No. 686,925. Patented Nov. 19, 1901.

T. C. DRAKE.

PARTY LINE SELECTOR SYSTEM.

(Application filed Mar. 2, 1901.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.

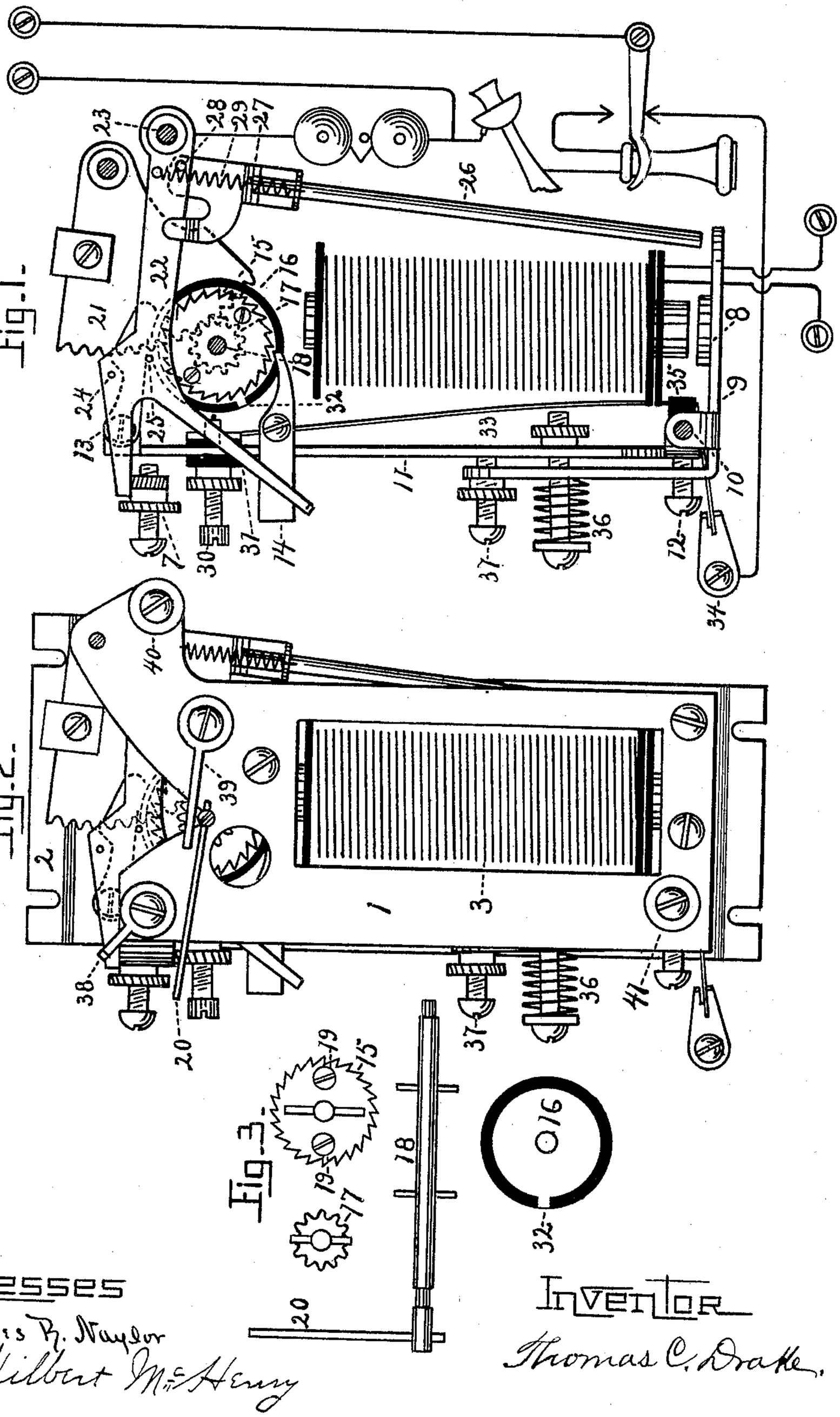


Fig. 2.

Fig. 3.

Witnesses
James R. Naylor
Wilbert McHenry

Inventor
Thomas C. Drake.

No. 686,925. Patented Nov. 19, 1901.

T. C. DRAKE.

PARTY LINE SELECTOR SYSTEM.

(Application filed Mar. 2, 1901.)

(No Model.) 4 Sheets—Sheet 2.

Fig. 4.

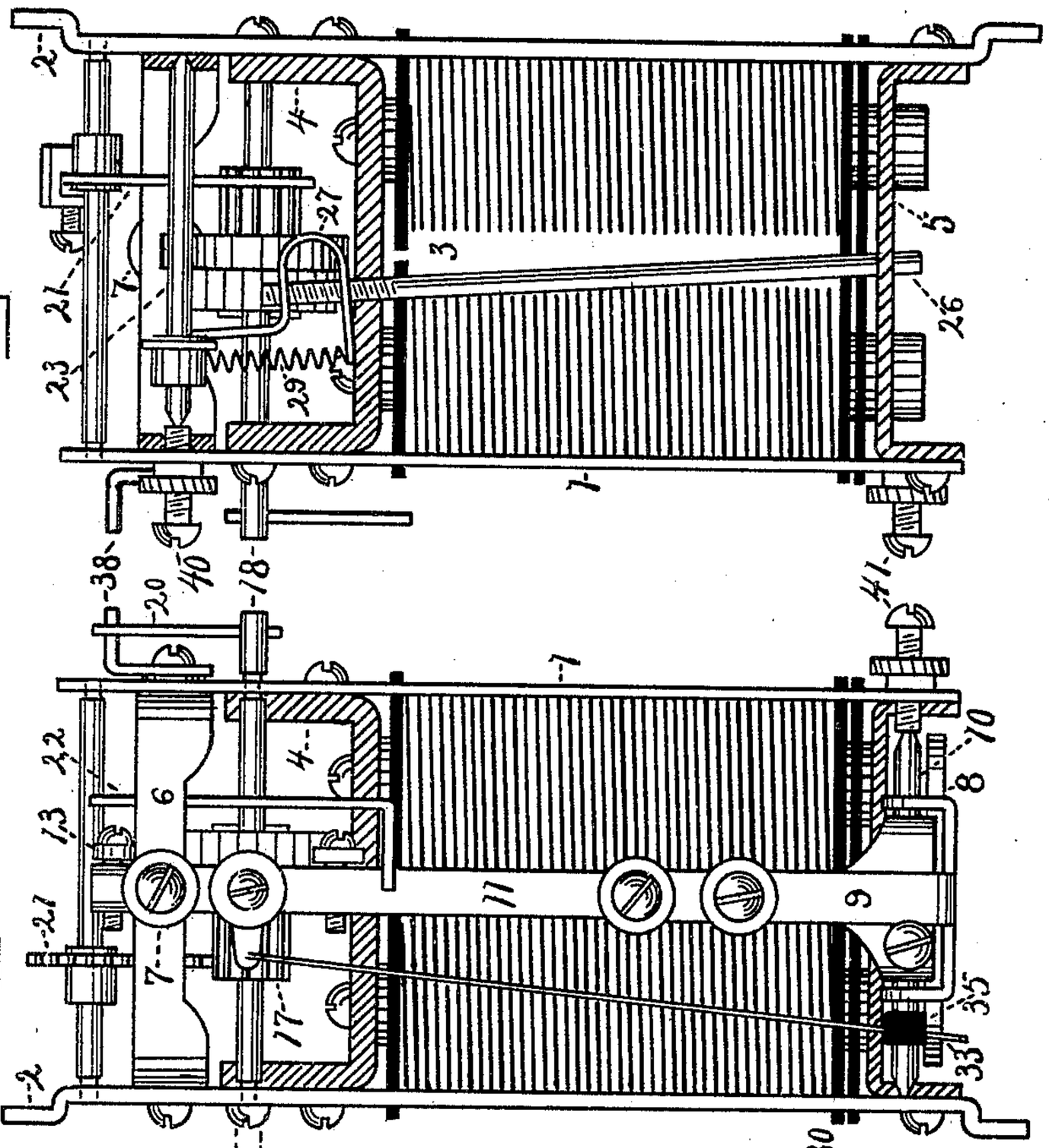


Fig. 5.

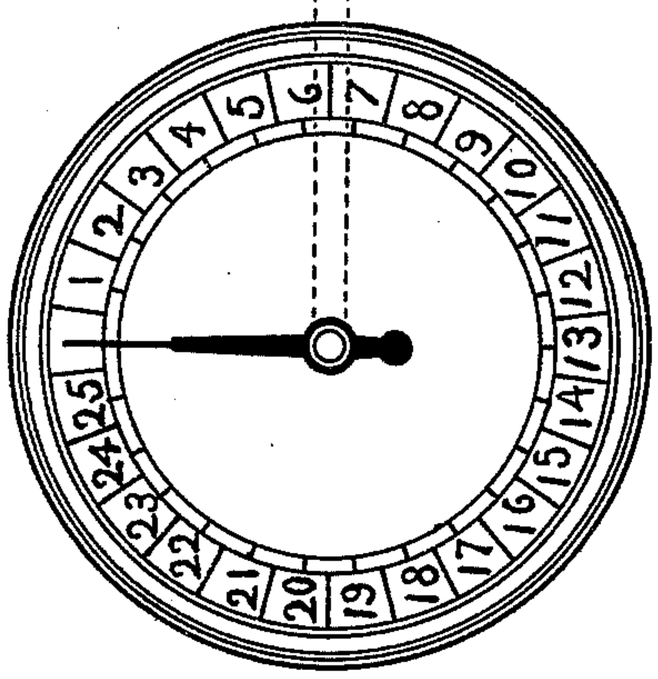


Fig. 6.

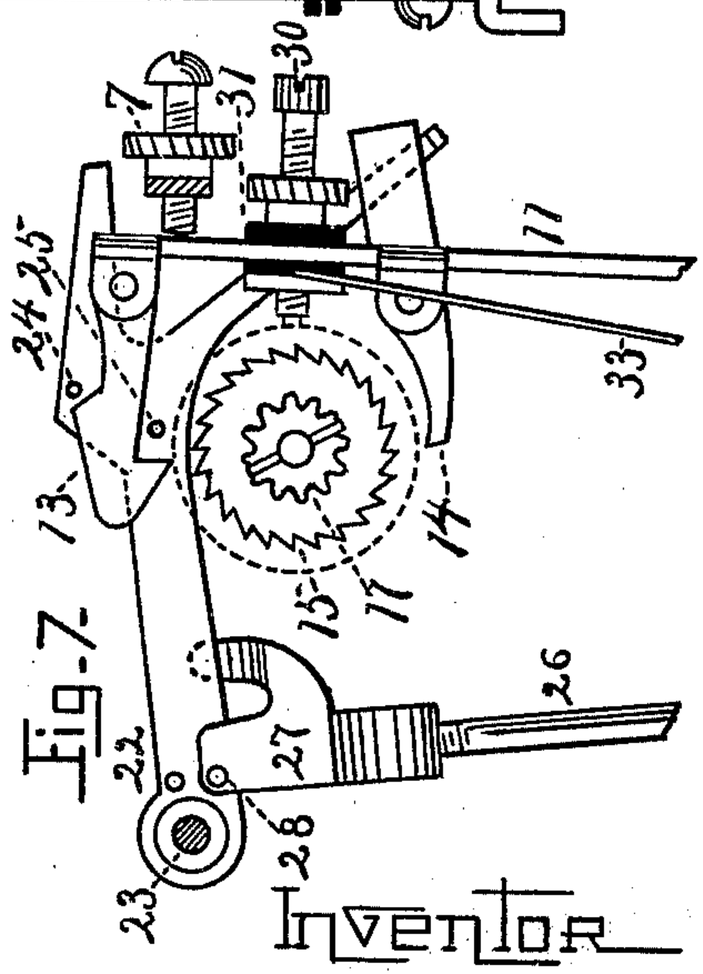


Fig. 7.

Witnesses

James B. Naylor

Wilbert McHenry

Inventor

Thomas C. Drake.

No. 686,925. Patented Nov. 19, 1901.

T. C. DRAKE.

PARTY LINE SELECTOR SYSTEM.

(Application filed Mar. 2, 1901.)

(No Model.) 4 Sheets—Sheet 3.

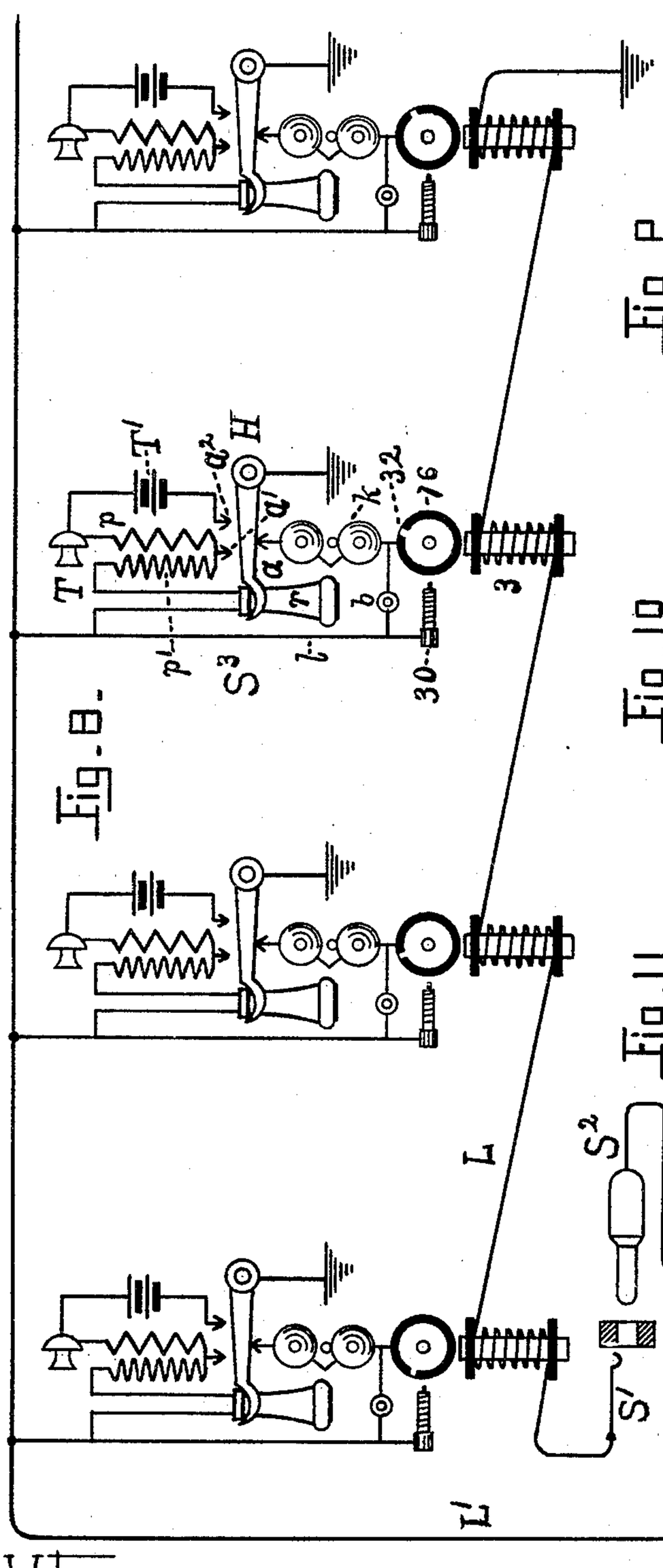


Fig. 8.

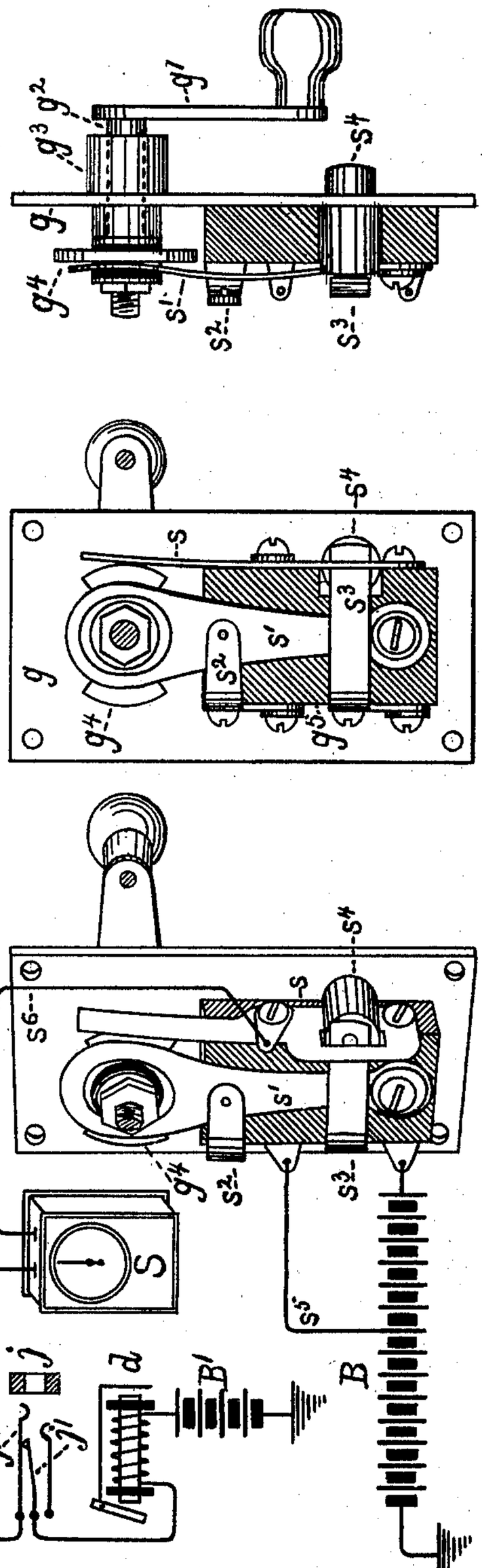


Fig. 9.

Fig. 10.

Fig. 11.

Witnesses

James B. Naylor

Gilbert McHenry

Inventor

Thomas C. Drake.

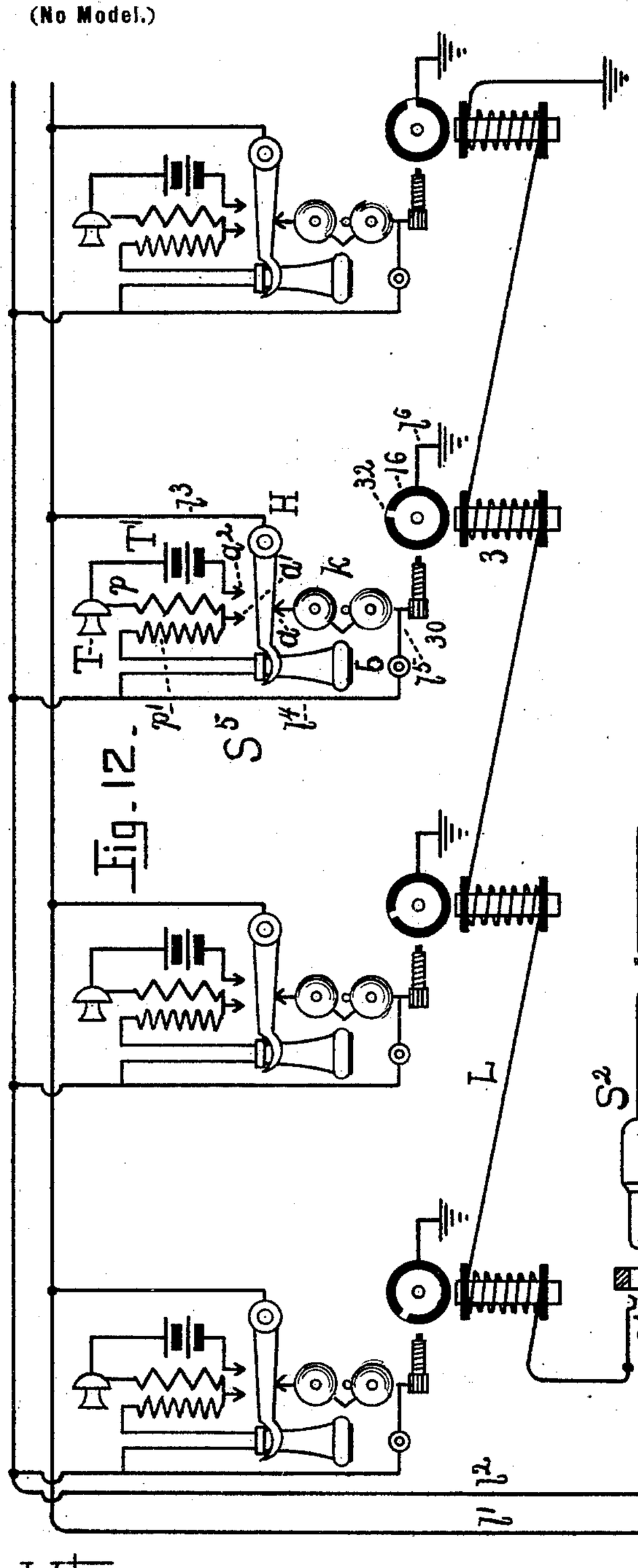
No. 686,925. Patented Nov. 19, 1901.

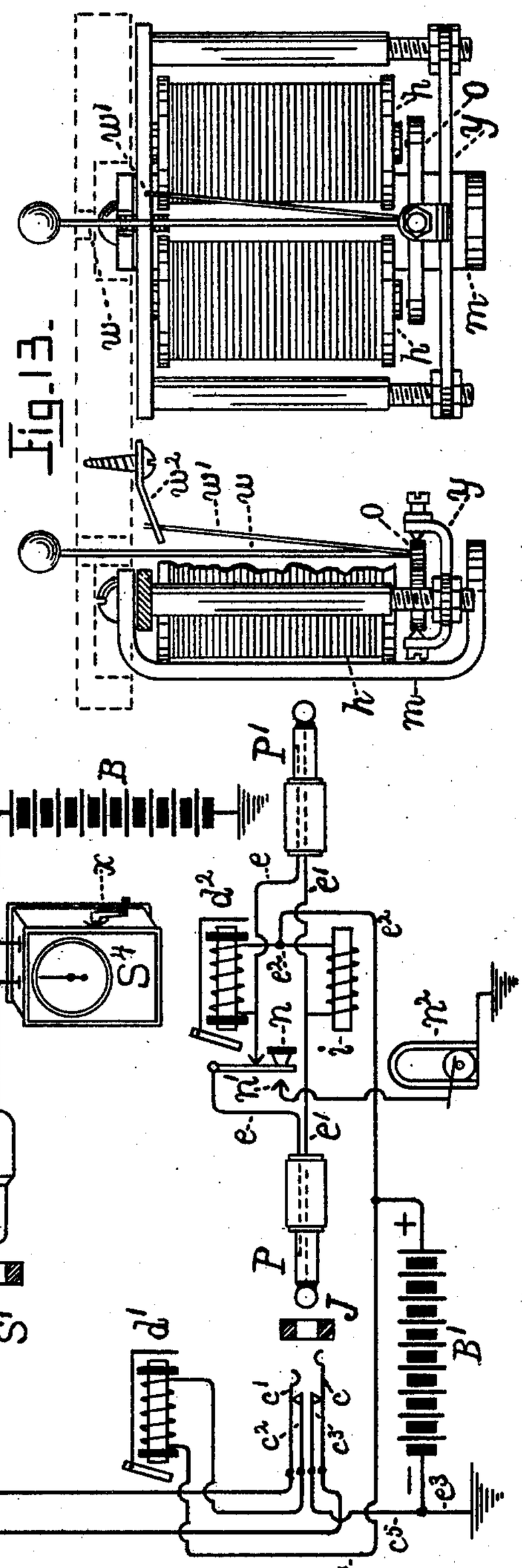
T. C. DRAKE.

PARTY LINE SELECTOR SYSTEM.

(Application filed Mar. 2, 1901.)

(No Model.) 4 Sheets—Sheet 4.





Witnesses

James R. Naylor

Hilbert McHenry

Inventor

Thomas C. Drake.

UNITED STATES PATENT OFFICE.

THOMAS C. DRAKE, OF MALTA, OHIO.

PARTY-LINE SELECTOR SYSTEM.

SPECIFICATION forming part of Letters Patent No. 686,925, dated November 19, 1901.

Application filed March 2, 1901. Serial No. 49,656. (No model.)

To all whom it may concern:

Be it known that I, THOMAS C. DRAKE, a citizen of the United States, residing at Malta, in the county of Morgan and State of Ohio, have invented certain new and useful Improvements in Party-Line Selector Systems, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

My invention relates to party-line telephone systems of that class in which many stations or instruments are connected to one line and controlled from an exchange or master-station. Such lines as my system is intended to operate have heretofore been almost universally operated by means of the bridging-bell system, especially such lines as are required to operate so many as twenty-five stations, this system having been found by experience to be the best scheme yet devised for that purpose. As is well understood, the bridging-bell system is so arranged with the ringer-magnets permanently bridged across the line-circuit that the signal-bells at every station on the line ring simultaneously when it is required to ring but a single station. This mode of operation requires a code of signals by means of which the various stations are enabled to determine their respective calls, and the confusion of these signals has been found by experience to be a most objectionable feature of the system.

The primary object of my invention is to enable the signaling on such lines to be selective in character—that is, in such a manner as to enable the operator at central or the master station to pick out or select the desired station and ring its bell to the exclusion of all others on the same line.

With the bridging-bell system a certain amount of the voice-current is absorbed or short-circuited by reason of so many ringer-magnets being permanently bridged across the line-circuit, and the voice-currents at the opposite end of a long line is therefore weaker than it would be if the ringer connections were eliminated at all stations during the time the line was in use for conversation.

A further object of my invention is to eliminate the permanent ringer connections at all stations on a party-line, the only ringer ever connected being that selected from the master-station or central office.

A further object of my invention is to provide each party-line station with an effective means of determining the busy condition of the line without cutting in on the parties talking or in any way disturbing the line by removing the receiver from the hook-switch in order to listen in.

The selective device employed in my system is of that class of step-by-step mechanisms in which contacts are arranged successively in advance of each other at the successive line-stations, each contact being adapted to close a signal-bell circuit at a predetermined number of steps, the selective mechanism being of a stepping and restoring nature and actuated by means of "light" and "heavy" currents, which are controlled from a master-station, a centralized source of energy, preferably an open-circuit battery, together with other auxiliary devices for pulsating the battery-current, being employed to step the series of mechanisms in synchronism to a predetermined position, then restore the contact elements to home or normal position after sending a calling-current to actuate the signal-bell at the selected station, the magnet-coils of the step-by-step mechanism being connected serially in a separate line from that of the talking-circuits of the telephone apparatus.

My invention consists of improvements in step-by-step mechanism, auxiliary devices to successfully operate the same, and the system hereinafter described for selectively operating-party line telephone systems. It may best be summarized, however, as consisting of the combinations as hereinafter described, and definitely set out in the claims.

The drawings clearly disclose my invention, the same numerals and letters of reference indicating the same or corresponding parts throughout the several figures.

Figure 1 is a front elevation of the selector, showing the moving elements of the mechanism. Fig. 2 is a similar view showing the front and rear supporting frame-plates, together with such of the moving elements as are not covered by the front plate. Fig. 3 is a detail of the ratchet-wheel, contact-disk,

and arbor hereinafter more fully referred to. Fig. 4 is a right-hand side elevation showing certain features of construction, while Fig. 5 is a left-hand side elevation showing certain other features of construction. Fig. 6 represents a dial and indicator for the central-office or master-station selector, the substation-selectors not requiring anything of this kind in the ordinary operation of the system. Fig. 7 is a rear view of the upper part of Fig. 1, showing the disengaged or restoring position of the stepping-pawls. Fig. 8 is a diagram of the system when making use of the ground as a return for both the selecting and talking circuits, four substations being here shown in connection with the master-station equipment. This is not the most desirable arrangement of the system for good telephonic results, but it admits of changing existing overloaded metallic-circuit bridging-bell systems to the party-line selector system without the stringing of a third wire. Fig. 9 is a side elevation, Fig. 10 a rear elevation, and Fig. 11 a perspective view, of the make-and-break contact-crank by means of which the centralized selector-battery is controlled by the master-station operator. Fig. 12 is a diagram of the system when a metallic circuit is employed for talking and the ground is employed as a return for the selecting-circuit, this arrangement of circuits having been found in practice to be the best for telephonic results. With this arrangement of circuits the master-station has full supervision of the substations, both as to signaling for a connection and also clearing out or signaling for a disconnection without listening in on the line, the master-station line-signals furnishing this information automatically in a manner hereinafter more fully described. Fig. 13 is a bottom and side view of the specially-constructed ringer or call-bell mechanism employed in this system, this construction admitting of the ringer being employed as a "busy-line" signal for the substation-telephones.

Referring to Figs. 1, 2, 3, 4, 5, and 7, the construction of the step-by-step mechanism may be understood. 1 and 2 are the parallel side plates of the framework supporting the various parts of the apparatus. 3 is a pair of electromagnets vertically secured to an iron heel-plate or yoke 4, another yoke 5 of non-magnetic material retaining the poles of the magnets in proper position, as well as securing the bottom of the frame-plates in a rigid manner. The heel-plate 4 and a third yoke 6, carrying a chuck-nut adjusting-screw 7, secure the frame-plates in a rigid manner at the top. The armature 8 is secured to the angle-lever 9, supported on an arbor 10, in a hinge-like manner. This arbor is pivoted at either end by means of trunnion-bearings in the frame plates. Said arbor also carries a lever 11, which is adapted to be oscillated, by means of angle-lever 9, to propel the ratchet-wheel, said lever 11 being securely but adjustably mounted on arbor 10 by means of set-screw 12. The pawls 13 and 14 are pivotally mounted on the upper end of lever 11 and act by gravity to engage the ratchet-wheel.

15, 16, and 17 represent the ratchet-wheel, contact-disk, and pinion-gear, respectively, all of which are adapted to be mounted on an arbor 18 between the two pins, as is clearly shown in the detail view Fig. 3. The ratchet-wheel contains two set-screws 19 for securely binding the contact-disk in any predetermined position. The arbor 18 carries an arm 20, adapted to stop the retrograde movement imparted to the ratchet-wheel and contact-disk by the weighted segment-gear 21, which meshes with the pinion-gear 17, this segment-gear being wound up or elevated in an obvious manner when propelling the ratchet-wheel by oscillating the lever 11.

22 represents a bifurcated lever mounted on an arbor 23, said arbor being pinioned at either end by trunnion-bearings in the frame-plates. The upper fork of this lever is adapted to rest normally on the cross connecting-yoke 6, while the lower fork has its tip bent to right-angle and adapted to lift the pawl 14 out of engagement with the ratchet-wheel on being elevated in the manner hereinafter explained.

Two pins 24 and 25 are secured to the lever 22, the latter adapted to lift the pawl 13 out of engagement with the ratchet-teeth, while the former is adapted to ride on the inclined part of the pawl 13 when the lever 11 is brought against adjusting-screw 7, said pawl being shaped, as shown, with a curved recess on its top surface in order that the pin 24 may not interfere with the forward movement when retracted to engage another tooth. The object of having the pin ride the pawl in this manner is to prevent the ratchet-wheel from lifting said pawl and go by momentum beyond its limit or pass more than one tooth each time the magnets are energized, thus preventing the series of mechanisms from getting out of unison.

A lifting-rod 26, threaded at its upper end, screws into an adjustment 27, which is pivotally connected to the bifurcated lever 22 at the point 28 in a very sensitive manner, a light helical spring 29 being adapted to take up the lost motion or back play in this joint, so that there will be no lost motion between the armature 8 and the poles of the electromagnets. The lower end of this lifting-rod passes through a guide-hole in the yoke-plate 5 and is adapted to be lifted by means of the horizontal arm of the angle-lever 9.

A contact-screw 30, with a platinum point, is carried by but insulated from the lever 11 by means of an insulating-bushing 31. This screw is adapted to make electrical connection with the contact-disk segment 32 and also to adjust the oscillating movement of the pro-

pelling-lever 11, and thereby cause the pawls to properly engage the ratchet-teeth.

A retractile spring of suitable wire is represented at 33. This spring is in electrical connection with a suitable nut on the contact-screw 30 and leads through a block of insulating material 35, carried by arbor 10 to an adjustment 34. This retractile spring and adjustment 34 constitutes one terminal of the signal-bell circuit, while the frame and other elements of the mechanism constitutes the other, the circuit through said signal-bell remaining normally open, but may be closed by stepping the segment 32 around in front of the contact-screw 30.

The periphery of the contact-disk 16, with the exception of a small segment 32, is composed of insulating material, preferably of vulcanized rubber, the contact-segments being arranged successively in advance of each other throughout the series of party-line stations, so that a different number of steps for each station is required in order to close the signal-bell circuits in a selective manner.

Levers 9 and 11 are held together for the purpose of propelling the ratchet-wheel by means of the stress-spring 36 in an obvious manner, the chuck-nut screw 37 being necessary only as a means of adjusting the field of force or the air-gap distance between the armature and the poles of the electromagnets.

As before stated, currents of two strengths are required to step and restore the mechanism, the light current giving only enough attraction to armature 8 to overcome the retractile spring 33 and actuate the mechanism in a step-by-step manner by oscillating both the propelling-lever 11 and the angle-lever 9 together.

The lifting-rod 26 is adjusted so as not to be acted upon by lever 9 when oscillated by the light current to step the ratchet-wheel, but is adapted to be lifted when energizing the coils with the heavy current, this operation actuating the armature to the full limit by overcoming the stress of helical spring 36, the bifurcated lever then being elevated to the position of disengaging the pawls, as is best shown in Fig. 7. The pawls being disengaged, the ratchet-wheel and contact-disk are then free to return to home or normal position under the influence of the weighted segment-gear 21.

38 indicates an adjustable arm which protrudes in the path of arbor-arm 20, said arm being adapted to stop the backward or retrograde movement of the ratchet-wheel and contact-disk at normal or home position. Said arm also limits the forward or step-by-step movement to one revolution of the ratchet-wheel or twenty-five steps, the construction here shown being intended to represent a twenty-five-station selector mechanism.

39 represents a retaining-arm secured by means of one of the framework-screws and adapted to normally retain the arbor 10 in its bearings, as is best shown in Fig. 2, the form of bearing here shown in frame-plate 1 admitting of the arbor, ratchet-wheel, and contact-disk being easily and quickly removed for inspecting and cleaning or resetting the contact-segment to any desired position. Chuck-nut trunnion-screws 40 and 41 also admit of an easy dismantling of levers 9, 11, and 22 for inspecting and repairs.

The rear frame-plate 2 is punched and formed with screw-slots at the bottom and top for mounting the mechanism in any desirable manner.

Fig. 6 represents a dial and indicator, preferably mounted on the outside of the selector-case at the central office or master-station, the pointer thereof being secured to an extension of arbor 10 in such a manner as to move over the dial in concordance with the stepping of the ratchet-wheel, each successive number indicating a successive step to the ratchet-wheels throughout the system.

Referring to Figs. 9, 10, and 11, the construction of the master-station contact-crank for controlling the light and heavy battery-current may be understood. Fig. 11 shows the proper connection of the battery. This contact device is preferably placed on the side of the master-station selector, but usually, for the convenience of operators, is set into a mortise in the switchboard when this system operates from a large-sized central office, the master-selector being located in any convenient position about the board. An escutcheon-plate g supports the various parts of the device and is adapted to cover a mortise into which the contact-springs and revolving parts enter. g' is a crank with a suitable handle. g^2 is a shaft revolving in a long bearing g^3 and having a longitudinal movement therethrough. g^4 is a double-segment disk mounted on the inner end of said shaft and adapted to make and break contact with a line-spring s when revolved, said double-segment disk being insulated from said shaft g^2 by means of suitable bushings and washers. Another spring s' is in rubbing contact with the segment g^4 and adapted to force the shaft g^2 normally outward and itself normally out of connection with a contact-arm s^2. s^3 is another spring normally out of connection with all other springs and adapted to force the push-button s^4 outward and itself out of contact with the spring s. All of said springs are mounted on a block of insulating material g^5, as is clearly shown in the drawings. The escutcheon-plate and crank are insulated from all electrical connection with other parts of the device, so as to prevent operators from getting shocks from accidental contact with the metal parts. The battery B is divided into two sections, the wire s^5 connecting the light-current section to the contact-arm s^2, while both sections or the entire battery is connected to the push-button spring s^3. Wire s^6 connects the master-station selector S in series with the line-spring s and the selector line-plug S^2. Under the

normal condition of the contact-crank all battery connection with the line-spring *s* is broken; but by pushing in and revolving the crank *g'* connection is made intermittently between the line-spring *s* and the arm s^2 by means of the double segment g^4 and spring *s'*, thereby pulsating the light current in the selector-circuit to step the mechanisms in unison at the various substations. By pushing in the button s^4 the spring s^3 is forced into contact with the line-spring *s* in an obvious manner, and the full potential of the battery or the heavy current is thereby connected in the selector-line. This operation restores the mechanisms at the various stations in a manner hereinafter more fully explained.

Fig. 13 represents an improved ringer or call-bell mechanism, one of which is intended to be shown diagrammatically at each substation in Figs. 8 and 12. The general construction of this ringer is that of the commercial forms now universally used in telephone work and depends for its mode of action upon the same principles. The improvement, however, consists of the addition of means to give the armature a permanent set or tendency toward one side only, so that a battery-current of a certain polarity may actuate the armature to the opposite side and give an audible signal by causing the bell-hammer to strike one of the gongs, this audible signal constituting a means to determine the busy condition of the telephone-line. In front of the electromagnets, whose coils *h h* are connected in series, is pivoted in a yoke *y* an armature *o*. This armature is given a permanent magnetization by means of a permanent magnet *m* in the usual manner. The bell-hammer rod *w* is securely attached to the middle of the armature *o* and carries at its other end the usual ball for striking the gongs. *w'* is a wire constituting a light spring. This wire is preferably attached to the armature at the same point as rod *w* and extends to an adjustment w^2, by means of which the armature and bell-striker are given a permanent set or tendency toward one gong. The spring *w'* is light enough not to affect the usual vibration of the bell-hammer when actuated by an alternating current. Ringers of this construction are arranged at each substation in bridge or multiple arc with the line-circuit, the ringer-circuit being normally open, but adapted to be closed momentarily by means of a suitable push-button, hereinafter referred to. At the central office or master-station a suitable battery is bridged across the line through a suitable line-signal, the polarity of the battery being such as to actuate the bell-hammers against the permanent set given by the spring *w'* when closing the circuit through the ringers by means of the push-button. In this manner a not-busy signal is audible at the substation, and the line-annunciator at the central office is also actuated to signal the operator.

Fig. 8 is a diagram of a selective party-line, showing four substations connected with the master-station or central office. In this diagram *j* represents a spring-jack, and *d* a line-annunciator of a switchboard. The line-annunciator is preferably of the self-restoring type. B' is a centralized battery for energizing the line-annunciator and also for actuating the busy-test ringer hereinbefore described. The operator's plug and cord-circuit is not shown in this diagram, as it is of the usual arrangement and is well understood by those familiar with telephone-switchboards. S' is another line-jack in which the selector-line L terminates. S^2 is the corresponding plug for the spring-jack S'. S is the master-selector mechanism with a dial, as hereinbefore described. B is the selector-battery divided in two sections, so as to give the light and heavy current for stepping and restoring the selector mechanism, and Fig. 11 is the contact-crank for controlling said selector-battery. S^3 represents, diagrammatically, one of the substation-telephone equipments. The series magnets of the selector mechanism are represented by Fig. 3, the contact-disk by 16, and the segment of the disk by 32, 30 being the contact-screw, registering with the segment 32, for closing the ringer-circuit to ground when stepping the disks in a selective manner, as already described. H is a hook-switch of the ordinary pattern, permanently connected to ground and having the usual three contact-anvils *a*, *a'*, and a^2. *r* is a telephone-receiver, *p'* the secondary of an induction-coil, and *p* the primary of the same coil. T is a microphonic transmitter connected with the primary of the induction-coil, and T' is the local battery for energizing the same in a manner well understood. *k* represents, diagrammatically, one of the improved ringers hereinbefore described, and *b* a suitable push-button, by means of which the ringer-circuit may be momentarily closed in order to ascertain the busy condition of the line.

The operation of the system is as follows: The four stations are wired and connected identically, the only difference being in the selector-contacts 32, which are set to close the ringer-circuits successively in advance of each other—that is, no two selectors close their ringer-circuits with the same number of pulsations of the light current. The system is shown in its normal or idle condition—that is, with the plugs withdrawn from the line-jacks and all receivers resting upon their respective hook-switches. Suppose now that a party at a substation desires to communicate with another party, either on the same or some other line. He first ascertains the busy condition of the line. This he does by means of the push-button *b*, which is adapted to connect the ringer *k* in bridge

or multiple arc with line L′ and the ground. If the plug is out of jack *j*, which is the normal condition at central, a current from battery B′ will traverse through line-signal *d* to the anvil-spring *j′*, which rests in contact with line-spring j^2, over line L′ and wire *l*, through push-button *b*, ringer *k*, switch-contact anvil *a*, hook-switch H, and back by ground to the opposite terminal of the battery. The current traversing the circuit thus formed through the line-signal *d* and ringer *k* actuates the line-signal to call the attention of the operator and being of the right polarity also actuates the ringer in the manner already explained to give an audible signal which the substation party will understand as indicating that the line is not busy. The operator inserts a plug (not shown) into the spring-jack *j* in the usual manner, and the party removes his receiver from the hook-switch, the two then being in communication. If another party should push the button at his station while the line is in this condition, he will be informed of a busy line by reason of the ringer at his station remaining quiescent, as the battery B′ was cut off at the line-spring j^2 on inserting the plug. Consequently there was no source of current to actuate the ringer. When the central-office operator desired to pick out or select any particular station on the line, the calling-plug of the operator's circuit (not shown) is inserted into the line-jack *j*, so that a ringing current may be sent to line in the usual manner. The selector-plug S^2 is next inserted into the line-jack S′, and the operator proceeds to pulsate the light current by pushing in and revolving the contact-crank *g′*. This operation actuates the mechanisms at all stations in a synchronous step-by-step manner, as before fully described. The operator, knowing the number of steps required to bring the segment-contact 32 around to the contact-screw 30 at the various stations, observes the dial-selector S and picks out the desired number. A ringing-current is now sent to line from the operator's magneto-generator in the usual manner. This actuates the ringer at the substation whose contact-segment 32 registered with the contact-screw 30, all other ringer-circuits being open by reason of their contact-screws resting on the periphery of their respective contact-disks. After ringing up the party the selective devices at the substations and also the master-selector S may be restored to home or normal position by pushing in the button S^4, which is adapted, as hereinbefore stated, to connect the heavy current or the full potential of battery B to the selector-line L. After restoring the mechanism the plug S^2 may be withdrawn, and after the conversation is ended the calling-plug of the operator's cord-circuit is also withdrawn from the line-jack *j*, thus restoring the line to its normal idle condition or ready for the next call.

Fig. 12 shows, diagrammatically, a selector party-line of four stations, with metallic circuit for talking and a ground return-circuit for operating the selector mechanisms, the general plan of the system, leaving out the selective features, being that of the "automatic signal" or centralized battery for actuating the calling and clearing-out annunciators, the substations' transmitters being supplied with current from a local battery. The two sides *l′* and l^2 of the metallic circuit are connected, respectively, with the two line-springs *c* and *c′* of the switchboard-jack J. These springs normally rest on two anvil-springs c^2 and c^3, the former of which connects through a line-signal *d′* with a wire c^4, leading to the positive pole of the calling-battery B′, and the latter connects, by means of a similar wire c^5, to the negative pole of the same battery. The line-signal is preferably of the self-restoring type in which the target is displayed when energized by the calling-battery, the target disappearing when the battery is cut off; but annunciators of any well-known kind may be employed as line-signals. The battery B′ is normally bridged through the line-signal *d′*, with the two sides *l′* and l^2 of the metallic circuit, the battery, and line-signal being cut out on inserting a plug into the jack J, this operation lifting the springs *c* and *c′* from the anvils c^2 and c^3. S^5 represents, diagrammatically, one of the substation equipments. The series magnets of the selector mechanism are represented by Fig. 3, the contact-disk by 16, and the segment of said disk by 32, 30 being the contact-screw, registering with the segment 32, for closing the ringer-circuit to ground when stepping the disks in a selective manner, as already described. H is a hook-switch of the ordinary pattern permanently connected by a wire l^3 to line *l′* and having the usual three contact-anvils *a*, *a′*, and a^2. *r* is a telephone-receiver, *p′* the secondary of an induction-coil, and *p* the primary of the same coil. T is a microphonic transmitter connected with the primary of said induction-coil, and T′ is the local battery for energizing the same in a manner well understood. *k* represents, diagrammatically, one of the improved ringers hereinbefore described. This ringer is adapted to be in open bridge or multiple with the line-wires *l′* and l^2 when the hook-switch is held down under the influence of receiver *r*. One terminal of the ringer is connected to the anvil *a* and the other is connected by wire l^5 to one terminal of the push-button *b* and is also connected by the same wire to the selector mechanism contact-screw 30. The other terminal of the push-button is connected to the line l^2 by wire l^4. The receiver *r* and secondary *p′* of the induction-coil are in series between the wire l^4 and the anvil-contact *a′* and adapted when the switch-hook is up to be connected in bridge or multiple with the line-wires *l′* and l^2 for talking.

During the idle condition of the system—

that is, when all receivers are on their respective switch-hooks—all circuits at the substation, both ringing and talking, are open, the ringer-circuit being open at push-button *b* and the talking-circuit being open at switch-contact *a'*. Therefore no current can traverse the lines *l'* and *l²*, and consequently actuate the line-signal *d'*, until a push-button is operated to close a ringer-circuit or a receiver removed from one of the hook-switches.

The switchboard is provided with plugs P and P', forming terminals of plug-circuit or cord-strands *e* and *e'*. P is the calling-plug, and P' is the answering-plug. *e* is the sleeve-strand, and *e'* is the tip-strand, as can be readily seen from the diagram. Bridged across the cord-strands is a clearing-out signal *d²* and an impedance-coil *i* for maintaining the balance of the line. One terminal of the clearing-out signal is connected to the sleeve-strand *e*, while one terminal of the balance-coil *i* is similarly connected with the tip-strand *e'*. The other terminals of the coils are connected together with the wire *e²*, which forms one terminal of the line-signal battery B', the other terminal of said battery being grounded by wire *e³*. A ringing-key *n* is adapted to normally maintain the continuity of the sleeve-strand *e*, but by depressing the same the P plug side of the *e* strand will be connected to the contact-anvil *n'*, which is the terminal of a generator *n²* of alternating currents, the other terminal of said generator being grounded, as the diagram indicates. The sleeve-terminals of the plugs are adapted to register with the long line-spring *c*, and the tip-terminals of the plugs register with the short line-spring *c'*.

S⁴ represents the master-station selector mechanism, with dial, the same being similar to that already described. This selector also includes a contact-crank of the kind shown in Figs. 9, 10, and 11, the same being diagrammatically represented as set into the side of the selector case at *x*.

B is the selector-battery for stepping and restoring the substation mechanism in a manner already described, the mechanism being serially connected by the selector-line L, as the diagram clearly indicates.

S' is the switchboard-jack in which the selector-line terminates, and S² the corresponding plug for connecting the master selector and battery to said jack.

The contact-disks are permanently grounded by wire *l⁶*, as the diagram indicates, and the contact-screws 30 are connected to the *l⁵* terminal of the ringer *k*, so that a ground tap or connection may be formed through wire *l³*, switch-hook H, anvil *a*, ringer *k*, contact-screw 30, segment-contact 32, and to ground through wire *l⁶* whenever the contact-disks 16 are stepped into the proper position at any substation. This will admit of sending a ringing-current from generator *n²* over the *l'* side of the metallic circuit to ground, and thereby actuate the selected call-bell. This means that calling a substation from the central office may be accomplished over one limb of the line and ground instead of over a metallic circuit, as in the case of talking and signaling central for a connection.

This party-line system operates as follows: The system is shown in its normal idle condition—that is, with the plugs withdrawn from the line-jacks at the central office and all of the receivers resting upon their respective switch-hooks at the substations. The operator's telephone is not shown in connection with the plug-and-cord circuits at the central office; but its arrangement as included in a normally open bridge across the two cord strands *e* and *e'* is well understood and need not be here described in detail. Suppose a party at a substation desires to converse with another party either on the same or some other line. The assistance of the central-office operator must first be had, her attention being attracted by the line-signal *d'*, which is actuated by certain operations performed by the substation party, as will now be explained. The substation party first ascertains whether or not the line is in use by some other party. This he does by means of the push-button *b*, which is adapted to close the ringer *k* in bridge with the line *l'* and *l²*. If the line is not in use and the plug withdrawn from the line-jack J, a current from battery B' proceeds over wire *c⁴*, which connects to the positive pole of the battery through line-signal *d'*, and to anvil-spring *c²*, which rests in contact with tip-spring *c'*, over line *l²*, wire *l⁴*, through push-button *b*, wire *l⁵*, ringer *k*, switch-contact anvil *a*, hook-switch H, wire *l³*, and back over the other line-wire *l'* to the sleeve-spring *c*, which rests in contact with anvil-spring *c³*, said anvil-spring being connected to the negative pole of the battery by wire *c⁵*. The current traversing the circuit thus formed through the line-signal *d'* and ringer *k* actuates the line-signal to call the attention of the operator, and being of the right polarity also actuates the ringer *k* in the manner already explained to give an audible signal, which the substation party will understand as indicating that the line at that particular moment is not busy. However, should the ringer remain quiescent on pushing the button the party endeavoring to use the line will be notified thereby that the line is in use, and not having effected a call to central should refrain from taking down the receiver. However, assuming that the party received the proper audible signal at his ringer, he proceeds to take down the receiver. The switch-hook being relieved of its weight rises and makes contact with anvils *a'* and *a²*. This operation bridges the receiver *r* and secondary *p'* of the induction-coil across the line *l'* and *l²* and at the same time connects the transmitter T, primary *p*, and the local battery T' into circuit for talking. This operation also maintains a continuous flow of current from battery B' through the line-sig-

nal d', receiver r, and the secondary of the induction-coil, this being very desirable where certain kinds of self-restoring annunciators are employed, as the line-signal is displayed until the operator answers the call. On receipt of a call the operator proceeds to insert a P′ plug into the line-jack J, this operation lifting the line-springs c and c' out of contact with anvil-springs c^2 and c^3, thereby cutting off the battery-current. She now connects her telephone set in bridge across the cord-circuit in the usual manner, the two then being in communication. Should another party endeavor to effect a call to central while the plug is in the jack, he will not receive a sound at his ringer on pressing the button, as the battery is now disconnected and remains so as long as the plug remains in the jack. When a substation is to be signaled, the operator inserts the selector-plug S^2 into the line-jack S′ and proceeds to pulsate the light current by pushing in and revolving the contact-crank x, assuming x to represent a contact-crank, as shown in Fig. 11. This operation actuates the mechanisms at all stations in a synchronous step-by-step manner, as hereinbefore described. The operator, knowing the number of steps required to bring the segment-contact 32 around to the contact-screw 30 at the various stations, observes the dial-selector S^4 and picks out or selects the desired number. At the station thus picked out and to which a ringing-current is to be sent the segment-contact 32 has been brought into electrical connection with contact-screw 30, said screws at all other stations resting upon the insulated periphery of their respective contact-disks. The next step in the operation of the system is to insert the P plug into jack J and send a ringing-current by throwing the key n over into contact with anvil n', the circuit now being completed through generator n^2, key n, sleeve-terminal of plug P, long-line spring c, line-wire l', wire l^3, switch-hook H, anvil a, ringer k, screw 30, contact-disk 16, wire l^6, and back by ground to the opposite terminal of the generator n^2. The substation having been rung, the key n resumes its normal contact to maintain the continuity of cord-strand e, and the clearing-out signal d^2 will display its target until the substation party removes his receiver from its hook-switch, thus breaking the ground connection at anvil a. After sending the ringing-current and before the party answers the clearing-out circuit was established through battery B′, wire e^2, clearing-out annunciator d^2, sleeve-strand e, key n, sleeve-terminal of plug P, long-line spring c, line l', wire l^3, switch H, ringer k, screw 30, disk 16, and back by ground to the e^3 terminal of the battery. When the conversation is ended, the act of replacing the receiver on the hook-switch and again establishing connection at anvil a will actuate the clearing-out signal in the same manner as before, but this time notifies the operator to disconnect the lines instead of notifying the operator that the called-for party has answered. On receipt of the latter signal the operator proceeds to restore the selector contact-disks to home or normal position by pushing in the button s^4, which is adapted, as hereinbefore stated, to connect the heavy current or the full potential of battery B in the selector-circuit. This operation actuates the restoring feature of the step-by-step mechanism to disengage the pawls from the teeth of the ratchet-wheels throughout the entire system. The operator next pulls out the plugs, thereby reconnecting the line-signal and battery across the metallic circuit. The system is now restored to its normal idle condition and ready for the next call either from or to the central office.

Changes may be readily made from the preferred embodiment of my invention herein shown and particularly described, and I do not, therefore, wish to be limited to the precise arrangement illustrated; but,

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a party-line selector system, the combination of a series of step-by-step and restoring mechanisms at a series of substations respectively, each mechanism comprising the electromagnets, propelling-levers and pawls, said pawls engaging a ratchet-wheel whereby a contact-disk may be propelled step by step to a predetermined position on energizing said electromagnets intermittently by means of the "light current," the electromagnets, armature-lever and bifurcated lever to disengage said pawls from the teeth of said ratchet-wheel when said electromagnets are energized by means of the "heavy current," and the segment-gear meshing with the pinion-gear to restore said ratchet-wheel and contact-disk to normal position when said pawls are disengaged, the contact-screw carried by said propelling-lever and adapted to make contact with said contact-disk at a certain predetermined position of its rotation, said contact-screw and contact-disk constituting a make-and-break in a call-bell circuit, a line-circuit serially connecting said mechanisms and terminating at a master-station or central office, means at the master-station or central office to connect a master step-by-step and restoring mechanism, a make-and-break contact device, and a source of "light current" to step said mechanisms, and a source of "heavy current" to restore said mechanisms, a second line-circuit with call-bells bridged thereto at said substations, the circuits through said call-bells being normally open but adapted to be closed successively in advance of each other by means of said contact-screws and contact-disks, said second line terminating at the master-station or central office in a suitable line-jack, and means at the master-station or central office to extend a ringing-current over said second line

to actuate said call-bells when put in circuit by said contact-screw and contact-disk, substantially as herein described.

2. In a party-line selector system, the combination of a series of step-by-step and restoring mechanisms at a series of substations respectively, each mechanism comprising the electromagnets, propelling-levers and pawls, said pawls engaging a ratchet-wheel whereby a contact-disk may be propelled step by step to a predetermined position on energizing said electromagnets intermittently by means of the "light current," the electromagnets, armature-lever and bifurcated lever to disengage said pawls from the teeth of said ratchet-wheel when said electromagnets are energized by means of the "heavy current," and the segment-gear meshing with the pinion-gear to restore said ratchet-wheel and contact-disk to normal position when said pawls are disengaged, the contact-screw carried by said propelling-lever and adapted to make contact with said contact-disk at a certain predetermined position of its rotation, said contact-screw and contact-disk constituting a make-and-break in a call-bell circuit, a line-circuit serially connecting said mechanisms and terminating at a master-station or central office, means at the master-station or central office to connect a master step-by-step and restoring mechanism, a make-and-break contact device, and a source of "light current" to step said mechanisms, and a source of "heavy current" to restore said mechanisms, a second line-circuit terminating at the master-station or central office in a suitable line-jack and having call-bells or ringer mechanism bridged thereto at said substations, the circuits through said call-bells or ringer mechanism being normally open but adapted to be closed successively in advance of each other by means of the contact-screw and contact-disk, and means at the central office to extend a ringing-current over said second line to actuate said call-bells, a battery or source of current normally bridged across said second line-circuit at the master-station or central office, and means to cut out said current when said line is in use, means at the respective substations comprising push-buttons or suitable switches arranged for momentarily closing said source of current through said call-bell or ringer mechanism, said call-bell or ringer mechanism having their bell-hammers and armatures given a permanent set or tendency toward one pole of the electromagnets, and adapted, on closing said ringer-circuit to be actuated in opposition to said permanent set by means of the current then traversing their coils, the bell-hammers and armatures being adapted to annunciate the busy condition of said party-line system, substantially as herein described.

3. In a party-line selector system, the combination, of a telephone-line terminating in a suitable line-jack at a master-station, and connecting to the substation-telephone apparatus in bridge or multiple arc, a line-signal and a centralized source of energy normally bridged to said line at said master-station but adapted to be cut out when said line is in use, speech-transmitting and speech-receiving apparatus at said substations normally disconnected from said telephone-line but adapted to be connected therewith by means of a suitable switch when required to be placed in a speech-transmitting condition, a call-bell or ringer mechanism at said substations in normally open circuit with said telephone-line, said call-bell or ringer mechanism having their bell-hammers and armatures given a permanent set or tendency toward one pole of the electromagnets, and adapted, on being connected with said teleplone-line and centralized source of energy, to give a busy-line annunciation by being actuated in opposition to said permanent set by means of the current then traversing their coils, means at the substations to connect said ringer mechanism to said telephone-line, said means comprising suitable push-buttons or switches when it is required to test the busy condition of said party-line, and selective mechanism when it is required to extend a signaling-current from said master-station, said selective mechanism comprising the electromagnets, propelling-levers and pawls, said pawls engaging a ratchet-wheel whereby a contact-disk may be propelled step by step to a predetermined position on energizing said electromagnets intermittently by means of the "light current," the electromagnets, armature-lever, and bifurcated lever to disengage said pawls from the teeth of said ratchet-wheel when said electromagnets are energized by means of the "heavy current," and the segment-gear meshing with the pinion-gear to restore said ratchet-wheel and contact-disk to normal position when said pawls are disengaged, the contact-screw carried by said propelling-lever and adapted to make contact with said contact-disk at a certain predetermined position of its rotation, said contact-screw and contact-disk constituting a means to connect said call-bell or ringer mechanism to said telephone-line, substantially as herein described.

4. In a party-line selector system, the combination of a telephone-line terminating in a suitable line-jack at a master-station or central office, and connecting to the substation-telephone apparatus in bridge or mutiple arc, a line-signal and a centralized source of current normally bridged to said line at the master-station, but adapted to be cut out on inserting a cord-plug in said line-jack, a speech-sending and a speech-receiving apparatus at said substations in normally open circuit, but adapted to be bridged to said line by means of a suitable switch when required to be placed in a speech-sending position, a call-bell or ringer mechanism at said substations in normally open circuit, but adapted to be bridged to said line, firstly, by means of a push-button or switch, when it is required to test the

busy condition of said party-line, and secondly, by means of a step-by-step and restoring mechanism, when it is required to send a signaling-current to said substations to actuate said ringer mechanism, said call-bell or ringer mechanism having their bell-hammers and armatures given a permanent set or tendency toward one side by means of a suitable spring, and adapted on being connected in bridge with said line to have their armatures and bell-hammers actuated in opposition to said spring by means of the centralized source of current which then traverses their coils, said step-by-step mechanism being serially connected in a separate line from that of the telephone apparatus and terminating in a suitable line-jack at the master-station or central office, said step-by-step and restoring mechanism comprising the ratchet-wheel, levers and pawls actuated by the "light current" to rotate the contact-disks to a predetermined position, the contact-disk and contact-screw adapted to close the call-bell circuit at a selected station so that a calling-current may be extended from the master-station to actuate the said call-bell, the bifurcated lever adapted to disengage said pawls when actuated by the "heavy current," and the segment-gear adapted to return said ratchet-wheel and contact-disk to home or normal position on disengaging said pawls, substantially as herein described.

5. In a party-line selector system, the combination of a telephone-line comprising the two limbs of a metallic circuit, both limbs terminating in a suitable line-jack at the master-station or central office, and connecting to the substation-telephone apparatus in bridge or multiple arc, a line-signal and a centralized source of current normally bridged between the limbs of said circuit at the master-station or central office and adapted to call the attention of an operator on establishing a bridge connection at the substations, a speech-sending and a speech-receiving apparatus at said substations in normally open circuit, but adapted to be bridged between the limbs of said line by means of a suitable switch when required to be placed in a speech-sending condition; a call-bell or ringer mechanism at said substations in normally open circuit, but adapted to be bridged between the limbs of said line-circuit by means of a suitable push-button when it is required to test the busy condition of said party-line system, means at said substations comprising selective step-by-step and restoring mechanism to place a ground tap or connection on one limb of said metallic circuit, said ground-tap embracing said ringer mechanism, means at the central office to extend a ringing-current over said grounded limb to actuate the call-bells at said substations, means at said substations to cut off said ground-tap and call-bell when the telephone apparatus is placed in a speech-sending condition, a jack-plug and a cord-circuit at the master-station or central office adapted to cut out said line-signal and centralized current when inserted in said line-jack, a clearing-out signal and a centralized source of current connected in said cord-circuit by means of which the speech-sending or call-receiving condition of the substation apparatus is annunciated to the central-office operator on inserting said jack-plug in said line-jack, said step-by-step and restoring mechanism being connected serially in a separate line from that of the telephone apparatus and terminating in a suitable selector line jack or switch at the central office, means at the central office to connect a master-selector mechanism, a make-and-break contact device, and a selector-battery or source of current whereby the substation step-by-step and restoring mechanism may be actuated to pick out or select a particular station, substantially as herein set forth.

6. In a party-line selector system, the combination of a telephone-line comprising the two limbs of a metallic circuit, both limbs terminating in a suitable line-jack at the master-station or central office, and connecting to the substation-telephone apparatus in bridge or multiple arc, a line-signal and a centralized source of current normally bridged between the limbs of said circuit at the master-station or central office and adapted to call the attention of an operator on establishing a bridge connection at the substations, a speech-sending and a speech-receiving apparatus at said substations in normally open circuit, but adapted to be bridged between the limbs of said line by means of a suitable switch when required to be placed in a speech-sending condition, a call-bell or ringer mechanism at said substations in normally open circuit, but adapted to be bridged between the limbs of said line-circuit by means of a suitable push-button when it is required to test the busy condition of said party-line system, said call-bell or ringer mechanism having their bell-hammers and armatures given a permanent set or tendency toward one side by means of a suitable spring, and adapted on being connected in bridge with said line to have their armatures and bell-hammers actuated in opposition to said spring by means of the centralized source of current which then traverses their coils, means at said substations comprising selective step-by-step and restoring mechanism to place a ground tap or connection on one limb of said metallic circuit, said ground-tap embracing said ringer mechanism, means at the central office to extend a ringing-current over said grounded limb to actuate the call-bells at said substations, means at said substations to cut off said ground-tap and call-bell when the telephone apparatus is placed in a speech-sending condition, a jack-plug and a cord-circuit at the master-station or central office adapted to cut out said line-signal and centralized current when inserted in said line-jack, a clearing-out signal and a centralized source of current

connected in said cord-circuit by means of which the speech-sending or call-receiving condition of the substation apparatus is annunciated to the central-office operator on inserting said jack-plug in said line-jack, said step-by-step and restoring mechanism being connected serially in a separate line from that of the telephone apparatus and terminating in a suitable selector line jack or switch at the central office, means at the central office to connect a master-selector mechanism, a make-and-break contact device, and a selector-battery or source of current whereby the substation step-by-step and restoring mechanism may be actuated to pick out or select a particular station, substantially as specified.

7. In a party-line selector system, the combination of a telephone-line comprising the two limbs of a metallic circuit, both limbs terminating in a suitable line-jack at the master-station or central office, and connecting to the substation-telephone apparatus in bridge or multiple arc, a line-signal and a centralized source of current normally bridged between the limbs of said circuit at the master-station or central office and adapted to call the attention of an operator on establishing a bridge connection at the substations, a speech-sending and a speech-receiving apparatus at said substations in normally open circuit, but adapted to be bridged between the limbs of said line by means of a suitable switch when required to be placed in a speech-sending condition, a call-bell or ringer mechanism at said substations in normally open circuit, but adapted to be bridged between the limbs of said line-circuit by means of a suitable push-button when it is required to test the busy condition of said party-line system, said call-bell or ringer mechanism having their armatures and bell-hammers given a permanent set or tendency toward one side by means of a suitable spring, and adapted on being connected in bridge with said line to have their armatures and bell-hammers actuated in opposition to said spring by means of the centralized source of current then traversing their coils, means at the substations comprising selective step-by-step and restoring mechanism to place a ground tap or connection on one limb of said metallic circuit, said ground-tap embracing said ringer mechanism, means at the central office to extend a ringing-current over said grounded line to actuate the call-bells at said substations, means at said substations to cut off said ground-tap and call-bell when the telephone apparatus is placed in a speech-sending position, a jack-plug and a cord-circuit at the master-station or central office adapted to cut out said line-signal and centralized current when inserted in said line-jack, a clearing-out signal and a centralized source of current connected in said cord-circuit by means of which the speech-sending or call-receiving condition of the substation apparatus is annunciated to the central-office operator on inserting said jack-plug in said line-jack, said step-by-step and restoring mechanism comprising the ratchet-wheel, levers and pawls actuated by the "light current" to rotate the contact-disks to a predetermined position, the contact-disk and contact-screw adapted to close the call-bell circuit at a selected station so that a calling-current may be extended from the master-station to actuate the said call-bell, the bifurcated lever adapted to disengage said pawls when actuated by the "heavy current," and the segment-gear adapted to return said ratchet-wheel and contact-disk to home or normal position on disengaging said pawls, substantially as herein described.

8. In a party-line telephone call-bell or ringer mechanism, the combination with the armature o, bell-hammer rod w, electromagnets h h, and the permanent magnet m, for polarizing said armature, of a spring w', secured to said armature and extending to a suitable adjustment w^2, by means of which said armature may be given a permanent set or tendency toward one of the two electromagnets, substantially as herein described.

9. In a busy-line signal for party-line telephone systems, the combination with the line-circuit, of a battery or source of current normally bridged across said line-circuit, and means to cut out said current when said line is in use, call-bells or ringers bridged across said line at the various stations, the circuits through said call-bells or ringers being normally open, but adapted to be closed by means of a suitable contact device under control of the station operators, said call-bell or ringer mechanism having their bell-hammers and armatures given a permanent set or tendency toward one of the two poles of the electromagnets by means of a suitable spring, and adapted, on closing said circuit, to be actuated in opposition to said spring by means of the current then traversing their coils, the bell-hammers being adapted to strike gongs or otherwise annunciate the "not-busy" condition of the party-line, substantially as herein described.

10. In a contact-crank for controlling the stepping and restoring current of a selector system, the combination, of a face-plate g, supporting a suitable bearing g^3, and a rectangular piece of insulating material g^5, a shaft g^2, adapted to revolve in said bearing and have a longitudinal movement therethrough, a crank and handle g', adapted to revolve said shaft, a contact-segment g^4, carried by said shaft and adapted to make and break contact with the line-spring s, when turning said handle, a stress-spring s', adapted to make rubbing contact with said contact-segment and force the said shaft longitudinally outward, a contact-arm s^2, normally out of contact with said stress-spring, but adapted to make electrical connection therewith when said shaft is forced longitudinally inward, a spring s^3, adapted to normally force

the push-button s^4, outward and itself out of contact with the said line-spring *s*, but adapted to make electrical connection with said line-spring on forcing said push-button inwardly, all as herein substantially described.

11. In a party-line selector system, the combination, at the master-station or central office, of suitable jacks or switches in which the selector-lines terminate, a master step-by-step and restoring mechanism and an indicator moved thereby, said indicator moving over a suitable dial by means of which the central-office operator may determine the relative position of the selector-line mechanism, a contact-crank, and a battery or source of current to step and restore said selector-line mechanism, said contact-crank comprising a shaft g^2, adapted to revolve in a suitable bearing g^3, and have a longitudinal movement therethrough, a crank and handle g', adapted to revolve said shaft, a contact-segment g^4, carried by said shaft and adapted to make and break contact with a line-spring *s*, when turning said handle, a stress-spring *s'*, adapted to make rubbing contact with said contact-segment and force the said shaft longitudinally outward, a contact-arm s^2, in electrical connection with the "light-current" section of the selector-battery and normally out of contact with said stress-spring, but adapted to make connection therewith when said shaft is forced longitudinally inward, a spring s^3, in electrical connection with the "heavy-current" section of the selector-battery and adapted to force the push-button s^4, outward and itself out of contact with the said line-spring *s*, but adapted to make connection therewith when forcing said push-button inwardly, means to connect the line-spring *s*, the master-selector mechanism and the selector-battery or source of current to said line jacks or switches whereby the selector-line mechanism may be actuated to pick out or select a particular station, substantially as herein described.

12. In a selective step-by-step and restoring mechanism, the combination, of the frame-plates supporting the various elements of the mechanism, a heel-yoke supporting the electromagnets, a cross-yoke adapted to secure the bottom of said frame-plates and guide the poles of said electromagnets, a cross-yoke supporting an adjusting-screw 7, and adapted to secure the top of said frame-plates, an arbor carrying a ratchet-wheel, contact-disk and pinion-gear, said arbor being pivotally mounted between said frame-plates and retained in position by means of retaining-arm 39, a segment-gear meshing with said pinion-gear and adapted to give a retrograde movement to said arbor, a stop-arm 20, carried by said arbor and adapted to strike against a rigid but adjustably-mounted angle-arm 38, to stop the retrograde movement of said arbor, a propelling-lever 11, mounted on an arbor 10, said lever carrying two pawls 13 and 14, by means of which said ratchet-wheel is engaged and propelled step by step, a contact-screw 30, carried by said propelling-lever and adapted to register with a segment-contact 32, of the disk aforesaid, an angle-lever 9, also mounted on said arbor 10, and adapted to be oscillated by the attraction of the armature carried thereby, a stress-spring 36, adapted to hold said levers 11 and 9, together to step the ratchet-wheel when the electromagnets are energized by the "light current," a bifurcated lever 22, mounted on an arbor 23, and adapted to disengage said pawls 13 and 14, from the teeth of said ratchet-wheel, a lifting-rod 26, supported by an adjustment 27, said adjustment being suitably attached to the bifurcated lever by means of the helical spring 29, and the pivot-joint 28, said lifting-rod being adapted to be actuated by the horizontal arm of lever 9, when the armature carried thereby is attracted by the electromagnets energized by the "heavy current," a retractile spring 33, adapted to retract said levers 11 and 9, and also form an electrical connection between contact-screw 30, and the adjustment 34, substantially as herein described.

THOMAS C. DRAKE.

Witnesses:
WILBERT MCHENRY,
JAMES B. NAYLOR.