

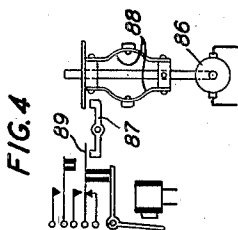
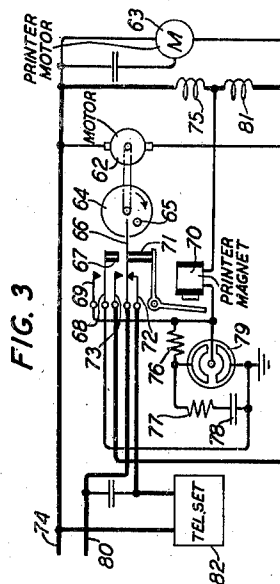
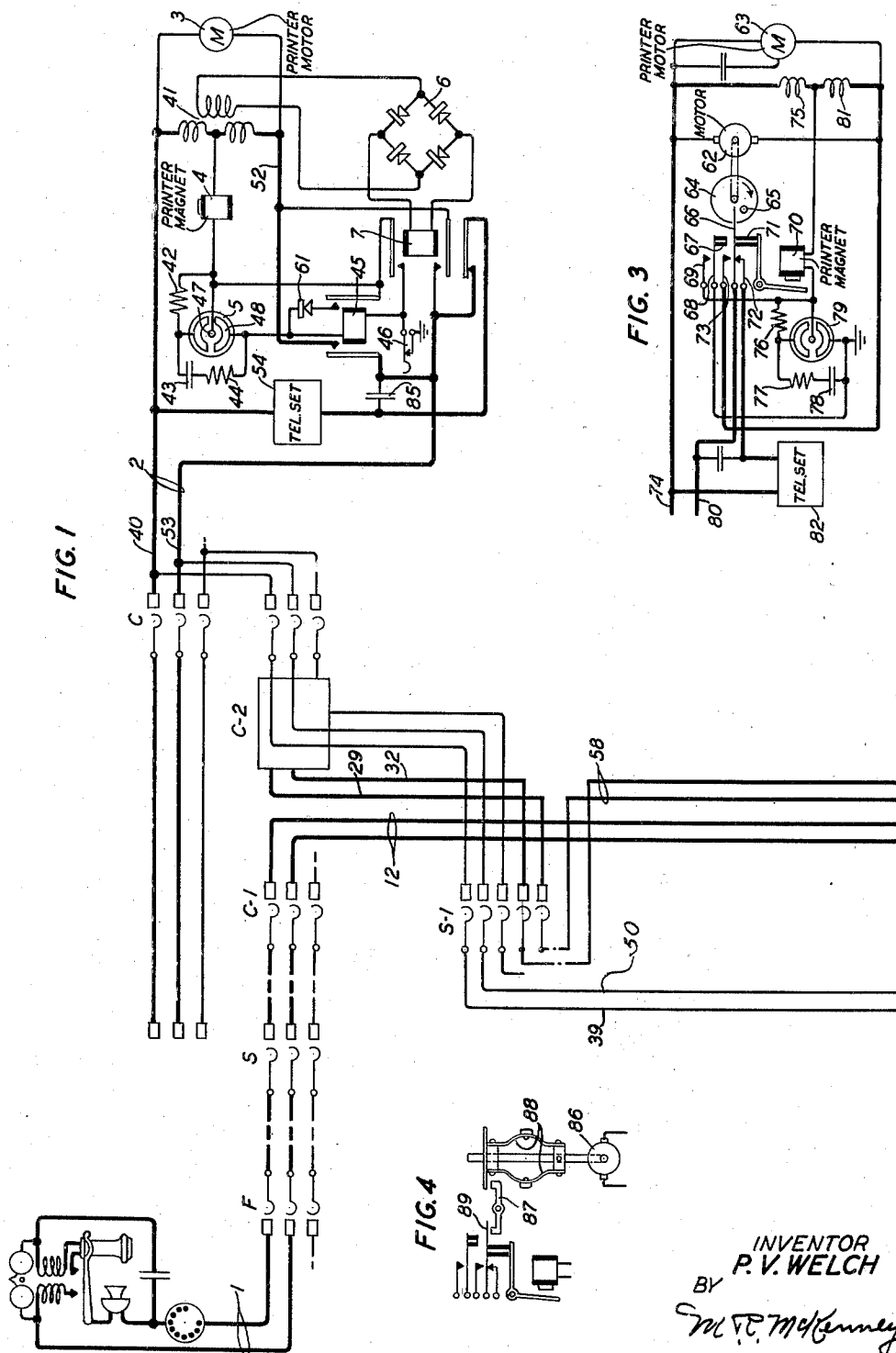
March 25, 1941.

P. V. WELCH
TELEPHONE SYSTEM

2,235,910

Filed Dec. 5, 1939

2 Sheets-Sheet 1



INVENTOR
P. V. WELCH
BY
M. P. McJannet
ATTORNEY

March 25, 1941.

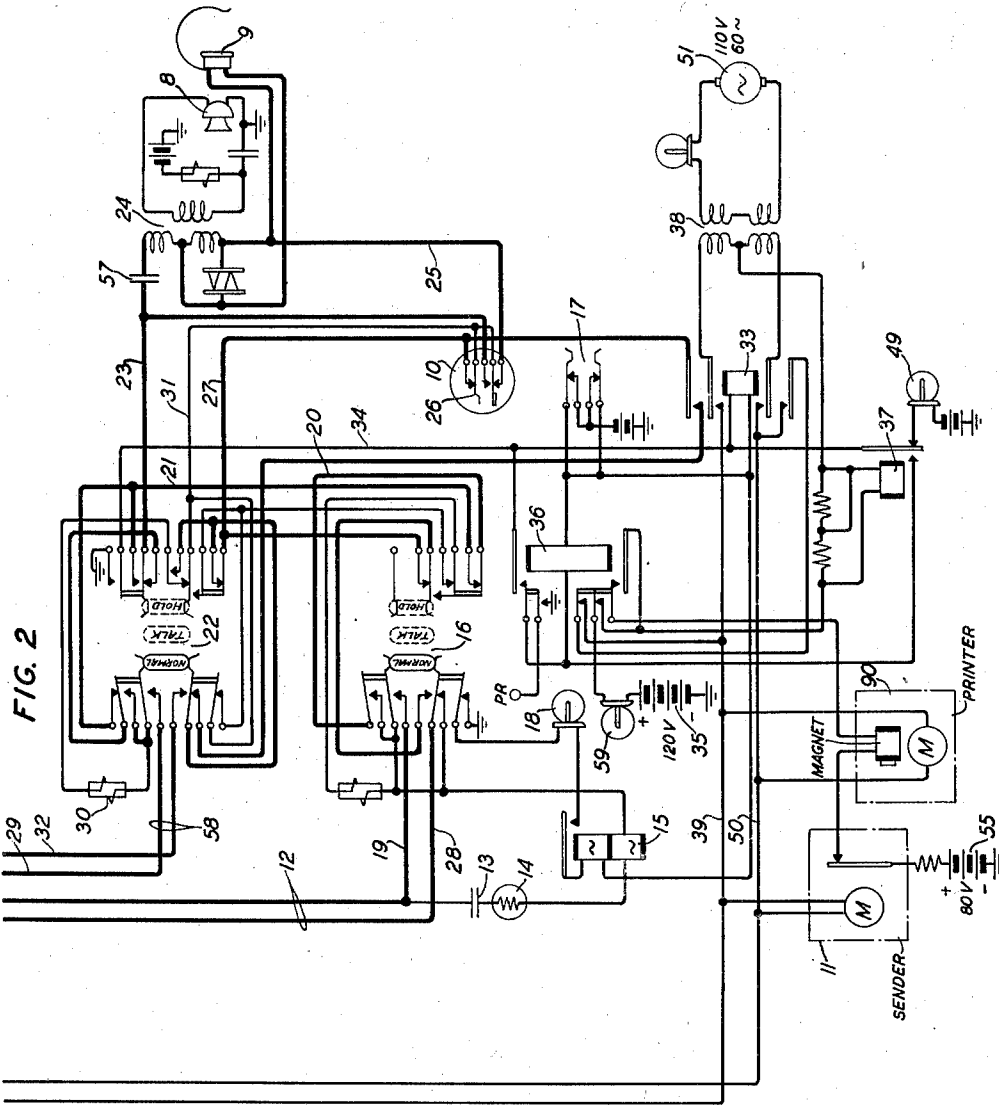
P. V. WELCH

2,235,910

TELEPHONE SYSTEM

Filed Dec. 5, 1939

2 Sheets-Sheet 2



INVENTOR
P. V. WELCH
BY
M. R. McFadden
ATTORNEY

UNITED STATES PATENT OFFICE

2,235,910

TELEPHONE SYSTEM

Paul V. Welch, Brooklyn, N. Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 5, 1939, Serial No. 307,597

8 Claims. (Cl. 179-4)

This invention relates to telephone systems.

The objects of the invention are to improve the equipment employed in telephone exchanges for obtaining and transmitting to subscribers who are frequently absent from their telephones information with respect to calls made during their absence; to enable the service operator in the exchange who obtains these messages during the absence of a called subscriber to initiate the operation of recording mechanism at the absent subscriber's substation and to transmit the messages over his line to the substation where they are recorded for his information when he returns; and to accomplish these purposes without the use of local power supply equipment or other expensive devices on the subscriber's premises.

The foregoing objects of the invention are realized by means of a system in which a party who has subscribed for this service is provided with a simple and relatively inexpensive telegraph printer at his substation which is wholly under the control of the service operator in the exchange. A calling party who has made an unsuccessful call to one of these special service lines and wishes to leave a message for the absent subscriber proceeds to operate his dial in accordance with a special code to obtain a connection with the service operator in the telephone exchange. Having obtained the operator, the calling party explains that his call to the special service line was unsuccessful and gives her the message he wishes transmitted to the absent subscriber's station. Thereafter the operator obtains connection with the special service line over automatic switches and transmits the message by telegraph signals.

A feature of the invention is a system of this character in which the operator first transmits a signal over the subscriber's line to disconnect the normally effective telephone instrument at the substation and to connect the printer to the line; in which the power for operating the printer motor is then supplied from a source at the central office over the subscriber's line to the substation; and in which the operating current flowing over the subscriber's line to drive the printer motor also serves to maintain the equipment at the substation in condition for receiving the telegraph signals which the operator now proceeds to transmit over the line to the printer. An advantage of this system is that the subscriber's substation is normally in condition for the use of his telephone, no special operation being required on his part to convert the substation equipment to the use of the printer instead of the telephone. An-

other distinct advantage is that the power for operating the printer is supplied from the central office, simplifying accordingly the equipment needed at the substation.

In the drawings accompanying the detailed specification:

Figs. 1 and 2 illustrate a dial telephone system partly in diagrammatic form and partly in detail embodying the features of the invention.

Fig. 1 illustrates the subscribers' lines, one of which is provided with a printer for recording messages, and the automatic switches used in establishing connections;

Fig. 2 discloses the circuits associated with the service operator's position and a telegraph transmitter for sending messages to the subscribers' stations;

Fig. 3 shows a modified form of one of the substations equipped with a printer for recording the messages; and

Fig. 4 shows a modified form of the switch mechanism of Fig. 3.

The line-finder switch F, the selector switch S and the connector switch C, by means of which calling lines, such as the line 1, establish connections with other subscribers' lines; the connector switch C-1, by which calling subscribers obtain connections with the service operator in the telephone exchange; and the connector switch C-2, by which the service operator obtains connections with subscribers' lines entitled to the special service, may be of any suitable type, such as the switches commonly used in step-by-step systems.

The subscriber's line 2, which is entitled to the special service, is equipped at the substation with a small telegraph printer including a driving motor 3 and a printing magnet 4. The motor 3 is driven by alternating current supplied over the line 2 from the central office, and the printing magnet is operated by direct current telegraph signals transmitted over the line from the operator's position. The substation is also provided with a gas-filled discharge tube 5 which responds to a seizure signal transmitted over the line from the operator's position to prepare the substation for an incoming telegraph message. The substation is further provided with a rectifier 6 which converts the alternating current flowing in the line to direct current for operating a relay 7, which disconnects the subscriber's telephone set and maintains the printer in operative relation to the line for the receipt of the incoming message.

The service operator's position in the central

office is equipped with a telephone transmitter 8 and receiver 9 for communication with subscribers who call her for the purpose of leaving messages for the absent subscribers. Also she has an impulse transmitter 10 for operating the automatic switches to extend connections from her position to the lines over which she wishes to transmit these messages. Furthermore, the operator's position is equipped with a telegraph transmitter 11 for sending the messages over the connections which she has established to the subscribers' lines and with a printer 90 for recording the messages sent.

The operator's telegraph transmitter and the printers at the substations may be of any desired types, such, for example, as those disclosed in the patent to Zenner No. 2,173,147, of September 19, 1939, and in Zenner Patent No. 2,147,075 of February 14, 1939.

The operation of the system will now be described, and to this end it will be assumed that the subscriber of line 2 is absent from his premises. During his absence the subscriber of another line, such as line 1, may call him. The connection to the called line 2 is established in the usual manner over the line-finder switch F, selector switch S and connector switch C. Finding the called subscriber absent from his telephone and knowing that his line is entitled to special service, the calling subscriber releases the unsuccessful connection and dials a special code to operate the selector S and connector C—1 to extend his line over the trunk circuit 12 to the service operator's position. The connector C—1 applies ringing current to the trunk 12, and this current flows from one side of the trunk 12 through the condenser 13, thermistor 14, lower winding of the relay 15, normal contacts of key 16 to the other side of the trunk 12. The thermistor 14 becomes heated and lowers its resistance, and sufficient current flows through the winding of relay 15 to attract the armature. Thereupon a circuit is closed from battery through the contacts of key 17, upper winding and front contact of relay 15, signal lamp 18 to ground at the normal contacts of key 16.

The lighted lamp 18 attracts the attention of the operator, and she answers the call by moving the key 16 to its intermediate position. The operation of key 16 to the intermediate position releases relay 15 and extinguishes the calling lamp 18 and also extends the trunk 12 to the operator's position. The extended circuit may be traced from conductor 19 through the left closed contacts of key 16, conductor 20, right closed contacts of said key, conductor 21, left contacts of key 22, right contacts of key 22, conductor 23, condenser 57 through the induction coil 24, conductor 25, through the normal contacts and the impulse contacts 26 of the dial 10, conductor 27, right normal contacts of key 16, left closed contacts of said key to conductor 22. The operator converses with the calling subscriber, who informs her of the unsuccessful call and leaves with her any message that he may care to have transmitted to the called party.

The operator, having made memoranda of the messages intended for the absent subscriber, proceeds to establish a connection between her position and his line. To do this she first throws the key 22 to the intermediate position to establish a circuit from her impulse transmitter 10 over trunk 58 to the pulsing mechanism of the selector switch S—1 and connector switch C—2. The impulse circuit may be traced from the tip con-

ductor 29, through the left closed contacts of key 22, coil 30, right closed contacts of said key, conductor 31 through the impulse contacts 26 of the transmitter 10, conductor 27, right normal contacts of key 22, left closed contacts of said key to the ring conductor 32, extending to the selector switch S—1 and connector switch C—2. The operator manipulates the dial 10 to transmit series of impulses to the pulsing mechanism of the selector S—1 and connector switch C—2. The selector and connector respond to these impulse series and step their brushes into engagement with the terminals of the subscriber's line 2. During each impulse series the off-normal contacts of the dial 10 close a short circuit around the coil 30 to improve the pulsing operation.

After the connector C—2 has been set on the terminals of the called line, the operator moves the key 22 to its right-hand position. In this position a bridge is closed for holding the selector S—1 and connector C—2. This bridge may be traced from conductor 29, left contacts of key 22, coil 30, right closed contacts of key 22, left contacts of the key to conductor 32. The key 22 also closes an operating circuit for relay 33, traceable from battery through the contacts of key 17, winding of said relay, conductor 34 to ground at the right contacts of key 22. Also the guard lamp 49 is lighted in an obvious circuit extending over conductor 34 to ground at the contacts of key 22. Relay 33 closes a circuit for sending a seizure signal over the called line to operate the gas-filled tube 5 at the substation thereof. This circuit may be traced from the positive pole of 120-volt battery 35, resistance lamp 59, normal contacts of relay 36, winding of relay 37 through the upper left winding of transformer 38, closed contacts of relay 33, conductor 39 thence through the tip brushes of the selector S—1 and connector C—2, conductor 40, through the upper primary winding of transformer 41, printer magnet 4, resistance 42, condenser 43, resistance 44, winding of relay 45, closed contacts of key 46 to ground. Current flowing in this circuit charges the condenser 43 until it reaches the ionizing voltage of the control gap of the tube 5. When the ionizing voltage is reached, the tube fires, and the anode circuit is established from the source at the central office over the circuit traced through the printer magnet 4 to the anode 47 and cathode 48 of the tube, thence through the winding of relay 45 to ground at the key 46. Sufficient current flows in this circuit to operate the relay 45 at the substation but not the relay 37 at the central office. Relay 45 at its right contact extends the circuit, above traced, through the magnet 4, through rectifier 61 and relay 45 to ground, thus excluding tube 5. Relay 45 also closes a parallel circuit from source 35, resistance lamp 59, normal contact of relay 36, relay 37, lower left winding of coil 38, thence over the ring side of the line, conductor 53, left contact of relay 45, lower left winding of transformer 41, magnet 4, right contact of relay 45, rectifier 61, winding of relay 45 to ground at key 46. Since these parallel circuits for magnet 4 short-circuit the tube 5, the latter becomes deionized. The increase of current due to these parallel paths and the inclusion of low resistance rectifier 61 in place of the tube causes relay 37 to operate. Relay 37 at the central office extinguishes the guard lamp 49 and operates relay 36 in a circuit from battery through the contacts of key 17, winding of relay 36, front contacts of

relay 37 to ground over conductor 34. Relay 36 locks through its own front contact directly to the grounded conductor 34. The circuit for printer magnet 4 is now transferred from 120-volt battery 35 to 80-volt battery 55 and may be traced from the latter through contacts of the operator's telegraph sender 11, magnet winding of printer 90, front contacts of relay 36, thence as traced over the line in simplex through magnet 4, relay 45, rectifier 61, relay 45, and ground at key 46. By excluding the impedance of tube 5 sufficient current is derived from the reduced voltage at central office to insure the continued operation of relay 45 at the lower voltage. The rectifier 61, included in the circuit of relay 45, prevents the relay from locking on central office talking or signaling battery.

Prior to the operation of relay 36 a short circuit exists across the conductors 39 and 50 of the connection extending to the called subscriber's line. This short circuit may be traced from conductor 39 through the normal contacts of relay 36 and the operated contacts of relay 33 to conductor 50. Between the time, therefore, that relay 33 is operated and the operation of relay 36, no current from the source 51 flows over the called subscriber's line. Instead of the short circuit for disabling source 51 during this interval a contact on relay 36 could be used, if desired, to hold open the primary winding of transformer 38. As soon, however, as relay 36 operated as above described, the short circuit is opened and alternating current from the source 51 flows in a loop circuit including the conductors of the called subscriber's line. This circuit may be traced from the upper left winding of the transformer 38, closed contacts of relay 33, conductor 39, tip brushes of selector S-1 and connector C-2, conductor 40 thence in parallel through the driving motor 3 of the printer and the primary windings of transformer 41, conductor 52, closed contacts of relay 45, conductor 53, ring brushes of connector C-2 and selector S-1, conductor 50, closed contacts of relay 33 to the other terminal of the secondary winding of transformer 38. The motor 3 is driven in this circuit to supply the necessary power for operating the printer. Also an alternating voltage is induced in the secondary winding of transformer 41, and the current resulting therefrom is rectified by the rectifier 6 and applied to the winding of relay 7. Relay 7 operates and disconnects the telephone set 54 from the line. Relay 7 also closes a short circuit around the relay 45 and rectifier 61, and relay 45 releases. Relay 7 now maintains the operating circuit for the printer magnet 4 and the circuit for supplying the alternating current to the transformer 41 and motor 3. The printer magnet operating circuit may be traced from the positive pole of battery 55 through the transmitting contacts of the operator's telegraph transmitter 11, magnet winding of printer 90, closed contacts of relay 36, winding of relay 37 to the mid-point of the secondary winding of transformer 38, thence in a simplex circuit through the contacts of relay 33 over conductors 39 and 50 and conductors 40 and 53 of the subscriber's line, the conductor 40 extending through the upper primary winding of transformer 41, the conductor 53 extending through closed contacts of relay 7, conductor 52 and the lower primary winding of transformer 41, the circuit continuing from the middle point of the primary winding through the printer magnet 4, closed contacts of relay 7 to ground at the

contacts of key 46. The alternating current circuit is the same as previously described, except that it now extends through a front contact of relay 7 instead of relay 45.

The circuits are now in condition for the sending of telegraph messages to the called subscriber's station. The operator proceeds to send whatever messages she may have for the absent subscriber by manipulating her telegraph transmitter 11 to send telegraph signals over the simplex circuit through the printer magnet 4 at the called station. After the messages have been transmitted and recorded by the printer in the well-known manner, the operator releases the connection she has established to the subscriber's line by restoring the key 22 to its normal or left-hand position. The restoral of the key removes ground potential from conductor 34 and relays 33, 36 and 37 release. Relay 33 opens the printing circuit and also opens the circuit for supplying alternating current to the motor 3 and transformer 41. Thereupon relay 7 releases, and the subscriber's station is restored to its normal condition.

Should the absent subscriber return to his telephone and wish to make use of it while the operator is in the act of transmitting messages, he may recover control of his telephone by operating the key 46. The operation of this key opens the printing circuit, allowing the relay 37 to release. The release of relay 37 lights the guard lamp 49 steadily to notify the operator that the subscriber wishes to use his telephone and she should discontinue the further transmission of messages. Should the subscriber attempt to make use of his telephone without operating the key 46 at a time when messages are being transmitted he would hear a tone through condenser 85 produced by the alternating current flowing in his line and would then realize that the operator was in the act of sending messages to his substation.

The modified substation circuit shown in Fig. 3 differs essentially from the one disclosed in Fig. 1 in that the switching operations are performed by an auxiliary switch operating motor and by the printer magnet, thus dispensing with the relays 7 and 45 and with the rectifier 6 used in the arrangement of Fig. 1. The small auxiliary motor 62 is connected in parallel with the printer motor 63 and is actuated by the same source of alternating current at the central office. The printer magnet 70 and the motor 62 both act upon the switch operating spring 66 to control the opening and closing of the associated electrical contacts. When the magnet 70 is first energized, its armature, acting through the insulating member 71, urges the spring 66 upwardly out of engagement with contact spring 72 and into engagement with spring 73. The spring 66, however, when thus operated by the full movement of the printer magnet armature, does not close the contact springs 68 and 69. The motor 62, when energized, rotates a driven member 64 through a small angle, causing the pin 65 to engage the spring 66. The spring 66 when urged by the pin 65 engages insulating member 67 and flexes the spring 68 into engagement with contact spring 69. When the spring 69 has been moved into engagement with spring 69, the resistance offered to further movement of these springs causes the motor 62 to stop in its partially rotated position where it remains, as long as power is supplied to the line, to hold the contact springs in their closed condition.

The operation of the modified circuit arrangement will now be described. When the 120-volt battery 35 is connected to the tip and ring conductors of the line as hereinbefore described, current flows from this source over the tip conductor 74 through the upper winding 75 of the induction coil, winding of printer magnet 70, resistances 76 and 77, condenser 78 to ground. The condenser charges; whereupon the control gap of the tube 79 is ionized. An operating circuit for the magnet 70 is now closed from conductor 74 through winding 75, magnet 70 through the anode and cathode gap of the tube 79 to ground. The printer magnet 70 operates in this circuit and moves the spring 66 out of engagement with spring 72 and into engagement with spring 73. The other path of the simplex circuit for the magnet 70 may now be traced over the ring conductor 80 through springs 66 and 73, lower winding 81 of the induction coil, magnet 70, thence through the tube to ground.

The opening of contact springs 66 and 72 disconnects the subscriber's telephone 82 from the line, and the closing of springs 66 and 73 completes a circuit for supplying alternating current to the motors 63 and 62. This circuit may be traced from the alternating current source at the central office over conductor 74 through the motors 63 and 62 in parallel, springs 73 and 66 and thence over the other line conductor 80. The motor 63 rotates preparatory to the operation of the printer when signals are subsequently received. The auxiliary motor 62 rotates the pin 65 into engagement with the partially operated spring 66, and the spring 66 is now fully operated to close the springs 68 and 69. When the spring 66 is in its fully flexed position the load on the armature of the printer magnet 70 is removed, leaving the magnet free and unhampered to perform the printing selections when telegraph signals are received. When springs 68 and 69 are closed, the simplex operating circuit of the printer magnet 70 is diverted around the tube 79, and the tube thereupon deenergizes. One side of the revised simplex circuit for the printer motor may now be traced from conductor 74, winding 75, magnet 70, contacts 69 and 68 to ground; and the other side of the circuit may be traced from conductor 80, contacts 66 and 73, winding 81, magnet 70, springs 69 and 68 to ground.

With this arrangement the substation circuit is prepared by the operation of the printer magnet in response to the initial seizure signal. This initial preparation closes the circuits for supplying alternating current to the printer motor and to the auxiliary motor, the latter of which performs a second switching operation to disconnect the tube and to place the printer magnet circuit in condition for the receipt of the telegraph signals from the central office. The auxiliary motor holds the substation circuits in condition for printing as long as alternating current is supplied over the line. After the messages have been transmitted the substation circuit is restored to its normal condition by opening the alternating current circuit and permitting the auxiliary motor to return to its normal position under the influence of the switch operating spring 66.

If desired, the switching functions performed by the auxiliary motor may be effected by a governor device actuated by the main motor of the printer. Such a device is shown in Fig. 4. When the printer motor 85 starts, it operates lever 87 through the governor or centrifugal device 88. Lever 87 operates the switch spring 89 and holds

it in operated condition as long as motor 86 continues to run. Spring 89 performs the same switching functions that spring 66 performs in the arrangement of Fig. 3. This arrangement dispenses with the necessity of an auxiliary motor.

What is claimed is:

1. In a telephone system, a central office, a subscriber's line terminating therein, said line having a substation thereon, a telephone at the substation of said line normally in operative connection with said line, a message recording device at said substation, means at said substation controlled over said line for rendering said telephone ineffective and for operatively connecting said recording device to said line, a source of current at the central office for operating said recording device over said line, and a signaling circuit including said line for controlling said recording device to record messages.

2. In a telephone system, a central office, a telephone line terminating therein, a telephone for said line normally connected thereto, a recording device for said line normally disconnected therefrom, means controlled over said line from the central office for disconnecting said telephone from the line and for operatively connecting said recording device to said line, a source of current at the central office for operating said recording device over said line, a signaling circuit including said line for controlling said recording device to record messages, and means responsive to the current flowing over said line from said source for holding said signaling circuit in condition for the transmission of said messages.

3. The combination in a telephone system of a central office, a subscriber's line terminating therein, said line having a substation thereon, a printer at the substation of said line normally disconnected therefrom, a space-discharge tube at said substation responsive to a seizure signal transmitted over the line for operatively connecting said printer to said line, a source of current at the central office for driving said printer, and a signaling circuit including said line for operating said printer from the central office to record messages.

4. The combination in a telephone system of a central office, a subscriber's line terminating therein, said line having a substation thereon, a printer at the substation of said line normally disconnected therefrom, a motor for driving said printer, a source of alternating current at the central office for operating said motor, a space-discharge tube at said substation responsive to a seizure signal transmitted over said line, means responsive to the operation of said discharge tube for operatively connecting said printer to the line and for closing a circuit over said line to supply current from said source to said motor, and a signaling circuit including the conductors of said line for controlling said printer to record messages.

5. The combination in a telephone system of a central office, a subscriber's line terminating therein, said line having a substation thereon, a printer at the substation of said line normally disconnected therefrom, a motor for driving said printer, a source of alternating current at the central office for operating said motor, a space-discharge tube at said substation responsive to a seizure signal transmitted over said line, means responsive to the operation of said discharge tube for operatively connecting said printer to the line and for closing a circuit over said line to supply

current from said source to said motor, a signaling circuit including the conductors of said line for transmitting message signals to operate said printer, and means at the substation operated in response to the current flowing over the line from said source of alternating current for maintaining said signaling circuit closed during the transmission of messages.

6. In a telephone system, a central office, a subscriber's line terminating therein, said line having a substation thereon, a telephone at the substation of said line normally connected thereto, a message printer at said substation normally disconnected from said line, an operator's position in the central office, means under the control of the operator for establishing a connection from her position to said subscriber's line, means at the operator's position for transmitting a seizure signal over the subscriber's line, means at the substation responsive to said signal for disconnecting said telephone and for operatively connecting said printer to the line, a source of current in the central office for driving said printer, a circuit over said line for supplying current from said source to said printer, a signal transmitter at the operator's position, and means at the substation of said line responsive to the current flowing thereover from said source for holding said printer in operative connection to said line to receive signals from said signal transmitter.

7. The combination in a telephone system of a central office, a subscriber's line terminating therein, said line having a substation thereon, a

printer at the substation of said line normally disconnected therefrom, a character selecting magnet for said printer, a motor for driving said printer, a source of alternating current at the central office for operating said motor, means for sending a signal over said line to energize said magnet, switching means responsive to the energization of said magnet for closing a motor operating circuit over which current is supplied from said source to said motor, and means controlled by said motor in response to the flow of current in said motor operating circuit for holding said circuit closed independently of said magnet.

8. The combination in a telephone system of a central office, a telephone line terminating therein, a printer associated with said line and normally disconnected therefrom, a select magnet for said printer, a motor for driving said printer, a source of alternating current at the central office, a driving circuit including the conductors of said telephone line for supplying current from said source to said motor, means for sending a seizure signal over said line to operate said magnet, a switch operated in response to the energization of said magnet for closing the driving circuit of said motor, an auxiliary motor operated in response to the flow of current in said driving circuit for holding said switch in operated position to maintain said driving circuit closed independently of said magnet, and means for sending message signals over said line to operate said magnet.

PAUL V. WELCH.