No. 780,439. PATENTED JAN. 17, 1905.

J. K. NORSTROM & H. M. GRAIF.

ELECTRIC CIRCUIT CLOSER.

APPLICATION FILED JUNE 18, 1903.

3 SHEETS—SHEET 1.

Fig. 2

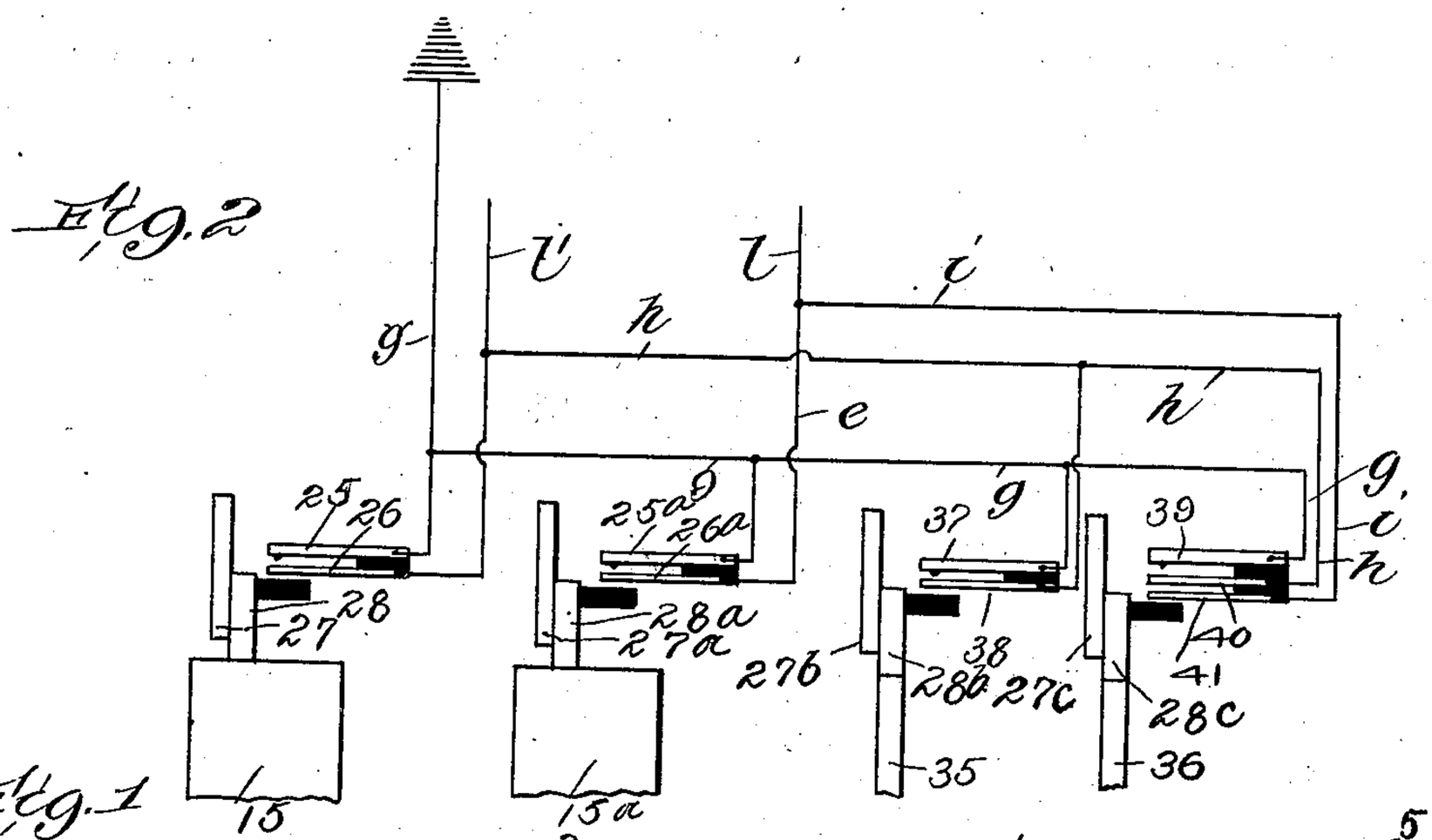
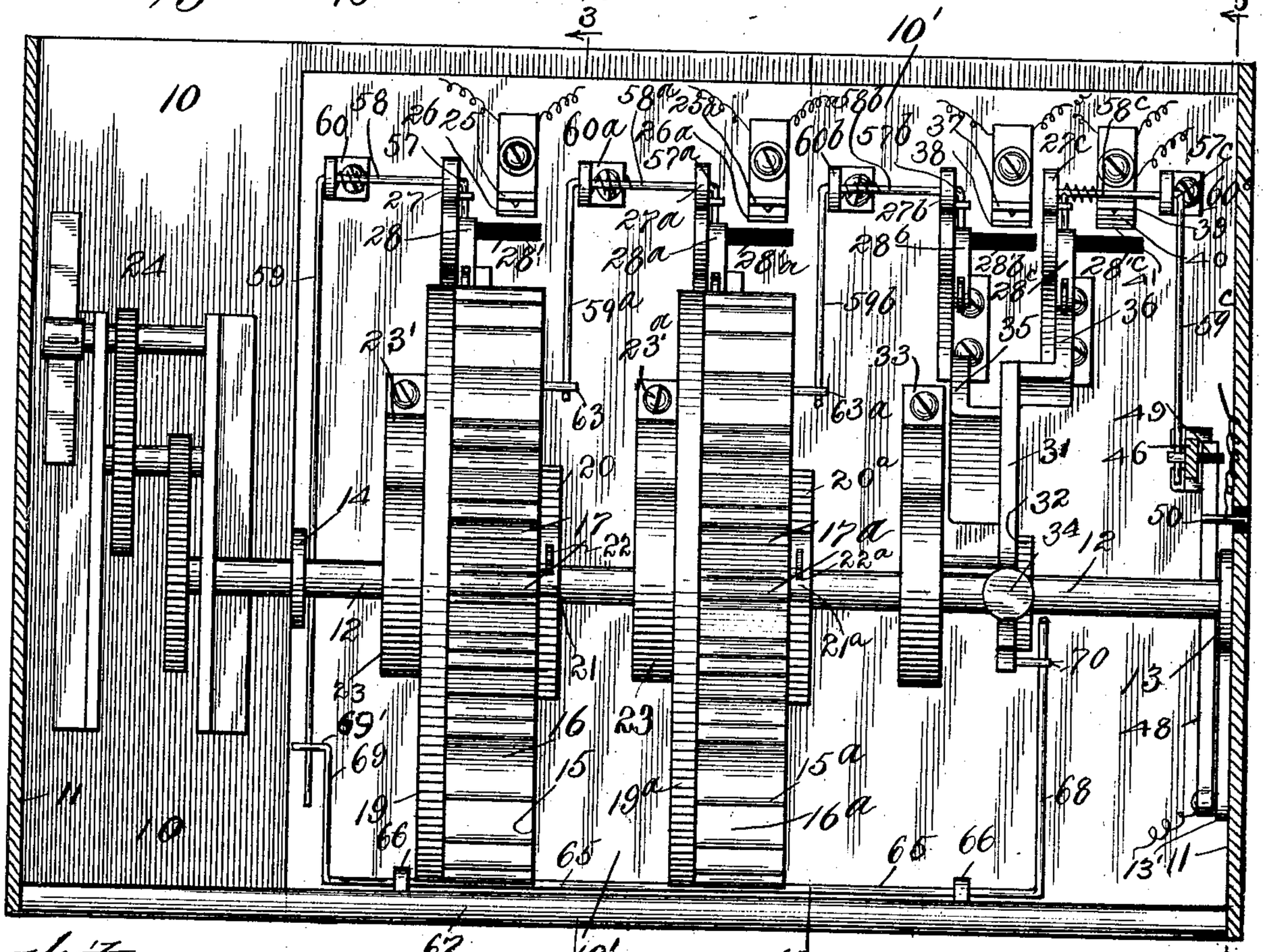


Fig. 1



Witnesses!
Ray White.
Harry B. Lirlute

Inventors:
John K. Norstrom
Henry M. Graif.
By Jones Bain Atty.

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3 SHEETS—SHEET 2.

Fig. 3

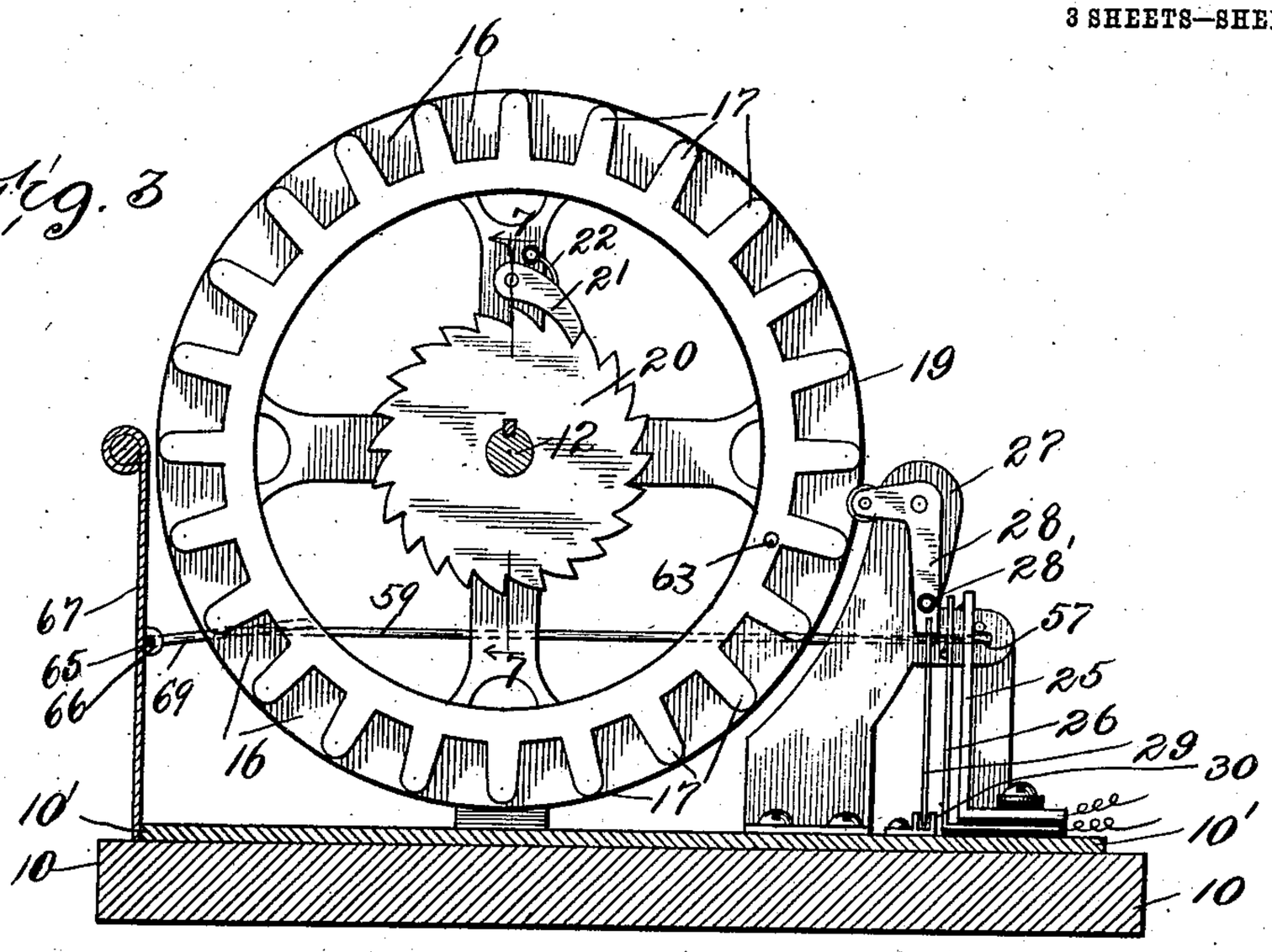
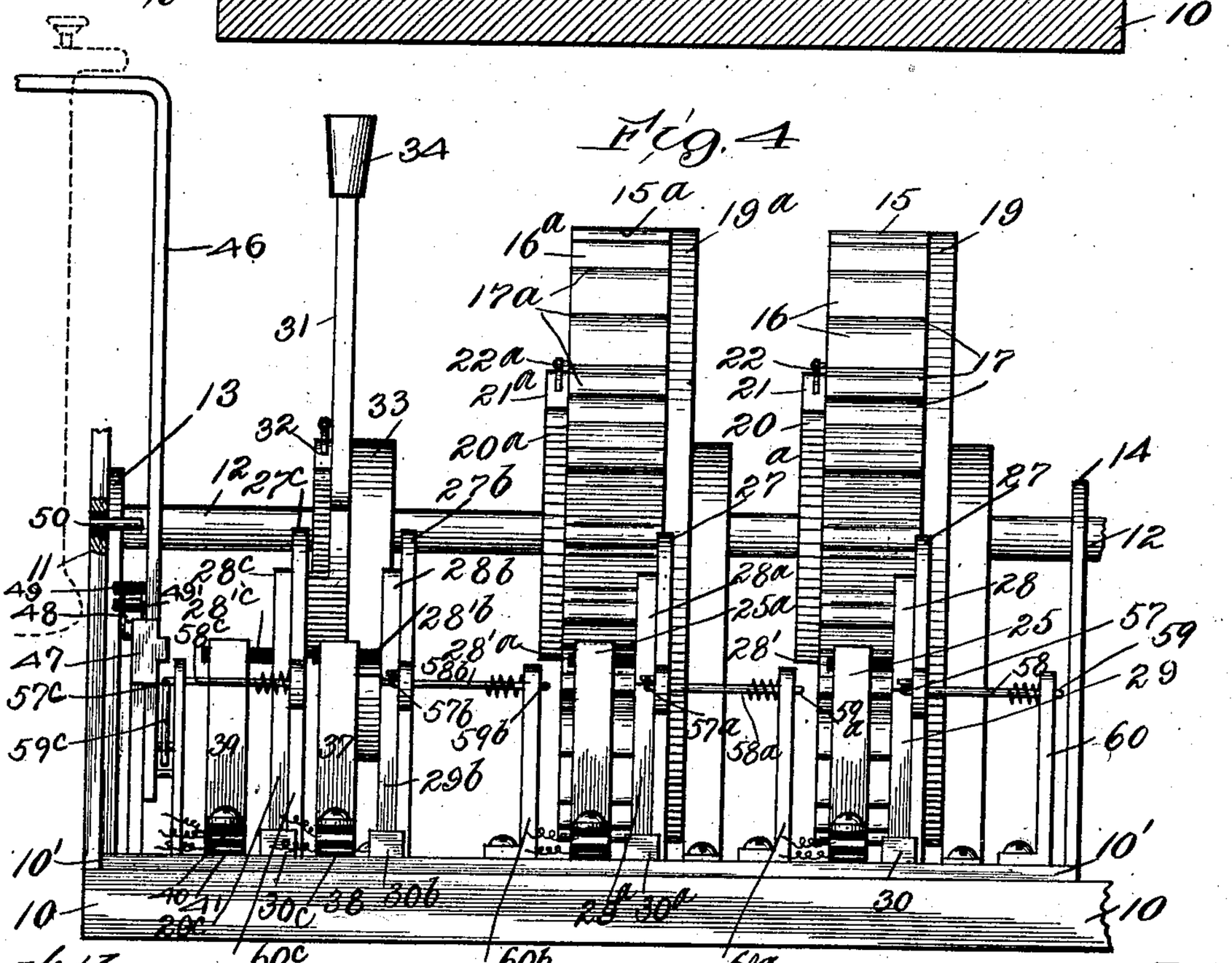


Fig. 4



Witnesses.
Ray White.
Harry B. Leslie.

Inventors
John K. Norstrom
Henry M. Graif.
By Jones Bain Atty.

No. 780,439. PATENTED JAN. 17, 190

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3 SHEETS—SHEET

Fig. 5.

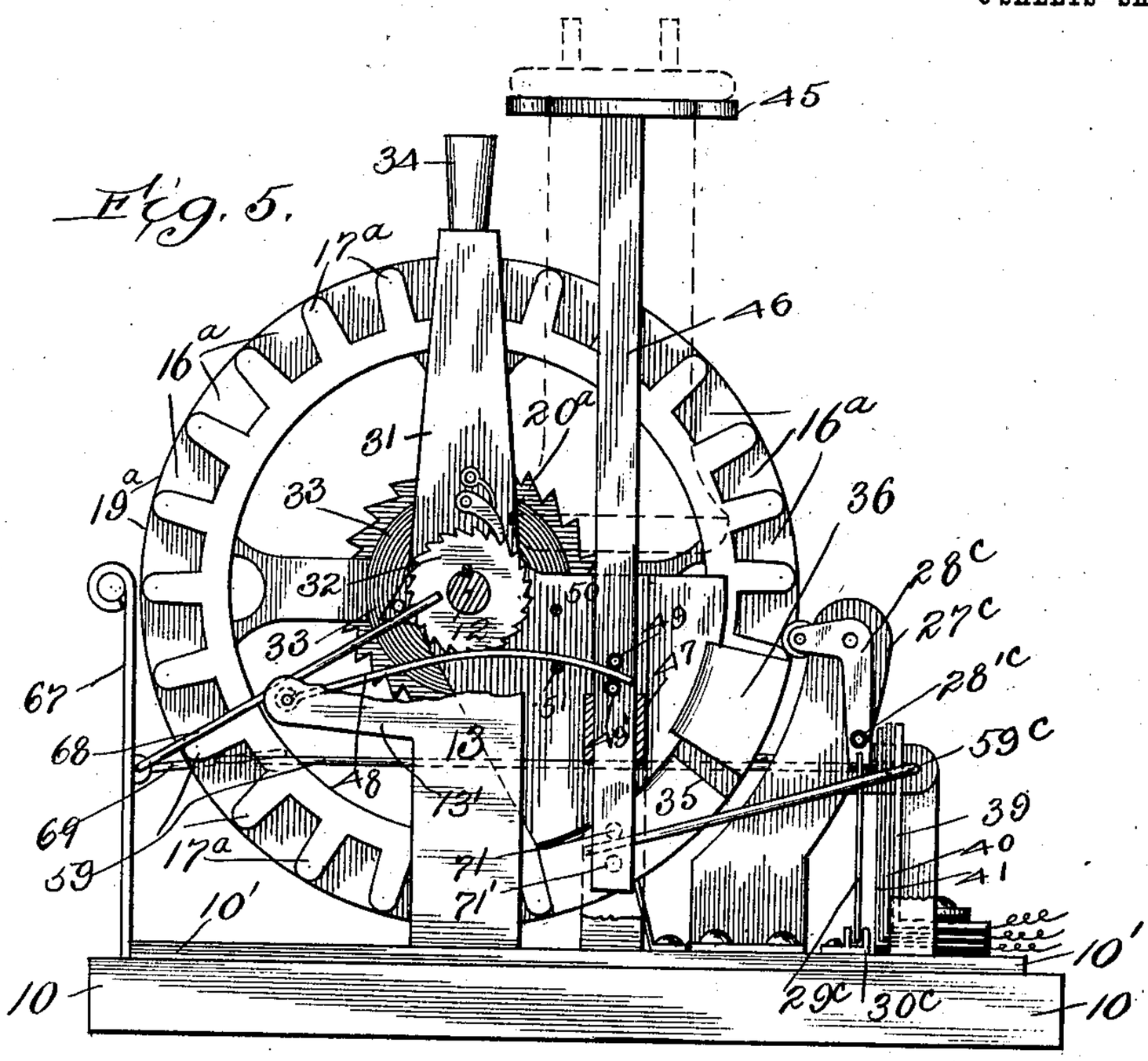


Fig. 6

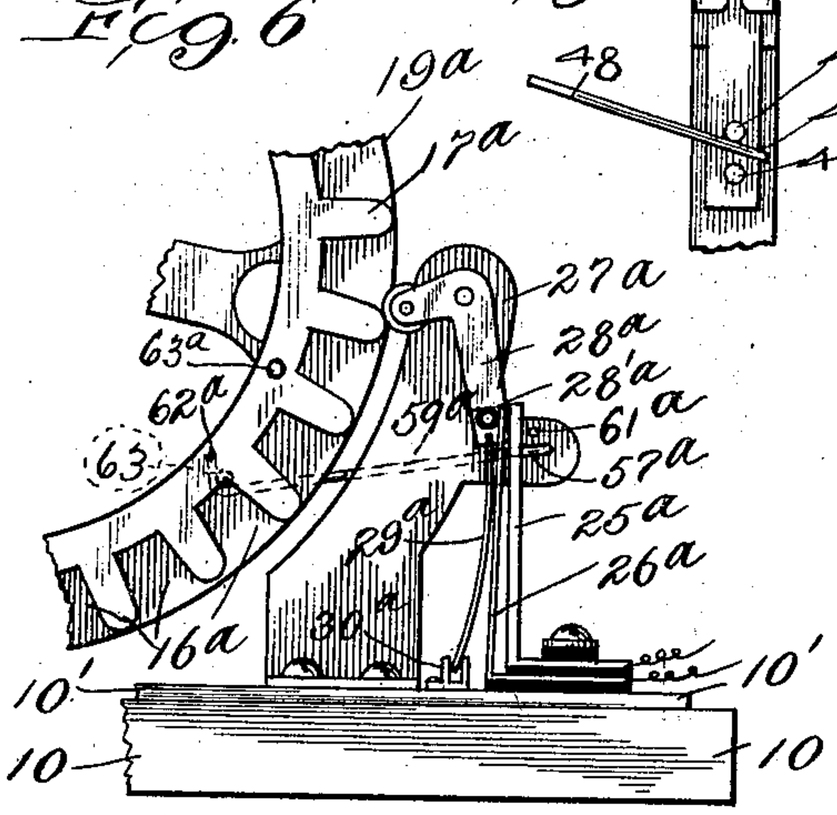
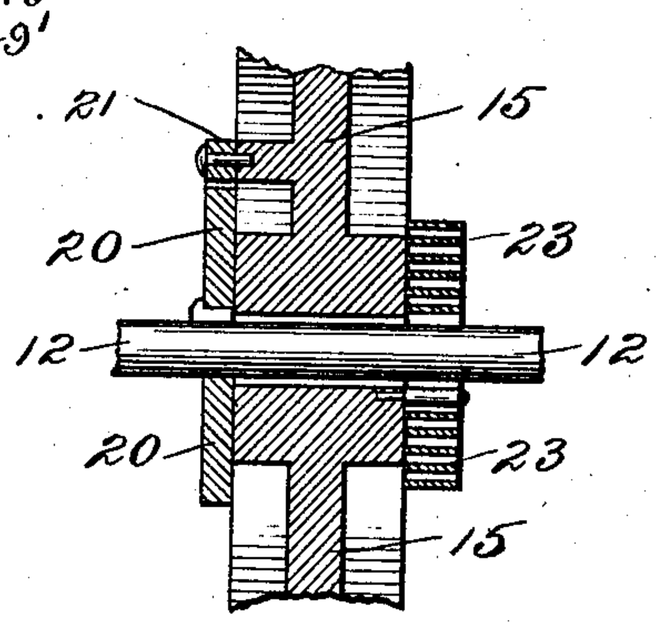


Fig. 8

Fig. 7.



Witnesses:
Ray White.
Harry B. Lubke.

Inventors:
John K. Norstrom
Henry M. Graif.
By Forée Bain Atty.

No. 780,439. Patented January 17, 1905.

UNITED STATES PATENT OFFICE.

JOHN K. NORSTROM AND HENRY M. GRAIF, OF CHICAGO, ILLINOIS, ASSIGNORS TO AUTOMATIC TELEPHONE COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

ELECTRIC-CIRCUIT CLOSER.

SPECIFICATION forming part of Letters Patent No. 780,439, dated January 17, 1905.

Application filed June 18, 1903. Serial No. 161,979.

To all whom it may concern:

Be it known that we, JOHN K. NORSTROM and HENRY M. GRAIF, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric-Circuit Closers; and we hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, which form part of this specification.

Our invention relates to electric-circuit closers, and more particularly to multiple-circuit closers adapted for use as calling devices in conjunction with automatic telephone-exchange systems.

In the practice of automatic exchange telephony it is desirable to employ calling mechanism designed to automatically perform its functions of circuit making and breaking upon the accomplishment by the subscriber of certain preliminary steps of such a simple and obvious nature as to require of the subscriber no greater mental exertion than is required to be used in the employment of the ordinary manual exchange systems. It is also desirable that the arrangement of the apparatus be such that the operation of the parts in their normal or self-suggestive sequence will produce in proper sequential relation the results sought to be attained, so as to make instruction in the use of the devices practically unnecessary. It is primarily with a view to accomplishing these disiderata that our invention is designed; but other and further objects will become apparent to those skilled in the art from the following description and the appended claims.

Referring now to the drawings, wherein we have illustrated an operative embodiment of our invention, Figure 1 is a top plan view of our improved circuit-closing mechanism. Fig. 2 is a distorted diagrammatic plan illustrating certain possible circuit connections with the same. Fig. 3 is a transverse vertical section taken on line 3 3 of Fig. 1. Fig. 4 is a rear elevation of a part of the apparatus. Fig. 5 is a transverse vertical section on line 5 5 of Fig. 1. Fig. 6 is a detail illustrating one of the primary actuating-wheels in operation to close its contact-springs. Fig. 7 is a fragmentary transverse section on line 7 7 of Fig. 3. Fig. 8 is a fragmentary view of the lower portion of the receiver-hook and its associated devices.

Throughout the drawings like numerals of reference refer to like parts.

Referring now to the drawings, 10 indicates a base-block, and 11 11 side pieces of a supporting-framework, which may be of wood or other preferred material.

10′ indicates a metallic base-plate having secured thereto or formed integral therewith such standards or supports as are provided to afford bearings or mountings for the mechanism employed.

12 indicates a longitudinally-extending main shaft finding bearing at its opposite ends in the standards 13 and 14 provided therefor. The said shaft is adapted and arranged to afford support for the primary actuating members of the apparatus which require to be actuated by the user in order to enable the device to automatically perform its function.

The primary actuating members are herein illustrated as three in number and comprise two toothed finger-wheels 15 and 15ª and a segmental cam member to be hereinafter more fully described. The wheels 15 and 15ª and their respective associated devices are identical in their construction and arrangement, and it will therefore be necessary to describe one only of these members—for instance, the wheel 15—it being understood that the wheel 15ª embodies exactly similar parts indicated on the drawings by similar numerals differentiated by the exponent character "a." The wheel 15 is provided with a series of finger-notches 16, separated by teeth 17 and provided with a smooth peripheral surface 19, adapted to have suitably marked thereon indicia, such as numbers or letters, to identify the various finger spaces or notches in the face of the wheel. The wheel 15 is loosely mounted on the shaft 12, but is adapted to be connected therewith for rotation in one direction through the intermediary of a ratchet-and-

pawl mechanism. As herein illustrated, 20 indicates a ratchet keyed to the shaft, and 21 a pawl pivoted to a suitable part of the wheel 15 and held in engagement with the ratchet by the spring 22.

23 indicates a coiled spring one end of which is secured to the wheel 15, the other end of which is suitably fastened, as at 23′, to the framework of the device.

It will be apparent from the illustration and description that when the top of the wheel 15 is drawn forward toward the front of the mechanism the pawl 21 may slip freely over its ratchet 20 without turning the shaft 12; but at the same time the spring 23 is put under tension. If now the wheel be released, it tends to return to its normal or initial position under tension of the spring 23, in its movement rotating with it the shaft 12 through the operative engagement of the ratchet-and-pawl devices.

24 indicates generally a fan governor or retarding device of well-known construction geared to the shaft 12 to regulate or retard its rotative speed, so that the return of an actuating device to normal position after an initial movement therefrom will be suitably slow.

Associated with each primary actuating device is a set of circuit-closing springs normally arranged in open position and designed to be closed by the operation of the primary actuating mechanism.

The devices associated with wheels 15 and 15ª are identical, so that again one set of devices only will be described.

25 and 26 indicate two contact-springs associated with the primary actuating-wheel 15, such springs being insulated from each other and having their major portions arranged in vertical parallelism at a suitable distance from the wheel 15. Interposed between the primary actuating-wheel and the contact-springs is a motion-translating mechanism arranged to transmit from the wheel when rotated in one direction only to the springs lateral motion to close the springs a number of times determined by the number of teeth of the wheel 15 passing thereby. This translating mechanism comprises a standard 27, whereon is pivoted a bell-crank lever 28, the shorter horizontal arm whereof projects into the path of the teeth 17 of the wheel 15 and the longer arm of which depends into proximity to the springs 25 and 26. The horizontal arm of the lever 28 is preferably provided with an antifriction-roller to receive the thrust of the teeth of the primary actuating-wheel, while the longer arm is provided with insulated pin 28′, projecting laterally therefrom and overlying the spring 26 in front thereof, so that when the horizontal arm of the lever is depressed the depending arm, with its projecting pin 28′, is moved to close the contact-springs. A leaf-spring 29, secured to the depending arm of the lever and slidingly engaging guides 30, mounted on the base-plate, serves as a damping-spring and to normally position the bell-crank lever.

Referring now to the "segmental-cam" primary actuating device heretofore adverted to, it will be seen that it generally comprises a body member 31, connected with the shaft 12 by a pawl and ratchet and normally held at one limit of its movement by a coiled spring in a manner similar to the wheel 15, the ratchet-and-pawl devices being generally indicated at 32 and the spring at 33.

34 is an operating-handle for the cam member, which when the device is in normal condition stands preferably in vertical position. The member 31 is provided with two laterally and peripherally separated segmental cams 35 and 36 of suitable proportions, preferably formed integral with the body 31. The larger cam 35, having the most extended peripheral surface, is arranged in the lower relative position and is offset to the side of the segmental member adjacent the wheel 15ª, the peripherally-short cam 36 being arranged in uppermost position and offset the other side of the body portion of the member. Each of the cams 35 and 36 has associated therewith a set of contact-springs and a transmitting device similar to those associated with primary actuating-wheels 15 and 15ª. The two springs associated with the cam 35 are indicated at 37 and 38, respectively, while three springs associated with the cam 36 are indicated at 39, 40, and 41, respectively. It will be understood that these springs are arranged in the same manner as the springs 25 and 26, associated with the wheel 15, and that the bell-crank transmitting device associated with each set of springs is identical with the lever devices provided for the wheels 15 and 15ª. These transmitting devices need not, therefore, be specifically described; but their parts will be designated by the numerals employed to designate the like parts associated with wheel 15, the devices associated with the cam 35 being distinguished by the exponent character "b" and those associated with the cam 36 by the exponent character "c."

45 indicates a receiver-hook provided with a vertically-disposed stem 46, arranged to slide vertically in guide 47, suitably secured to the framework of the device. The hook is provided with a spring 48, tending to normally hold it in raised position, said spring being of such strength, however, that the weight of the receiver suffices to overcome its tension and depress the hook. In the present illustrative embodiment we have shown the spring 48 as fixedly attached at one end to a projection 13′ from the bracket 13 and its other end arranged to slide between two insulated pins 49 and 49′, secured to the stem 46 of the hook. If desired, the spring 48 may, as herein illustrated, be employed as the switch-spring, whose function is too com-

monly known to need specific description. To this end the contact-pins 50 and 51, projecting from a suitable part of the framework, such as the side piece 11, are arranged to limit the vertical movement of the spring 48 and act as the upper and lower contact-points of the receiver-hook switch.

From the preceding description it will appear that the wheels 15 and 15ª and the segmental cam member 31 may any one be manually moved in a forward direction—that is to say, the upper portion of the wheel or segment may be drawn toward the front of the machine without actuating its bell-crank lever to close the contact-springs associated therewith and also without rotating the shaft 12, as heretofore described. Upon the release of the wheel or segment, however, it will be apparent that it will return to its initial position under tension of its spring, thereby depressing the horizontal arm of the bell-crank lever associated therewith during the passage of each tooth or its cam, as the case may be, and closing the associated contact-springs a number of times or a length of time corresponding with the number of teeth or the length of the cam passing the horizontal arm of the lever. By the construction herein illustrated, however, we provide means for making the return or actuating movement of each of the primary actuating devices mutually interdependent in such a way that when the actuating devices are initially operated in their normal sequence they will automatically perform their functions in proper relative order.

In the operation of the telephones now commonly employed in conjunction with manually-operated exchange systems the usual sequence of operation is as follows: The receiver is first removed from its hook to prepare the line for the transmission to "central" of information as to the number desired to be called, the number is called and the connection given by central; and after the conversation is finished the receiver is hung upon its hook to inform central that connection may be broken and the lines restored to their normal condition. It is our object to so arrange the devices of our calling mechanism that these operations may be followed out in the automatic calling device, the receiver being first removed from its hook, the number-wheels being then actuated to call the number, then the segment arbitrarily depressed to secure the connection of the lines, and when the conversation is finished the receiver being placed upon its hook to disconnect the lines, the single operation of hanging up the receiver serving to cause the performance of all the functions necessary to restore the lines to their initial condition. To this end the actuating devices are arranged in proper sequence, and their actions are made so interdependent that all of the primary devices must be set or prepared for action before any may act, while the setting of the last device of the series automatically causes the successive release for action of all of the set devices of the series.

Referring now to the drawings, it will be seen that associated with the crank-lever 28 of the wheel 15 is a catch or detent 57, carried by or formed integral with the rock-shaft 58, mounted in suitable brackets provided therefor in the frame and having an operating-arm 59 extending forward to the front portion of the device. A suitably-arranged coiled spring 60 tends to hold the rock-shaft 58 in such position that the detent 57 is held in raised position against the stop 61, carried by one of the supporting-brackets, in which position the detent 57 lies immediately behind the depending arm of the bell-crank lever in position to prevent said arm from moving rearwardly or in a functionally-operative direction. Accordingly when the detent is in operative position the wheel 15 may be given its initial movement in a forward direction, the teeth 17 passing the bell-crank lever, throwing its depending arm away from springs and the detent 57; but it will be apparent that the lever 28 and detent 57 form a stop to prevent the return of the wheel to its normal position. When, however, the detent 57 is removed from its position in rear of the depending arm of the bell-crank lever, the latter is at liberty to swing rearwardly and the wheel is free to return to normal position. Similar catch mechanisms are provided for the wheel 15ª, the parts being indicated by the same numerals as the like parts associated with wheel 15, distinguished, however, by exponent "a." The operating-arm 59ª of the detent of wheel 15ª is, however, slightly differently arranged, such arm 59ª extending into close proximity to the wheel 15 and provided at its free extremity with an upturned hook or stop portion 62ª. A pin 63 is arranged to project from wheel 15 in such position that during the rotation of the wheel 15 it strikes the operating-arm 59ª, depressing the latter to remove the detent 57 from its operative position. The hook 62ª of the detent-operating arm is so arranged as to receive the pin 63 when the arm is depressed and form a positive stop for the movement of the wheel 15 in its return direction.

Detent and operating devices similar to those described are provided for the lever 28ᵇ, the parts being indicated by the same numerals as like parts in the mechanism heretofore described and distinguished by the exponent "b." It will be understood, however, that the operating-arm 59ᵇ of the detent device is arranged for actuation by the pin 63ª of the wheel 15ª.

The operation of the detent mechanism of the first wheel 15 is made dependent upon the initial movement of the segmental cam mem-

ber 31. This may be accomplished by the provision of a rock-shaft 65, mounted in suitable bearings 66, provided therefor upon a front rail or casing member 67 and provided at its opposite end with arms 68 and 69. The arm 69 is provided with an elbow 69′, arranged to overlie the forward extremity of the operating-arm 59 of the detent device or wheel 15, while the arm 68 is arranged in the path of movement of pin 70, mounted on the suitable portion of the segmental cam member 31 in front of the shaft 12.

The detent device associated with the bell-crank lever 28 is similar in its general construction to those employed in conjunction with the other translating instrumentalities and the parts thereof are indicated by the same numerals of like parts of the other devices differentiated by the exponent character "c." The operating-arm 59^c, however, is operatively associated with the movable receiver-hook, so that when the receiver is upon its hook the detent is moved to inoperative position, while when the receiver is removed from its hook the accompanying movement of the hook serves to bring the detent to operative position. To this end the hook-stem 46 is provided with two pins 71 and 71′, between which the operating-arm 59^c of the detent is arranged to play.

While the devices herein described are susceptible of use under varying conditions and may be readily changed in minor particulars to suit its condition of use, the specific construction herein shown and described is particularly adapted for use in telephone systems constructed and arranged in accordance with our invention disclosed in our pending application filed May 18, 1903, and serially numbered 157,552.

In Fig. 2 we have shown diagrammatically the connections that would be employed between the springs of the circuit-closing device and the various circuit-wires in adapting our invention to its use in such environment, and reference is now made to such view.

l and *l′* indicate the two sides of the line-circuit, the line-wire *l* being connected with the spring 26^a of the pair associated with the wheel 15^a, while the line-wire *l′* is connected with the spring 26 of the pair associated with wheel 15. All of the stationary contact-springs of the sets of devices—viz., springs 25, 25^a, 37, and 39—are connected in common to a ground-wire *g*. The springs 38 and 40 are tapped to a wire *h* to the side *l′* of the line. The spring 41 is direct-connected by a wire *i* with the side *l* of the line.

In the operation of our system as set forth in the application heretofore referred to it is necessary to first ground the line-wire *l′* one or more times to prepare the central instruments to receive the number of the subscriber's station which it is desired to call. Next the side *l* of the line is grounded a number of times corresponding with the number of the subscriber's station to be called, and then the side *l′* of the line is again grounded for a suitable length of time to ring the called subscriber. These operations are all that is necessary to secure the party desired, while after the communication is completed and it is desired to restore the lines to normal condition it is necessary to ground both sides *l* and *l′* of the calling-subscriber's line at once.

The operation of our device as illustrated to accomplish the results just described is as follows: The operator first removes the receiver from its hook in the ordinary manner, permitting the hook to rise under the influence of its spring 48, so lifting the arm 59^c of the detent device associated with the lever 28^c and bringing the detent into operative position. In practice the lifting of the hook also serves to cut in the subscriber's talking set, as will be well understood. Now the wheel 15 is initially rotated in a forward direction until a desired number of its teeth have passed the forwardly-projecting arm of the bell-crank 28. The detent 57 being now held under the influence of its spring 60 in operative position, the depending arm of the bell-crank is prevented from moving rearwardly, so that the wheel 15 is held against return to its normal position under tension of its spring 23. Now the wheel 15^a is rotated until a number of teeth corresponding with the number of the subscriber desired to be called have passed the horizontal arm of the bell-crank 28^a. The movement of the wheel 15 having removed the pin 63 from engagement with the arm 59^a of the detent mechanism, the detent is in operative position, so that the lever 28^a is caused to act as a stop, and wheel 15^a is also held against return to its initial position. Now the segment 31 is rotated by means of the handle 34 being given a turn sufficient to cause both the cams 35 and 36 to pass their respective bell-crank levers 28^b and 28^c. The detent devices of both of said levers being free to operate, each lever 28^b and 28^c is held against movement to permit the return passage of its cam.

It will be noted that during the initial forward movement of the segment member 31 the pin 70 contacts with the operating-arm 68 of the rock-shaft 65, depressing said arm and correspondingly the arm 69 on the opposite end of the shaft. The elbow 69′ and the arm 69 being arranged to overlie the operating-arm 59 of the detent devices associated with wheel 15, said arm 59 is depressed, removing the detent 57 from the path of oscillation of the depending arm of bell-crank lever 28. Consequently the wheel 15 is now free to return to its normal position under tension of its spring, in its movement oscillating the bell-crank lever 28 and moving the depending arm thereof rearwardly to cause the springs 25 and 26 to close one or more times, so ground-

ing the side *l'* of the line one or more times. As the wheel 15 approaches its normal position its pin 63 strikes the arm 59ª of the detent mechanism of the wheel 15ª, depressing said arm and moving the detent 57ª to inoperative position. Now the wheel 15ª returns to normal position in manner like wheel 15, in its return movement actuating the translating device to close the springs 25ª and 26ª a number of times corresponding with the number of teeth passing the translating device, and so grounding the side *l* of the line a like number of times to cause the automatic exchange devices to select the number of the subscriber desired. The return of the wheel 15ª to normal position actuates the releasing-arm of the detent devices of the lever 28ᵇ, so that the cam 35 is free to pass its said lever 28ᵇ. During the return movement of the cam 35 the springs 37 and 38 will be closed for a period of time, depending upon the length of the peripheral face of the cam, again grounding the side *l'* of the line for a corresponding time. This results in ringing the subscriber desired to be called and completes the preliminary steps necessary to secure connection of the calling and called subscribers. If one ring is not sufficient to attract the attention of the party desired, the handle 34 may be again pulled down, and when released, the transmitting device not being held by its detent, the cam member will return past the translating device, again closing the circuit through the springs 37 and 38 and again ringing the called subscriber. It will be noted, however, that as long as the receiver is off its hook the operating-arm 59ᶜ of the detent mechanism remains in elevated position, preventing the rearward movement of the depending arm of the bell-crank lever 28ᶜ, and so prevents the cam 36 from passing said lever. When now the calling subscriber desires to restore the line to its normal condition, he has but to hang up the receiver on its hook to accomplish the desired result. The depression of the hook by the weight of the receiver moves the detent mechanism to inoperative position, allowing the cam 36 to pass the projecting arm of the bell-crank lever and return to normal position. The movement of the lever thus occasioned causes the springs 40 and 41 to close upon spring 39, thereby connecting both sides *l* and *l'* of the subscriber's line to the ground-wire *g*. The parts are now all restored to their initial positions ready for operation anew.

In the foregoing description the primary actuating devices are referred to as three in number; but it will be apparent that any number of such devices may be used as may be found necessary to suit its particular use, the system of auxiliary mechanisms being simply carried out to correspond with the incr[illegible] of actuating devices.

While we have herein shown in detail one operative embodiment of our invention especially adapted for use in conjunction with our peculiar exchange system, we do not desire to be understood as limiting ourselves either to the exact construction shown or the use of the device in the system referred to.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. In a device of the character described a series of independently-movable actuating devices, adapted to be set for sending predetermined signals, means associated with each device for holding it in set position, means for moving said devices when the holding devices are released, means associated with each actuating device for releasing the holding means of some other actuating device in the series, one of said releasing means being arranged to be actuated by the setting of the actuating device with which it is associated.

2. In a device of the character described a series of independently-movable actuating devices adapted to be set for sending predetermined signals, means associated with each actuating device for holding it in set position, means for moving said devices when the holding means are released, means associated with each actuating device for releasing the holding means of the next succeeding device throughout the series, the releasing means of the last actuating device in series being arranged to operate upon the holding means of the first device of the series and being arranged to be actuated by the setting of the last actuating device of the series.

3. In a device of the character described, a series of actuating devices independently movable in either direction, means tending to move said devices in one direction, instrumentalities associated with each actuating device to hold the same in set position against the stress of its moving means, and means associated with each actuating device for tripping the holding device of another actuating device of the series, all of said tripping means except one being arranged to operate upon the return of the corresponding actuating device from set position, and one such tripping means being arranged to operate during the movement of its actuating device to set position.

4. In a multiple-circuit closer, the combination with a frame, of a series of primary actuating devices supported therein for rotative movement, circuit-closing devices operatively associated with each actuating device, movable holding means associated with each primary actuating device, each adapted and arranged when in one position to hold its associated primary actuating device against functionally-operative movement, and a mechanical releasing means associated with each holding device for moving the same to inoperative position, the releasing means associated with the holding device of each primary actuating

device being arranged for operation by the movement of some other primary actuating device of the series.

5. In a multiple-circuit closer, the combination with a frame, of a series of primary actuating devices supported thereby for rotative movement, circuit-closing devices associated with each primary actuating device and arranged to be operated by the movement of the said actuating device in one direction only, a detent operatively associated with each primary actuating device to prevent its movement in such direction as to operate the circuit-closing devices, releasing means associated with each detent, adapted when actuated to move said detent to inoperative position, and a mechanical means associated with each primary actuating device for operating the detent-releasing means of the actuating device next in sequence thereto throughout the series.

6. In a multiple-circuit closer, a supporting-frame, primary actuating devices mounted therein for independent movement, circuit-closing devices associated with each primary actuating device, a motion-transmitting instrumentality arranged between each primary actuating device and its associated circuit-closing devices, a detent associated with each transmitting instrumentality adapted when in operative position to prevent the functionally-operative movement of said motion-transmitting instrumentality, releasing means for each detent, adapted to move the same to inoperative position, such releasing means for each detent except the first being operatively associated with the next adjacent primary actuating device for actuation thereby, and the releasing means for the first detent being operatively associated with the last primary actuating device for actuation thereby.

7. In a multiple-circuit closer, the combination with a frame, of a series of toothed actuating members mounted therein for independent movement, means associated with each actuating member for normally holding it at one limit of its movement, and returning it to said limit when moved therefrom, circuit-closing springs associated with each actuating member, a pivoted lever interposed between each actuating member and its contact-springs, arranged to operate said springs during the return of the actuating member to normal position after an initial movement therefrom, a movable holding device associated with each lever and arranged to normally prevent movement thereof in the spring-operating direction, a releasing means for each holding device, and means carried by each primary actuating device for actuating the releasing device associated with another actuating device of the series, the arrangement being such that the return movement of the first primary actuating device actuates the releasing means for the holding device associated with the next succeeding primary actuating device, and so on throughout the series, the releasing means for the holding device of the first primary actuating device being arranged to be actuated by the initial movement of the last primary actuating device of the series.

8. In a device of the character described, a frame, a primary actuating device mounted for rotation therein, said primary actuating device being provided with two laterally-separated cams, a set of contact-springs associated with each cam, and a translating device associated with each set of springs, adapted to be actuated by the corresponding cam, to operate its associated circuit-closing springs.

9. In a calling device for automatic telephone-exchange systems, the combination of a frame, a rotatable actuating member mounted therein, and provided with two laterally and peripherally separated cams, a spring for normally positioning the actuating member, two sets of springs, one for each cam, associated with said actuating member, motion-translating instrumentalities arranged between each set of springs and its cam, adapted and arranged to permit the cam to pass the said instrumentality in one direction without actuating the springs, but to actuate the springs upon the return of the cam to normal position, past said transmitting instrumentality, holding means adapted when in operative position to prevent passage of the uppermost cam past its transmitting instrumentality, a receiver-hook, a connection between said receiver-hook and the said holding means, adapted when the receiver is on its hook to move said holding means to inoperative position, and a spring for moving said receiver-hook when the receiver is removed therefrom to bring the holding means to operative position.

In testimony that we claim the foregoing as our own we affix our signatures in presence of two witnesses.

JOHN K. NORSTROM.
HENRY M. GRAIF.

In presence of—
MARY F. ALLEN,
GEORGE T. MAY, Jr.