No. 673,039. Patented Apr. 30, 1901.

A. T. M. THOMSON.

TELEPHONE SYSTEM AND APPARATUS THEREFOR.

(Application filed Oct. 9, 1899.)

(No Model.) 6 Sheets—Sheet 1.

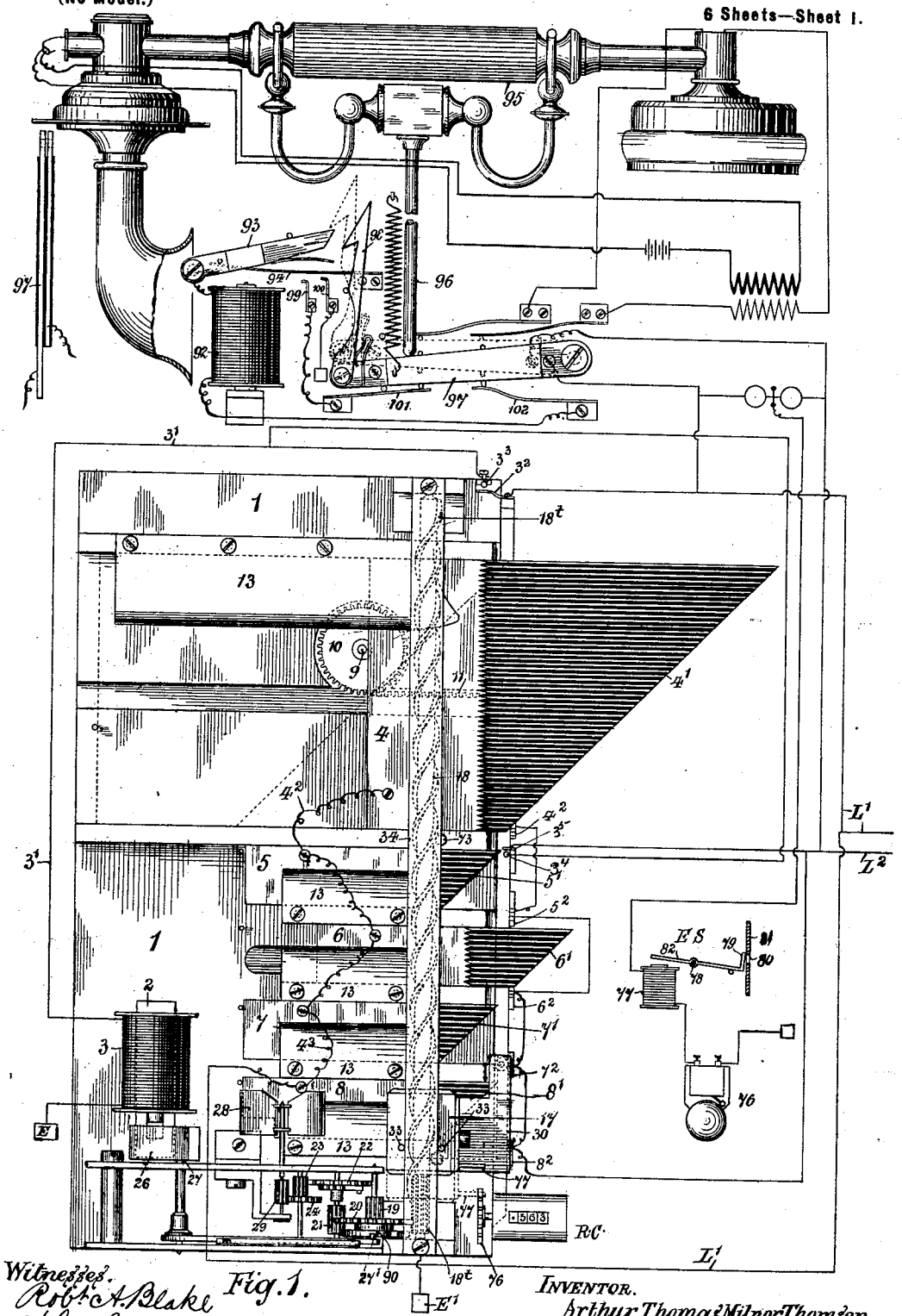


Fig. 1.

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No. 673,039.

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6 Sheets—Sheet 2.

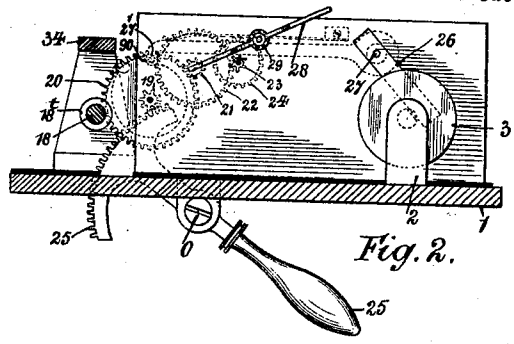


Fig. 2.

Fig. 3.

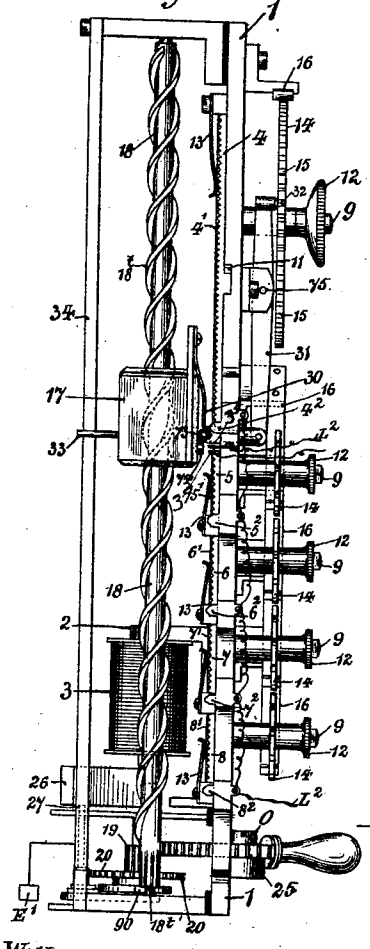
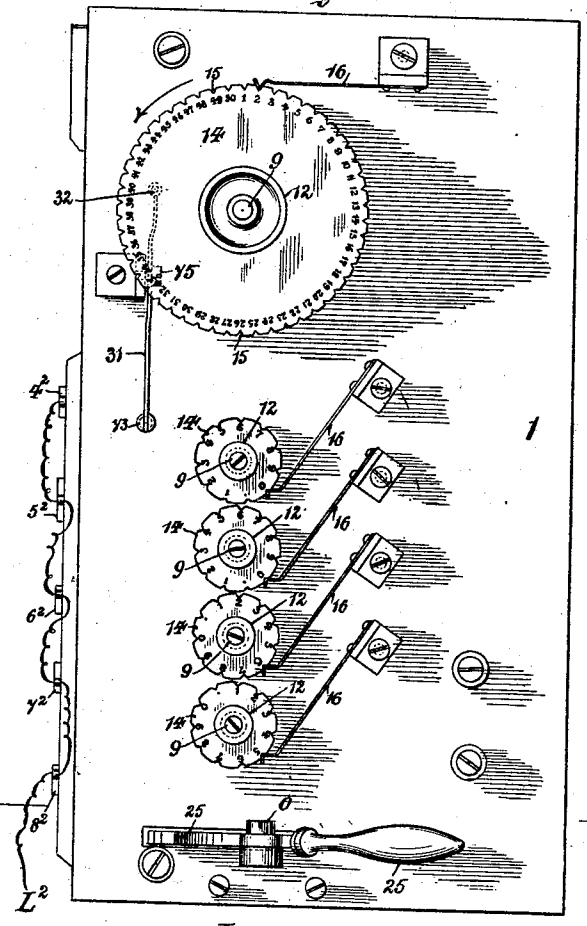


Fig. 4.



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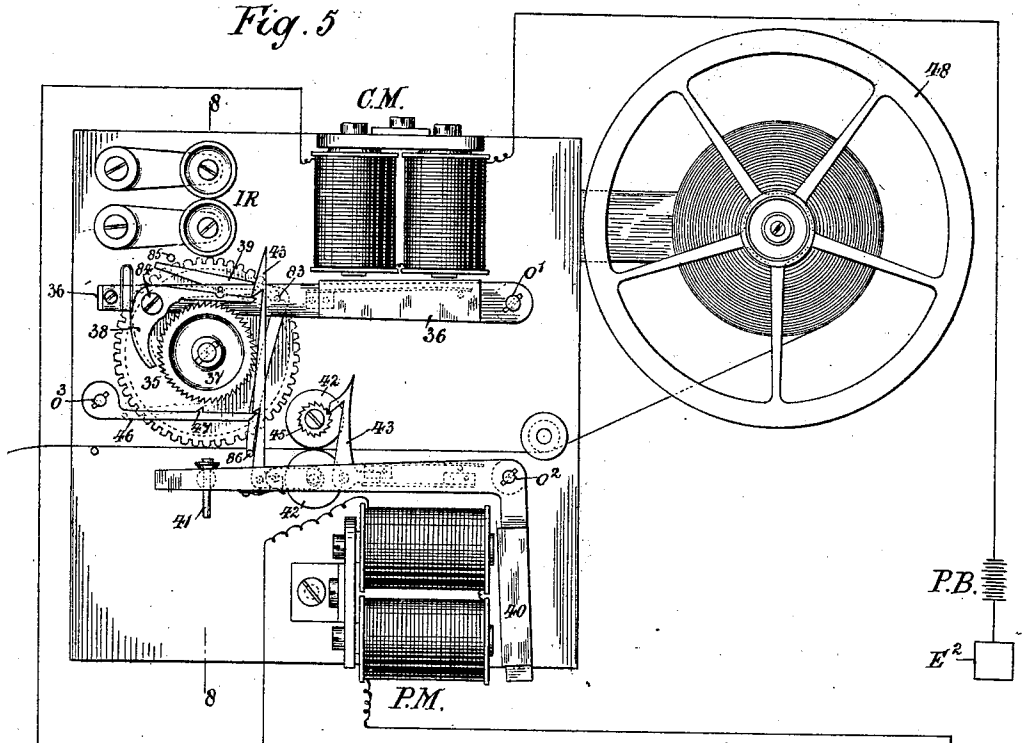
A. T. M. THOMSON.

TELEPHONE SYSTEM AND APPARATUS THEREFOR.

(Application filed Oct. 9, 1899.)

(No Model.) 6 Sheets—Sheet 3.

Fig. 5



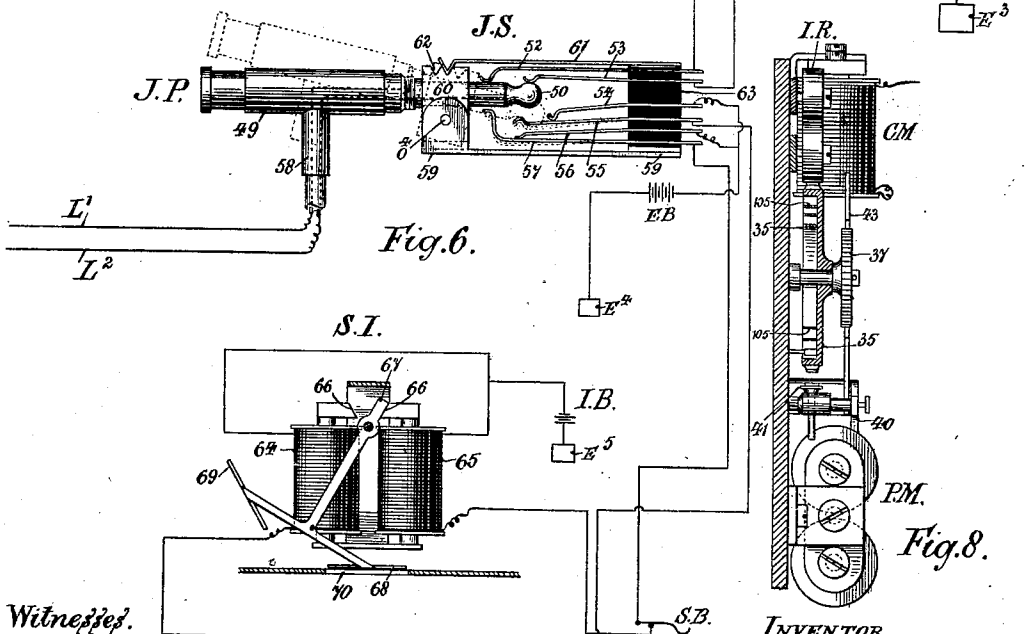


Fig. 6.

Fig. 8.

Fig. 7.

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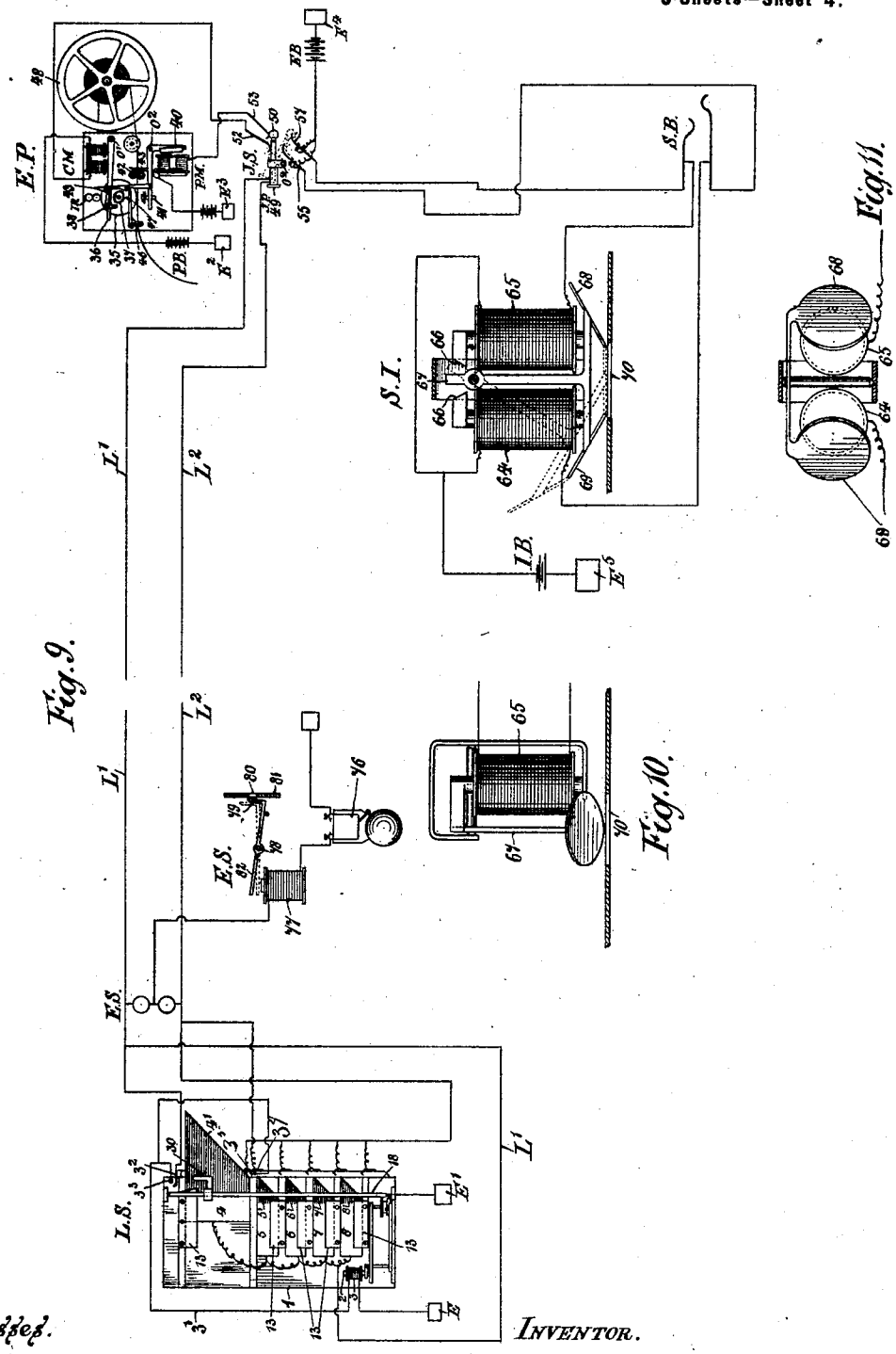
No. 673,039. Patented Apr. 30, 1901.

A. T. M. THOMSON.

TELEPHONE SYSTEM AND APPARATUS THEREFOR.

(Application filed Oct. 9, 1899.)

(No Model.) 6 Sheets—Sheet 4.



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TELEPHONE SYSTEM AND APPARATUS THEREFOR.

(Application filed Oct. 9, 1899.)

(No Model.) 6 Sheets—Sheet 5.

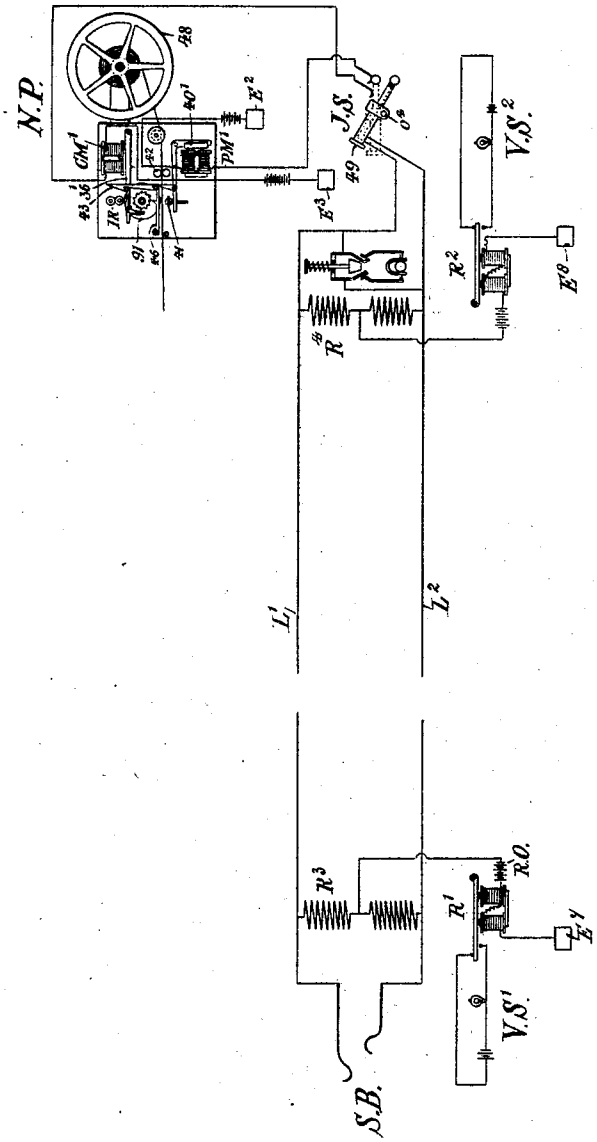


Fig. 12.

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No. 673,039. Patented Apr. 30, 1901.

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TELEPHONE SYSTEM AND APPARATUS THEREFOR.

(Application filed Oct. 9, 1899.)

(No Model.) 6 Sheets—Sheet 6.

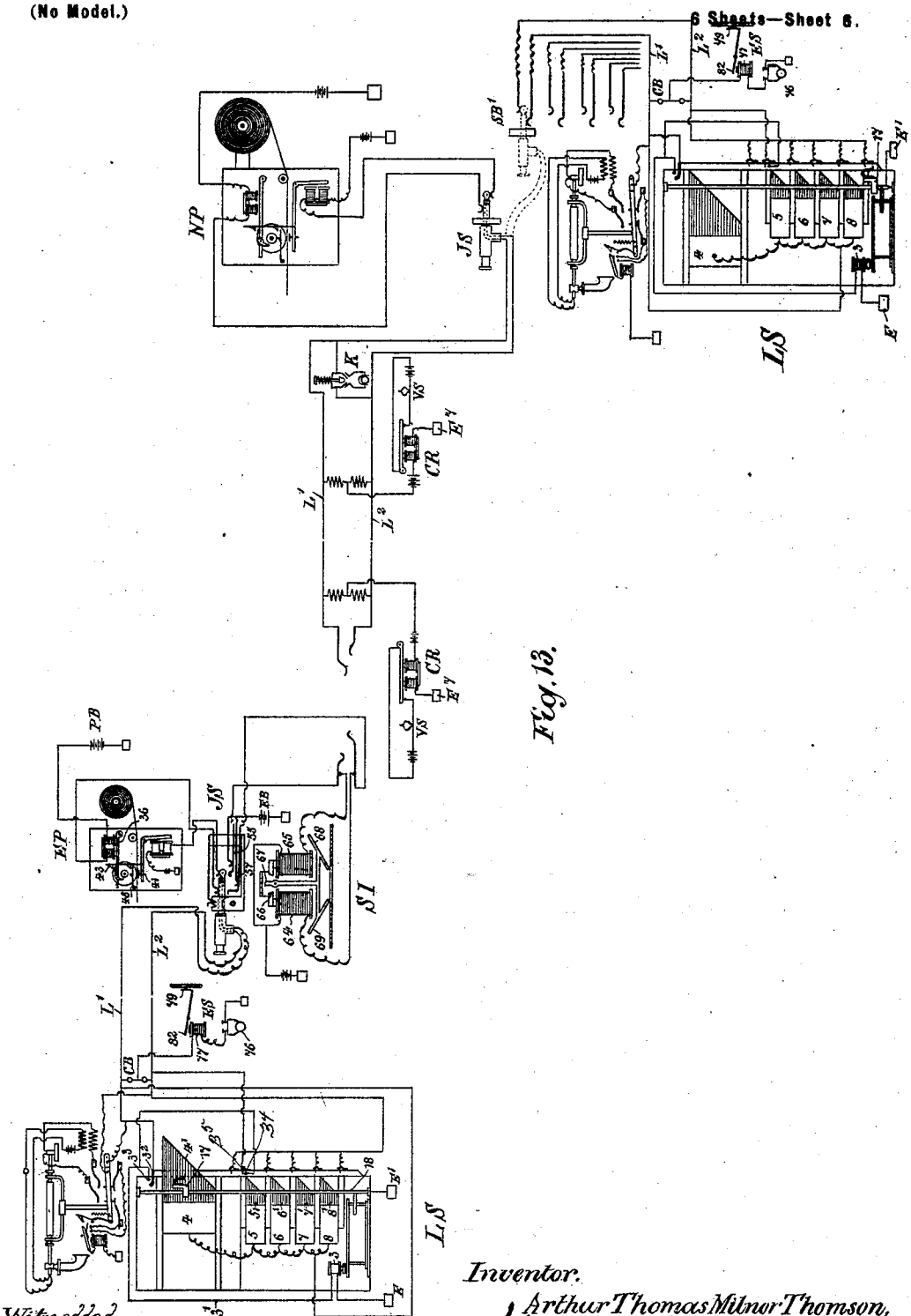


Fig. 13.

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THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

ARTHUR THOMAS MILNOR THOMSON, OF EAST DULWICH, ENGLAND.

TELEPHONE SYSTEM AND APPARATUS THEREFOR.

SPECIFICATION forming part of Letters Patent No. 673,039, dated April 30, 1901.

Application filed October 9, 1899. Serial No. 733,069. (No model.)

To all whom it may concern:

Be it known that I, ARTHUR THOMAS MILNOR THOMSON, electrical engineer, residing at No. 51 Beauval road, East Dulwich, in the county of Surrey, England, have invented certain new and useful Improvements in Telephone Systems and in Apparatus Therefor; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to improvements in telephone systems and in apparatus therefor.

The invention is more especially designed with a view to simplify, facilitate, expedite, and lessen the cost of working of complex telephone connections such as are required for an efficient service in large towns—that is to say, wherever the number of subscribers or users is very large, and consequently the system as a whole very busy; but of course it is applicable to any lesser demands.

The main objects of the invention are, first, to do away with the verbal intercommunication between the subscribers or users and the operators at the exchange now necessary in order for one subscriber to be put into communication with another or one exchange with another, as the case may be, and thus avoid all the attendant inconveniences and substitute therefor what may be called a "secret service," because the operators at the exchange have no means by which to overhear the conversation between two users, and, second, to do away entirely with the present multiple switchboard and so simplify and cheapen the outfit and expedite the operating at the exchange and cost of operating and maintaining the system and service.

The invention consists, then, in certain apparatus and in the group or combination of these apparatus comprising signaling, printing, and indicating devices and in the combination of this group of apparatus with ordinary or well-known telephonic instruments and connections to form a complete novel telephonic system.

Before describing the new group of apparatus itself it may be well to mention here, in order to render what follows the more intelligible, that part of this apparatus is located at the subscriber's end of the line, and is substituted for the present ringing-up or signal-transmitting apparatus of an ordinary telephone set, and part at the exchange, that the operators at the exchange in this system are not provided with telephone receivers and transmitters, and that the source of the electric or magnetic current employed for automatically signaling, indicating, recording, and clearing the connections is situated preferably at the exchange; but as in some cases it may be more desirable to locate it at the user's end of the line it is to be understood that I do not bind myself in this respect.

I will now proceed to describe my invention in detail, reference being had to the accompanying drawings, illustrating same, and in which—

Figure 1 is a rear elevation of one form of the indicator-switch, telephone apparatus, and connections at the subscriber's or user's end of the line. Figs. 2, 3, and 4 are respectively a cross-section and side and front elevations of the gravity latent switch, Fig. 1. Fig. 5 is a plan of the printer used to print the names of exchanges and shows how it is connected with the special switch. Fig. 6 is an elevation of the special switch at the exchange consisting of an oscillatory spring-jack and plug, the latter being shown inserted and in the position for operating a call. Its connections with the exchange-printer, line-wires, and special indicator are also shown. Fig. 7 is the special oscillatory indicator which distinguishes a call on the local exchange from one for a distant exchange, its connections with the jack at the switching-board, the special switch, the exchange-printer, and the line-wires. Fig. 8 is a section of the exchange-printer, taken on the line 8 8 of Fig. 5. Fig. 9 is a diagrammatic plan of the latent switch L S, the engaged or busy signal E S, the exchange-printer E P, the special jack-switch J S, the special indicator S I, and their connections. Figs. 10 and 11 are respectively an end view and front elevation of the special indicator S I. Fig. 12 is a diagrammatic plan of the numerical printer N P, clearing-relays C R, visual-signals V S, and their connections. Fig. 13 is a diagram of the entire system, showing the apparatus and connections necessary for a complete call

from one subscriber to another, the gravity form of latent switch being employed, L S being the latent switches, E S the "engaged" signals, C B the call-bells, E P the exchange-printer, N P the numerical printer, J S the special jack-switches, S I the special compound indicator, C R the clearing-relays, and V S the visual signals.

Latent switch—Gravity type.—The instrument or apparatus substituted for the usual telephone-call set or outfit at the subscriber's office or end of the line is an indicator latent switch, and is hereinafter for brevity referred to as the "latent switch." This switch is shown in detail in Figs. 1, 2, 3, and 4 and is composed substantially as follows: On a base or foundation plate 1 is mounted in a bracket 2 an electromagnet 3, one terminal of which is electrically connected by means of the wire 3′, insulated make-and-break contact 3^2-3^3, and line-wire L′, or, on the other hand, by the wire 3′, insulated make-and-break contact 3^4 3^5, and line-wire L^2 with a special switch situated at the exchange, preferably near the originating operator—that is, the operator who first receives the call. This special switch will be described in its turn later on; but I may here briefly remark that it is preferably of the spring-jack and plug type and is shown in detail at J S in Fig. 6 and in diagrammatic form in combination in other figures, the line-wires L′ L^2 terminating at the exchange in the plug J P of the said switch. The other terminal of the magnet 3 is connected, as indicated, by the plate E to earth. Mounted also upon the base-plate 1 at the back thereof are five plates 4, 5, 6, 7, and 8, bearing a number of raised contacts, respectively 4′, 5′, 6′, 7′, and 8′, in or upon their exposed or rear surface, the said contacts being advantageously formed as ridges or ribs produced by merely fluting, grooving, or corrugating the plates, but may be produced in any other suitable way. These plates are mounted upon the foundation-plate in such a manner as to be slidable thereon transversely in a substantially horizontal direction, the mechanism by which they are moved being advantageously formed, as shown, consisting of a spindle 9, rotatably mounted in the base-plate 1, a toothed pinion 10, fast on the rear end of said spindle, a rack 11, formed in or secured fast to the front face of the movable contact-plates and always in engagement with said pinion, and a milled thumb-nut 12, screwed fast on the outer or front end of the spindle 9, so that turning this nut in either direction causes a corresponding sliding movement of the contact-plates by reason of the pinion 10 engaging in the teeth of the rack 11, which it moves, the contact-plates sliding between the foundation-plate 1 and guides 13.

The contacts on the plate 4 represent the various exchanges in the town or city area and also, where necessary, special services, such as trunk or long-distance calls—that is, to exchanges in towns or cities outside the area of the others—telegraph-office, post-office, special-messenger service, and also certain special officials in such offices, such as clerk in charge, &c. The contacts on plates 5, 6, 7, and 8 represent, respectively, the thousand, hundreds, tens, and units of the subscribers' or users' numbers. The movable plates are all in electrical connection with the metallic foundation-plate 1, wires 4^3 serving to emphasize this connection.

It will be observed in Fig. 1 that the plates in question are cut off obliquely at their outer ends, terminating at their upper edges in a point, while the edge of the foundation-plate is cut "squarely" or at right angles to the top and bottom edges of the movable plates. The object of this is to enable the exposure beyond the edge of the foundation-plate of a single one or any number of the contacts at will by simply turning the thumb-nut in the outward direction, so as to advance the contact-plate to the desired extent. In order to inform the user from the outside of the apparatus as to how much to advance the plates so as to expose the right number of contacts to give a call correctly, disk wheels or dials 14, having notches 15 in their peripheries, and figures, letters, or other signs or combinations of figures, letters, or signs on their outer faces, preferably near to the periphery, may be fixed on the spindles 9 outside in front of the foundation-plate 1 between it and the thumb-nuts or knobs 12. The said numerals or other characters or signs correspond to the number of contacts exposed, and as these contacts, as above stated, represent the different exchanges, special services, and orders of numerals constituting the subscribers' numbers the user by simply turning the knobs or thumb-nuts 12 can set these dials to any exchange and number on that exchange desired.

In the construction shown in the drawings the spring 16 acts in conjunction with the notches 15 in the periphery of the dials, each of the notches being exactly in alinement with the numeral, character, or sign on the dial, and thus serves as a guide or pointer by which the adjustment may be effected with facility and accuracy. The adjustment may, however, be effected in several other ways, and I do not, therefore, confine myself to any particular device in this respect. For example, the disks 14 may not be fast on the spindle 9, but supported around it, and the spindle may carry an index or radial pointer which can be turned to any of the positions by the thumb-nut 12. Or, again, the dial may be fast on the spindle, but entirely inclosed or covered up with the exception of one little window in a cover-plate, through which one of the numerals, characters, or words may be exposed at a time.

The contact-finger which works in conjunction with the contact-plates 4, 5, 6, 7, and 8 is of course electrically insulated from them and is carried by a movable earth-connected

block 17. This block is mounted upon a support in such a manner as to be capable of moving transversely over or past all the contacts on the contact-plates should all these contacts be exposed in its path, its contact-finger 30 brushing across the contacts as it travels. As a means of support for the block in question I prefer to mount it upon a screw-spindle 18, having, preferably, a "helical" thread, the block having a correspondingly-screw-threaded hole through it. The block is threaded on the spindle and the latter supported in end bearings, so as to be free to turn. This spindle 18, then, is supported at each end in bearings in such a manner as to be capable of being freely rotated about its axis, but incapable of any longitudinal movement. This spindle is rotated in one direction by hand by means of the toothed sector-lever 25, (best seen in Fig. 2,) which is pivoted to the frame at O and engages with a pinion 19, fast on a toothed wheel 20, which engages with teeth 18^t on the spindle 18, the movement being preferably regulated by means of a fan 28, through the intervention of a train of wheels consisting of the pinion 29, fast on the fan-spindle, the toothed wheel 20, in engagement with a pinion 21, fast on a toothed wheel 22, which engages with a pinion 23, fast on a toothed wheel 24, which is in engagement with the pinion 29 on the fan.

The armature 26 of the magnet 3 is pivoted at 27, and the extremity remote from the magnet is provided with a pin 27′, which normally—that is, when the magnet is deënergized, and therefore not holding its armature—is in engagement with or resting against a notch or stop-tooth formed in or upon the periphery of a plain wheel or disk 90, mounted fast on one of the spindles of the winding-up train of wheels, preferably the one bearing the toothed wheel 20. The coöperation of this pin and tooth or notch serves to hold the train of wheels when wound up to prevent it running down until purposely released by a current from the exchange, as is fully explained in turn hereinafter.

R C is a revolution-counting device, which may be combined with the latent switch when calls are paid for by meter. It may be of any well-known construction as far as the actual counting mechanism is concerned, but in order to adapt it to the switch I provide it with an external-toothed wheel 76 and the block 17 with a crank-pin 77, so that should a call be "effective" the said pin, just when the said block reaches the end of its stroke, will strike in the teeth of the wheel 76, and thus revolve the set of numbered disks of the counter, and so register the number of calls made and act as a meter, which will always be in sight, so that the calls may be checked as made.

Instead of the contact-plates being movable to expose the number of contacts desired these plates may be fixed and a movable insulator adapted to move over them, so as to cover up a greater or less number of the contacts employed, and thus leave exposed only as many as may be required for the call.

The main or winding-up lever serves to rotate the spindle 18 in one direction, which winds up the block 17 or causes it to ascend or move in one direction, carrying with it the contact 30, which brushes across all the contacts on the contact-plates which lie in its path at the moment.

The indicator-switch may be used in any position. When used vertically, the nut-block 17 on the helical spindle 18, bearing the flexible contact spring or strip 30, will be raised by the hand-lever sector-rack 25 engaging in the pinion 19, fast on the toothed wheel 20, which rotates the helical spindle and so raises the said nut, while in its downward motion it will fall by gravity. Should, however, it be desirable to use the instrument in any other position—say horizontal—the movements of this nut-block in the unwinding direction, it is obvious, might be effected by means of a spring or other source of power, which is either wound up or extended when the nut is moved in the other direction by the winding-up lever 25, and consequently the potential energy thereby stored in it will constitute the latent force necessary to automatically return the block to its initial position when released.

31 is a spring-catch made to engage in a hole 32 in the back of the dial 14, bearing the numerals or characters corresponding to the various exchanges, &c., whenever the said hole in this dial is presented to the tooth on the end of the said spring-catch 31. The object of this is fully described under the heading "Calling and operating."

The electromagnet 3 is normally deënergized—in fact, cut out of circuit altogether—by the make-and-break contacts 3^2 3^3 and 3^4 3^5.

33 represents guide-arms on the blocks 17, which arms, coöperating with the guide-bar 34, along which they travel when the said block is in motion, serve to keep the block free from any lateral play.

The block 17 is preferably connected to earth, this connection being indicated in the drawings by the earth-plate E′. The contact-plates 4, 5, 6, 7, and 8 are connected with the line-wire L′ and the contacts 4^2, 5^2, 6^2, 7^2, and 8^2 with the line-wire L^2.

In Fig. 9 the connection of this switch with the printing apparatus, jack-switch, and special indicator at the exchange is shown.

Exchange-printer.—The exchange-printer—that is, the printing apparatus which prints the name or its equivalent of the exchange or other special office desired in a call and operated electrically by means of the latent switch just above described—is shown in detail in Figs. 5 and 8; also, its connections with the special jack-switch J S and the special indicator S I, Figs. 6 and 7. This printer is a modification of an ordinary printing or recording telegraph. It consists of an electromagnet C M, hereinafter referred to as

the "contact-magnet," electrically connected with the line-wire L′ and earthed at E^2 through a battery P B, a type-wheel 35, bearing in type letters, figures, words, or other characters or signs representing the various exchanges and other offices, if desirable, the types being arranged around the periphery of the wheel and the number of them corresponding with the number of contacts 4′ on the exchange contact-plate 4 of the latent switch. This type-wheel is operated automatically by the coöperation of the magnet 3, traveling contact 30, and the contacts 4′ of the latent switch, in conjunction with electric currents emanating, preferably, from the battery P B, but not necessarily from the exchange, the working being effected through the medium of the armature 36, pivoted at O′, of the magnet C M, the ratchet escape-wheel 37, the pawl or detent 38, and the double tripping-lever 43, the detailed actions of which will be described later on under "Calling and operating." Another electromagnet P M, hereinafter referred to as the "printing-magnet," is electrically connected with the line-wire L^2 and governs an armature 40, pivoted at O^2, the tripping-lever 39, above mentioned, type-hammer 41, a pair of feed-rollers 42, and a detent 43, which latter, in conjunction with the ratchet 45 on one of these rollers, turns the roller and advances the tape for spacing purposes by friction with its surface. A lever 46, pivoted at O^3 and bearing a tooth 47, adapted to be brought into and out of engagement with the teeth of the escape-ratchet 37, will be described, as regards its functions, later on. The supply of paper tape may be carried, as usual, in the form of a roll upon a skeleton bobbin 48, mounted in a bracket, so as to be free to revolve. I R are the inking-rollers. This printing apparatus may be at will electrically connected with the line-wires, as above stated, through the medium of the special switch next described.

Oscillatory jack-switch.—This switch is a modification of the well-known jack-and-plug type. The line-wires L′ and L^2 terminate in a plug J P, the wire L′ in the metallic sleeve of the plug, and the wire L^2 in the metallic tip of the plug, the tip and sleeve being of course electrically insulated one from the other. This plug J P shown is a modification of the ordinary one, having its lines leading in through a stem or arm 58, which projects out from about the center of the underneath side of the plug, and at right angles thereto, the object being to prevent the wires getting broken by frequent bending, as they do when they are led in at the rear end of the plug, because in the latter case the pushing into and pulling the plug out of the jack or socket bends the wires in reverse directions, and this frequently repeated, as it necessarily is in busy exchanges, necessitates frequent renewal. It will be noticed that with the design of plug shown in Fig. 6 the wires are always quite clear of the rear end of the plug, so that this can be thrust in the jack, as usual, without fear of crushing the cord containing the wires between the hand and the rear end of the plug. Moreover, the rigid stem provides a firm grip with which to pull the plug out of the socket with greater facility. The jack consists of the casing 59; but instead of the bush 60, of insulating material, at the entrance of the jack for the reception of the plug being stationary, as usual, it is pivoted at O^4, so as to permit the plug when inserted to be tilted, so that its tip points downward, as shown in dotted lines. Normally the plug J P rests in the jack in an oblique position, with its tip pointing downward. A spring 61, engaging in notches 62 in the oscillatory bush, is provided to hold the block in the position in which it is put. The free end of said spring rests normally in one or other of said notches and rides out of them when the block is moved with slight force, but not by the mere weight of the plug. A set of spring-contacts 52 53 54 55 56 57 are fixed in an insulating-block 63, secured in the rear end of the casing 59. The springs 52 and 53 are shown electrically connected through the plug J P with the line-wires L′ and L^2, respectively, and through connection-wires with the exchange printer, and when the plug 49 is inserted in the jack horizontally, as shown in Fig. 6, these two springs make contact one with the tip and the other with the sleeve of the plug, so that the said printer at the exchange is thereby thrown into circuit with the subscriber's latent switch when desired. The springs 54 and 56 are connected through a generator or battery E B to earth, (indicated by the plate E^4.) These are for the purpose of giving the "engaged" or "busy" signal to the calling-subscriber when the called-subscriber's line is already engaged, the indicator in question consisting of either a special magnetic bell or an electric bell 76 and electromagnetic device 77, such as shown in combination at E S, Fig. 9, and which is further described under "Calling and operating." Normally the plug J P being in the inclined position makes contact by its tip with the spring-contact 55 and by the sleeve with the contact 57, slightly depressing these two contact-springs, so that they break contact with the two springs 54 and 56. Consequently when the said plug is either drawn out or lowered into the horizontal position, the two springs 55 and 57 being thereby released spring up and make contact with the two springs 54 and 56, as shown in Fig. 6, and thus automatically actuate the indicator when the line is engaged, as desired. The contact-springs 55 and 57 are in electrical connection with the special indicator S I at the originating board and jack S B at the switching-board, these connections being obvious from a glance at Figs. 6 and 7 or Fig. 9.

In Fig. 9 the two contact-springs 55 and 57 are shown in contact with two stud-contacts, these latter being merely substitutes for the contact-springs 54 and 56 in Fig. 6.

Any one or more of the contact-springs

shown in the jack J S, Fig. 6, may be replaced by contact-studs or other suitable form of contact.

Special indicator.—The special indicator is shown in detail in Figs. 7, 10, and 11 and in combination with the exchange printing apparatus in Figs. 9 and 13. It consists of two electromagnets 64 and 65, the one coil, 64, having one of its terminals normally in electrical connection with the line-wire L′, and the one, 65, one of its terminals in connection with the line-wire L^2 through the medium of the springs 55 and 57 of the jack-switch J S, the plug 49 of which normally rests in the said jack in an oblique position, so that the tip 50 of the said plug is in contact with the spring 55 and sleeve 51 in contact with the spring 57, as shown in dotted lines. The other two terminals of the coils in question are connected through a battery to earth, (indicated by the plate E^5.) The poles of this electromagnetic device have their inner sides, which face each other, preferably finished obliquely, as shown at 66, and between these poles is hung or pivoted the armature 67 in such manner that it can oscillate from the one side to the other. At the opposite end of this armature is a rigid cross-bar, on each extremity of which is fixed, at an angle thereto, a disk or plate 68 69, which disks advantageously differ in color or are otherwise rendered visibly distinguishable. In front of the armature and supported centrally between the two magnets is a window 70, the whole being so arranged, as will be seen, that attraction of the armature to one pole or the other brings one of the disks or plates 68 or 69 on the ends of its cross-bar to appear at the window 70. This indicator and its functions are further dealt with under the heading "Calling and operating," but it may be here briefly mentioned that it serves to indicate at a glance to an operator at the exchange whether a call is for a subscriber on that exchange or some other or distant one, and this is understood according to which disk 68 or 69 is presented at the window 70 or other predetermined arrangement, as the case may be. Fig. 7 shows the armature of this indicator in one of the positions it assumes the instant a call is made by means of the latent switch first above described.

The numerical printer and its circuits.—The instrument or apparatus called the "numerical printer" and shown at N P, Fig. 12, is the device for automatically printing the subscribers' numbers. It consists, accordingly, of a type-wheel 91, bearing, preferably arranged in a circle around its periphery, the numbers "1" to "9," a "0," and a dot or dash or other sign representing zero. There are thus eleven signs in all, corresponding with the eleven contact-ridges 5′, 6′, 7′, and 8′ on each of the plates 5, 6, 7, and 8 of the latent switch shown in Fig. 1. This type-wheel is connected with a ratchet-and-pawl mechanism substantially similar to that described above in connection with the exchange printer. It is also similarly connected with electromagnetic devices and provided with paper-tape roll and inking and spacing devices and may be also fitted with means for bringing the wheel back to zero each time after it has printed a figure, this latter contrivance being to save the type-wheel having to make a complete revolution after printing each figure of the called-subscriber's number. V S V S are two visual or light signals operated by currents sent through relays C R C R. R^3 and R^4 are resistances bridged across the line-wires preferably at the points and in the manner shown in the figure and serve to prevent the electrical balance of the line being upset by the earth connected at E^7. These signals V S light up at each operating-board simultaneously on the operator's plug being inserted in the jack L S B, and they remain alight until cut out of circuit when cutting in the numerical printer. They are also subsequently lighted by earthing the current on the lines automatically by the weight of the receiver when placed on the switch-hooks at the end of a conversation, and thus also serve as clearing signals to the operators.

The functioning of the above signals is also further described under "Calling and operating" farther on.

Calling and operating.—I will now proceed to describe in detail a "call" and the operating thereof. For the purposes of this description it will be assumed that a subscriber, whom for convenience I will call A, wishes to speak with a subscriber B, B's number being, say, "4105" on the local exchange and this exchange indicated by the numeral "2" on the exchange-dial 4. A is therefore the calling-subscriber and B the called subscriber, and the call and operating thereof will be effected by the combination of apparatus hereinbefore described, the subscriber's latent switch employed being of the gravity type, as in Fig. 1. To start the call, A first sets the dials of the latent switch to the exchange and number on that exchange assigned to B. This is done by merely turning the knobs 12 in the outward direction, these actions advancing the respective contact-plates till they expose just the right number of contacts corresponding to the exchange and number desired, and as the exchange assumed in the present call is the local one and the numeral "2" on the corresponding dial 14 denotes this exchange A simply turns the said dial until the spring-pointer 16 drops into the notch of the said dial immediately over the figure "2" on the face of the dial, thus advancing, as desired, the plate 4 through the medium of the rack-and-pinion device at the back and exposing two of its contacts 4′ in the path of the contact-brush 30 on the traveling block 17. A next in like manner sets the numeral-dials 5, 6, 7, and 8, respectively, to "4," "1," "0," and "5," thus setting B's number and

exposing in the path of the contact-brush 30 corresponding numbers of contacts. Having done this, A next winds up this switch by simply bringing around the hand-lever 25 by means of its handle as far as it will go toward the opposite side, this action, through the medium of the toothed sector on the said lever, the wheel 20, pinion 19, and teeth 18^c on the spindle 18, rotating the latter, which thereupon carries up the nut-block 17, bearing the contact-brush 30. The height to which this block will be thereby raised depends always upon whether the call is for a subscriber on the local exchange or some other exchange. For calls on the local exchange it is arranged so that the block will be arrested when it has arrived about half-way up in order that the contact 30 shall not actuate the exchange printer at the exchange, because that is of course unnecessary for a call on the local exchange, as the special indicator (see that heading) has in the meantime indicated it. It is only required when B's number is on some other exchange to inform the operator at the local exchange what other exchange is required. This arresting of the contact-block 17 is automatically brought about by the tooth on the upper end of the spring-catch 31 springing into the hole 32 in the exchange-dial as soon as the said hole is presented to it, which, as before explained, is arranged to take place whenever the dial is set for "local exchange." On the lower or tail end of this spring-catch 31 is a projection 73, which is brought into the path of the traveling block 17, or rather into the path of an insulated stud 74 on the said block, when the upper end of the spring-catch 31 is in engagement with the hole 32 in the exchange-dial by reason of the said spring turning on its pivot 75, thereby tilting its tail end backward. Just as the block arrives at the point at which it is arrested, as above explained, it drops slightly and presses the contact 35 against the contact-stud 3^4, which is in electrical connection with the line-wire L', which in turn is in connection with the special indicator S I (see Fig. 7) at the exchange through the plug J P and springs 55 and 57 in the special jack-switch J S. The current waiting on the line is thereby earthed; but the current is only a feeble one from the battery I B and not sufficient to energize the electromagnet 3, (see Fig. 1,) although this current will traverse this coil to earth; but the said current is sufficient for actuating the special indicator S I at the exchange, which it does immediately the traveling block makes the said contact. The normal position of the armature of the indicator S I is central, as shown in Fig. 9. The two line-wires L' and L^2 terminate in the jack-plug J P, the one L' in the sleeve 51 of the plug and the one L^2 in the tip 50. This plug, as already explained, normally rests in the jack-switch J S in the inclined position, as indicated in dotted lines in Fig. 6, consequently making contact with the springs 55 and 57, which close the circuit in which the indicator, Fig. 7, is included. This indicator S I having been actuated, one of its disks (the one indicating "local exchange") is thereby presented at the little window 70, as in Fig. 7, thus indicating to the operator who first receives the call, and hereinafter referred to as the "originating operator," that the call is for a number on that exchange. The call having been thus announced, the operating is commenced by the originating operator at the calling-board pulling the plug J P out of the jack J S, thereby locking the subscriber's switch by cutting out all connection with the indicator S I. The contact-springs 55 and 57 thereupon spring up and make contact with the two contact-springs 54 and 56, respectively, which are connected through the battery E B to earth, (indicated by the earth-plate E^4.) This is for the purpose of giving the engaged or busy signal to any other calling subscriber, automatically indicating to him that the line is engaged. This busy or engaged indicator preferably takes the form of a bell-indicator, such as shown at E S, Fig. 9, wherein it consists of an ordinary electric single-stroke bell 76 and an electromagnetic device 77, the armature 82 of the latter being pivoted at 78 and bears at one end a plate 79 bearing the word "Engaged" or similar information, this plate being exposed at an aperture 80 in a board 81 in front whenever the armature is attracted by the magnet. The bell 76 in its entirety might obviously be dispensed with and in lieu thereof a simple gong might be mounted within reach of the armature 82 to strike. The plug is then inserted in a jack of a local junction connection leading from the calling-board to the switching-board, this action putting the visual signals V S in circuit, and consequently lighting them. The operator there then plugs the jack leading to the numerical printer to ascertain the number wanted. The numerical printer being now in circuit, the current on the line L', emanating from the battery P B, is strong enough to energize the coil 3, Figs. 1, 9, and 13, attracting its armature, and thus releasing the catch 27' at the end of the lever out of the notch in the wheel 20, and thus releasing the winding-up mechanism. The block 17, carrying the contact 30, then commences its descent, breaking the contact at 3^4 3^5, and consequently taking the "earth" E off the line, said contact brushing in succession those contact-ridges of the plates 5, 6, 7, and 8 which lie in its path, and thereby giving a corresponding number of pulsations to the armature 36' of what I will call the "contact-magnet" C M' of the printer in question, thus rotating the type-wheel to the figure to be printed, and on the contact 30 arriving in its descent at the contact-studs 5^2, 6^2, 7^2, and 8^2 it earths at E', the current now coming from the battery N P B, which causes a pulsation of the armature 40 of what I will call the "printing-magnet" P M', thereby pressing the printing-hammer and paper

against the type, and thus producing the imprint. This action in detail is as follows: To the armature 36 is pivoted at 83 (see Fig. 5 for the details) a bent lever 39 and at 84 a pawl 38, so that the said armature carries with it when attracted this bent lever, the tip of which on coming in contact with the fixed stop 85 becomes depressed, thereby throwing out its other leg, on which there is a pin 86, which latter pushes back the detent 43 off the tips of the pawl 38, and a lever 46, having a tooth 47, thereby releasing the said pawl and lever 46, both of which being spring-pressed immediately engage in the teeth of the ratchet escape-wheel 37. Each time the armature 36′ drops it causes, by means of the pawl 38, a tooth-by-tooth rotation of the ratchet, which in turn rotates the respective type-wheel 35, these pulsations occurring for every contact on the plates 5, 6, 7, and 8 brushed by the contact-spring 30, thus causing the proper type to be presented to the type-hammer, and on the said contact-spring arriving at each of the contact-studs 5^2 6^2 7^2 8^2 a pulsation is given to the armature 41 of the printing-magnet P M′. On this armature being attracted by its magnet the printing-hammer 41 strikes the paper against the type-wheel, thereby printing on the paper the number, character, or sign which is presented at that point of the type-wheel immediately above the paper at the moment. Simultaneously the detent 43 is raised, and during the descent of the armature the detent 43 again catches on the ends of the pawl 38 and toothed lever 46, bringing the former out of the teeth of the ratchet-escape 37 and the tooth on the lever 46 also out of engagement with the said escape-wheel, thus leaving the latter free to be turned back to its zero or initial position under the influence of a coiled spring 105 within the barrel of the said wheel, which spring has of course been wound up by the pawl 38 during the pulsations of the armature 36′. When the armature drops, it also brings down with it the detent 43′, which, catching in its descent in one of the teeth of the ratchet 45, fast on the friction-roller 42, rotates this roller, thus by friction rotating the other roller 42 and advancing the paper tape between them for spacing purposes after each imprint. The number being thus ascertained and printed for future reference, the call is completed by connecting this number by taking the plug out of the jack 49 and putting it into the called-subscriber's jack S B′. The operator then depresses a key K, connected in the lines, which action causes a signal (bell C B to ring) to be given to both subscribers, indicating that the connection required is completed.

The above is a description of the series of events or operations which take place to put one subscriber in connection with another on the local exchange. I will now proceed to describe what would take place had B's number been on some other or distant exchange.

A would set his dials as before, except that the exchange-dial would of course be set to an exchange other than the local, and thus the spring-catch 31 would not be able to drop into the hole 32 in the said dial, and consequently would not tilt its tail end into the path of the block 17 and obstruct its upward passage, as before, so that when the switch is wound up by the toothed sector-lever 25 the block 17 will be thereby carried right to the top and press the spring 3^2 against the contact-stud 3^3, thereby earthing the latent current onto the line L′, the said current originating at the battery I B, thus actuating the special indicator, Fig. 7, at the exchange, as before. The operator at the calling-board now knowing that the call is for some distant exchange must ascertain which one, so instead of pulling the subscriber's plug J P out of the jack J S simply brings it down into the horizontal position (shown in full lines in Fig. 6,) thus cutting out of circuit the indicator S I and cutting in circuit the exchange-printer E P, Figs. 5 and 8, which thereupon prints the name of the exchange wanted. The contact-springs 55 and 57 being released fly up and make contact with two other springs 54 and 56, which are connected through a generator or battery to earth, (indicated by the earth-plate E^4.) This is for the purpose of giving the engaged or busy signal, as previously explained. The mechanism and operation of the exchange-printer are almost identical with those of the numerical printer and so need not be here repeated, the difference consisting in the type-wheel containing on its periphery words, numerals, characters, or other signs denoting exchanges, &c., instead of the numerals for the numbers, as in the other printer. Either or both of these printers may be made simpler, if desired, by eliminating the mechanism for returning the type-wheel back to zero after each print. The name of the distant exchange being thus ascertained, the originating operator plugs A's line direct into a jack corresponding to L S B, leading to the switching-board of that exchange instead of, as in the former case, to the switching-board at the same exchange, and the call is then completed by the operator at this switching-board, as in the former case. Thus without any intercourse with the operators at the exchange the most complex telephonic service can be supplied by means of the combination of apparatus above described.

Most of the apparatus is of novel construction and specially adapted one instrument to the other as well as to the whole system, to carry out the invention in the best way, although in a fundamental form some of the instruments, I am aware, are not novel for other uses than telephony.

The apparatus and system described in this specification have been devised with the London system in view, so that certain modifications, which, however, are obvious, must

be made in some of the apparatus and also in the way they are grouped to adapt them to the service to be supplied. For instance, the exchange-printer herein described is constructed to print the names or equivalents therefor of exchanges and other offices numbering fifty in all; but it is obvious that this number is entirely dependent upon the number of exchanges, &c., and where there are no junction exchanges the exchange-dial and contact-plates can be dispensed with entirely. As regards grouping, the combinations may be also altered to suit the requirements and some of the instruments may be omitted entirely. For instance, the compound indicator might be dispensed with where there is only one exchange—that is, where there are no junction or distant exchanges as well as the local one—and, again, other equivalent instruments may be substituted for those eliminated. For example, instead of the subscriber's latent switch being made to operate a printing device the latter may be eliminated and a revolution-counter or a counter-indicator substituted therefor, the said counter-indicator being operated by impulses imparted to a lever-armature in exactly the same way as the printer is worked.

The end of a conversation is made known to the operators in the exchange by the following means: 92 (see Fig. 1) is an electromagnet normally deënergized, but supplied by a current when required from the exchange, so that the clearing-signal can be received there, said current being derived from the batteries R O, indicating "ring off." (Shown in Figs. 12 and 17.) The armature 93 of this magnet is held normally out of or beyond the magnetic field by means of the spring 94, but is automatically brought into the field when the hand telephone set 95 is placed on the switch-hook arm by reason of the weight bearing down the said hook, which by its central stem 96 depresses the pivoted link 97, causing the detent 98 on the latter to catch on the tip of the armature 93 and pull it down. Immediately the armature is in the field the spring 94 makes contact with contact 100, which is earth-connected at E^6, thereby earthing the current on the lines, which energizes the coil 92, and the armature 93 is drawn on to the magnet, in which position it makes contact with the two contact-springs 99 and 100, thereby closing the circuit, putting an earth on the line by reason of the spring 101 and 102 being always in contact with the link 97, so that the clearing-signal can be received in the exchange, the spring 101 being in connection with the line-wire L' and the spring 102 in connection with the line-wire L^2. This earthing of the current on the line causes the lamps V S in the exchange to light up, which serves as the clearing-out signal to the operators, and these lamps remain alight until the clearing is done.

Thus this invention consists of a group of apparatus for automatically electrically signaling connections required from subscribers to the telephone-exchange operators and from one exchange to another without either subscriber or operator speaking, thus securing secrecy of messages, as telephone instruments form no part, necessarily, of the operator's apparatus, and they are therefore unable to tap or tamper with the wires. The circuits are very materially simplified, and multiple switchboards even for the largest exchanges are dispensed with, thereby saving enormous expense in construction and maintenance and doing away with numberless sources of faults and wrong connections. With this system it would be possible to carry on the operating with from twenty to fifty per cent. of the staff required by the systems now in use. It is considered to be an improvement on the purely automatic systems, as it is available for the largest as well as the smallest exchanges or groups, whereas the automatic systems will only work satisfactorily up to a limited number, and the mechanism is necessarily too elaborate and costly. In the case of multiple switchboards the cost per subscriber's line increases as an exchange grows; but with this system the cost per line would always remain the same and the prime cost per line would be very much less.

The novelty of the invention consists in part of the general arrangement or combination of the parts which in different forms have been used for other purposes, but not for telephony, and also some of the parts are novel—such, for instance, as the apparatus or latent switch at the subscriber's end—whereby he can set his dials to the number required, and the switch is worked preferably by currents from the exchange when the operator is ready to operate the call.

What I claim, and desire to secure by Letters Patent, is—

1. A semi-automatic latent signaling-switch for actuating and controlling a distant indicator or signal, consisting of a frame in electrical connection with one terminal of the circuit, movable contact-plates, a contact-piece on the frame, an externally-screw-threaded spindle rotatably mounted in, but insulated from, the frame, means for rotating the spindle in one direction, a traveling nut-block mounted on said spindle, and a contact carried by the nut-block in electrical connection with the other terminal of the circuit, and adapted to brush the contacts on the plates and frame, substantially as described and shown.

2. The combination with an electric circuit and a distant indicator or signal included in the circuit, of the semi-automatic latent signaling-switch for actuating and controlling the said indicator or signal, consisting of a frame in electrical connection with one terminal of the circuit, movable contact-plates, a contact-piece on the frame, an externally-screw-threaded spindle rotatably mounted in, but insulated from said frame, means for ro-

tating the spindle in one direction, a traveling nut-block mounted on the spindle, and a contact carried by the nut-block in electrical connection with the other terminal of the circuit, and adapted to brush the contacts on the plates and frame, substantially as described and shown.

3. The combination with an electric circuit and a distant indicator or signal included in the circuit, and the semi-automatic latent signaling-switch for actuating and controlling the said indicator or signal, consisting of a frame in electrical connection with one terminal of circuit, movable contact-plates, contact on frame, screw-spindle rotatably mounted in the frame, traveling contact-block on said spindle in electrical connection with other terminal of said circuit, of a revolution-counter actuated by a projection on the said traveling contact-block engaging on its downward travel in the driving-wheel of the counter substantially as described and shown.

4. The combination with an electric circuit a distant indicator or signal included in the circuit, and the semi-automatic latent signaling-switch consisting of a frame in electrical connection with one terminal of the circuit, contact on the frame, screw-threaded spindle rotatably mounted in, but insulated from the frame, means for rotating the spindle, traveling nut-block, contact on said block in electrical connection with other terminal of the circuit and adapted to brush the contact on the frame, of an electromagnetic printing device, a simple switch for cutting said printer in circuit and means for actuating said printer from the semi-automatic latent switch, consisting of the adjustable contact-plate, an electromagnet, the armature of which is adapted to release the traveling contact which then falls by gravity its contact brushing the contacts on the adjustable plate thereby causing the pulsations of the printer, substantially as described and shown.

5. In apparatus for use in connection with telephonic intercommunication, the combination with an electric circuit, of the latent switch, the special compound indicator, the special jack-switch, the line-wires, the exchange-printer having mechanism arranged and adapted to return the type-wheel to zero or initial position after each print, and means for actuating, locking, and releasing the latent switch, substantially as described and set forth.

6. In apparatus for use in connection with telephonic intercommunication, the combination with an electric circuit, of the latent switch, the special compound indicator, the special jack-switch, the line-wires, the exchange-printer, and means for actuating, locking and releasing the latent switch, substantially as described and set forth.

7. In apparatus for use in connection with telephonic intercommunication the combination with an electric circuit of the latent switch, the compound indicator, the jack-switch, the line-wires, the exchange-printer, having mechanism adapted to return the type-wheel to initial position after each print, and means for actuating, locking and releasing the latent switch, of the numerical printer, an oscillatory jack-switch adapted to cut said printer in and out of circuit with the compound indicator and visual signals, all constructed, combined and operating, substantially as described and set forth.

8. The combination of apparatus constituting a complete semi-automatic system of telephonic intercommunication, comprising in combination with electric circuits, telephone transmitter and receiver, indicator-bell "engaged" or "busy" device, the means for bringing the armature of the clearing-electromagnet into the magnetic field automatically by the weight of the transmitter and receiver when on the switch-hook, the latent switch, the automatic revolution-counter, the line-wires, the oscillatory jack-switch and plug, the compound indicator, the exchange-printer, the visual signal devices, the exchange-printer, the numerical printer and intermediate jack-switch for connecting either with the line, all constructed, combined and operating substantially as described and set forth.

9. In a latent switch for use in connection with signaling telephonic connections desired, the combination with the exchange-dial and traveling contact-block, of a hole and spring-pressed catch adapted to engage in said hole when same is presented to it, a projection on the tail end of said catch adapted to project in the path of the traveling contact-block automatically on the dial being set to a predetermined point, substantially as described.

10. The apparatus whereby a signal is transmitted to a distance by the weight of the telephone hand set when placed on the switch-hook, consisting of the combination with the stem of the switch-hook, of electromagnet the armature of same pivoted normally out of the magnetic field, a pivoted lever carrying a detent adapted to engage when lowered on the tip of the free end of the said armature and bring it into the magnetic field, two contacts constituting terminals of the electric circuit in which is included an electrical signaling device, substantially as described and set forth.

11. An electric or magnetic printing apparatus the combination of the type-wheel, means for rotating same step by step, means for inking the type, the magnetic or electromagnetic device, the armature, the ratchet and pawl for rotating the type-wheel the magnetic or electromagnetic device and the printing-hammer, the combination therewith of the spring located in the type-wheel and tending always to hold the wheel at normal position,

the bent lever pivoted on the rotation-arm, the double detent pivoted on the printing-armature adapted to engage with the actuating-pawl and the pivoted toothed lever and bring them out of engagement with the ratchet to free the type-wheel, substantially as described.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

ARTHUR THOMAS MILNOR THOMSON.

Witnesses:

ROBT. A. BLAKE,

FRED C. HARRIS.