuit is not split, and a reserve battery for operating in conjunction with the normal battery when the circuit is split, substantially as described.

25. In a signaling system, the combination of a series of sub-stations, each containing a visual-signaling mechanism, the armature whereof is normally out of the field of magnetic force when the current is of normal strength, a circular switch provided with individual and collective signaling-segments, a rotatable arm carrying brushes which are swept over the said segments, step-by-step mechanism connected with the said arm, a step-magnet for operating the said mechanism and having its armature located without the field of magnetic force when the current is of normal strength, unison mechanism also operated by said step-magnet for bringing the visual signal mechanism of the said sub-station into its normal position after the operation of the apparatus, and a reserve battery located at the central station and cut into the line to operate the unison mechanism, substantially as set forth.

26. In a signaling system, unison mechanism located in each of the sub-stations and consisting of two disks, each provided with a shoulder and rotated together by a step-by-step action, and two locking-levers provided with operating-fingers, respectively engaging with the shoulders of the said disks and with notches co-operating with the armatures of the step and visual magnets, also located at the sub-stations, substantially as described.

27. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations, each containing a stored-signal mechanism adapted to be unlocked from the central station, and therefore set so as to be automatically released when any sub-station is opened, substantially as described.

28. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a normally-locked stored-signal apparatus, and a central station also located on the said circuit and containing a transmitter adapted to unlock and therefore set the stored-signal apparatus of any sub-station for operation as soon as that sub-station is opened, substantially as described.

29. In a signaling system, the combination, with a metallic electric circuit, of a series of sub-stations located thereon and each containing a normally-locked stored-signal apparatus and a central station located on the said circuit and containing a transmitter adapted to unlock and therefore set all of the stored-signal apparatus collectively, so that they will be released automatically when the sub-stations are opened, substantially as described.

30. In a signaling system, a stored-signal apparatus located at a sub-station and consisting of a magnet, an armature therefor constructed to have an unlocking function, a train normally locked and held by the said armature, a slide, and a crank connecting the same with the train, which is wound by the slide when the door of the case of the station is closed, the signal being given when the said door is opened subsequently to the unlocking of the train by the energization of the magnet from the central station, substantially as described.

31. In a signaling system, a sub-station provided with a visual-signal apparatus consisting of one or more semaphores, a vertically-sliding bar with which the said semaphores are connected, a train or movement directly connected with the said bar controlling the downward movement thereof and therefore the elevation of the semaphores and wound by the upward movement of the said bar, a visual magnet, an armature therefor, and means whereby the said armature operates to lock the train with the bar in its elevated position and to unlock it when the magnet is energized, whereby the train is released and the bar permitted to drop down under its control, substantially as described.

32. In a signaling system, a sub-station having a visual magnet, an armature therefor, a locking-lever connected with the said armature and provided with a circuit-changing finger and adapted when the magnet is energized to lock the armature thereof within the field of magnetism and at the same time to shift through its circuit-changing finger the main circuit of the apparatus through the magnet, substantially as described.

33. In a signaling system, the combination, at a sub-station thereof, of a visual-signaling apparatus having a magnet which is normally cut out of the circuit, a unison apparatus, and a locking-lever having also the function of a circuit-changer, the said lever operating when the magnet is energized to lock the armature thereof in the field of magnetic force and at the same time to change the circuit of the system through the said magnet, and the unison

apparatus operating through the said lever to unlock the armature and restore the circuit to its normal path, substantially as described.

34. In a signaling system, the combination, with a single metallic electric circuit, of a series of sub-stations, each containing a flash-signal apparatus, including a visual-signal magnet, a selecting-switch and locking mechanism for holding the said magnet in the circuit in certain adjustments of the switch, a central station also located on the circuit and containing a transmitter constructed to co-operate with the said switches in selecting any or all of the sub-stations for operation, and a circuit-interrupter located at the central station and adapted to have a make-and-break wheel applied to it for the purpose of making and breaking the circuit and so energizing the visual-signal magnets of the respective sub-stations selected for operation conformably with the character of the signal to be flashed by the flash-signal apparatus in the sub-stations, substantially as described, whereby any desired flash-signal may be automatically given at any sub-station or in any group of sub-stations or in all of them from the central station.

35. In a signaling system, the combination, with an electric circuit, of a sub-station having a flash-signal apparatus consisting, essentially, of a visual-signal magnet, an armature and a gas-valve arranged to be operated by the said armature, and a central station having a circuit-interrupter adapted to receive a signal-wheel for making and breaking the circuit conformably with the character of the signal to be flashed at the sub-station, substantially as described.

36. In a signaling system, the combination, with an electric circuit, of a series of sub-stations located thereon, a central station located thereon and having a transmitter provided with a rotatable arm, a pivotal switch carried by the said arm, two concentric contact-rings located in the path of the switch, and a stop normally located in the path of the switch and provided for stopping the rotatable arm before it returns to its zero position in certain cases, substantially as described.

37. In a signaling apparatus, the combination, with a single metallic electric circuit, of a series of sub-stations located thereon and each containing a step-by-step and a signal magnet and means for locking the said magnets in the field of magnetic force, a central station also located on the said circuit and having a transmitter by which any or all of the sub-stations are selected for operation, and a circuit-interrupter operating in conjunction with the transmitter when the same is set to hold the mechanism of the sub-stations in a certain position of adjustment, substantially as described.

38. In a signaling system, the combination, with a single metallic electric circuit, of a series of sub-stations located thereon and each containing a step-by-step magnet and two or more signal-magnets, including a gas-magnet which forms an element of an apparatus for turning the gas on and off, a switch located at each sub-station for selecting any or all of said magnets, and a transmitter located in the central station and constructed to co-operate with the switches located in the sub-stations in selecting any of their signal-magnets for operation, substantially as described, whereby the gas may be simultaneously turned on and off in any one or more or in all of the sub-stations.

39. In a signaling system, the combination, with an electric metallic circuit, of a series of sub-stations located thereon and each containing mechanism for producing one or more signals of distinctive character and including means for turning the gas on or off at the said sub-stations, and a transmitter located at the central station and adapted to operate the gas apparatus of the sub-stations collectively without disturbing the signaling mechanism of the said sub-stations, substantially as described.

40. In a signaling system, the combination, with an electric circuit, of a sub-station provided with a multiple call-box adapted to make long and short breaks of the circuit, a central station provided with a relay located in the main circuit, a switching-magnet situated in a local circuit and energized only during the long interruptions of the main circuit produced by the multiple call-box at the sub-station, a circuit-changer controlled by the said switching-magnet and operated when the same is energized, and an indicator located in a normally-open branch of the main circuit and cut into circuit by the operation of the circuit-changer when the said switching-magnet is energized owing to long interruptions of the main circuit by the multiple call-box, substantially as described.

41. In a signaling system, the combination, with an electric circuit, of a sub-station provided with a call-box adapted to make long and short interruptions of the said circuit, a central station having a relay located in the said circuit, a local circuit containing a switching-magnet which is energized only during the long interruptions of the main circuit produced by the multiple call-box, and a circuit-changer controlled by the said switching-magnet, and an audible alarm located at a point distant from the central station and on a normally-open branch of the main circuit and adapted to be cut into the said circuit when the said circuit-changer is operated by the energization of the switching-magnet, substantially as described.

42. In a signaling system, the combination, with an electric circuit, of a sub-station provided with a multiple call-box adapted to make long and short breaks of the said circuit, a switching-magnet located in a local circuit controlled by said relay, which operates it only when the main circuit is interrupted by the long breaks of the multiple

call-box, an armature for the said switching-magnet, and a double circuit-changer controlled by the said armature, and an indicator located in a normally-open branch of the main circuit and cut into the same when the circuit-changer is operated under the control of the switching-magnet, the said circuit-changer operating at the same time to make new connections for the switching-magnet, whereby it becomes a vibrator for an audible signal located in the central station, substantially as described.

43. In a signaling system, the combination, with a switching-magnet located in a local circuit situated at the central station of the system, of an armature for the said magnet, provided with a locking-pin and a bell-hammer, a lever provided with two notches respectively adapted to receive the said pin for locking the armature within the field of magnetic force and for permitting it to retire therefrom, a double circuit-changer connected with the said lever and operating therewith, a vibrating spring engaging with the armature and having electric connections, whereby when the said switching-magnet is energized its armature is locked in the field of magnetism, and the circuit-changer operated to send the current through the vibrating spring of the armature, thus transforming the magnet into a vibrator for an audible signal, substantially as described.

FRANK B. WOOD.

Witnesses:
FRED C. EARLE,
GEORGE D. SEYMOUR.