

Sept. 13, 1938.

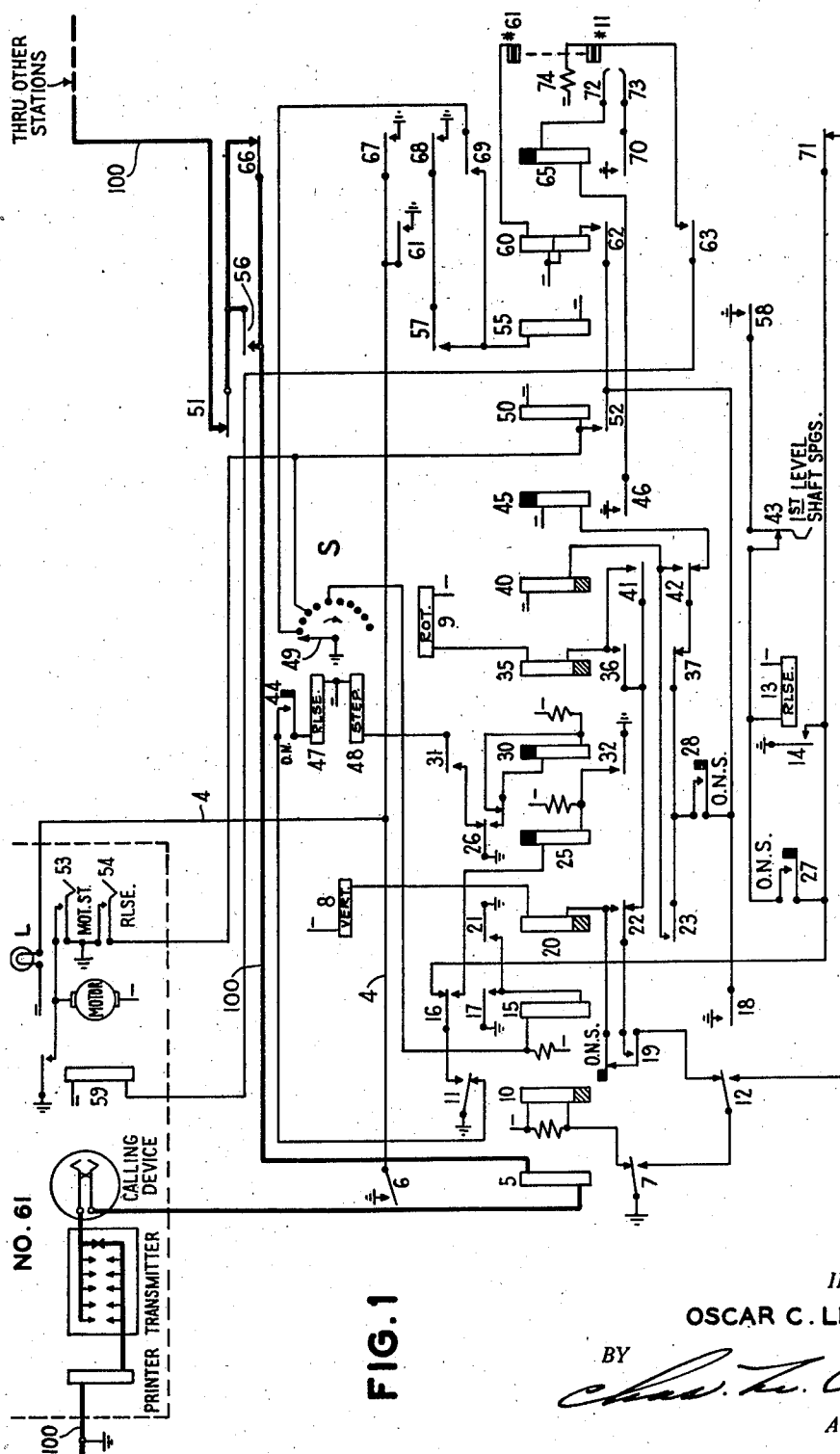
O. C. LEVY

2,129,741

TELEGRAPH SWITCHING SYSTEM

Filed Aug. 9, 1935

3 Sheets-Sheet 1



WAY STATION # 61

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3 Sheets-Sheet 2

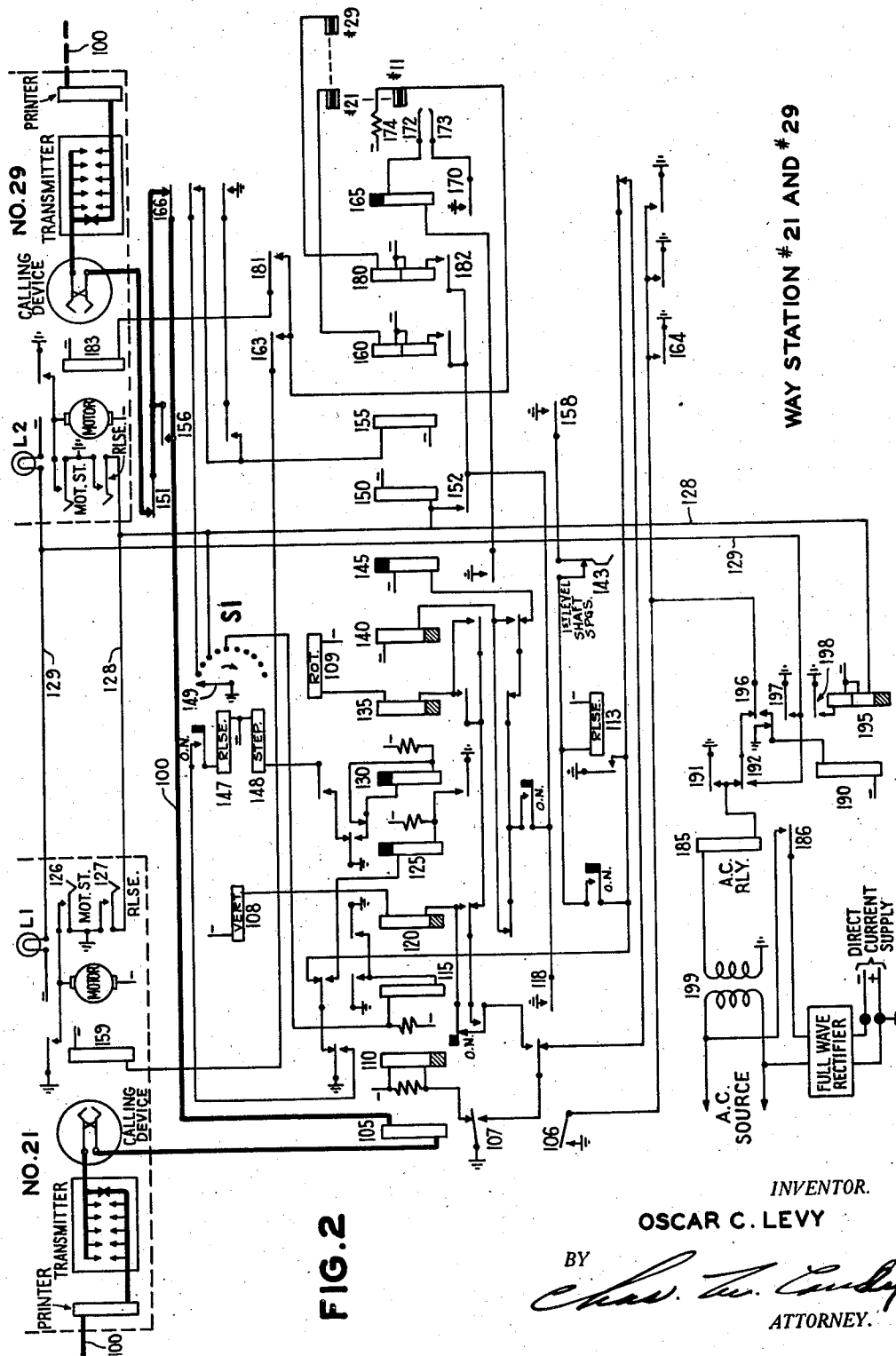


FIG. 2

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3 Sheets-Sheet 3

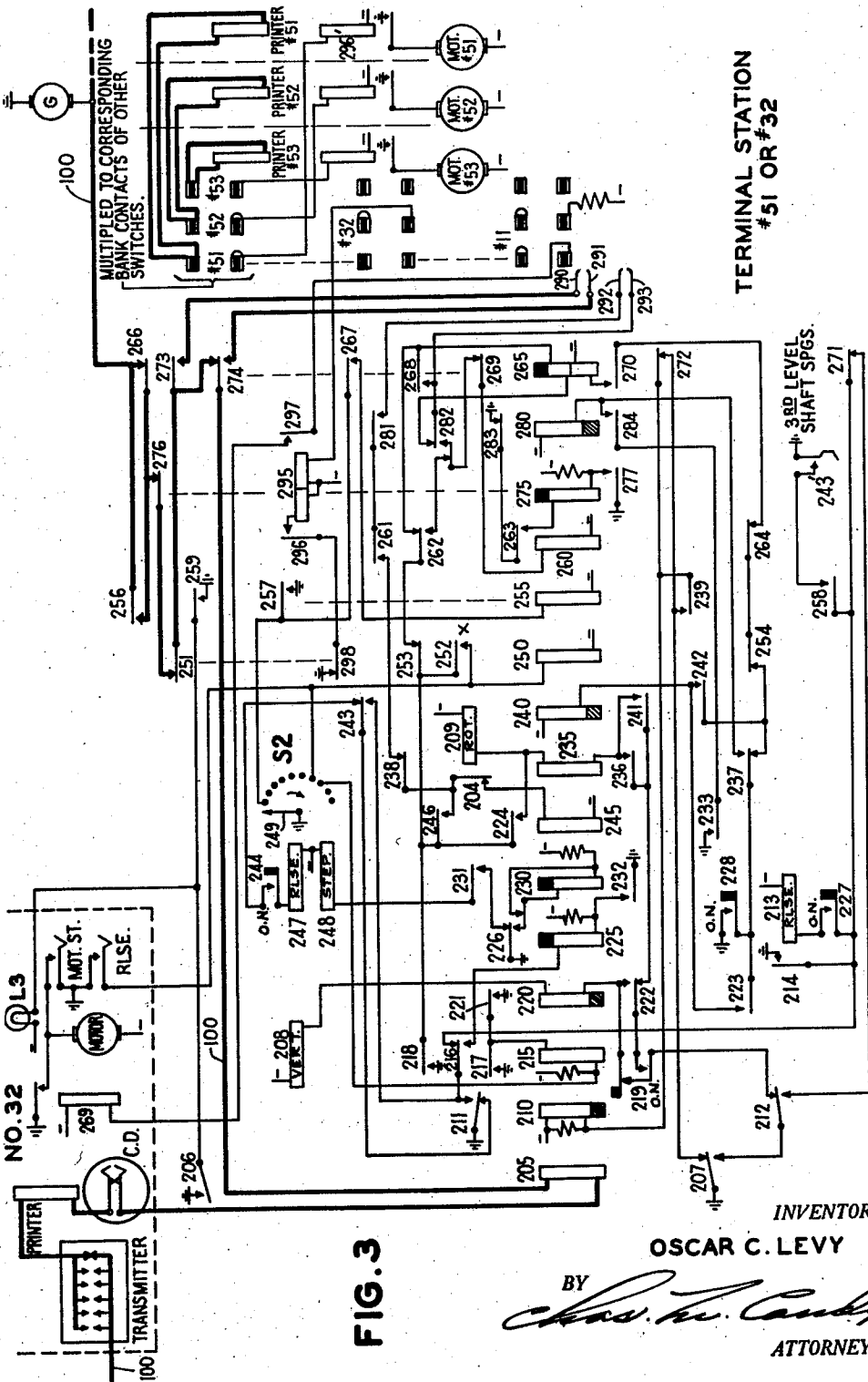


FIG. 3

UNITED STATES PATENT OFFICE

2,129,741

TELEGRAPH SWITCHING SYSTEM

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Application August 9, 1935, Serial No. 35,425

29 Claims. (Cl. 178—2)

This invention relates in general to telegraph systems but more particularly to telegraph switching systems wherein means are provided at the printing telegraph stations to selectively establish communication between any desired ones of said stations.

The principal object of the invention is to design an improved telegraph switching system in which the selection and control of the telegraph stations is considerably facilitated and in which the switching apparatus employed and the operation thereof is greatly simplified.

A particular object is to effect the operation and automatic release of the selective switches; the supervision and guardance of the established connections; and the operation of the printing telegraph equipment, all over a single wire telegraph line by means of improved simplified apparatus and circuit arrangements.

A feature of the present invention is concerned with a system comprising a plurality of printing telegraph stations arranged on a common line in which each station is provided with a selective switch directly controlled from any station and in which the switches are all first operated and then released to select the particular station desired, and then reoperated in accordance with a common code to effect the setting of the printing telegraph equipment of the selected station so that it can subsequently be operated for communication purposes.

A further feature is concerned with the provision of means whereby a particular station on the line may be equipped with a single selective switch but with a plurality of printing telegraph equipments, any one of which may be selectively prepared for operation over the line.

Additional features of the invention are presented in the means and circuit arrangements for effecting the release of established connections; supplying operating current to the apparatus and switch at a station; provide a terminal station with a plurality of concentrated printing equipments accessible from a plurality of lines; and to provide a stepping switch in each selective switch having variable means for controlling the release and answer-back functions of the selective switch.

The foregoing objects and features will be pointed out hereinafter in the detailed description which together with the accompanying drawings illustrates an embodiment of the invention. Referring to the drawings—

Fig. 1 is a schematic circuit arrangement of a telegraph way station; Fig. 2 is another way sta-

tion on the same line; while Fig. 3 discloses a terminal station.

General description

In the system disclosed a single wire telegraph line indicated as 100 and normally having current flowing thereover extends in serial relation through a plurality of telegraph stations, only three stations of which have been illustrated, although it will be understood that any additional number of similarly arranged stations can be connected in the line circuit. For the purpose of illustration, the three stations disclosed are each of a different type. In Fig. 1 an ordinary way station such as may be located along a railroad is indicated. The equipment of this way station comprises a step-by-step selecting switch of the well known Strowger type as used in automatic telephony in which the wipers are first elevated to a particular level or row of bank contacts and then rotated to the desired contact in the level. Incorporated in the selective switch is an additional small 10-point rotary step-by-step switch S of well known form. Inserted in the line of this station is a printing telegraph mechanism comprising a transmitter or keyboard and a printer by means of which communication can take place over the line between the stations. As this telegraph mechanism is well known in the art it need not be further described in detail. An impulse sender or calling device for stepping the selective switches; a relay for controlling the motor of the telegraph apparatus; release and local motor start keys; and a supervisory lamp complete the equipment located at this way station which for convenience has been indicated as way station #61.

In Fig. 2 another way station on the line is illustrated similar to station #61 but which is provided with two sets of printing telegraph and control apparatus, either of which can be selected for operation by the single selective switch at this station. This station, therefore, has two call numbers assigned to it, #21 and #29. An arrangement such as this is desirable where two sets of telegraph machines are located in a building with each set in a different room. A single selective switch centrally located would therefore be sufficient as the lines to the telegraph equipment are not of very great length. This station is also equipped with a current rectifier and control means for supplying a source of current to the equipment from an alternating current source whenever the equipment at the station is engaged for operation.

Fig. 3 shows a terminal station in which the selective switch is arranged to have access to a concentrated group of telegraph printing mechanisms #51, #52, and #53, any idle one of which it can automatically select. In addition, this switch can also engage a single particular printing mechanism such as #32. This terminal station has a number of other telegraph lines entering it each provided with an individual selective switch, and certain of the bank contacts of all the switches are therefore multiplied together in order that an idle one of the connected group of printing mechanisms can be selected.

As will be noted the telegraph line at each station passes in series through the telegraph transmitting and printing apparatus, the calling device, and the line relay and certain contacts of the selective switch. In order to effect the selection of any one station on the line the calling operator at a station is required to dial a two-digit number. This effects the operation of all of the selective switches on this line, but the digits of only the called station are registered after which all switches are automatically released. Means are provided for indicating to the calling operator the condition of the line and the progress of the connection. A two-digit number such as #11, termed the motor-start number, is then dialled resulting in the conditioning of the telegraphic apparatus at the called station so that telegraphic communication can begin. As many additional stations as desired may be brought into the connection by the calling operator dialling the wanted station numbers in succession after which the common motor-start number is dialled. In calling the terminal station with an individual printer number such as #32 the operations which take place are the same as that which take place at the ordinary way station. When, however, a number is dialled such as #51 the selective switch at the terminal station does not automatically release and it is not necessary to dial the motor start number. An idle printer mechanism is automatically selected for operation immediately.

Selection of way station #61

A description of the operation of the system under various conditions will now be given, the first being that of a call from way station #21, Fig. 2, to way station #61, Fig. 1, both of said stations being way stations on the telegraph line 100. The operator at station #21 first ascertains the busy or idle condition of the telegraph line by observing the condition of his supervisory lamp L1. If the line is not in use the lamp is dark. This is true of all station lamps on the line. The calling device or impulse transmitter is then actuated by the operator in accordance with the digit 6 thereby transmitting six break impulses over the telegraph line 100 through all of the switch line relays at all the associated stations. Line relay 5 of the selective switch at station #61, as well as all other line relays, is normally held in energized condition over the line, and at its front contacts 7 holds slow release relay 10 operated over an obvious circuit. Responsive to the line interruptions the line relay repeats them at the back contacts 7 while relay 10 being slow acting remains energized between the series of impulses. The resistor connected across relay 10 renders it still slower in action.

Responsive to the first break or impulse in the line, line relay 5 deenergizes and retracts its armatures. At back contacts 7 it closes a circuit extending from ground through front contacts

12, the closed off normal springs 19, winding of slow release relay 20, through the winding of the vertical magnet 8 to battery. The vertical magnet 8, upon energizing, elevates the shaft carrying the wipers 72 and 73 one vertical step opposite the first level of bank contacts. The elevation of the shaft likewise results in the operation of the off normal springs 19, 27, and 28, resulting in their shifting to their alternate position. Line relay 5 at its back contacts 6 closes ground onto conductor 4 to close the circuit of the supervisory lamp L. The supervisory lamp L is illuminated in this circuit and flashes in response to the impulses delivered to line relay 5. At each of the way stations the associated lamp is likewise flashed by the corresponding line relay indicating at each station the occupancy or busy condition of the telegraph line 100. This is also an indication to the transmitting operator of the correct transmission of the impulses. The slow release vertical series relay 20 upon operating closes its front contacts 22 to close a locking circuit for itself through these contacts and the normally open off normal contacts 19 which are now closed. The remaining series of five impulses delivered by line relay 5 therefore pass through front contacts 12, the now closed off normal contacts 19, front contacts 22, the winding of relay 20 and the vertical magnet 8 to battery. The vertical magnet 8 thereby elevates the wipers 72 and 73 six vertical steps or opposite the sixth level of bank contacts. Relay 20 in addition to closing its contacts 22 at front contacts 21 closes an obvious circuit through the winding of relay 15 and the parallel resistance connected thereto to battery, resulting in the energization of this relay which at its front contacts 17 closes a locking circuit for itself independent of relay 20. At front contacts 23 relay 20 prepares the circuits of relays 40 and 45 which are completed as soon as relay 15 closes ground on its front contacts 18; the circuit for slow acting relay 40 being closed by way of the now closed off normal contacts 28, front contacts 23, through the winding of relay 40 to battery, while that of relay 45 is closed through the off normal contacts 28, back contacts 37 and 42, through the winding of relay 45 to battery. Relay 45 is provided with a slug on the heel end so that it is slow to energize, while relay 40 energizes immediately and opens at its back contacts 42 the circuit of relay 45 before it is fully energized, and at the front contacts 42 closes a locking circuit for itself independent of contacts 23. At front contacts 41 the circuit for relay 35 is prepared. Relay 20 remains energized throughout the series of impulses and when these cease line relay 5 again becomes permanently energized and at its back contacts 7 opens the locking circuit of relay 20 which extends through its front contacts 22, and relay 20 consequently deenergizes and transfers the impulsing circuit to the rotary magnet 9.

The telegraph operator, at way station #21 now proceeds to dial the second digit of the called station #61. In response thereto line relay 5 deenergizes once and at its back contacts 7 closes a circuit through front contacts 12, the now closed off normal springs 19, back contacts 22, front contacts 41, winding of the slow release relay 35, through the winding of the rotary magnet 9 to battery. The operation of the rotary magnet 9 rotates the wipers 72 and 73 in a rotary direction onto the first set of bank contacts in the sixth level. Series relay 35 energizes in the rotary magnet circuit and at its front contacts 36 closes a lock-

ing circuit for itself through which additional series of impulses are received in case there are more than one. Relay 35 at its back contacts 37 opens the energizing circuit of relay 40 which 5 extended through its front locking contacts 42 from the ground on front contacts 18 and off normal springs 28. Relay 40 consequently de-energizes and prepares a circuit for relay 45 at back contacts 42. After the impulse has been re- 10 ceived relay 35 restores due to the opening of back contacts 7 of the line relay, and at its back contacts 37 closes the aforesaid circuit for relay 45.

The foregoing operations constitute the control 15 of the selector switch at station #61 in selecting this particular station by positioning the wipers 72 and 73 on bank contacts #61. At all of the other stations on the line, as well as the terminal station the associated selector switches will like- 20 wise be operated to the bank contacts corresponding to bank contacts #61. At these locations, however, the bank contacts will be dead, that is, no operating circuits will be connected to them. At station #61, however, the bank contacts #61 25 will be engaged by wipers 72 and 73 and the upper bank contact is connected directly to a relay 60.

As a result of the energization of relay 45 it closes ground on its front contacts 46 through the winding of slow-to-energize relay 65, the wiper 30 72, bank contact #61 upon which it is now resting, through the upper winding of relay 60 to battery. Relay 60, upon energizing, closes a locking circuit for itself through its front contacts 62 to grounded contacts 18 of relay 15. At its front contacts 61 35 it closes ground onto conductor 4 to permanently illuminate the lamp L to indicate to the operator at the way station #61 that his selector switch has been operated to the proper contacts at his station and also that the line is busy. At front 40 contacts 63, relay 60 prepares a circuit for the motor-start relay 59 of station #61. Relay 65 at its front contacts 70 closes ground through wiper 73 now resting on the lower contact of bank #61 which in this instance is dead. At front contacts 45 69 an operating circuit for relay 55 is prepared, while at front contacts 69 an alternate holding and locking circuit is prepared for this relay. At the back contacts 71 a point in the circuit of re- 50 lease magnet 13 is opened. At the back contacts 66 relay 65 opens a point in the circuit of telegraph line 100 for a period of time which is somewhat longer than the breaks occurring between the transmission of the series of impulses.

Answer-back indication

55 The purpose of opening the line circuit at this time is to provide an answer-back indication to the operator at the calling station #21 to advise him that the selector switch at station #61 has 60 been properly operated and station #61 selected from all the other stations on the line. The manner in which this answer-back supervision is brought about will now be pointed out. The opening of the line at back contacts 66 results in 65 the deenergization of line relay 5 for an appreciable length of time. Relay 5 upon de-energizing closes ground on its back contacts 7, and opens the front contacts for a time sufficient to permit slow release relay 10 to completely de- 70 energize. Contacts 12 of this relay restore without effect at this time. A circuit however is now closed from ground on back contacts 11, front contacts 16, through the winding of slow-to-pull-up relay 25 and the multiple connected resistor to 75 battery. After a time interval relay 25 com-

pletely energizes and operates its front contacts 26, thereby removing the short circuit from around slow-to-energize relay 30 and connecting ground through the winding of this relay and the resistor connected thereto, to battery. At front 5 contacts 32 relay 30 connects ground to one side of the winding of relay 25, thereby shunting the current flow to the winding of this relay and permitting it to slowly deenergize. After a short time relay 25 opens its front contacts 26 again 10 and closes the shunt circuit around relay 30, while at back contacts 26 it now completes a circuit extending from ground through front con- 15 tacts 31, before relay 30 has completely de-energized, through the winding of stepping magnet 48 of the stepping switch S to battery. Relay 30 upon eventually falling away opens its front 20 contacts 32, thereby removing the short circuit from around relay 25 so that it can again energize from the ground on back contacts 11. At back contacts 26 relay 25 opens the circuit of the stepping magnet 48 and at the back contacts again 25 closes the circuit of relay 30. The alternate interaction between relays 25 and 30 continues indefinitely as long as slow relay 10 is deenergized. Each time that relay 30 energizes and closes its 30 front contacts 31 and subsequently opens these contacts the stepping magnet 48 receives an impulse of current which results in the rotary movement of the wiper 49 step by step across its as- 35 sociated bank contacts.

Responsive to the first step of wiper 49 it engages the first bank contact thereby closing a circuit extending from ground on the wiper 35 through front contacts 69, which are at this time closed, through the winding of relay 55 to battery. At its front contacts 57 relay 55 upon energizing closes a locking circuit for itself ex- 40 tending from grounded front contacts 68. Responsive to the first step of the wiper 49 the off normal contacts 44 are closed, resulting in the preparation of the circuit of the release magnet 47 of the switch S. At the front contacts 56 45 relay 55 again closes the circuit of the telegraph line 100 which during this time has been opened at back contacts 66. This action results in the energization again of the line relay 5 so that at its front contacts it again closes the circuit of 50 slow-release relay 10. Slow-release relay 10 upon energizing at its back contacts 11 opens the energizing circuit of relay 25 to stop the inter- 55 action of this relay with relay 30. At front contacts 11 a circuit is closed by relay 10 extending to off normal springs 44 and release magnet 47 to battery. The operation of the release mag- 60 net 44 results in the restoration of the wiper 49 from the bank contact upon which it had been resting. An instant before wiper 49 reaches its normal position the off normal contacts 44 are 65 opened to deenergize the release magnet 47.

During the time that the telegraph line circuit 100 is opened at back contacts 66 and sub- 70 sequently closed at front contacts 56, the supervisory lamp L1 at station #21 is given a prolonged flash caused by the line relay 105 of station #21 deenergizing and closing contacts 106 to light the lamp. This likewise occurs at all other stations and serves as a busy indication 75 to these stations, and as an answer-back indication to the operator at station #21 to advise him that the switch at telegraph station #61 has been set on the proper contacts. The lamp L at station #61 remains lighted constantly from ground on contacts 61 of relay 60. 75

Automatic release of switch

As a further result of the energization and locking up of relay 55 which terminates the answer-back period, ground is closed on its front contact 58 through the vertical shaft springs 43, which are only opened when the wipers are positioned opposite their first level of bank contacts, through the winding of release magnet 13 to battery. The energization of release magnet 13 closes its front contacts 14 to close a locking circuit for itself by way of the off normal contacts 27. As a result of the energization of release magnet 13 the selector switch shaft is caused to be released. The wipers 72 and 73 are withdrawn from the bank contacts upon which they are resting and an instant before the wiper shaft has reached its normal position the off normal contacts 19, 27, and 28 are opened. At off normal contacts 27 the locking circuit of release magnet 13 is opened. At off normal contacts 28 the circuit of relay 45 is opened and it restores. As the wiper 72 leaves the contact 61 the circuit of relay 55 is broken and this relay deenergizes, opening the holding circuit of relay 55 at front contacts 68, while at back contacts 66 it closes a point in the telegraph line circuit which, however, is closed at this time at contacts 56. Relay 55 subsequently deenergizes and opens the initial operating circuit of the release magnet 13 at its front contact 58, while at front contacts 57 it opens a further point in its locking circuit. At front contacts 56 the previously closed point in the circuit of the telegraph line 100 is opened. The selector switch at way station #61 is now in its normal released position with relays 5, 10, 15, and 60 held energized at this time.

The operation and release action of the selector switches at each of the other way stations on the line takes place exactly in the same manner as that described in connection with the selector switch at station #61, with the exception that their associated relays corresponding to cut-through relay 60 of station #61 will not be operated. The stepping switches S at each of the other stations connect their relay corresponding to relay 55 up for operation to effect the release action of the switch. At station #21 the corresponding cut-through relay which is not operated is 160 while at station #29 at the same location the relay is 180. Relay 60 being now locked in energized condition the circuit from contacts 61 over conductor 4 to the supervisory lamp L maintains this lamp lit to call the attention of the operator at station #61 that he has been called, while the supervisory lamp L1 at station #21 having been flashed once to give an answer-back indication informs the operator at this station that the proper connection has been made. The lamps at the remaining stations on the line are dark at this time.

Starting the printer motors

The operator at station #21 receiving the answer-back signal then operates his calling device in accordance with the motor-start number, which conveniently is #11. All the selective switches on the line as well as that at way station #61 thereby operate their wipers one vertical step and one rotary step in the same manner as has been previously described in the first setting of these switches. The line relay 5 falls back once for each digit, the first operating the vertical magnet 8 and the second the rotary magnet 9. Wipers 72 and 73 are thereby placed into engagement with bank contacts #11. As a further result of

the engagement of the wipers with the bank contacts #11 on the first level, the first level shaft springs 43 are opened thereby opening a point in the circuit of the release magnet 13 to prevent the possibility of the release of the switch at this time. Slow-to-energize relay 55 is now energized as before from relay 45 by ground on front contact 46 of this relay, winding of relay 65, wiper 72 resting on bank contact #11, through the resistance 74 to battery. At back contacts 66 relay 55 again opens the line circuit 100 to transmit the answer-back signal to the sending operator at station #21 to inform him that he has correctly dialled the motor-start contacts at way station #61. At front contacts 69 and 68 relay 55 closes the initial energizing and the locking circuits for relay 55 which at its front contacts 56 again closes the line circuit to end the answer-back time interval.

During the second answer-back transmission the stepping switch S operates as before to set its wipers 49 opposite the first bank contact to close the initial energizing circuit for relay 55 and terminate the answer-back time interval at contacts 58. When the line circuit is again closed relay 5 energizes and closes the circuit to relay 10 to stop the interaction of relays 25 and 30 and to release the stepping switch S. At grounded front contact 58 relay 55 prepares a circuit for release magnet 13 which, however, is opened by the shaft spring 43 at this time. At grounded front contacts 70 relay 55 closes a circuit extending from these contacts to the wiper 73 and the lower bank contact #11 upon which it is now resting, front contacts 63 of relay 60 which has previously been locked energized the first time the selector switch was operated, then over the circuit extending to the motor-start relay 59 to battery. Relay 59 upon energizing closes an obvious circuit for the operating motor of the printing and transmitting telegraph mechanism. The operator at station #21 operates his motor-start key 126 which closes a local circuit for his printing and transmitting apparatus motor. Telegraphic communication may now take place over the telegraph line 100 between station #21 and station #61. The line relay 5 as well as all other relays along the telegraph line 100 may flutter slightly in response to the telegraphic impulse transmitted over the telegraph line 100, but this will have no effect upon the switches as the duration of the impulses is not of sufficient length to permit the relay 10 to restore between the impulses and because the circuits to the operating magnets are open.

The dialling of the motor-start number by the operator at station #21 in addition to operating the switch at station #61 to the motor-start level also operates all the other switches on the line including that at station #21 and terminal station #51. The printing motors, however, will not operate at these other stations due to the fact that the associated relay corresponding to relay 60 of station #61 was not operated. The switches do not release but remain with their wipers in engagement with the motor-start contacts as long as the connection exists.

It will be appreciated that when a telegraph station has been called by another station in addition to the operation of the associated supervisory lamp, the motor of the selected station will commence operating as an indication to the operator at that particular station that his station is selected and a message is to be sent to his position. In case he is the sending operator it is not neces-

sary to dial up his own selective switch in accordance with his own particular number, but merely to operate his motor-start key such as 53 at station #61 or 126 at station #21. This results in the direct operation of the motor.

It will be apparent from the foregoing description that the operation of the supervisory lamp indicates to the operator at the associated station the condition of the telegraph line 100 at all times. Whenever the lamp is dark it is an indication that the line is idle and no messages are being transmitted. If the lamp is in continuous illumination it is an indication that the line is engaged in transmitting telegraphic messages. If the lamp flashes intermittently in accordance with the particular number being dialled it is an indication that dialling is taking place. When the answer-back indication is flashed back to the sending station from a switch which has been set upon a particular contact, the lamp flashes slowly off and on again to indicate the answer-back condition. A still further indication is given by the lamp intermittently flashing off and on which occurs continuously whenever the terminal station printers are all in busy condition which will be shortly explained.

By moving the circuit connections extending from the bank contacts of the switch S to any other desired one of the banks to which the wiper 49 has access, variable time intervals may be introduced to compensate for various lengths of the line circuit between the stations or where different line conditions may exist. The length of the answer-back signal and release periods of the switches at different stations is thereby conveniently varied. For example, by moving the conductor which is now attached to the fifth bank contact to the sixth or seventh, the length of time required for the release of the particular switch at that way station is considerably extended. Similarly by moving the conductor attached to the third bank contact to the fifth or sixth, the time during which the operation of release relay 50 is started, and therefore the time of the line opening, is likewise lengthened. In a similar manner the time during which the conductor connected to the first bank contact is rendered effective may be varied by moving this conductor along to one of the other bank contacts and thereby lengthen the time during which relay 55 is started to operate, which terminates the answer-back period. This change lengthens the period during which the contacts 56 are open and 56 are closed to give a longer time interval for the answer-back signal.

Release of connection

After the telegraphic communication has been terminated the release of the connection may take place from either of the stations #21 or #61. Assume that release is effected at station #61, the operator thereat will momentarily operate the release key 54 at her position. This places ground on the conductor extending to release relay 50 and its winding to battery. At its front contacts 52 a locking circuit for itself is completed to grounded front contacts 18 of relay 15, independent of release key 54. At the back contacts 51 of relay 50 a point in the continuity of the circuit of the telegraph line 100 is opened. The circuit of line relay 5 as well as all other line relays on the line is consequently opened and permits this relay to restore its contacts 7, thereby opening the circuit of slow relay 10 which after a time completely deenergizes. Relay 10 after

restoring, at its back contacts 12 closes a point in the switch release magnet circuit from back contacts of armature 7. At its back contacts 11 it connects ground through the front contacts 16 of relay 15 which is still locked energized, through the winding of slow to energize relay 25 and the resistance to battery. Relay 25 at its front contacts 26 removes the short circuit from around relay 30 and closes the circuit through this relay. Relay 30 upon energizing at its front contacts 31 prepares the circuit of the stepping magnet 48 of switch S which is closed as soon as relay 25 is short circuited at contacts 32 to permit its back contacts 25 to close the circuit to the stepping magnet 48. Relays 25 and 30 continue the foregoing interaction, alternately energizing and deenergizing each other and operate the stepping magnet 48 in a step-by-step manner to rotate the wiper 49 of the switch S across its bank contacts. As it steps onto its first bank contact no effect is produced on relay 55 as it is locked energized from ground on front contacts 68 through its own locking contacts 57. When the third bank contact is reached by the wiper 49, ground is connected from this wiper without effect at this station, however, as relay 50 already has been operated by key 54, but the relays corresponding to relay 50 at all other stations will be energized to effect the release of the selector switches at these stations as will be pointed out.

Wiper 49 eventually reaches its fifth bank contact, thereby connecting ground through one side of the resistance and winding of relay 15, short circuiting the relay and permitting it to restore its armatures. At its front contacts 17 it opens its original locking circuit, while at front contacts 16 it opens the circuit for energizing relay 25 and this in turn permanently restores and prevents further interacting between relay 30 and this relay to stop the operation of the stepping switch S. At grounded front contacts 13 relay 15 removes the locking ground which extended to locking front contacts 52 for relay 50 and permits this relay to restore. At back contacts 51 the telegraph line circuit 100 is thereby again permanently closed. This closure results in the reenergization of the line relay 5 which at its front contacts 7 again closes a circuit through the winding of relay 10. At its front contacts 11 relay 10 closes a circuit for the release magnet 47 of the stepping switch S by way of the now closed off normal springs 44. The energization of release magnet 47 permits wiper 49 under action of a tension spring to restore to its normal position, which an instant before reaching normal position opens the off-normal contacts 44, permitting the release magnet 47 to deenergize.

Relay 15 in addition to disconnecting the locking ground at its front contacts 18 from relay 50 likewise opens the locking circuit extending through front contacts 62 of relay 60. Relay 60 thereupon deenergizes and restores its armatures. At front contacts 63 it opens a point in the circuit of the motor-start relay 59. Relay 15 at its back contacts 18 closes a circuit, before relay 10 has fully energized, from its grounded back contacts 11, the off-normal contacts 27, and the winding of release magnet 13 of the selector switch to battery. At its contacts 14 magnet 13 upon operating closes a locking circuit for itself through off-normal contacts 27. The energization of the release magnet 13 restores the shaft carrying the wipers 72 and 73 to its normal position and out of engagement with the set of bank contacts #11. An instant before the shaft

reaches its lowermost position the off-normal contacts 27, 28, and 19 are moved to their alternate positions and at off-normal contacts 27 the circuit of release magnet 13 is permanently opened. The shaft springs 43 are also closed. The restoration of the wiper 72 from the bank contact upon which it was resting, opens the circuit of the relay 65 which after an interval restores its armature. Relay 65 at its back contacts 66 again closes a point in the telegraph line 100 around front contacts 56. At grounded front contacts 63 the locking circuit of relay 55 which extended through its front contacts 57 is opened and this relay restores its armatures. At front contact 67 the ground connected to the lamp conductor 4 is opened and the supervisory lamp becomes dark, indicating to this particular station #61 that the switch has been restored to normal position. Relay 45 restores as soon as the off-normal contacts 23 are opened.

The foregoing release operations of the selector switch at station #61 occur in exactly the same manner at the remaining way stations along the line, except that instead of directly energizing relay 50 by the operation of the release key such as 54 at each station, the opening of the telegraph line at back contacts 51 permits the stepping switches S at these various stations to operate their wipers to a position corresponding to the third bank contact of the switch so as to energize the relay in the associated selector switch corresponding to the relay 50.

Selecting either of two stations at one location

The arrangement shown in Fig. 2 as has previously been stated, comprises two separate telegraph stations #21 and #29. As these two telegraph stations may be located, for example, in different rooms of a building, it is not necessary to provide a separate selector switch for each station. The circuit arrangement of the selector switch is exactly the same as that described in connection with the way station #61 of Fig. 1 and as the detailed operations have already been described they will only be pointed out generally hereinafter. When station #21 is dialled from any of the other way stations the switch steps its wipers 172 and 173 up to the bank contacts comprising #21. This results in the energization of relay 160 which locks to its front contacts under control of relay 115. Relay 160 in locking up, at its contacts 163 prepares the circuit of the motor-start relay 159 of telegraph station #21. Relay 165 when it energizes in series with relay 160 opens the telegraph line circuit 100 at its back contacts 166 in order to send the answer-back signal to the calling station. This opening of the line for the answer-back signal, results in the falling back of line relay 105 to start the step-by-step operation of the stepping switch S1, which, when its wiper 149 encounters its first bank contact, closes a circuit through contacts of relay 165 for relay 155. Relay 155 at its front contacts 156 again closes the line circuit to terminate the answer-back period. At its grounded front contacts 152 it closes a circuit through the vertical shaft springs 143 to the release magnet 113, thereby effecting the release of the switch. The stepping switch S1 is released, as has been pointed out, as soon as relay 110 again energizes. The answer-back flashing of the supervisory lamp at the calling station indicates to the operator thereat that the selection has been made and that the circuits are now in condition for the dialling of the motor-start number. This motor-

start digit again operates the selector switch at all the way stations including the desired station and steps the wipers 172 and 173 upon bank contacts #11, thereby again resulting in the transmission of the answer-back signal and in addition the closing of the ground from grounded contacts 170 of relay 165 through wiper 173 and the bank contact upon which it is resting, front contact 163, and motor-start relay 159, resulting in the operation of the motor at station #21. Telegraphic communication can then begin between the calling and called stations, the lamp L1 and all other supervisory lamps at other way stations being steadily illuminated to indicate the busy condition of the telegraph line 100. Release of the selector switch is effected by the operation of the release key such as 127 at either the calling or the called telegraph station. If release is brought about at station #21 the momentary operation of release key 127 results in the energization of relay 150 which at its back contacts 151 opens the telegraph line circuit to effect the release of the associated selector switch and all other selector switches at the various way stations on the line. As a consequence the step-by-step switch S1 steps around to the fifth bank contact to short circuit relay 115 thereby permanently effecting the control of the release of the switches. The station #21 is therefore selected in the same manner as if it were only a single station at a particular location such as Fig. 1.

Should an operator at any way station dial the digit #29 the selector switch in Fig. 2 would operate in accordance with this digit to step the wipers 172 and 173 of the switch upon the bank contact set #29, resulting in the energization and locking up of relay 180 which at its front contacts 181 prepares the circuit of the motor-start relay 183, which is completed when the selector switch subsequently releases and is reoperated in accordance with the motor-start number. The circuit for the motor-start relay 183 is completed by relay 181 through ground at front contact 170 and the wiper 173 resting on bank contact #11. The answer-back signal is again sent at the back contacts 165 to inform the sending operator that the motor of telegraph station #29 is operating and that telegraphic communication can begin. The release action of the selector switch is brought about in the manner previously pointed out. The release conductor 128 and the supervisory lamp conductor 129 are common to both stations so that the release and supervision can be had at either one. The motor-start and line leads, however, extend separately to the stations.

It will be understood from the description given of the operation of the way station #61 and way stations #21 and #29 that any additional stations on the telegraph line 100 may be conditioned for operation by operating their selective switches from the sending station, one at a time. In this manner, three, four, five, or more stations may all have their cut-through relays, such as the relay corresponding to 60 at station #61 operated by dialling up the switches successively and after each selection have the switches automatically released. Subsequently when the motor-start number is dialled and all the switches are set upon the bank contact #11 those stations which have their cut-through relays operated will have their motor-start relays energized to start their motors. Telegraphic messages will therefore be transmitted from the sending sta-

tion to all of the way stations which have been selected and placed in the conference circuit. As each station is provided with a receiving printer and a transmitter or keyboard each station can both send and receive messages.

Rectifier control

In the telegraph station shown in Fig. 1 it has been assumed that the selector switch and other apparatus at the station #61 is provided with a source of direct current for operating the same. This source of direct current may take the form of a storage battery, a generator, etc. The battery and ground symbol connections shown in Fig. 1, it will be understood, are all connected to the common bus bars of the battery. It may well happen that at certain way stations along a railroad telegraph line it is not possible to obtain a source of direct current, but a source of alternating current of a particular frequency may be available. In an instance of this kind illustrated in Fig. 2 a full-wave rectifier is provided for converting an alternating current source into direct current for supplying the battery current for the operation of the various relays and apparatus at this particular location. The rectifier and the control circuit therefore, shown in the lower portion of Fig. 2 comprise a transformer 199 connected to a source of alternating current and a full-wave rectifier for converting the current. An alternating current relay 185 controls the circuit of the full-wave rectifier. Relays 190 and 195 are auxiliary control relays. Although in Fig. 2 battery and ground connections to all of the apparatus has been indicated the same as in Fig. 1, it will be assumed that these connections are directly connected to the bus bar leads extending from the output of the rectifier. Therefore, the relay 110 controlled by line relay 105 will not be normally energized until the direct current supply has been connected up by the rectifier.

In order to explain the operation of the rectifier control it will be assumed that the selector switch of Fig. 2 is to be operated to select the station #21 from any other station along the telegraph line. In order to first prepare the rectifier for operation so that the equipment at the station at Fig. 2 can be operated, the sending operator must first open the telegraph line 100 for a short period of time which must be longer than the dialling of the digit 1, for example. In order to accomplish this, the operator at station #61 presses the release key 54 for a certain period, this act resulting in the operation of release relay 50. Relay 50 at its back contacts 51 opens the telegraph line circuit thereby permitting line relay 105 of station #21 to deenergize for a period of time corresponding to the length of time the release key 54 is held operated. The dropping back of the line relays at all other way stations results in the deenergization of slow relay such as 10 at each station. This action results in the operation of the vertical magnet 8 to elevate the switch shaft one vertical step and operate relay 15 which locks to its front contacts 17. The step-by-step switch S is thereby operated through the interaction of relays 25 and 30 until the wiper 48 reaches the fifth bank contact, whereupon relay 15 is short circuited and effects the immediate release of the switch. The same action occurs at all the other selecting switches at each of the way stations. The reclosure of the telegraph line circuit which results when relay 50 is released, permits the line relays 5 to again ener-

gize and in turn close the circuit to the associated relays 10.

As a result of the deenergization of line relay 105, Fig. 2, and during the time of the foregoing operations, the front contacts 107 are opened, thereby opening a point in the circuit of relay 110 which however, has not been energized due to the absence of battery potential at its terminals. The closing of ground on back contacts 106 however, connects ground to the conductor extending from these contacts, back contacts 196 of the rectifier control relay 195, back contacts 192, through the winding of alternating current relay 185, the secondary of the transformer 199 to ground. Relay 185 energizes from alternating current received from the A. C. source. At front contacts 186 the circuit of the full-wave rectifier is connected across the alternating current leads. After the rectifier reaches its full operating value the direct current supply from its output is fed directly to the battery mains, and the equipment of the station receives its full current supply. As soon as the full voltage is connected to the direct current supply mains relay 190 immediately energizes from ground on the closed alternate contacts 196 through its winding to battery. At its front contacts 191 an alternate circuit for the alternating current relay 185 is completed independent of line relay 105. At the front contacts 192 a circuit is completed from grounded back contact 106 of the line relay, back contacts 196, to the conductor 129 extending to the lamps L1 and L2 in parallel. This notifies the operators at these stations that a call is about to be received. The calling operator at station #61 then proceeds to dial the digits of the telegraph station #21, resulting in the operation of the selective switch thereat to associate the wipers 172 and 173 with the bank contacts #21, and the operation and locking up of the relay 160, which in addition to preparing the motor-start relay circuit 159 at its front contact 163 closes a further point in the circuit of the supervisory lamps L1 and L2 at front contacts 164. The motor-start number is then dialled resulting in the stepping of the switch the second time into engagement with the bank contacts #11 to complete the circuit from grounded front contacts 170 of relay 165 to the motor-magnet relay 159. The starting of the motor in addition to the lighting of lamp L1 at the station #21 indicates that this station has been selected. The remaining operations are the same as have been heretofore described.

When the release of the connection is to be brought about the operation of the release key 54 of the calling station #61 effects the release of all of the switches involved in the connection. At way station #21, when the switch S1 encounters its third bank contact, ground from wiper 149 is connected to the conductor 128 attached to this bank contact. If the release is effected at station #21 the operation of release key 127 directly grounds this same conductor. Relay 150 is thereby energized, and at its front contacts 152 closes the locking circuit for itself under control of contacts 118 of relay 115. At back contact 151 the telegraph line 100 is opened for a period of time to insure the stepping of the step-by-step switches S to a position which will permit the short circuiting of the relays such as 115 and effect the release of the associated switches.

As a further result of the grounding of conductor 128 relay 195 of the rectifier control equipment is energized and at its front contacts 198 closes a locking circuit for itself. At front contacts 197 a further point in the circuit of the su-

pervisory lamp L1 is completed in order to maintain this lamp lit at this time, while the releasing action is taking place. At the front contacts 196 the energizing circuit for relay 190 is changed to the control over the back contacts 106 of line relay 105. After a time when all release actions in the selective switches have taken place the line relays such as 105 again energize over the telegraph line. At contacts 106 the circuit extending through front contacts 196 holding relay 190 energized is opened and relay 190 thereupon restores. At the front contacts 191 the circuit extending to the alternating current relay 185 by way of the secondary winding of transformer 199 is opened and this relay upon restoring opens the front contacts 186 to disconnect the rectifier from the source of alternating current. This stops the supply of direct current voltage to the equipment and as a result the relay 110 deenergizes although relay 105 has again energized. Relay 195 no longer having current connected to its locking contacts 198 and its winding, after a time deenergizes. The rectifier control equipment has now been completely restored to its normal resting position as well as the remaining equipment at this way station.

Terminal station operation

Referring now to Fig. 3, this arrangement illustrates a so-called terminal station having assigned to it the numbers 32 and 51. The dialling of the number 32 from another station on the line sets the selective switch at this station to a particular group of contacts numbered 32 to prepare the telegraph equipment at the operator's position #32 for operation. The switch selected as well as the other ones on the line are immediately released, after which the common motor-start number is dialled. This operation is the same as that described in connection with the other way stations. When a particular number, such as 51 however, is dialled over the telegraph line this station is arranged so that its selective switch is operated up to the fifth level of bank contacts and then automatically rotated to select an idle one of a group of printer machines. Under these conditions the selector switch is not released, and it is not necessary to dial the motor-start number to start the printing motor, unless other stations on the line have been previously dialled to prepare their printing motors for operations, in which event the dialling of the motor-start number would not effect the further operation of the selector switch at the terminal station.

As the terminal station #51 is the terminus of a plurality of other telegraph lines each of which has an individual selector switch connected to it, provision is made whereby the single group of telegraph printers are selectable from any one of the switches. Arrangements are not provided whereby a way station on one of the lines is enabled to perform switching operations so that it can connect with another telegraph line and communicate thereover. However, the bank contacts to which the group of telegraph printers are connected are all multiplied together between the switches and provisions are made in the event that a telegraph printer of the group is busy for the wipers of the operating switch to automatically step to the next set of contacts and connect with the next idle printer. Although only telegraph printers #51, #52, and #53 have been shown connected to contacts at the terminal station, it will be understood that these each may be combined with a separate telegraph transmitter

mechanism or the transmitter shown in location #32 may be utilized on the line shown for transmitting thereover.

Selection of special terminal operator

In describing the operation of the equipment of Fig. 3 it will be first assumed that some way station on the line 100 desires to establish a connection with the special operator #32 at the terminal station. Therefore the dial such as at station #21, Fig. 2, is operated in accordance with the digit 32. The line relay 205 at the terminal station follows the impulse series and responsive to the first break in the line closes its grounded back contacts 206 to illuminate the supervisory lamp L3 and a similar action takes place at all the intervening and other way stations on the line. The lamp L3 therefore, follows the series of impulses indicating the dialling operations which take place over the line. At front contact 207 the circuit of slow release relay 210 is opened, but not for a sufficient length of time between the impulse series to permit the relay to fully restore its armature 212. A circuit is closed responsive to the first impulse, from the now closed back contacts 207, front contacts 212, closed off-normal contacts 219, winding of relay 220, and the vertical magnet 208 to battery. The wipers 290, 291, 292, and 293 of the switch are elevated by the switch shaft one vertical step, operating the off-normal contacts 219, 221, and 228 of the switch. At front contacts 222, relay 220 closes a locking circuit for itself and the remaining series of impulses constituting the first digit of the called number are now transmitted to the now closed off-normal contacts 219 and the front contacts 222. The shaft of the switch is thereby further elevated in accordance with the remaining impulses of the digit by the vertical magnet 208. At front contacts 221 ground is connected through the windings of relay 215 through the resistance to battery. Relay 215 upon energizing closes its grounded front contacts 217 to close the locking circuit for itself. At front contacts 223 a circuit is closed as soon as off-normal contacts 228 operate, from ground at these contacts through the winding of slow release relay 240 and battery. Relay 240 at its front contacts 242 closes a locking circuit for itself independent of contact 223 and at front contacts 241 prepares a circuit for the relay 235. At back contacts 243 relay 240 opens a point in the circuit of release magnet 247 of the stepping switch S2.

After the first digit has been transmitted line relay 205 again energizes. At the back contacts 207 the circuit of relay 220 is opened long enough for it to retract its armature including 222. The first one of the next series of impulses to which the line relay 205 is responsive follows a path extending from back contacts 207, front contacts 212, the now closed off-normal contacts 219, back contacts 222, front contacts 241, through the winding of relay 235 and the winding of rotary magnet 209 to battery. Responsive to this first impulse relay 235 upon operating closes its locking contacts 236, and the remaining impulses extend through these contacts. The wipers 290 to 293 have been elevated opposite the third level of bank contacts in response to the first digit are now rotated to the second set of bank contacts #32, by the action of the rotary magnet 209. Relay 220, upon falling back after the first digit, opens the initial circuit of relay 240 at contacts 223 and relay 235 at its back contacts 237 opens the locking circuit extending to contacts 242 of

relay 240 so it restores. At the front contacts 237 relay 235 extends ground from the off-normal contacts 228 through the winding of relay 280 to battery, thereby energizing this relay. At back contacts 243 relay 240 prepares the release circuit of the stepping switch S2. Relay 280 at its back contacts 282 opens a point in the upper winding of relay 265 while at the alternate front contacts 282 it prepares a circuit for relay 260 extending to back contacts 269, front contacts 282, and the wiper 293 for a purpose to be described.

After the final impulse of the series, relay 235 deenergizes and at its front contacts 237 opens the circuit of relay 280. Relay 280 in restoring closes its back contacts 282 so that a circuit is now closed extending from grounded front contacts 218, back contacts 253, back contacts 262, upper winding of switching relay 265, back contacts 282, wiper 293, lowermost bank contact #32 upon which it is now resting, through the right-hand winding of relay 295 to battery. Relay 295 upon operating closes its locking contact 296 to grounded back contacts 298 and thereby remains energized. At its front contacts 297 it prepares the circuit of the motor-start relay 269 at station #32. Relay 265 upon energizing closes its locking contacts 270 to a circuit extending over back contacts 264, back contacts 254, back contacts 237 to ground on the off-normal contacts 228. At its front contacts 268 it places direct ground from grounded contacts 218 to the wiper 293 instead of through its upper winding, while at its back contacts 269 it opens a point in the circuit of busy relay 260. At front contacts 267 a point in the circuit of relay 255 is prepared, at back contacts 272 the energizing circuit of slow release relay 210 is opened, and at back contacts 271 a part of the release magnet circuit 213 is opened. At the front contacts 273 and 274 relay 265 connects the telegraph line 100 directly in series with the wipers 290 and 291 through the bank contacts #32 upon which they are now resting, while at back contacts 266 a point in the telegraph line is opened for the purpose of giving the answer-back indication to the sending station and the busy indication to the remaining stations on the line.

As a result of the opening of the line circuit line relay 205 restores and slow release relay 210 which previously had its circuit opened at back contacts 272 eventually restores and closes ground onto its back contacts 211, so that a circuit is now closed from back contacts 211, front contacts 216, (relay 215 being locked in energized condition), through the winding of slow-to-energize relay 225 and resistance to battery. Relay 225 energizes and at its front contacts 226 opens the short circuit around relay 230 and connects ground from the front contacts through the winding of this relay and the resistance to battery. Relay 230 eventually energizes and at its front contacts 232 places a short circuit around the winding of relay 225 so that it again restores its contacts 226 to short circuit relay 230 and deenergize the same. After relay 230 deenergizes it opens the short circuit from around the winding of relay 225 at front contact 232 so that relay 225 again slowly energizes. The alternate energization and deenergization of relays 225 and 230 continues as long as relay 10 remains in its deenergized state. Each time relay 230 energizes it closes the front contacts 231, thereby completing the circuit to the stepping magnet 248 of the stepping switch S2 from grounded back contacts

226. The stepping magnet 248 is energized step-by-step to rotate the wiper 249 across its bank contacts. Responsive to the first advancement of wiper 249 into engagement with the first bank contact, ground is connected from this wiper through front contacts 267 and the winding of relay 255 to battery. Immediately that the wiper 249 is advanced from its normal position the off-normal contacts 244 are closed. The circuit for the release magnet 247, however, is opened at this time at the front contacts of armature 211. At front contacts 257 relay 255 closes a locking circuit for itself independent of its energization circuit. At front contacts 239 relay 255 prepares a point in the circuit of relay 210, and at grounded front contacts 259 it connects ground to the supervisory lamp L3 to indicate to the operator at station #32 that his position has been selected. At front contacts 256 relay 255 closes the telegraph line 100 around contacts 266 to terminate the answer-back indication. The closing of the telegraph line at front contacts 256 permits line relay 205 to again energize so that at grounded front contacts 207 it closes the circuit of relay 210 by way of front contacts 239. At back contacts 211 the operating circuit for relay 225 is opened to halt the stepping of the switch S2 while at the front contacts ground is extended through back contacts 243, off-normal contacts 244, and the winding of release magnet 247 to battery. Release magnet 247 upon energizing permits the wiper 249 of switch S2 to restore to its normal position, at which point the off normal contacts 244 are opened.

The release of the selective switch at the terminal station is prepared as soon as the switch shaft carrying wipers 290 to 293 is elevated to the third level or row of bank contacts. The third level shaft springs 243' are thereby closed and connect ground through front contacts 258 of relay 255, off-normal contacts 227, which were closed as soon as the switch took its first vertical step, through the winding of release magnet 213 to battery. The energization of the release magnet 213 permits the switch to restore to its normal position. The release magnet 213 at its front contacts 214 closes a locking circuit for itself until it has completely restored independent of the off-normal shaft springs 243. The foregoing operations for releasing the switch do not take place until relay 255 has closed its contacts 258 which takes place after the stepping switch S2 is operated. An instant before the switch shaft reaches its lowermost position the off-normal contacts 219, 227, and 228 are opened resulting in the opening at off-normal contacts 227 of the circuit of release magnet 213. Grounded off-normal contacts 228 upon opening, open the locking circuit of switching relay 265 so that this relay restores and at back contacts 266 closes another point in the circuit of the telegraph line which, however, is still closed at front contacts 256. At front contacts 267 the locking circuit for relay 255 is opened and this relay restores, opening its front contacts 256 and at front contacts 259 the circuit of lamp L3. The line wipers 290 and 291 are disconnected from in series with the telegraph line 100 when contacts 273 and 274 are restored. The selector switch at the terminal station has now been restored to its normal condition with the exception that relay 295 has been locked in energized position under control of the release relay 250. Relay 215 is also locked energized.

If the operator at station #61 desires that

other stations be connected to the telegraph line to receive the telegraphic messages, he proceeds to dial the digits corresponding to the desired stations. The selective switches at all of the stations thereby operate into connection with a set of bank contacts corresponding to the dialled digits, and only those stations which are desired to be selected have their cut-through relays energized, whereupon the switches are restored to normal again. After all stations have been selected the operator dials the motor-start number #11. The selective switch at the terminal station is elevated one vertical and one rotary step in the same manner as has been previously described when the switch was stepped up to contacts No. 32 and the operation is the same. The shaft springs 243', however, are not closed on this particular motor-start level. When wiper 293 is resting upon bank contacts #11 a circuit is completed extending from grounded front contacts 218, back contacts 253, back contacts 262, upper winding of relay 265, back contacts 282, wiper 293, bank contact on which it is now resting, front contacts 297 of relay 295 which is locked energized, through the winding of motor-start relay 269 to battery. Relay 269 at its grounded front contacts closes a circuit to the telegraph motor to operate the same. Relay 265 at its front contacts 270 locks under control of the off-normal contacts 228. At front contacts 268 it disconnects the upper winding of relay 265 from the aforesaid circuit. At front contacts 273 and 274 the wipers 290 and 291 are connected together in series with the line through the bank contacts 11 upon which they are resting. At front contacts 267 the circuit of relay 255 is prepared while at back contacts 266 the circuit of the telegraph line 100 is opened to initiate the transmission of the answer-back signal to indicate to the calling station that the motor-start number has been correctly received and that the printing motor of the desired station is operating. It has been explained that the stepping switch S2 rotates wiper 249 to the first bank contact to operate and lock up relay 255 which at its front contacts 256 terminates the answer-back indication. The stepping switch S2 is subsequently released as has been pointed out, and telegraphic communication can take place over the telegraph line between the calling station and the selected position #32 at the terminal station. The telegraph line circuit extends through the transmitter and printing mechanism, calling device, line relay 205, front contacts 274, wiper 291 and the bank contact #11 on which it is resting, the upper bank contact upon which wiper 290 is resting, front contacts 273, back contacts 251, back contacts 276, front contacts 256 and out over the line 100.

Searching for an idle printer

The foregoing operations of the selector switch at the terminal station in accordance with a particular number such as #32 it will be appreciated, are somewhat similar to the operations described in the way stations #61 and #21. The terminal station in addition is provided with a concentrated group of telegraph printer machines which are arranged so that they are accessible not only to the selector switch illustrated but to selector switches associated with other telegraph lines. When connected with an idle one of the telegraph printing mechanisms the switch operates in a different manner than it will when operated in accordance with a particular number such

as #32 heretofore described. The switch upon being operated in accordance with a particular two digit number associated with the group of telegraph printer mechanisms elevates its wipers to the desired level and then rotates them across the particular level to select a set of bank contacts connected to an idle one of the printers, where it remains. The switch is not subsequently released and it is not necessary to subsequently dial the motor-start number to start the printing motor of the printing mechanism. In case additional stations are dialled to engage a conference connection with one of the printers at the terminal station, the other stations are first dialled up to the required position, released and then the terminal station selector switch is dialled up and remains in this position, after which the motor-start number may be dialled to operate the other switches to start the motors of the other way stations. The switch at the terminal station, however, does not respond to the motor-start number.

The dialling up of the selector switch in the terminal station in accordance with the #51, operates the various relays in a similar manner as has been explained in the operation of the switch when it was operated in connection with the #32. The wipers 290 to 293 are elevated to the fifth level and rotated one step into association with the set of bank contacts representing the telegraph printer #51. The operation from this point on will now be described in detail. As the wipers reach the bank contacts #51 the following relays will be in operated position; relays 205, 210, 215, 235, 280, and all of the off-normal contacts. Should it occur that the telegraph printer #51 be busy and connected for operation by another selector switch of another telegraph line the switch wipers are rotated to the next set of bank contacts in the same row. Ground will be connected to the bank contact #51 upon which the wiper corresponding to wiper 293 is resting at the engaged switch. This ground is extended to the switch at the terminal station to wiper 293, front contacts 282 of operated relay 280, back contacts 269, through the winding of busy relay 260 to battery.

Relay 260, upon energizing, at its front contacts 262 closes a locking circuit for itself extending through back contacts 253 to grounded front contacts 218. At back contacts 262 a point in the circuit of the upper winding of relay 265 is opened to prevent its energization at this time. After the first rotary step or subsequent step in case there are more than one, relay 235 will de-energize due to the continued energization of line relay 205 which opens the circuit of relay 235 at back contacts 207. At front contacts 237 relay 235 upon falling away opens the circuit of relay 280 which slowly falls back and at its front contacts 282 after an interval opens the initial energizing circuit of relay 260. Relay 235 in addition closes its back contacts 238 to close a circuit for relay 245 extending from battery through the winding of this relay, back contacts 204 of rotary magnet 209, back contacts 238, front contacts 261, front contacts 281 before relay 280 has completely restored due to its slow action, wiper 292 and 293 and the bank contacts #51 upon which they have been set and which are strapped together at this point, to ground connected through the multiple bank contact of the other switch which is in engagement with the same contacts. Relay 245 upon energizing in the above circuit, closes its contacts 246 to close a

locking circuit for itself extending to grounded front contacts 218, independent of the aforesaid circuit. At grounded front contacts 233 it closes a locking circuit for relay 280 over front contact 284 before this relay has fully restored. At front contacts 224 relay 245 closes the circuit from the grounded front contacts 218 to the rotary magnet 209. The rotary magnet upon operating rotates the wipers 290 to 293 one rotary step into connection with the next set of bank contacts connected to telegraph printer #52. As soon as the rotary magnet 209 energizes it opens its back contacts 204, thereby opening the locking circuit of relay 245 which subsequently deenergizes and at its front contacts 224 opens the circuit of the rotary magnet 209. At front contacts 233 the circuit of relay 280 is opened and this relay slowly starts to restore its armatures. If the bank contact #52 encountered by wiper 292 is also in a busy condition, ground from the busy switch will be again connected to wiper 292 through contacts 281 and 261, back contacts 238, back contacts 204, to the winding of relay 245. At the front contacts 224 the circuit for rotary magnet 209 is again closed and at grounded front contacts 233 the circuit of relay 280 is closed before it has completely deenergized. The rotary magnet steps the wipers to the next set of bank contacts #53 and at back contact 294 opens the circuit of relay 245. The foregoing cycle of operations and the interaction between relay 245 and rotary magnet 209 continues as long as busy bank contact sets are encountered by test wiper 292. The selector switch continues to automatically step in a rotary direction across the bank contacts as long as busy ones are encountered by the wipers, and if all of the printing mechanisms are busy the wipers rotate until the last one of the group is reached. It will be noted that the test bank contacts of the last group are not connected together while all the others are.

Printers all busy

When wipers 290 to 293 of the selector switch reach the last set of bank contacts and still encounter a busy printing mechanism and the particular bank contacts are not connected together, the wipers 292 and 293 will not have a circuit closed between them through the contacts. Under this condition wiper 292 will no longer be grounded from the busy bank contact on which wiper 293 is now resting. The grounded bank upon which the wiper 293 is resting, however, will maintain relay 260 operated through front contacts 282, relay 280 still being energized. Relay 245 no longer receives an energizing circuit from wiper 292 and it restores its armatures. At grounded front contacts 233 the locking circuit for relay 280 is opened. At front contacts 263 relay 260 prepares the circuit for slow-to-energize relay 275; at front contacts 262 it closes a point in its locking circuit, while at the back contacts 262 it opens a point in the upper winding of relay 265. Relay 280 eventually restores its armatures, and at grounded back contacts 283 closes the circuit to relay 275 by way of front contacts 263 and the resistance to battery, while at the alternate contacts 232 it closes a point in the locking circuit for relay 260 by way of back contacts 269 and front contacts 262 to grounded front contacts 218. At back contacts 264 a point in the locking circuit of relay 265 is opened.

Busy indication

Relay 275 upon energizing closes its grounded

front contacts 277 and thereby short circuits itself so that after a time due to its slow acting characteristic it restores. As soon as contacts 277 are opened the relay again energizes, and thereafter operates continuously in the manner of a buzzer as long as contacts 283 are closed and under control of relay 260. At the back contacts 276 relay 275 opens a point in the telegraph line 100 each time it energizes, and these interruptions in the line continue until the release of the connection by the calling operator is effected. As a result of these interruptions in the line circuit all of the supervisory lamps at all the stations, which have not been selected including the calling station, are intermittently flashed due to the fact that the associated line relays such as 205 are alternately energized and deenergized. The lamps of the other selected stations, in case there are any, are not flashed because they are lit steadily due to the energization of their cut-through relays such as 60 at way station #61. The interruptions are fast enough so as not to release the switches or permit the relays such as 19 to restore. This serves as an indication that all of the printers in the group are in a busy condition and not available for the reception of messages. The release of the connection stops the busy flash as will be subsequently described.

Encountering an idle printer

In the event that the wipers 290 to 293 encounter a printer mechanism which is idle and not engaged by a selector of another line, ground is no longer encountered by wiper 293. Relay 245 can therefore no longer energize over this wiper and upon restoring opens its grounded front contacts 233 to open the circuit of relay 280 which also eventually restores. Relay 260 likewise has its circuit opened due to the absence of ground on the bank contact and upon restoring closes at the back contacts 262 a point in the circuit to the upper winding of relay 265 which is completed at back contacts 282. As a result relay 265 is energized through its upper winding from grounded front contacts 218, back contacts 253, back contacts 262, upper winding of relay 265, back contacts 282, wiper 293, bank contact #51 upon which it is now resting, the winding of motor-start relay 296' to battery. At the front contacts of this relay the motor of the printer mechanism #51 commences to operate. As soon as relay 265 completely energizes it closes its locking front contacts 270 by way of back contacts 264 (as soon as relay 260 falls back), 254, 237, to the grounded off-normal contacts 228. At front contacts 268 the upper winding of relay 265 is disconnected from its energizing circuit in order to remove the resistance of this winding from the circuit of the motor-start relay 296'.

As a further result of the energization of relay 265 it opens its back contact 272 to open a point in the circuit of relay 210. At its back contacts 269 it opens a further point in the circuit for relay 260. At its front contacts 263 relay 260 opens the circuit of relay 275, while at front contacts 262 a further point in its locking circuit is opened. At front contacts 273 and 274 the telegraph line is switched directly in series with the wipers 290 and 291 and bank contacts #51 upon which they are resting and which are connected with the printing mechanism #51. At back contacts 266 the telegraph line circuit is opened for a period of time initiating the answer-

back indication to signal the calling station that an idle printing mechanism has been selected.

As a result of the opening of the line circuit by the contacts 266 the line relay 205 restores and at grounded back contacts 206 grounds the lamp L3 to illuminate the same and indicate that this station has cut through on a printer mechanism. Relay 210 having its energizing circuit opened by relay 265 at back contacts 212 eventually restores its back contacts 211 thereby completing a circuit through front contacts 216 to relay 225. Relay 225 at front contacts 226 removes the short circuit from relay 230 and closes its energizing circuit. Relay 230 upon energizing at front contacts 232 short circuits relay 225 and at front contacts 231 closes the circuit through back contacts 226 for the stepping magnet 248 of the switch S2. The interaction of relays 225 and 230 continues alternately with the stepping magnet taking one step each time, resulting in the moving of wiper 249 onto its first bank contact and the closing of a circuit through front contacts 267 for relay 255. Relay 255, upon energizing, at its grounded front contacts 257 closes a locking circuit for itself; at grounded front contacts 259 closes a further circuit for the lamp L3; and at front contacts 239 prepares a further point in the circuit of relay 210 which will energize as soon as the line relay 205 again energizes. At front contact 256 the answer-back period is terminated by short circuiting the contacts 266 and the line circuit is again closed so that the line relay 205 is re-energized. Relay 210, upon energizing, halts the operation of relays 225 and 230 to stop further operation of the stepping switch S2. At front contacts 211 ground is extended through back contacts 243, the operated off-normal springs 244 and the release magnet 247 of switch S2, resulting in the release of this switch. The answer-back supervision results in the operation of the supervisory lamp in accordance with a flash at the calling station to indicate that an idle printer has been selected and that the sending of telegraphic messages between that station and the printing mechanism #51 at the terminal station can take place. In case it is necessary to perform any transmitting of messages from the terminal station to the sending station the transmitter illustrated at the station #32 may be utilized by operating the motor-start key locally to start the motor at this location.

Release of terminal station apparatus

The release of the established connection may take place by the operator at any station. If it occurs at the sending station #61 the operator presses the release key 54 momentarily resulting in the energization and locking up of relay 50 which at its back contact 51 opens a point in the telegraph line. As a result all of the line relays of all of the switches on the line restore their armatures, including line relay 205 of the selective switch at the terminal station. At front contacts 207 the circuit for relay 210 which at this time extends through front contacts 239 is opened. Relay 210 thereby controls the circuit of relays 225 and 230 to operate the switch S2 in a manner which has been explained to rotate the wiper 249 to the seventh bank contact which is connected to relay 250. Relay 250 upon energizing immediately closes its front contacts 252 to lock itself energized by way of grounded front contacts 218. If the selective switch at the terminal station was released di-

rectly by the operator the release key at position #32 would have directly operated relay 250 instead of through the medium of the stepping switch S2. At back contacts 254 the locking circuit of relay 265 is opened and it restores its armatures. At contacts 267 the circuit for locking relay 255 energized is opened and this relay restores and opens the ground connection at its contacts 259 from the lamp L3 which, however, is maintained at back contacts 206 of line relay 205 which is now in deenergized position. The circuit to wipers 290 and 291 is disconnected by the restoration of contacts 273 and 274 and the line circuit is connected straight through. At the back contacts 266 the line circuit is again closed before front contacts 256 of relay 255 have opened. At back contacts 253 relay 250 disconnects the ground from contacts 218 extending to wiper 293 thereby permitting relay 296' to deenergize and at its grounded front contacts open the circuit for the motor #51, stopping the operation of the same.

During the foregoing releasing operation the wiper 249 of the switch S2 continues to advance eventually reaching the bank contact #8 connected to one side of the winding of relay 215. Ground from wiper 249 thereby short circuits relay 215 and allows it to restore. At front contacts 216 the stepping operation of the switch S2 is halted and at the back contacts a circuit is closed extending through grounded back contacts 211 of relay 210 which at this time is deenergized, through the off-normal contacts 227 and the winding of release magnet 213 to battery. Magnet 213 upon energizing closes its grounded front contact 214 independent of ground from back contacts 211 until the off-normal contacts 227 are opened. Release magnet 213 upon energizing restores the switch to its normal position and withdraws the wipers 290 to 293 from the bank contact sets #51 upon which they have been resting. At front contacts 218 relay 215 opens the locking circuit of relay 250 which has been closed through contacts 252, and this relay restores. At back contacts 251 the open point in the telegraph line circuit is closed. An instant before the switch shaft reaches its normal position, the off-normal contacts are open thereby opening the circuit of the release magnet 213. As a result of the reclosing of the telegraph line circuit the line relay 205 again energizes and in turn at its front contacts 207 by way of back contacts 272 closes the circuit of relay 210. At front contacts 211 the circuit extending through these contacts and contacts 243 is closed through the off-normal springs 244 to the release magnet 247 of the stepping switch S2 and this switch is released. The wiper 249 opens the off-normal contacts 244 an instant before it reaches its normal position to open a permanent point in the circuit of magnet 247. The mechanism including all of the relays at the terminal station has now been restored to its normal position in readiness for operation by any other station to select the same and prepare its printing mechanism for operation. It will be understood that the remaining switches at all of the way stations located on the telegraph line 100 are released in the same manner as has been previously described.

Particular attention is called to the fact that the stepping switches at the way stations are operated to their first bank contact responsive to the initiation of the answer-back signal in order to provide a time interval to subsequently

terminate the answer-back indication. The stepping switches are likewise operated to their third bank contact when they are not associated with a station whose operator initiates the release in order to effect the release of the associated switch and to insure that each switch opens the line circuit at its location. This provision is made to take care of the condition whereby one switch may effect its release and reclose the line circuit before the other switches on the line would have time to fully release. When the final release of the switch is to be effected the stepping switch is operated to its fifth bank contact resulting in the operation of the relays such as 15 to finally restore the selective switch at that particular way station to its normal position. The connection of the conductors to the aforesaid bank contacts of the stepping switches may be varied in any particular manner desired. That is, the release time may be extended for a longer period so that the wiper 49, for example, at way station 61, is required to step to the sixth or seventh bank contact before final release is effected. Similarly the answer-back period between the opening of the line conductors at the contacts 66 and the closing again at front contacts 56 may be varied any amount by moving the conductors connected to the first bank contact to the second, third, or fourth, as the case may be. The period of time or the number of steps of bank contacts between the conductor connected to the third lead and the conductor connected to the fifth lead, must remain constant, in order that a uniform release action by all of the switches may be had.

From the foregoing description of the operation of the system it will be understood that a considerable number of variations in the operation and arrangement of the way stations and the terminal stations may take place from that described, and it is therefore desired not to be limited to the exact embodiments illustrated and described but only to the extent of the appended claims.

What is claimed is:

1. In a telegraph system, a line, a plurality of stations connected to said line, a selecting switch at each station, means at each station for transmitting impulses over said line, means in each switch responsive to said impulses for operating the switch to a particular position, a cut-through relay in each switch, each cut-through relay being connected to a different position of its associated switch from that of the other cut-through relays, means responsive to the operation of said switches to a particular position for operating one of said cut-through relays and for automatically effecting the release of all of said switches, means for locking the operated cut-through relay in energized condition independent of the release of its associated switch, and means for indicating to the calling station that the operated cut-through relay has been operated.

2. In a signalling system, a line, switches connected to said line, a cut-through relay and a switching relay in each of said switches, means for simultaneously operating all of said switches over said line, means controlled by the operation of only one of said switches for operating its associated cut-through and switching relays, means responsive to the operation of said switching relay for effecting the release of said switches, means for locking said operated cut-through relay energized independent of the release of the switches, and further means controlled by the

operation of said operated switching relay for transmitting an indication over said line that said cut-through relay has been operated.

3. In a signalling system, a line, a switch connected to said line, a cut-through relay, a switching relay, and a stop relay in said switch, means for operating said switch over said line to operate said cut-through and said switching relays, means controlled by the operation of said switching relay for initiating the transmission of a signal over said line to indicate the operation of said cut-through relay, means responsive to the duration of said signal for operating said stop relay, means controlled by the operation of said stop relay for terminating the transmission of the signal over the line and for effecting the release of said switch, and means for maintaining said cut-through relay operated independent of the release of said switch.

4. In a telegraph system, a telegraph line, a plurality of telegraph stations on said line, a selective switch at each of said stations connected to said line, a cut-through relay and a switching relay in each switch, means responsive to the transmission of impulses over said line from a calling station for operating all of said switches, means responsive to the operation of only one of said switches for operating the associated cut-through and switching relays, means controlled by the operation of said switching relay for initiating the release of all of said switches and for transmitting a signal over said line indicating the operation of said operated cut-through relay to said calling station, means for locking said operated cut-through relay operated independent of the release of said switch, means responsive to the transmission of further impulses for reoperating all of said switches, means responsive thereto for reoperating said switching relay to effect the retransmission of the signal over said line, and a circuit initially prepared by said operated cut-through relay when the switch is operated the first time and closed when the switch is reoperated for rendering the associated station telegraph apparatus operable.

5. In a signalling system, a line, a switch connected to said line, means for operating said switch over said line, a relay in said switch, means responsive to the operation of said switch to a particular position for operating said relay, means for transmitting a signal over said line to indicate the operation of said relay, means for releasing said switch and for maintaining said relay operated, means for reoperating said switch to a particular position, means for retransmitting another signal over said line to indicate the operation of the switch to the last particular position, and a circuit connection closed through said operated relay and by the reoperation of said switch for rendering effective the transmission of further signals over said line.

6. In a telegraph system, a telegraph line, a plurality of telegraph stations each having telegraphic apparatus, a selective switch at each station connected to said line, means for operating all of said selector switches over the line from a calling station, a relay in each switch, means responsive to the operation of only one of said switches for operating the associated relay and for releasing said switches, means for transmitting a signal over said line to the calling station indicating the operation of said operated relay, means for maintaining said operated relay locked energized when said switches re-

lease, means for reoperating said switches from said calling station and for retransmitting the signal thereto, means for preventing said switches from releasing when reoperated, and a circuit connection closed by said operated relay and the reoperation of its associated switch for rendering the telegraph apparatus of the associated station operable over said line.

7. In a signalling system, a signal line, stations on said line, a selective switch at each station connected to said line, means controlled from a calling station over said line for operating all of said selective switches, means operated by only the switch of the called station for recording the call, means responsive to the recording of the call for initiating the transmission of an answer-back signal to the calling station to indicate that the call is recorded, a stepping switch in said selective switch of the called station, and means operated responsive to the initiation of the answer-back signal for operating said stepping switch to terminate said answer-back signal after a time interval.

8. In a signalling system, a line, a selective switch connected to said line, means for operating said switch over said line, means responsive to the operation of said switch for initiating the transmission of a signal over said line, a stepping switch in said selective switch, means responsive to the transmission of said signal for initiating operation of said stepping switch, means responsive to the continued operation of said stepping switch for an interval of time for terminating the transmitted signal, and means responsive to the termination of said signal for stopping the operation of said stepping switch.

9. In a signalling system, a line, a selective switch connected to said line, means for operating said switch over said line, means responsive to the operation of said switch for initiating the transmission of a signal over said line, a stepping switch in said selective switch, means responsive to the transmission of said signal for initiating operation of said stepping switch, means responsive to the continued operation of said stepping switch for an interval of time for terminating the transmitted signal, means responsive to the termination of said signal for stopping the operation of said stepping switch, and means for varying the time during which said stepping switch is operated in order to provide a signal period of any desired length.

10. In a telegraph system, a telegraph line, stations on said line, a selective switch at each station connected to said line, means controlled over said line from a calling station for operating all of said switches on said line, means in only one of said switches for recording said call, means responsive to the recording of said call for initiating the transmission of an answer-back signal over the line to the calling station to indicate the recording, a stepping switch at each station, means responsive to the initiation of said answer-back signal for initiating operation of the stepping switch in said one of said stations, means controlled by the operating stepping switch after it has operated for a time interval for terminating said answer-back signal, and means controlled at any station to initiate the operation of said stepping switch for a time interval to effect the release of said selective switches.

11. In a signalling system, a line, selective switches connected to said line, means for operating all of said switches, recording means operated by only one of said switches, means at

said one switch for initiating the transmission of a signal over said line to indicate the operation of said recording means, a stepping switch associated with each of said selective switches, means responsive to the initiation of said signal for starting and continuing the operation of the one stepping switch associated with said one selective switch, means controlled by said one stepping switch after it has operated to a certain position for terminating the signal transmission, means responsive to the termination of said signal for releasing said one stepping switch, releasing means in said one selective switch for again starting and continuing the operation of said one stepping switch to a different position, and means controlled by said one stepping switch after it reaches said different position for effecting the release of said one selective switch.

12. In a telegraph system, a telegraph line, a plurality of stations each having telegraphic apparatus including an operating motor, a selective switch at each station connected to the line, means controlled from any calling station over the line for operating all of said selective switches, means in only one of said switches for recording the call and closing a point in the operating circuit of the telegraph motor at that station, means responsive to said selection for transmitting an answer-back signal to the calling station to indicate that the proper selection has been made, means in said selected switch for automatically effecting the release of said selected switch and all of said other switches, means controlled from the calling station for reoperating all of said switches and for preventing their automatic release, means in the switch at the selected station for completing the circuit of said selected telegraph motor to operate the same, means responsive to the reoperation of said selected station switch for again transmitting the answer-back signal to the calling station to indicate that the motor of the called station is operating, means at either the calling or called stations for directly releasing the switches at the associated stations, and means controlled by the switch at which the release is effected for releasing all said other switches on the line.

13. In a signalling system, a normally closed line circuit, signalling stations on said line, a selective switch at each station connected to said line, each switch normally having battery potential disconnected therefrom so it cannot operate, means at a calling one of said stations for opening said line circuit prior to the initiation of a call over said line, means in each switch responsive to the opening of the line for connecting battery potential to the switch, means controlled over the line from the calling station for operating all of said switches and effecting the selection of only the called station, means controlled from the calling station for effecting the release of said switches, and means responsive to the release of the switches for disconnecting the battery potential therefrom.

14. In a signalling system, a normally closed line circuit, signalling stations on said line, a selective switch at each station connected to said line, each switch normally characterized by an absence of battery potential therefrom, a source of alternating current at each station, rectifying means at each station for converting said alternating current to direct current to render the associated switch operable, means at a calling one of said stations for transmitting a control over said line to said switch, means in each switch re-

sponsive to said control for connecting said rectifying means to said alternating current source to render said switch operable, and means controlled over said line from said calling station for operating all of said switches to effect a selection of only one of said stations and establish a signalling path thereto over said line, means at any station on the line for effecting the release of said switches, and means responsive to the release of said switches for disconnecting said rectifying means from said alternating current means.

15. In a signalling system, a selective switch, a group of signal stations accessible to said switch, a single station also accessible to said switch, means for operating said switch to select one of said group of stations, means for maintaining said switch in connection with said selected group station, means for operating said switch to select said single station and prepare it for operation, means responsive to said selection for automatically releasing said switch, and means for reoperating said switch to a position rendering said selected single station operable.

16. In a telegraph system, a telegraph line, telegraph stations on said line including a terminal station, a switch at each of said stations connected to said line, a group of telegraph apparatus accessible to the switch at said terminal station, and a single apparatus at each of said other stations, means controlled from a calling station over the line for operating all of said switches including said terminal station switch and for automatically selecting one of said group of telegraph apparatus, means for releasing all of said switches except said terminal switch, means controlled from a calling station for operating all of said switches including said terminal switch to prepare the telegraph apparatus at a called station other than said terminal station for operation, means for releasing all of said switches including said terminal switch, and means for reoperating all of said switches including said terminal switch to render the selected telegraph apparatus at the called station operable.

17. In a telegraph system, a telegraph line, stations on said line including a terminal station, a selective switch at each station connected to said line, telegraph apparatus at each station connected to the line, means controlled from a calling station over the line for operating all of said switches to select the telegraph apparatus at only one of said stations, means responsive to said selection for transmitting an answer-back signal over the line from the selected station to the calling station to indicate the selection, means for automatically releasing said switches at the end of the signal, further means controlled from the calling station for reoperating said switches and rendering the telegraph apparatus at the called station operable, means for again transmitting the answer-back signal to the calling station to indicate that the telegraph apparatus is in operable condition, a plurality of telegraph apparatus accessible to said terminal station switch, means controlled from a calling station for operating all of said station switches including said terminal switch, means in said terminal switch for automatically selecting an idle one of said telegraph apparatus thereat, means for releasing all of said switches while maintaining said terminal switch operated, and means operable in case all of the telegraph apparatus at the terminal station is in a busy condition for transmitting a busy-flash signal over said line to the calling station.

18. In a telegraph system, a telegraph line, a plurality of telegraph stations arranged on said line, a selective switch at each of certain of said stations connected to said line, telegraph apparatus at each of said stations, some of said stations being provided with a single set of telegraph apparatus selectable by its associated switch, other stations being provided with a single set of telegraph apparatus, a selective switch common to two or more of said other stations, at least one other station being provided with a group of telegraph apparatus, means controlled by any station over said line for operating all of said switches to select the telegraph apparatus at only the called station, means responsive to said selection for transmitting an answer-back signal over the line to the calling station, means for repeatedly reoperating said switches to select the telegraph apparatus at other stations, and means controlled from the calling stations for finally reoperating all of said switches after all of said selections have been made to render the selected telegraph apparatus operable over the line.

19. In a telegraph system, a normally closed line circuit, stations on said line each having a selective switch associated therewith, a current source at each station normally disconnected from said switch, means controlled from a calling station for interrupting said line circuit, and means at each station responsive to the line interruption for connecting the current source to the associated switch.

20. In a telegraph system, a normally closed line circuit, stations on said line, a selective switch at each station connected to said line, a current source at each station normally disconnected from said switch, means controlled from a calling station for momentarily opening said line circuit, means in each switch responsive to the line opening for connecting the current source to the switch to render the switch operable, and means at the calling station for transmitting calling impulses over said line circuit to operate all of said switches but which render only the called station operable for telegraphic communication.

21. In a telegraph system, a normally closed line circuit, stations each having a selective switch connected to said line, a current source normally disconnected from each switch rendering it inoperative, a key at each station, means responsive to the operation of said key at a calling station for momentarily opening said line circuit, means responsive to said line circuit opening for connecting the current source to each switch to render it operable, means at the calling station for operating said switches to select the called station for operation to establish a telegraphic communication path between the calling and called stations, and means responsive to the reoperation of said key for releasing all of said switches and for disconnecting said current source therefrom.

22. In a telegraph system, a line circuit, a plurality of stations each having a selective switch connected to said line, a release key at each station, a release relay in each switch controlled by said key for opening said line circuit, a stepping switch in each switch also controlling said release relay, means at a calling station for operating all of said switches to effect a connection with a called station to enable telegraphic communication to take place, means whereby the operation of said release key at the calling station directly operates said release relay to open said

line circuit, and means in each of the other operated switches responsive to the opening of the line circuit for operating said stepping switch to a position to operate the associated release relay, and means responsive to the operation of said release relay in each instance for initiating the release of the associated switch.

23. In a telegraph system, a line, a plurality of stations each having a selective switch connected to said line, means at a calling one of said stations for operating all of said switches to effect a telegraphic communication path with only the called one of said stations, means responsive to the connection of the called station to the line for transmitting an answer-back signal to the calling station, a stepping switch at the called station, means responsive to the initiation of the answer-back signal for initiating operation of said stepping switch, and means controlled by the stepping switch after it has operated for a period of time for terminating said answer-back signal.

24. In a telegraph system as claimed in claim 23 in which means are provided in the stepping switch for varying the time period for which the answer-back signal is terminated.

25. In a telegraph system, a line, a plurality of stations each having a selective switch connected to said line, means at a calling one of said stations for operating all of said switches to effect a telegraph communication path with only a called one of said stations, means responsive to the connection of the called station to the line for transmitting an answer-back signal to the calling station, a stepping switch at the called station, means responsive to the initiation of the answer-back signal for initiating operation of said stepping switch, means controlled by said stepping switch after its operation for a period of time for terminating the answer-back signal, a release key at the stations for terminating the connections, and means responsive to the operation of the release key at the calling station for starting the stepping switch to operate for a period of time to effect the release of the associated switch.

26. In a telegraph system as claimed in claim 25 in which said stepping switch includes a plurality of bank contacts and connections thereto, said connections to said contacts being changeable to adjust the period of time for which the

stepping switch is operated to terminate the answer-back signal, and the period of time it operates to release the selective switch.

27. In a telegraph system, a line, a plurality of selective switches each at a different location and connected to said line, a plurality of telegraph stations, certain of said stations having an individual selective switch associated therewith, while others of said stations have a single switch common to all of them, means controlled by a calling station for repeatedly operating said individual switches selectively to render at least certain of their associated stations operable for telegraphic communication, and means for repeatedly operating said common switch to render its associated stations operable one at a time.

28. In a telegraph system, a line, a terminal station on said line including a plurality of sets of telegraph apparatus, other stations on said line individually including one set of telegraph apparatus, means operative from a calling one of said stations for partially conditioning for operation the telegraph apparatus at at least one of said other stations, means operative from said calling station for completely conditioning one of said plurality of sets of apparatus for operation, and means operative from said calling station for completing the conditioning for operation of the partially conditioned set or sets of apparatus following the complete conditioning for operation of said one of said plurality of sets of apparatus.

29. In a telegraph system, a plurality of lines, a terminal station common to said lines, said station including a plurality of sets of telegraph apparatus each adapted to be associated with any one of said lines for operation thereover, other stations on at least one of said lines and individually including one set of telegraph apparatus, means operative from a calling station for partially conditioning for operation the telegraph apparatus at at least one of said other stations, selective means at said terminal station operative from said calling station for selecting and completely conditioning for operation an idle one of said plurality of sets of apparatus, and means operative from said calling station for completing the conditioning for operation of the partially conditioned set or sets of apparatus following the complete conditioning for operation of said one of said plurality of sets of apparatus.

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