

Oct. 18, 1927.

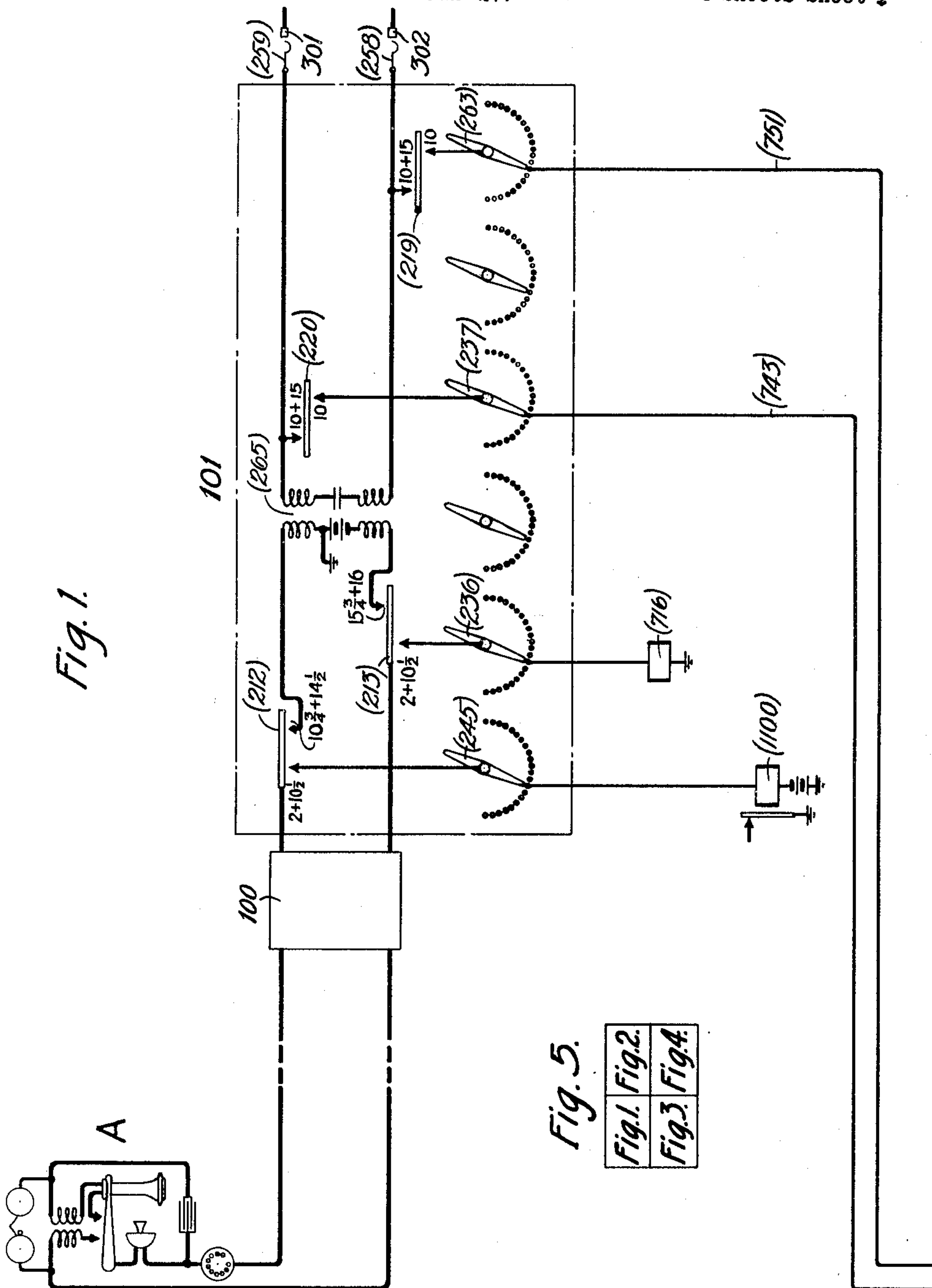
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1,645,573

TELEPHONE EXCHANGE SYSTEM

Filed Jan. 27, 1926

4 Sheets-Sheet 1



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by

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Oct. 18, 1927.

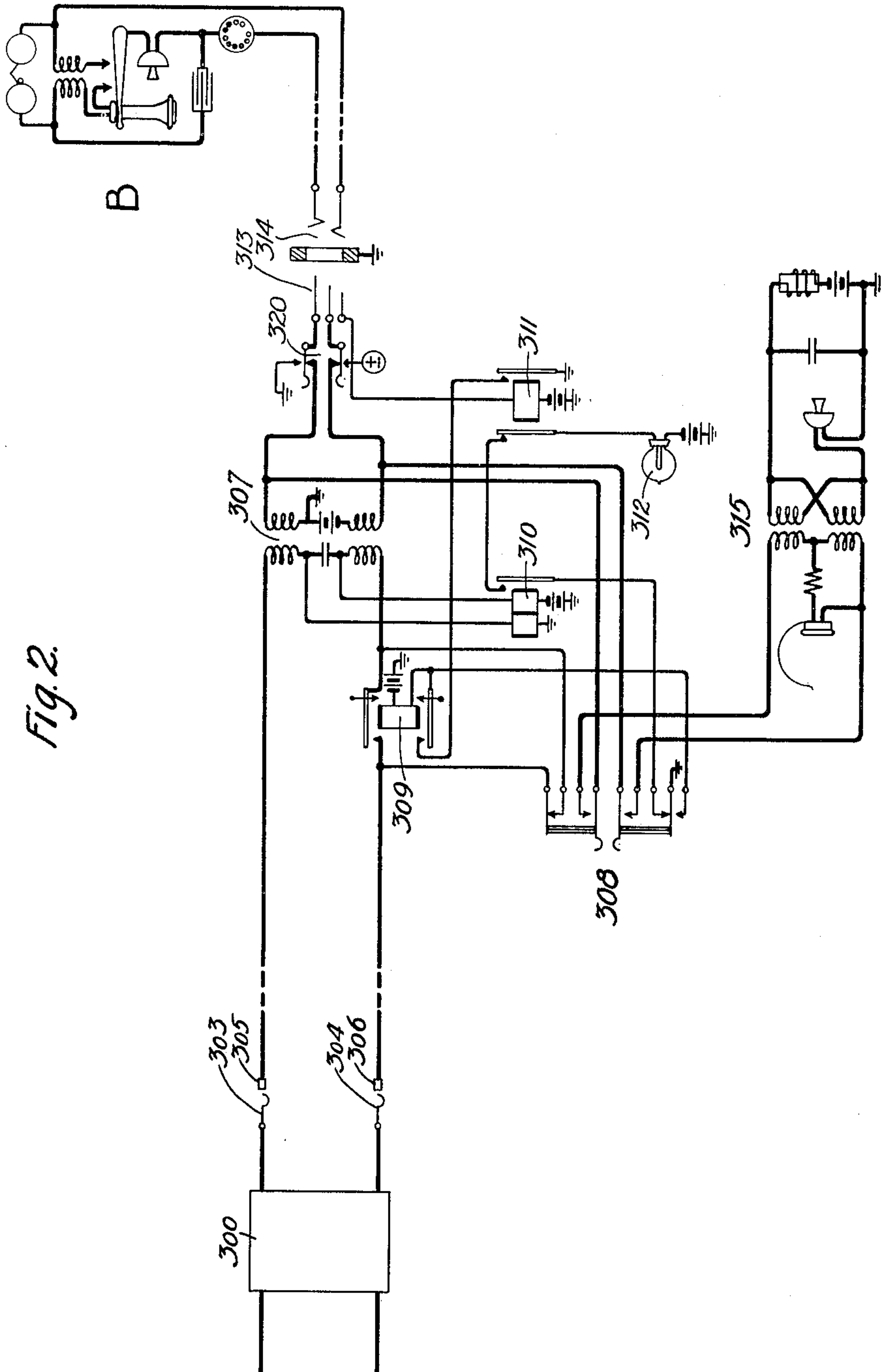
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TELEPHONE EXCHANGE SYSTEM

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4 Sheets-Sheet 2



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TELEPHONE EXCHANGE SYSTEM

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4 Sheets-Sheet 3

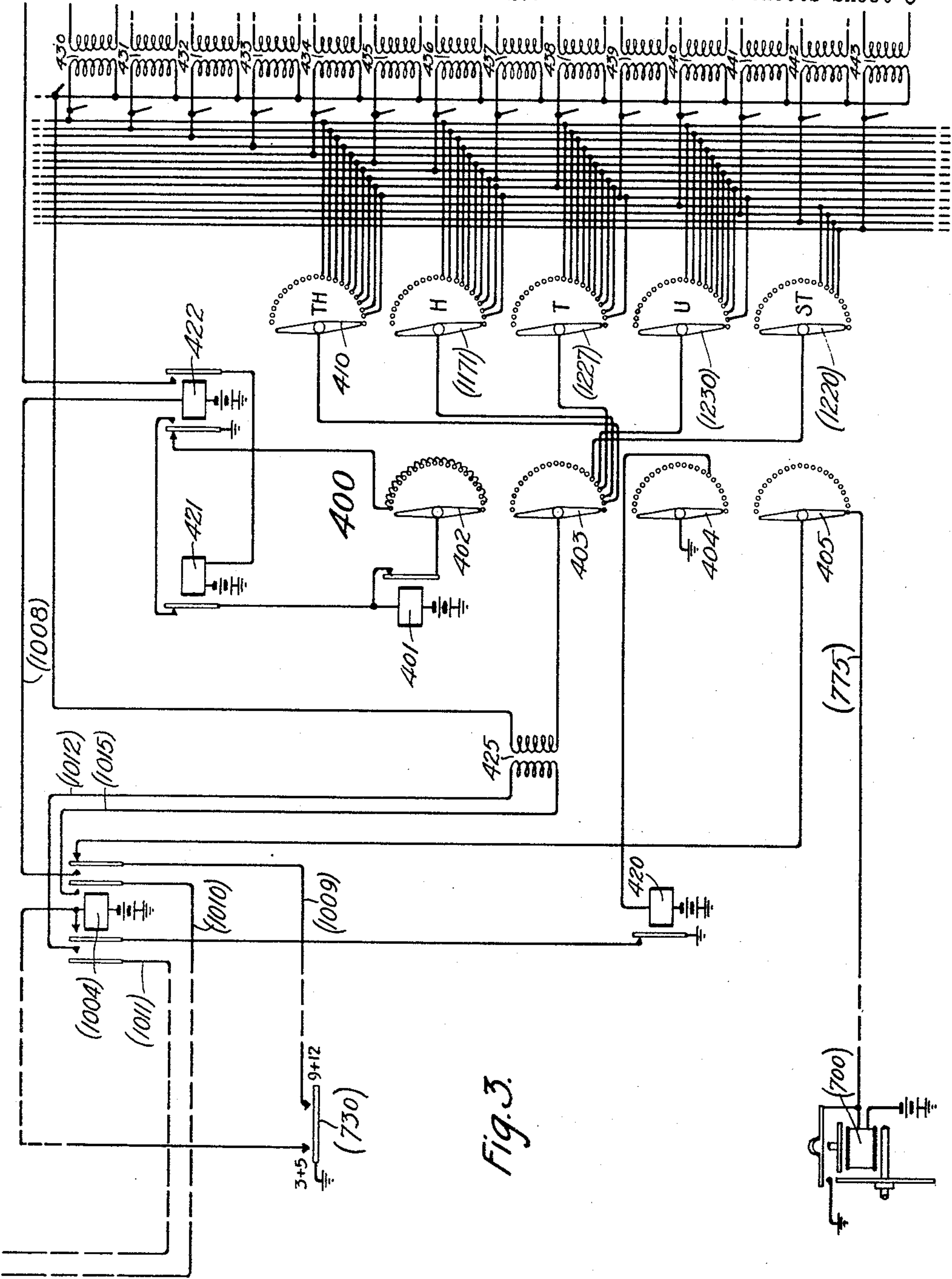


Fig. 3.

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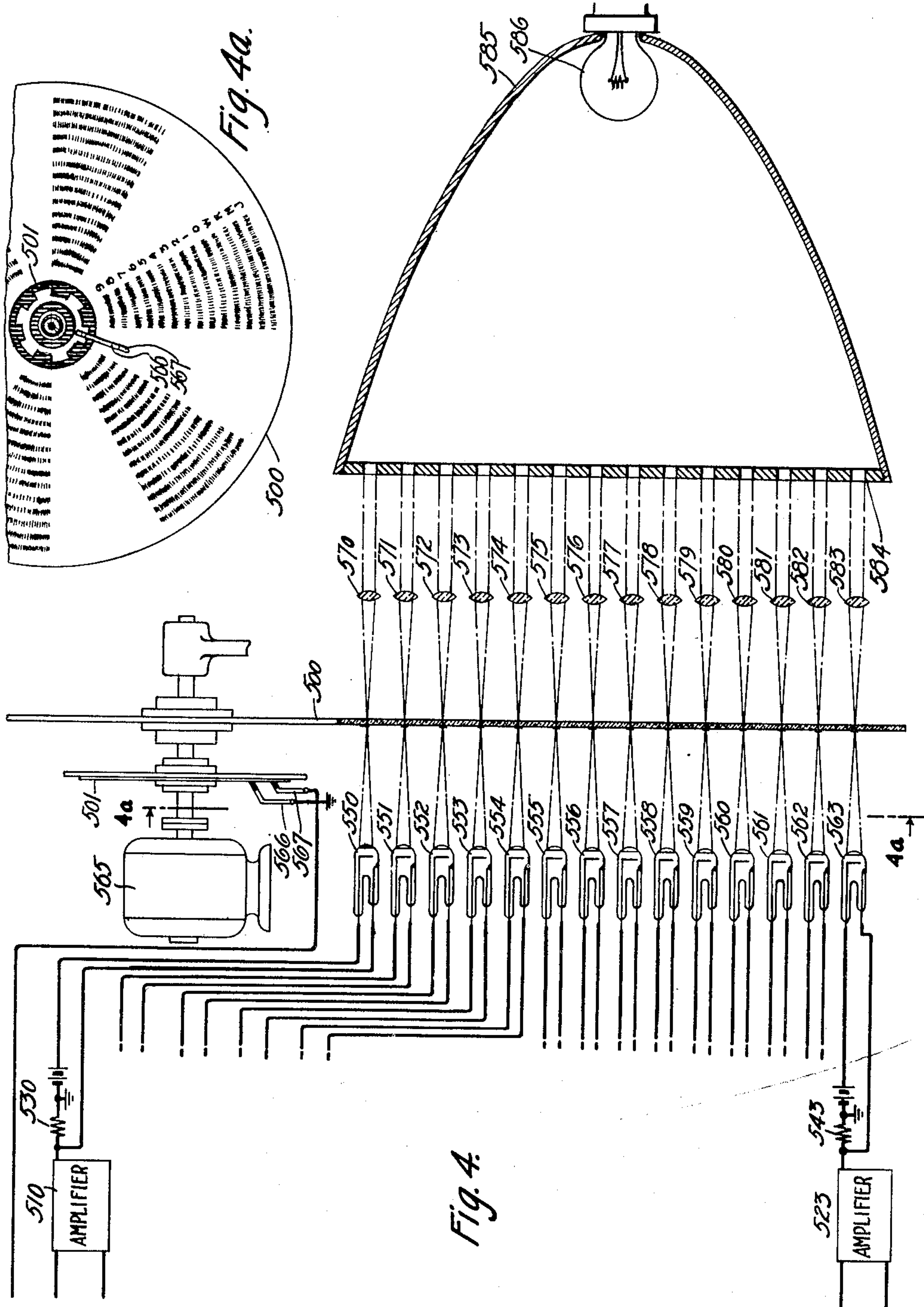
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TELEPHONE EXCHANGE SYSTEM

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE.

HENRY M. BASCOM, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed January 27, 1926. Serial No. 84,188.

This invention relates to telephone exchange systems and more particularly to the transmission of signals between automatically operated and manually operated telephone offices.

It is an object of this invention to provide an improved method of transmitting signals from an automatically operated office to an operator at a manually operated office.

10 In telephone exchange areas comprising automatically and manually operated telephone offices, signals must be transmitted to the manual office from the automatically operated office in accordance with a call
15 number dialed by the calling subscriber. In some telephone systems this transmission of call signals is made by the operation of visual signals placed before the manual operator. The visual signals are controlled
20 by the apparatus of the automatic office which has been set by the dial interruptions. A large amount of apparatus is used in the manual office for the operation of such signals and thus adds greatly to the expense in
25 telephone exchange areas comprising both types of offices.

A feature of this invention is in the provision of common selectable means in automatically operated offices for transmitting
30 signals orally by the excitation of photoelectric cells from light rays directed through striations of a constantly rotating film.

35 This and other features of the invention will be apparent from the following description taken in connection with the accompanying drawings.

While the invention has been disclosed as particularly adapted for transmitting signals from a full mechanical office to a manual office it is apparent from the following description that the invention has a wider utility and that by slight modification it could be adapted for selecting and transmitting
40 signals from a common source to any destination.

Referring to the drawings, Figures 1, 2, 3 and 4 as arranged in the order illustrated by the diagram Fig. 5 disclosed the apparatus for transmitting telephone station call
50 numbers and letters orally from the subscriber's station A through a full mechanical

office to subscriber's station B connected to a manual office.

Figs. 1 and 3 are a diagrammatic representation of a line switch 100, district 101 and sender for a full mechanical office as disclosed and described in detail in Patent 1,505,171 to F. A. Stearn. The sender is modified to include selecting and switching
55 means for embodying this invention.

Fig. 2 is a diagrammatic representation of an office selector 300 and the circuits and apparatus necessary at a manual switchboard for receiving calls from a full mechanical office.

Fig. 4 illustrates apparatus for transmitting oral signals into an amplifier by excitation of photoelectric cells from light transmitted through striations of a film.

Fig. 4^a illustrates a cross sectional view of the film and commutator.

The diagrammatic illustration of the line switch 100, district 101 and sender, Figs. 1 and 3 taken from Patent 1,505,171 to F. A. Stearn has been combined with this disclosure in such manner that the conductors and apparatus of this disclosure have been connected thereto in place of the part of the relay call indicator apparatus of the patent.
75 The conductors and apparatus thus interconnected have been given the same numbers as are used in the patent in order to make clear the association of the apparatus employed in this invention with the apparatus
80 and circuits of the patent. The numbers which are the same as those used in the patent are shown in brackets.

The apparatus of the line switch 100, district 101, office 300 and the sender is the same as described in the aforementioned patent. The switch 400 is a step-by-step switch known as a back acting switch arranged to cause the forward movement of the brush assembly upon the deenergization of magnet 401.

The film 500 may be made in any form to move the striations thereon in a manner to vary the excitation of the photoelectric cell for the transmission of sound waves to an amplifier. For the sake of simplicity this film has been shown in the form of a disc rotated by motor 565. Commutator 501 is also rotated by the motor at the same speed
100

as the film. This commutator is equipped with conducting and non-conducting segments in order to transmit energy to the apparatus in the sender at proper intervals.

Light 586 is of the proper power to transmit direct light rays through the lenses 570 to 583 inclusive and film 500 to cause the proper excitation of the photoelectric cells 550 to 563, inclusive. The reflector 585 is in the form of a perfect parabola in order to transmit parallel light rays through the apertures of screen 584. The direction of light rays through the lenses 570 to 583 may be accomplished in any form other than that disclosed. The transformers 430 to 443 are of any type used for audio-frequency output transmission.

General description.

Let it be assumed that a call is initiated from station A. The removal of the switch-hook actuates line switch 100 to select an idle district such as 101. The actuation of this district, after selection, positions its sequence switch and step-by-step switch to select an idle sender, and associate the dialing fundamental circuit of the sender, including pulsing relay 1100 and coil 716, with station A to be intermittently energized and de-energized from the dial interruptions.

The energization and deenergization of the pulsing relay 1100 sets the register switches in the sender in a manner to control the selection of a wanted line. The code registers position the district brushes 258 and 259 upon the terminals of an idle office selector 300 and the office selector is controlled by the sender to select terminals associated with the trunk extending to a manual switchboard.

Upon the completion of office selections the sender sequence switches and other apparatus of the sender are positioned to establish a fundamental loop through the left winding of repeating coil 425. Relay 1004 is at this time energized. The establishment of this loop in the sender energizes apparatus in the manual office to illuminate signal lamp 312. The manual operator responds to the signal by the actuation of key 308 which causes a further movement of the sender sequence switches in response thereto.

Assuming that the wanted subscriber's number is 9874 and the station letter is W, the station register brushes 410, 1171, 1227, 1230 and 1220 are associated with the proper contacts for such a number. These registers are set by the previously described operations of pulsing relay 1100. With the register brushes thus set, the output transformers of the amplifiers are brought into association with the contacts of switch 400. Upon the response of the manual operator to signal lamp 312, apparatus in the sender is energized to start the rotation of the brush

members of switch 400. The film 500 is constantly rotating and the numbers and letters are constantly transmitted into the output transformers 430 to 443. Upon the rotation of switch brush 403, the thousands, hundreds, tens and units numerals and station letter are progressively transmitted through the right winding of repeating coil 425 and are thus induced to the left winding of this repeating coil and transmitted to the manual operator over the trunk conductors.

A large number of sender register switches may be associated with the output transformers at any one time and signals transmitted simultaneously to manual operators through the register switches in the manner described.

Detailed description.

The circuit and apparatus used in Fig. 4 has been generally described. Its exact nature will be more clearly understood by a detailed description of its operation. The constantly rotating film 500 passes between the light source and the photoelectric cells. The light rays from source 586 transmitted through the apertures of screen 584, lenses 570 to 583 inclusive and the striations of the film 500 are focused on the photoelectric cells 550 to 563. The battery current flow through the photoelectric cells is caused to vary in accordance with the striations corresponding to the different numbers or letters recorded upon the film. These variations are impressed upon the input circuits of the amplifiers 510 to 523 inclusive and are transmitted with increased volume to the output transformers 430 to 443, inclusive. The general character of this transmission is described in detail in the patent application to Charles F. Sachia, Serial No. 711,033, filed May 5, 1924, which became Patent No. 1,623,756, dated April 5, 1927.

The equipment shown in Fig. 4 plus the output transformers shown in Fig. 3 is common equipment for a large number of senders, the register switches being associated therewith as shown in Fig. 3.

The initiation of a call from station A and the selection of a line switch, district and sender has been described in a general manner and is described in detail in Patent 1,505,171 and it is therefore not thought necessary to encumber this description with further details of this operation. On the rotation of the translator control sequence switch of the sender, a circuit is established to energize relay 1004 from battery through its winding to ground through the left upper contact of cam 730. Relay 1004 in operating establishes a locking circuit for itself through its left inner contact to ground through the normal contact of relay 420. Until such time as the district and office selector have been controlled to associate their

brushes with the wanted trunk line, conductors 1011 and 1010 are not associated with the fundamental circuit conductors 743 and 751 since the selector switches are controlled
 5 over the fundamental circuit apparatus in the sender. Upon the selection of terminals 305 and 306 associated with a trunk extending to a manual office, the sender sequence switches are rotated to positions where the
 10 conductors 743 and 751 are extended through the sender apparatus to conductors 1011 and 1010. A continuity circuit is thus established through the left outer and right inner contacts of relay 1004 over conductors
 15 1012 and 1015 and through the left winding of repeating coil 425. The district selector sequence switch is in position 10 at this time and a circuit is thus established to energize relay 310. The operation of the sender during the control of switches to associate an incoming call with a manual operator is described in detail on pages 48, 49, 50 and 51 of the aforementioned patent to F. A. Stearn and it is therefore believed that it is
 20 not necessary to include a full disclosure and description of such circuits herein. The description in the aforementioned patent deals with manual office equipment with relay call indicator apparatus operated by an impulse switch in the sender. The relay call indicator apparatus of the manual office is replaced by the apparatus shown in Fig. 2 of this disclosure and the impulse switch is replaced by the photoelectric cell apparatus and associated switching apparatus shown in
 25 Figs. 3 and 4.

The circuit for energizing relay 310 may be traced from battery through its right winding, left lower winding of repeating
 40 coil 307, uppermost contact of key 308, terminal 306, brush 304, apparatus of office selector 300, terminal 302, brush 258, upper and lower contacts of cam 219, brush 263 and its associated contact thence over the
 45 circuit traced through the left winding of the repeating coil 425 to conductor 743, brush 237 and its associated contact, lower and upper contacts of cam 220, brush 259, terminal 301, apparatus of office selector 300,
 50 brush 303, terminal 305, left upper winding of repeating coil 307, to ground through the left winding of relay 310. The operation of relay 310 establishes an obvious circuit through the filament of lamp 312. The illumination of lamp 312 is a signal to the operator that a call has been received at the switchboard position.

The operator actuates key 308 to extinguish the lamp and to establish an energizing circuit for the slow operating relay 309. It will be noted that the operation of key 308 opens the trunk circuit extending to the sender and until such time as relay 309 operates, the circuit remains open. This open
 60 period of the fundamental trunk circuit is

of sufficient duration to cause the release of certain of the sender apparatus and the operation of other sender apparatus including the rotation of sequence switches as described on page 48, lines 90 to 122 of the
 70 aforementioned patent to F. A. Stearn. A circuit is thus established to operate relay 422 from battery through the winding of said relay, right outer contact of relay 1004 through sender apparatus to ground at the
 75 right upper contact of cam 730.

The operation of relay 422 establishes an energizing circuit for switch magnet 401. This magnet is of the type that controls the rotation of the switch brushes upon its back
 80 stroke and therefore the brushes will remain in their normal positions until the energizing circuit for magnet 401 is opened. The operation of relay 422 further established a circuit from battery through the
 85 winding of relay 421, right contact of relay 422, brush 567, commutator 501 to ground through brush 566. This circuit is established only when brush 567 is associated with the non-insulated portion of commu-
 90 tator 501. The segments of commutator 501 for energizing relay 421 are slightly in advance of the striated portions of the film in order that the relay 421 may be operated
 95 and the magnet 401 released to advance the brush assembly to its first position, previous to the rotation of the striated portion of the film to a point for the excitation of the photoelectric cell associated therewith. This
 100 is done in order to transmit a complete excitation period to the manual switchboard operator.

Let it be assumed for this description that the number of the wanted station B is 9874-W. The register switch brushes are
 105 positioned as follows by the dial interruptions from station A. Thousands register brush 410 in position 10, hundreds register brush 1171 in position 9, tens register brush 1227 in position 8, units register brush 1230
 110 in position 5 and stations register brush 1220 in position 8.

The operation of relay 422 energizes the winding of switch magnet 401 and the initial operation of relay 421 opens this energizing
 115 circuit and advances the brush assembly of switch 400 from its normal position to position 1. Brush 403 is thus associated with the thousands register brush 410 for the transmission of the number 9 to the switchboard
 120 operator.

The film 500 and commutator 501 are constantly rotating and light 586 is constantly illuminated to extend rays of light through
 125 lenses 570 to 583, striations of film 500 and photoelectric cells 550 to 563. Audiofrequency currents generated by the cells 500 to 563, in accordance with the speech records representing numerals 0 to 9 and letters W, R, M and J are amplified by the amplifiers
 130

510 to 523 and impressed on the primaries of audio transformers 430 to 443, to be transmitted through the right winding of repeating coil 425 for transmission to the trunk and switchboard operator.

The circuit for associating the transformer for transmitting the digit nine with repeating coil 425 may be traced from brush 403 and its associated contact in position 1, brush 410 and its associated contact in position 10, left winding of transformer 430, right winding of repeating coil 425 from whence it returns to brush 403.

During the rotation of the film through the striated position, portion of the commutator for the transmission of the digit nine, brush 567 is associated with an insulated portion of commutator 501 and relay 421 is in a released position thus establishing an energizing circuit for magnet 401 from ground at the left contact of relay 422. When the digit 9 has been transmitted the brush 567 is again associated with a conducting portion of the commutator to energize relay 421. The operation of relay 421 opens the energizing circuit for magnet 401 to advance the brush assembly of switch 400 to its second position. In this position of the switch, brush 403 is associated with the hundreds register switch to transmit the digit eight. During the transmission of this digit the relay 421 is released to again energize magnet 401 and upon the completion of the transmission of the digit, relay 421 is again energized to advance the brush assembly of switch 400 to position 3. In this position the tens digit is transmitted over the trunk and switch 400 is advanced for the transmission of the units digit and the stations letter in the manner above described.

During the transmission of the stations letter the magnet 401 remains energized in order to advance the brush assembly of switch 400 to the sixth position upon the transmission of said station letter. In the sixth position of switch 400 a circuit is established to energize relay 420 from ground through brush 404 and its associated contact, winding of relay 420 to battery. The operation of relay 420 opens the circuit for relay 1004 to cause it to release. Since cam 730 has rotated beyond the position for energizing relay 1004, the relay cannot again operate.

The release of relay 1004 opens the trunk conductors associated with the manual operator's position, Fig. 2. The release of relay 1004 further opens the energizing circuit for relay 422 to cause its release. The release of relay 422 establishes a circuit to energize switch magnet 401 and rotate the brush assembly of switch 400 to its normal position. This circuit may be traced from battery through the winding and contact of magnet 401, brush 402 and its associated contacts which are strapped, to ground through the

left normal contact of relay 422. When the switch 400 has been restored to its normal position a circuit is established to energize the sender sequence switch magnet 700 from battery through its winding, brush 405 and its associated contact, right outer normal contact of relay 1004 to ground through the right upper contact of cam 730. The operation of the sender described in the above mentioned patent to F. A. Stearn establishes a similar circuit when the relay call indicator impulser switch returns to its normal position 1.

The sequence switch 700 is now advanced to a position for controlling the district selector which rotates its sequence switch into the talking position and the sender is disassociated from the district selector and restored to normal.

After the called number has been transmitted verbally into headset 315, the operator selects the proper line jack and inserts plug 313 therein. Since it is assumed that station B corresponds to the called number, plug 314 is inserted into line jack 313. A circuit is thus established to energize relay 311 which permanently disassociates the lamp 312 from its energizing circuit. The operation of relay 311 further establishes a locking circuit for relay 309. The ringing key 320 is now actuated by the operator to sound the bell at station B for signaling the subscriber. Key 308 is restored to normal.

In large central office areas there may be only a small number of offices equipped with this common photoelectric cell apparatus and the offices not equipped with such apparatus may be associated therewith for verbal transmission of line designations to operators at manual offices. When a call is originated in an office not equipped with this apparatus, the sender in such office is set to extend the call to a machine switching office in which the common photoelectric cell apparatus is located. The sender of the latter office is set by the sender of the originating office in a manner well known in the art and operated in the manner shown in this disclosure to make a telephone connection to the wanted subscriber line. The manner of setting a sender in a common office from a sender in a different office is fully disclosed in Patent 1,505,171 to F. A. Stearn hereinbefore referred to.

What is claimed is:

1. A system for audibly reproducing telephone line designations comprising a plurality of photo-electric cells, a light source, a record carrying device for intermittently and successively interposing records between said light source and said photo-electric cells, said records comprising an opaque portion and a translucent record portion, the record portion being different for each cell, a sound reproducing device, and means for selectively

associating the output of said cells with said sound reproducing device to reproduce the sounds represented by said record in any desired sequence or combination.

2. A system for audibly reproducing telephone line designations comprising a plurality of photo-electric cells, a light source, a record carrying device for intermittently and successively interposing records between said light source and said photo-electric cells, said records comprising an opaque portion and a translucent record portion, the record portion being different for each cell, a sound reproducing device, means for selectively associating the output of said cells with said sound reproducing device to reproduce the sounds represented by said record in any desired sequence or combination, and means associated with said record carrying device for progressively changing the sounds in said sequence to reproduce a telephone line designation.

3. A system for audibly reproducing telephone line designations comprising a plurality of photo-electric cells, a light source, an opaque disc with a plurality of translucent striations thereon, means to rotate said disc for intermittently and successively interposing said striations between said light source and said photo-electric cells for exciting said photo-electric cells in accordance with the structure of said striations, the striations being different for each cell, a sound reproducing device, and means for selectively associating the output of said cells with said sound reproducing device to reproduce the sounds represented by said striations in any desired sequence or combination.

4. A system for audibly reproducing telephone line designations comprising a plurality of photo-electric cells, a common light source, means for dividing said light source into a plurality of light sources individual to each of said photo-electric cells, a record carrying device for intermittently and successively interposing records between said plurality of light sources and said photo-electric cells, said records comprising opaque portions and translucent record portions, the record portions being different for each cell, a sound reproducing device, and means for selectively associating the output of each cell with said sound reproducing device to reproduce the sounds represented by said record in any desired sequence or combination.

5. A system for audibly reproducing telephone line designations comprising a plurality of photo-electric cells, a light source for exciting said photo-electric cells, a common film for varying the excitation of said photo-electric cells, said film having a plurality of groups of records thereon, one group of records for each photo-electric cell, each record of the same group representing the same character for a line designation and

the records of different groups representing different characters for line designations, means for intermittently and successively interposing, between said light source and each of said photo-electric cells, the records of each group, a sound reproducing device, means for selectively associating the output of each cell with said sound reproducing device to reproduce the sounds represented by said record in any desired sequence or combination, and means associated with said film for progressively changing the sounds in a sequence to reproduce a telephone line designation.

6. A system for audibly reproducing telephone line designations comprising a plurality of photo-electric cells, a plurality of lenses, one for each photo-electric cell, a common light source, means for projecting the light from said source separately through each of said plurality of lenses forming pencils of light to individually excite each of said photo-electric cells, a record carrying device for intermittently and successively interposing records between said projected pencils of light and said photo-electric cells, said records comprising opaque portions and translucent record portions, the record portions being different for each cell, a sound reproducing device, and means for selectively associating the output of each cell with said sound reproducing device to reproduce the sounds represented by said record in any desired sequence or combination.

7. In a system for audibly reproducing telephone line designations, the combination of a plurality of light valves, a corresponding plurality of record traces, common means for interposing said record traces between each valve and a light source, a common reproducing circuit, and means for selectively associating the output of said light valves with said reproducing circuit in any desired combination.

8. In a system for audibly reproducing telephone line designations, the combination of a plurality of light valves, a corresponding plurality of record traces, common means for interposing said record traces between each valve and a light source, a plurality of reproducing circuits, and means for selectively associating the output of said light valves with said reproducing circuits in any desired combinations for simultaneously reproducing a plurality of different line designations.

9. A system for audibly reproducing telephone line designations, comprising a plurality of photo-electric cells, a light source, a record carrying device for intermittently and successively interposing records between said light source and said photo-electric cells, said records comprising an opaque portion and a translucent record portion, the

record portion being different for each cell, a plurality of reproducing circuits, and means for selectively associating the output of said cells with said plurality of reproducing circuits in any desired combination for simultaneously reproducing a plurality of different line designations.

10. In a system for audibly reproducing line designations, in combination, calling lines, called operators' positions, a plurality of senders for directing the selection of said called operators' positions in response to signals from said calling lines, audible reproducers at said operators' positions, a device for controlling the audible reproduc-

tion of line designations common to said senders comprising a plurality of light valves, a corresponding plurality of record traces, common means for interposing said record traces between each valve and a light source, and means for associating said device with a plurality of said senders for simultaneously reproducing like or different line designations in said audible reproducers.

In testimony whereof, I have signed my name to this specification this 26th day of January, 1926.

HENRY M. BASCOM.