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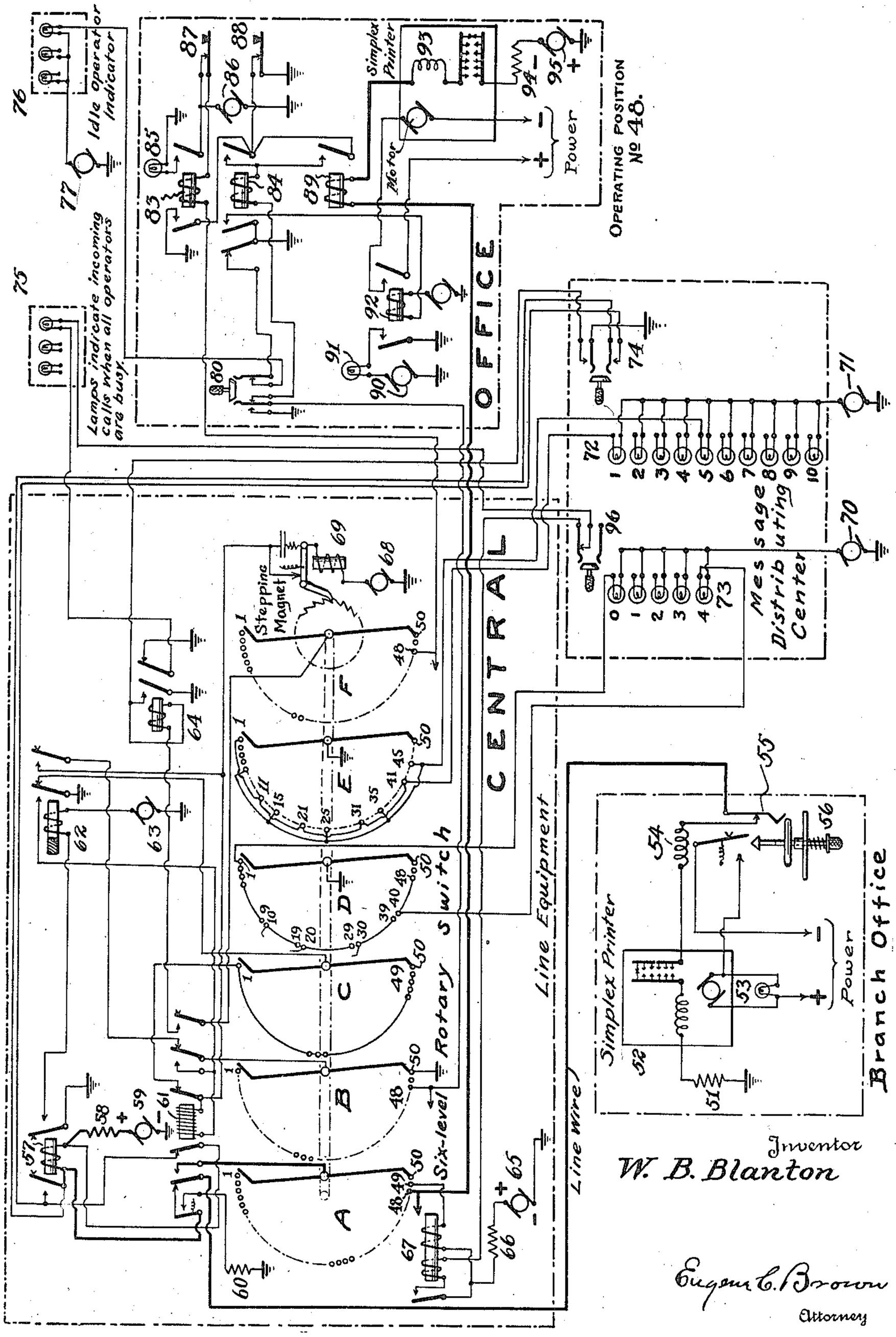

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MACHINE SWITCHING FOR PRINTER CONCENTRATOR CIRCUITS

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This invention relates to an arrangement for handling traffic over telegraph circuits between a central office and a plurality of branch or patrons offices. More particularly, this invention provides an equipment at the central office, where a large number of branch office circuits are concentrated, which automatically switches incoming calls to the lowest numbered idle operator, indicates at both the central and branch offices that the circuit has been completed, and then causes the motors of the simplex printers at both offices to start into operation.

Various machine switching equipments have been devised which provide concentration facilities for simplex printer circuits. Such prior arrangements generally provide for a group of sending positions and a group of receiving positions. Incoming calls are automatically switched to the lowest numbered idle operator or else they are switched at random to an idle receiving operator. For outgoing calls, some equipments provide dialing facilities, while in others multiple jack panels are provided at the sending positions, thus requiring the sending operator to patch her cord circuit to the proper jack when calling an outer branch office. These equipments generally include means for controlling the printer motor at the outer office, either manually or automatically from the central office.

It has been proposed to provide a machine switching arrangement which enables the same position to be used both as a sending and as a receiving position, but requiring a switch to be thrown to cut out the receiving function and direct the incoming calls to the associated sending position. Such an arrangement is not economical of machine switching equipment if all positions are equipped as joint receiving and sending positions, as outgoing calls are completed through one set of switches while incoming calls are completed through an entirely different set of switches.

One of the main purposes of the present invention is to provide a machine switching equipment for printer concentrator circuits in which all operating positions are identical and can be used either for answering incoming calls or for initiating outgoing calls, the same set of switches being used for completing both incoming and outgoing calls. This results in fewer operators being required and provides a more flexible arrangement than is the case where the operators positions are divided into two distinct classes, one for receiving and the other for sending. It is also a purpose of this invention to indicate which operator is working any particular busy line.

The accompanying drawing is a schematic diagram showing one arrangement of a machine switching concentrator at a central office and illustrating the manner of receiving or transmitting calls between the central and branch offices.

I will first give a general description of the operation of a concentrator embodying my invention. The branch office will call the concentrator by momentarily pressing a push button 56. This will cause the rotary switch associated with this line at the central office to search for and connect this line to the lowest numbered idle operator. When this has been accomplished a signal lamp 53 will light and the printer motor will start at the branch office, thus indicating to this operator that she has been connected to a printer at the central office. Similarly, a signal lamp 91 will light and the printer motor will start at the operating position of the concentrator to which this line is connected. The branch office operator can immediately begin to transmit business or the routine may require that the concentrator operator send "GA" (the go-ahead signal) before permitting the branch office operator to send. After the connection is made, transmission may be in either direction, that is the concentrator operator after receiving business from the branch office may then send to the branch office any business that may then be on hand. At the completion of the exchange of business, the concentrator operator releases the line by depressing a push button or key 88.

All messages destined for transmission to the branch offices terminated in this concentrator are delivered to a message distributing center located near the concentrator. At this distributing center will be located a routing rack having one compartment for each line terminating in the concentrator. Underneath each compartment there are provided two push buttons 74 and 96 and two columns or banks of lamps, one column 73 being designated the tens column and the other, 72, being the units column. When a line is switched to an operating position, these lamps are lighted to indicate the number of the operating position to which the line is connected. For example, if as a result of an incoming call the line is switched to the No. 35 operating position, the No. 3 lamp in the tens column and the No. 5 lamp in the units column on the message routing rack will be lighted. Thus, there will always be at the routing rack a visual indication of the number of the operating position

which is working each of the busy lines. These indications will be utilized by the routing aids or messengers in distributing messages for the busy lines. Messages destined for transmission on those line wires which are idle at the moment are handled in the following manner. The routing aid who distributes these messages will depress the push button 74 associated with the compartment assigned to the line wire for which she has messages. This sends a call into the concentrator in somewhat the same manner as if the branch office were calling, thus causing the line to be automatically switched to the lowest numbered idle operator. The routing aid by noting which lamps are lighted underneath this line compartment is thus advised of the number of the operator to which this line has been switched. She then conveys the messages to this operator for transmission to the branch office.

Two lamps will light at an operating position when a line is switched to this position as a result of depressing the push button 74 at the message routing center. One of these lamps 91 is the one that lights to indicate an incoming call, whereas the second lamp 85 only lights when that incoming call has been initiated from the routing rack. The operator is thus advised that the call is being initiated from the central office and that messages will be handed her for transmission. The routing aid, when she arrives at this operating position to deliver these messages, depresses a push button 87 which causes the second lamp 85 to be extinguished, the first lamp 91, however, remaining lighted. The operator can release this line at the completion of the exchange of business by depressing the push button 88 in the same manner as if the call had been initiated from the outer office.

When messages are delivered to the message distributing center for transmission on line wires which are busy at that moment, the routing aid can depress the push button 74 associated with this line compartment and thus light the lamp 85 on the operating position which is working this line. This will warn the operator that there are more messages to be sent and that she should not disconnect until they are delivered to her. The routing aid, when she delivers these messages to the operator, will depress the push button 87 which will extinguish the lamp 85. The circuit arrangement is such that when the lamp 85 is lighted the operator cannot intentionally or accidentally release the line circuit by depressing the push button 88. The push button 87 which controls the lamp 85 must be depressed first.

An idle-operator indicator 76 will be located within view of the routing aids when they are standing in front of the message routing rack. The lighted lamps in this indicator denote operating positions which are idle at that moment. The supervisor by observing this indicator can determine whether more or less operators are required to handle the load and also she can determine how the operators should be utilized, i. e., should the idle operators be reserved for answering incoming calls or should they be utilized for transmitting outgoing business to the branch offices which are idle at that moment.

Another feature of this circuit arrangement is that when a branch office calls and all the operating positions are busy, a lamp 75 associated with this line in a calling lamp panel will be lighted. The lamp and motor in the branch office failing to operate, indicate to the calling operator that she has not been connected to a central office operator. In prior machine switching concentrators this situation is handled by giving the branch office a busy signal when all operators are busy. The branch office operator must then continue to call until she finds an operator idle. According to the present invention, however, these incoming calls are stored up on the calling lamp panel and the supervisor can give them preference over outgoing business. Thus when she notes one of these lamps 75 lighted she can depress the push button 74 associated with this line at the message routing rack at the first instant an idle operator becomes idle and thus connect this operator to the line in question. Since both lamps 85 and 91 would light on the operating position, thus advising the operator that the call had been initiated from the central office, the routine would probably require that the supervisor should notify the operator that the branch office has business on hand that they wish to transmit.

An unstaffed position can be "busied" by operating a key 80 located at this position. This will prevent any lines being switched to this position while there is no operator assigned to it.

For the purpose of illustrating the machine switching concentrator circuit disclosed herewith, standard rotary switches having 50 contacts are shown on the drawing. Using these standard 50 contact switches the concentrator can be provided with 48 operating positions, the two remaining contacts being used for other purposes in our circuit. The number of lines that can be terminated in such a concentrator will depend on the number that these 48 operating positions can handle. It will be evident to engineers that a larger number of operating positions and lines can be accommodated with this type of concentrator by using switches with more than 50 contacts or using a combination of two or more switches.

Detailed description of circuits

For illustrative purposes I have shown only one branch office. The line from this branch office terminates in machine switching equipment at the central office. Only one operating position, No. 48, is shown. It should be remembered that there may be a total of 48 operating positions using the type of rotary switch illustrated. The number of lines accommodated is determined by the number that these 48 operating positions can handle.

All of the equipment is shown in the idle or deenergized condition except relays 54 and 57, which are shown energized by the line current. The line circuit may be traced from generator 59 through resistance 58, relay 57, outer left hand armature and associated contact of relay 61, line wire, contacts 55, relay 54, simplex printer 52, resistance 51, to ground at the branch office. Generator 59 applies a potential of positive polarity to the line. Relay 54 is a polar relay and the current from generator 59 maintains the armature of this relay against its right hand contact. Therefore the motor in the simplex printer at the branch office is not running and the signal lamp 53 is not lighted.

In order to initiate a call into the central office, the branch office operator momentarily depresses key 56. This key should be so constructed mechanically that when it is depressed, springs 55 are momentarily opened and the stem of the key locks the armature of the relay 54 or an extension thereof, in the position that it is in at that

moment. If it were not for this latter arrangement, the opening of contacts 55, which open the circuit through the winding of relay 54, would allow the retractile spring of this relay to pull the armature over against its left hand contact. When the contacts 55 are again closed, the armature would be returned to its right hand contact. In the meantime, however, the circuit to the printer motor would have been closed and opened just at the moment that the printer motor was drawing its large starting current. Mechanically locking the armature of relay 54 over on its right hand contact when initiating a call, prevents momentarily the starting of the motor and thereby eliminates excessive arcing on the left hand contact of relay 54.

The momentary opening of the circuit at the branch office causes the armatures of relay 57 at the central office to move to their deenergized position. The left hand armature of relay 57 completes a short circuit around its winding which may be traced from the left hand side of the winding through the left hand armature and back contact of relay 57, the inner left hand armature and associated back contact of relay 61, and then to the right hand side of the winding of relay 57. This short circuit maintains relay 57 in the deenergized position, although the opening in the line circuit is only momentary. The right hand armature of relay 57 completes a circuit through relay 62, thereby energizing it.

The operation of the outer right hand armature of relay 62 complete a circuit through the stepping magnet 69 of the rotary switch which may be traced from battery 68 through stepping magnet 69 and its associated armature and contact, front contact and outer right hand armature of relay 62, back contact and middle right hand armature of 61, wiper B of the rotary switch, contact 50 and then to ground. This causes the stepping magnet to advance all the wipers of the rotary switch to the No. 1 contact. If there is ground on the No. 1 contact of the B level or bank of contacts of the rotary switch, which is the case if the No. 1 operating position is busy, the wipers of the rotary switch will be advanced to the No. 2 contact. The armature and back contact of the stepping magnet are so arranged as to open the circuit through the stepping magnet each time the wipers are advanced one contact. This causes the stepping magnet 69 to be deenergized, and if ground is encountered on the contact of the B level or bank of the rotary switch, the stepping magnet will be again energized, thereby stepping the wipers to the next contact. This will continue until the wiper of the B level or bank encounters a contact on which there is no ground, which will be the case when the operating position is idle.

It will be noted that the circuit from generator 68 has two paths from the back contact of the stepping magnet. One path is through the outer right hand armature and front contact of relay 62, middle right hand armature and back contact of relay 61, wiper B and thence directly to ground. The other path is from the back contact of stepping magnet through the winding of relay 61, inner right hand armature and front contact of relay 62, to ground. Thus, as long as wiper B encounters ground on the contacts of switch level B, the winding of relay 61 is shorted out. Assuming that the first 47 operating positions are busy, when wiper of switch level B arrives on contact 48, it will encounter an open circuit. The current from generator 68 will now flow through the stepping magnet 69, its armature and back contact, the winding of relay 61 and front contact and inner right hand armature of relay 62 to ground. Relay 61 will be energized, but on account of the high resistance of the winding of relay 61, the stepping magnet 69 will remain in the denergized position.

The operation of the outer left hand armature of relay 61 disconnects relay 57 and generator 59 from the line and connects the line wire to the operating position No. 48, through wiper A, contact 48, relay 89, simplex printer 93, resistance 94, and generator 95 to ground. Current will flow over this circuit energizing relay 89. Since generator 95 has the negative polarity to line, the armature of the polar relay 54 at the branch office will move to its left hand contact. This will start the motor of the branch office printer and light the signal lamp 53, thus indicating to the outer operator that her equipment is connected to a central office operating position.

The operation of relay 89 completes a circuit from ground through key 88, relay 84, left hand spring and front contact of key 80, contact 48 of level B and wiper B, middle right hand armature and its associated front contact of relay 61, winding of relay 61, stepping magnet 69 and generator 68 to ground. The current flowing in this circuit holds relay 61 in the operated position and causes relay 84 to operate and lock itself in the operated position. Due to the high resistance of relay 61, the current flowing through the stepping magnet 69 is not of sufficient value to energize this magnet. The operation of the inner left hand armature of relay 61 opened the short circuit around the winding of relay 57. The operation of the outer left hand armature of relay 61 besides disconnecting relay 57 from the line, completed a circuit from generator 59 through resistance 58, relay 57, resistance 60 to ground. Relay 57 is thus energized and its right hand armature opens the circuit to relay 62. Relay 62, however, having a slow-to-release characteristic, remains in the operated position a short interval of time after the circuit through its winding is open. The inner right hand armature and associated front contact of relay 62 maintains a circuit through relay 61 and maintained a ground on contact 48 of the B level so as to protect operating position 48 from being selected by another calling line during the time it takes relays 89 and 84 to become operated. Thus when relay 62 does fall to its deenergized position, the ground on key 88 is then connected to contact 48 of the B level.

We have seen that the line is connected to position 48 through the wiper of the A level of the rotary switch and contact 48 thereof. Contact 48 of switch level B on all the rotary switches is connected to ground so that this operating position is busy to any other incoming call. Level C functions to return the rotary switch to its initial idle position as will be described later when operator No. 48 disconnects. Wiper of switch level D places a ground on contact 48 of said level D, thus causing the No. 4 lamp in the tens group at the message routing rack to light. Wiper of switch level E comes to rest on contact 48 of level E and causes lamp No. 8 in the unit's group to light. The function of switch level F will be described later.

The operation of relay 84 at the operating position completes a circuit from ground through its inner left hand armature and front contact, relay 92 and generator to ground. The operation of

relay 92 causes the motor of the simplex printer to start and lights lamp 91, thus indicating to the concentrator operator that a line has been connected to her position.

If a message or messages are received at the message distributing center and are destined to the branch office then connected to operating position 48, the routing aid or messenger will depress key 74 before delivering these messages to operator 48. The closure of the top contacts of key 74 completes a circuit from ground through these contacts, relay 64, outer right hand armature and front contact of relay 61, wiper of switch level or bank F, contact 48, relay 83, key 87, generator 86 and then to ground. This causes operation of relays 64 and 83. The inner right hand armature of relay 64 substitutes another ground for this circuit so that current continues to flow in the circuit after key 74 is released. The operation of relay 83 completes a circuit to lamp 85, thus causing this lamp to glow. The lighting of lamp 85 indicates to the operator that she should hold the circuit until the routing aid delivers the messages. When the routing aid arrives at position 48, she depresses key 87 which opens the circuit through relays 83 and 64. The deenergization of relay 64 removes the locking ground so that the circuit continues open even after key 87 is closed. The denergization of relay 83 extinguishes lamp 85. If the operator had depressed key 88 while the lamp 85 was still glowing, she would not have released the line because the continuity of the circuit from generator 68 through relays 61 and 84 would then be completed to ground through the left hand armature and front contact of relay 83. Thus it can be seen that when lamp 85 is lighted the line cannot be released except that keys 87 and 88 be depressed in that sequence.

At the completion of the exchange of business between the branch office and the concentrator operator, the concentrator operator releases the line by depressing key 88. This causes the deenergization of relays 84 and 61. A circuit is completed from generator 68, stepping magnet 69 and its associated armature and contact, inner right hand armature and back contact of relay 61, contacts 1 to 49 of level or bank C of the rotary switch, wiper of level C, inner right hand armature and back contact of relay 62 to ground. This causes the operation of the stepping magnet of the rotary switch so as to advance the wipers to contact No. 50 where they remain at rest in readiness for the next incoming call. When the outer left hand armature of relay 61 moves to its deenergized position, generator 59, resistance 58 and relay 57 are again connected to the line. Because of the continuity-preserving contacts of relay 61, relay 57 is in the energized position when connected to the line and thus in readiness to receive another incoming call. The positive polarity of generator 59 causes the armature of the polar relay 54 at the branch office to move to its right hand contact, thus opening the circuit to the printer motor and the signal lamp 53.

When messages are received at the message distributing center destined for transmission on a line which is idle at that moment, the supervisor, by noting the idle operator indicator 76, determines whether she wishes to use her idle operators for transmitting this outgoing business or reserve these operators for answering incoming calls. If she decides to use an idle operator for the transmission of these outgoing messages she depresses the key 74 associated with the line for which the messages are destined. The depression of this key puts a call on this line which actuates the machine switching mechanism in the same manner as if this call were originated from the branch office. The rotary switch will function so as to connect this line to the lowest idle operator. The lamps 73 and 72 will indicate the number of this operator, thus enabling the supervisor to send the outgoing messages to the proper operating position.

The operation of the equipment is as follows: When key 74 is depressed the lower set of springs short-circuit the winding of relay 57. The deenergization of relay 57 completes another short-circuit around the winding of this relay in the same manner as if the relay had been deenergized by a momentary open in the line circuit at the branch office.

The deenergization of relay 57 causes relay 62 to be energized which in turn starts the rotary switch searching for an idle operator. The equipment functions to connect this line to an idle operator in the same manner as has already been described when the branch office initiated a call.

Key 74 should be held depressed until the lamps 73 and 72 indicate that an operating position has been selected. The upper group of springs on key 74 will complete a circuit through relays 64 and 83, thereby lighting lamp 85 at the operating position. Lamp 91 at the operating position will also be lighted. The operator noting that both lamps 85 and 91 are lighted will be advised that the call was initiated from the message distributing center and that outgoing messages are being forwarded to her for transmission to the outer office. When the routing aid arrives with these messages she (the routing aid) will depress key 87, thus extinguishing lamp 85. The operator releases this line by depressing key 88 in the same manner as has been described before.

Incoming calls when all operators are busy

The operation of the machine switching equipment when a call is initiated from the branch office and all operators are busy will now be described. The branch office operator by depressing key 56, momentarily opens the line and causes relay 57 to lock up in its deenergized position. Relay 62 is energized and starts the rotary switch to seek an idle operator. We will assume that all 48 of the operators are busy. Thus a ground will be placed on each of the contacts 1 to 48 of switch level B of the rotary switch. This will cause the rotary switch to step around until it reaches contact 49 where it will encounter open circuit on level B. All of the wipers will come to rest on contact 49, and relay 61 will be energized. The energization of relay 61 causes relay 57 to be energized by completing the circuit which may be traced from generator 59, resistance 58, relay 57, outer left hand contacts of 61, resistance 60 to ground.

The circuit to relay 62 is opened at the right hand armature and contact of relay 57. Relay 62, because of its slow-to-release characteristic, will remain energized for a short interval of time after the circuit through its winding is open.

The operation of the outer left hand armature of relay 61 connects the line wire to the wiper of level A, contact 49 of bank A, right hand winding of relay 67, resistance 66, generator 65 and then to ground. Relay 67 is energized and its armature and front contact complete a holding circuit for this relay which may be traced from

generator 65, resistance 66, armature and front contact of relay 67, left hand winding of the same relay, contacts of key 96, lamp 75, armature and back contact of relay 64 to ground. All of this takes place while relay 62 is still in the energized position. When the armature of relay 62 falls to its deenergized position, relay 61 will immediately be deenergized. Thus the line wire is disconnected from wiper of level A and connected to generator 59 through relay 57 and resistance 58. The inner right hand armature of relay 61 completes a circuit through the stepping magnet of the rotary switch which causes this switch to step to its idle position, i. e. with the wipers at rest on contact 50.

When one or more operators become idle the supervisor may use these idle operators to answer these stored up calls rather than use them for the transmission of outgoing business. In order to connect one of these idle operators to a line that called when all operators were busy, she depresses the key 74 which is associated with one of these lines. This causes the line to be connected to the lowest numbered idle operator in the same manner as has been described when a call is initiated at the message distributing center. Also, relays 64 and 83 are operated. The latter relay lights lamp 85 and the former relay besides providing a locking ground for this circuit also extinguishes the lamp 75 and causes relay 67 to be deenergized.

If, after lamp 75 has been lighted and before the supervisor depresses key 74, the outer office should again depress key 56, the rotary switch would again rotate and search for an idle operator. If no idle operator were available, the rotary switch would function in the same manner as described for the first call originated from the outer office. If, however, an idle operator were available, the line would be connected thereto. The fact that the line was connected to an operating position would be indicated on lamps 72 and 73. In this case, the supervisor would not depress key 74, but would depress key 96 which would extinguish lamp 75.

It will be noted that when an operating position is idle and key 80 is in the unoperated position, a circuit is completed to the lamp 76 associated with this position in the idle operator indicator. This circuit may be traced from ground through the outer left hand armature and back contact of relay 84, right hand set of contacts on key 80, lamp 76, battery 77 to ground. Lamp 76 will thus glow indicating that this position is idle. When a line is connected to this position, relay 84 is energized and the circuit to lamp 76 is open at the outer left hand armature and back contact of relay 84, thus extinguishing lamp 76.

When there is no operator assigned to an operating position, key 80 should be in the operated position. The opening of the right hand contacts will open the circuit to lamp 76 thereby maintaining this lamp in the extinguished condition. The operation of the left hand set of springs on key 80 places a ground on the contact associated with this position on the level B of all the rotary switches. This puts a busy signal on all the rotary switches so that they will not connect a line to this position.

I claim:

1. In a signaling system, a central station and a plurality of remote stations each provided with telegraph printers, a plurality of signaling lines extending from the central station to the remote stations, a plurality of telegraph printers at said central station arranged in a predetermined sequence, automatic switching means for invariably connecting incoming calls to the lowest numbered idle printer, and means for automatically starting the motors of the printers at the central and remote stations upon the establishment of said connection.

2. A signaling system as defined in claim 1 and means for automatically indicating the number of the printer at the central station which is connected to any line being operated.

3. In a signaling system as defined in claim 1, electro-responsive devices associated with each line for storing a call when all the central station printers are busy, and means for causing the stored calls to be connected in sequence when said central station printers become available.

4. In a telegraph system, a central station and a plurality of remote stations, each provided with telegraph printers, telegraph lines extending from the remote stations to the central station, a plurality of telegraph printers at the central station arranged in a predetermined sequence, automatic selector switches associated with said plurality of printers, means for causing said switches to connect the lowest numbered idle printer with one of said lines upon the initiation of a call, means for storing indications of calls received when all of the central office printers are busy, means for indicating released idle printers, and means for causing said switches to connect said stored calls to released idle printers.

5. In a telegraph system, a central station and a plurality of remote stations, each provided with telegraph printers, telegraph lines extending from the remote stations to the central station, a plurality of telegraph printers at the central station arranged in a predetermined sequence, automatic selector switches associated with said plurality of printers, means for causing said switches to connect the lowest numbered idle printer with one of said lines upon the initiation of a call either incoming from a remote station or outgoing from the central station, and means for indicating to a busy central station operator to hold the line for other outgoing messages for that line.

6. In a telegraph system as set forth in claim 5, a message distributing center at the central station and means thereat for causing said switches to connect a designated line to the lowest numbered idle printer and to indicate to the operator thereof that the call is outgoing and was initiated at the central station.

7. In a telegraph system as set forth in claim 5, a message distributing center at the central station and means thereat for causing said switches to connect a designated line to the lowest numbered idle printer and to indicate to the operator thereof that the call is outgoing and was initiated at the central station, and means at said distributing center for indicating that said line and said printer are operatively connected.

8. In a telegraph system as defined in claim 5, a message distributing center at the central station and means thereat for locking the connection with said line until said outgoing messages have been delivered to the operator for transmission.

9. In a signaling system as defined in claim 1, electro-responsive devices associated with each line for storing a call when all of the central station printers are busy, means for causing the stored calls to be connected in succession when said central station printers become available,

and means for preventing the starting of the printer at the calling station when all central station printers are busy to thereby indicate at the calling station that no connection has been made with a central station printer.

10. In a signaling system, a central station and a plurality of remote stations each provided with telegraph printers, a plurality of signaling lines extending from the central station to the remote stations, a plurality of telegraph printers at said central station arranged in a predetermined sequence, automatic switching means for invariably connecting incoming calls to the lowest numbered idle printer, and means at the central station, automatically effected upon establishing a connection, for continuously displaying an indication that a line is busy at a designated operator's position until said line is released by the operator.

11. In a telegraph system, a central station and a plurality of remote stations, each provided with telegraph printers, telegraph lines extending from the remote stations to the central station, a plurality of telegraph printers at the central station arranged in a predetermined sequence, said printers being free at all times to receive calls either incoming from a remote station or outgoing from the central station except when actually connected to a line for the transaction of business, automatic selector switches for invariably connecting the lowest numbered idle printer with one of said lines upon the initiation of a call, and means at the central station for displaying an indication that a line is busy at a designated operator's position until said line is released by the operator.

12. In a signaling system as defined in claim 1, means for maintaining the printer motor at the branch station inoperative after the initiation of a call until a connection has been established with the lowest numbered idle printer at the central station.

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