April 16, 1935. F. S. KINKEAD 1,998,086

TELEGRAPH EXCHANGE SYSTEM

Filed Dec. 29, 1933 2 Sheets-Sheet 1

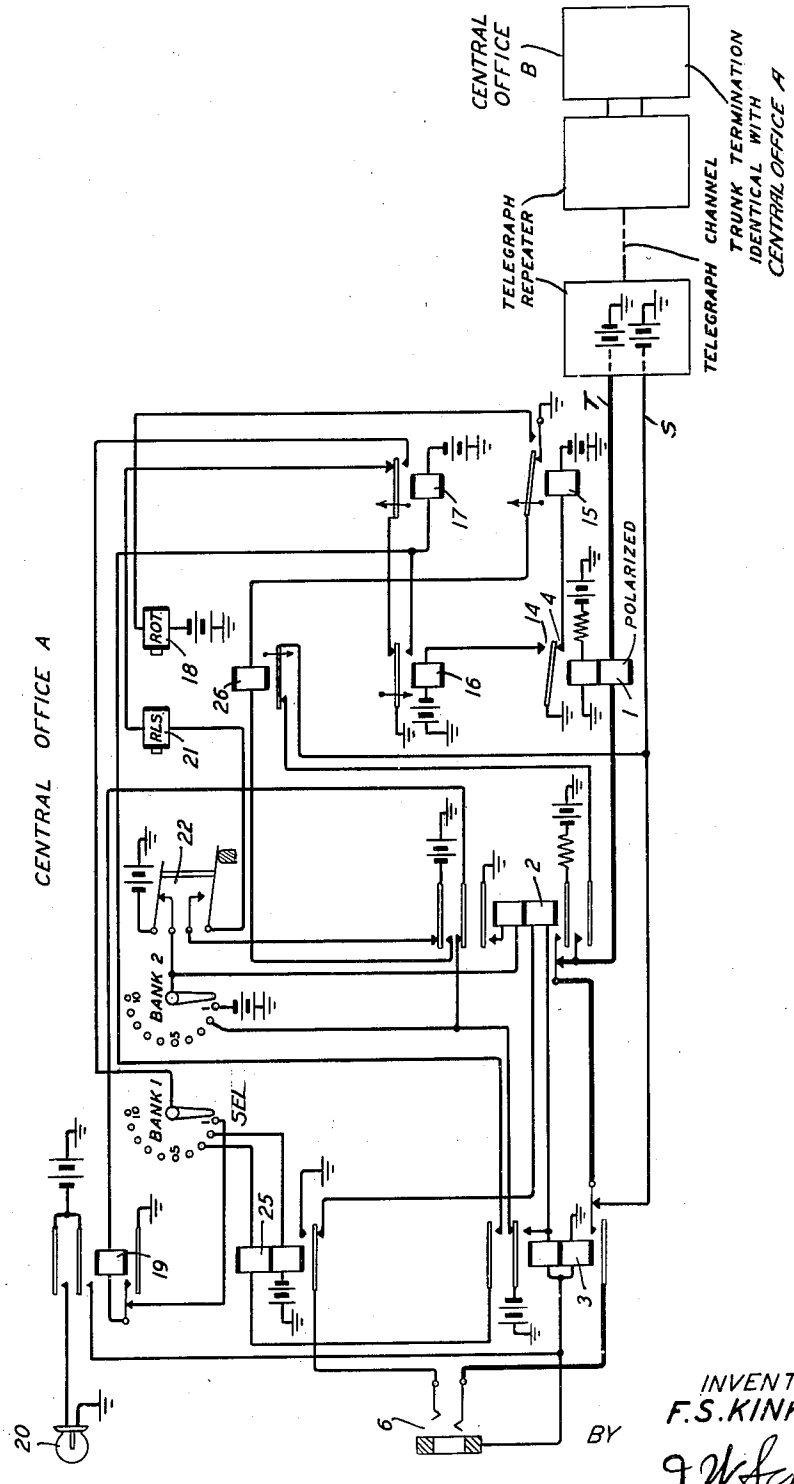


FIG. 1

INVENTOR
F. S. KINKEAD
BY
J. W. Schmied
ATTORNEY

April 16, 1935. F. S. KINKEAD 1,998,086

TELEGRAPH EXCHANGE SYSTEM

Filed Dec. 29, 1933 2 Sheets-Sheet 2

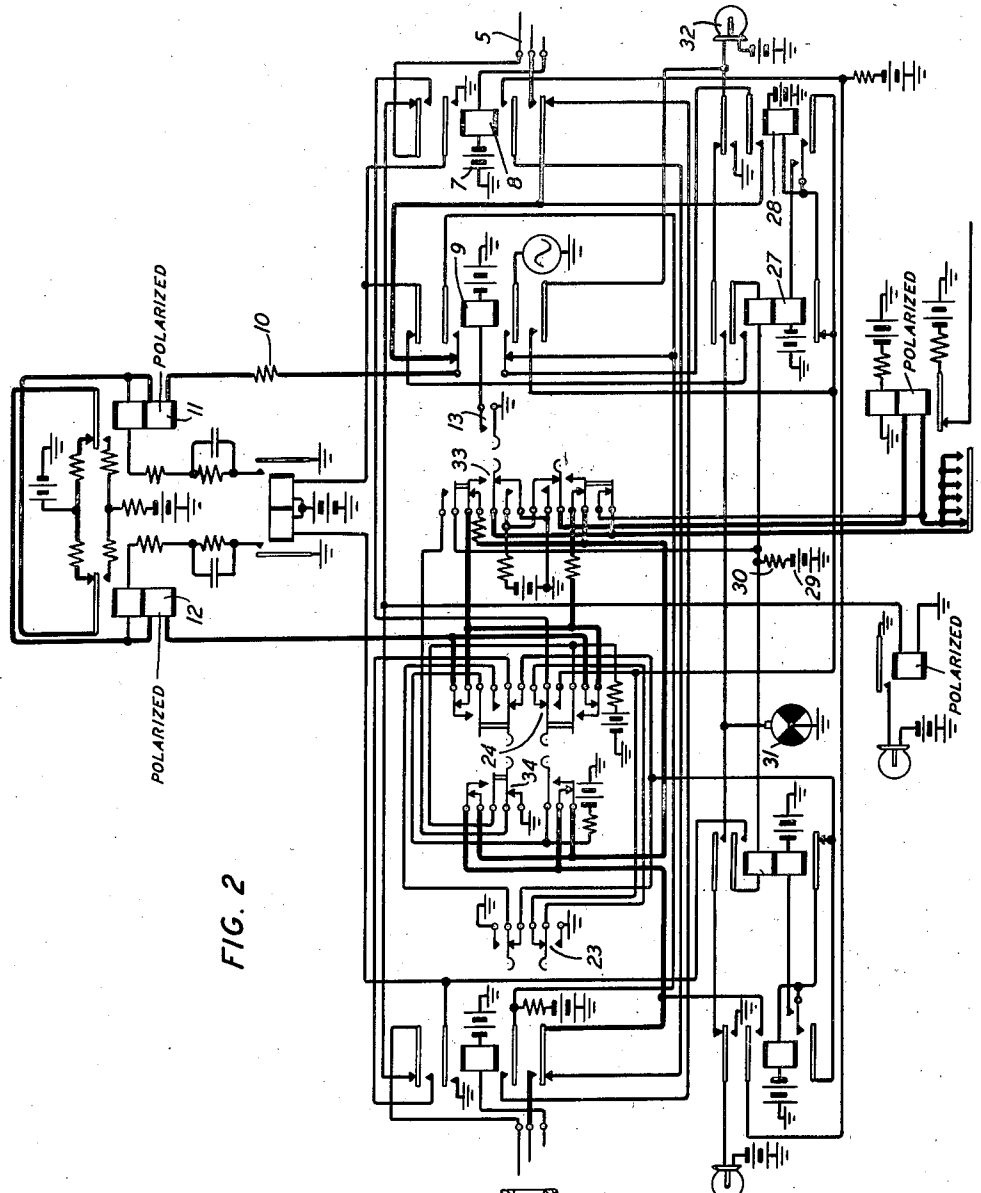


FIG. 2

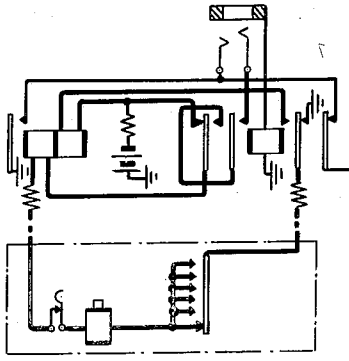


FIG. 3

INVENTOR
F. S. KINKEAD
BY J. W. Schmied
ATTORNEY

Patented Apr. 16, 1935 1,998,086

UNITED STATES PATENT OFFICE

1,998,086

TELEGRAPH EXCHANGE SYSTEM

Fullerton S. Kinkead, Ridgefield Park, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 29, 1933, Serial No. 704,379

9 Claims. (Cl. 178—2)

This invention relates to teletypewriter switching circuits of the manually operated type employing link circuits preferably in the form of cord circuits for interchangeably connecting subscribers' and toll lines and supervising connections set up over them.

Features of the invention are:

The use of a novel arrangement for transmitting supervisory signals over a toll line. There are three kinds of signals that need to be transmitted over a telegraph toll line for supervisory purposes: 1. A call signal; 2. A recall signal; and 3. A disconnect signal. It has been proposed and claim is made elsewhere to the use of selectors stepping synchronously at each end of the line, these selectors being actuated by independent sources of one-second impulses. In accordance with this invention the use of independent synchronously operated timing systems or devices is entirely eliminated.

A feature of the invention is that, instead of timing the open impulses by a locally actuated timing device, the impulses which step the selectors are generated by self-interrupting relays at the central office originating the supervisory signals and are transmitted over the line to the distant central office. The breaks or interruptions, of which these impulses consist, are long enough to cause the release of slow release relays designed to hold up over the break impulses sent by normal operation of printing telegraph machines. The closed period of the line between breaks must be short to prevent breaking the series of impulses. The chance of such a series of breaks being produced by normal operation of a printing telegraph machine is negligible.

The time required for the transmission of supervisory signals is reduced. In the past it has been the practice to use signals differentiated by the fact that the line was opened for various lengths of time. This time had of necessity to be longer than any open period of the line normally met during telegraph transmission. In accordance with this invention a peculiar combination of signals is used which will not be duplicated in telegraph transmission and which are of much shorter duration than that previously used.

The time required to send the calling signal is unlimited in length. In the past the time required to operate the calling signal was limited by the independently operated selectors. In this invention a single open and closure of the line is used for this function and the time of the open is of no importance.

An open at the distant end or any part of the line will not mutilate or hinder the transmission of a recall or disconnect signal but will only delay its transmission.

This system is designed primarily for use on the toll lines of teletypewriter exchange systems, where the main switching points are separated by long distances and are connected by means of telegraph channels including links of the voice or high frequency carrier current type or of the open wire or metallic cable direct current type including repeaters.

General description

In general, a teletypewriter exchange system is made up of a number of switching points which are connected one to another by means of toll lines. Each switching point also has connected to it a number of subscribers. Connections are manually made between subscribers, either direct as in the case of two subscribers connected to the same switching point or exchange, or by means of toll lines when the subscribers are located at distant points.

It is necessary in order to supervise these interconnecting toll lines that provision be made for certain signals to be transmitted over these which are different in character than those transmitted over the line during transmission by the teletypewriters.

These signals, as covered in this description are: 1. The call signal to establish connection between one operator and another; 2. The recall signal to reestablish communication between the operators after a call has been completed and the operators have retired from the circuit; and 3. The disconnect signal to indicate that the communication is complete and the cords can be removed. It is obvious that other signals can be transmitted for other purposes in the same way and this application is not limited to these three.

Drawings

In the accompanying drawings:

Fig. 1 shows a teletypewriter tool line termination at a central office A connected to a telegraph repeater of a type which is well known in the art, and is therefore not shown in detail. This repeater is connected over a telegraph channel to a similar repeater in central office B which is in turn connected to a toll line termination which is identical with Fig. 1 and is indicated by a block at central office B.

Fig. 2 shows a cord and operator's circuit for

use in connection with Fig. 1, from which the supervisory signals are sent and in which they are received at the distant office.

Fig. 3 shows a subscriber circuit connected to a subscriber's line terminating circuit at the central office. This circuit is shown only to complete the system and is not involved in the following description.

The teletypewriter machine used by the subscriber and the operator are of a known type in commercial use.

Originating a toll line call signal

Referring to Fig. 1, when the circuit is in the normal idle condition as shown, the transmission circuit is closed from battery in the telegraph repeater over the T lead, one winding of relay 1, a pair of contacts on relay 2, a pair of contacts on relay 3, over the S lead to the opposite polarity of battery in the repeater. Relay 1 is therefore held operated to its contact 4 which in turn holds relay 15 operated over an obvious circuit. A similar condition is existent at central office B.

If operator A wishes to call operator B the plug 5 of Fig. 2 is inserted into jack 6 of Fig. 1. A circuit may then be traced from battery 7, winding of relay 8, the sleeve of plug 5, the sleeve of jack 6, one winding of relay 3 to ground. Relays 3 and 8 will therefore be operated. The transmission lead may now be traced from battery in the telegraph repeater over lead T, one winding of relay 1, a pair of contacts of relay 2, a pair of contacts of relay 3, the ring of jack 6, the ring of plug 5, a pair of contacts of relay 8, a pair of contacts of relay 9, resistance 10, one winding of relay 11 to the opposite polarity of battery on the contacts of relay 12. The transmission circuit is now established from the cord of central office A over the telegraph channel to a Fig. 1, in central office B which is in the idle condition.

The operator at A now operates key 13, which in turn operates relay 9 over an obvious circuit. The operation of relay 9 opens the transmission circuit at a pair of contacts, and this open is transmitted over the line to central office B. The line is held open as long as key 13 is operated but is closed as soon as key 13 is released which releases relay 9.

Reception of call signal

At central office B when the open line or call signal is received, the operation of the telegraph repeater will remove current from the normally closed T lead, and in consequence will deenergize the winding of relay 1. Relay 1 will move to its contact 14 under this condition by means of the bias current in its other winding. The operation of relay 1 to its contact 14 will operate relay 16 which in turn will operate relay 17, both over obvious circuits. Relay 15, however, will release and close a circuit to operate the rotary magnet 18 which will step the wipers 1 and 2 of the selector SEL to point 1. When the line closes, relay 1 will return to its contact 4, relay 16 will release and apply ground through the contacts of relay 17, wiper 1 and contact 1 of the selector, a pair of contacts and the winding of relay 19, contacts of relay 2 to battery on the contacts of relay 3, causing relay 19 to operate and lock up. Relay 17 also releases but being of the slow release type provides time for the operation of relay 19. Relay 19 closes a pair of contacts which lights the lamp 20 indicating to operator B that she is being called. Relay 19 also applies the busy test condition as described in Locke-Kinkead application Serial No. 459,684 filed June 7, 1930.

The return of relay 1 to its contact 4 reoperates relay 15 removing current from the rotary magnet 18. Likewise when relay 17 releases, a circuit will be provided for the release magnet 21, from ground on the contacts of relay 16, contacts of relay 17, the winding of release magnet 21, a pair of the "off normal" contacts 22 which were operated when the selector stepped, to battery at the contacts of relay 2. The energization of the release magnet will restore the selector to normal and open the "off normal" contacts.

Answering a call signal

The B operator will answer by plugging a plug 5 of a cord circuit similar to that of Fig. 2 into jack 6 which will operate relays 3 and 8 as previously described. The operation of relay 3 will release relay 19 which in turn will extinguish the lamp 20. It is to be noted that relay 1 will follow all teletypewriter signal impulses but relay 15 is of the slow release type and will not release on these signal impulses.

Transmission of a recall signal

Assuming now that exchanges A and B are connected together as has been described with one each of Figs. 1, 2 and 3 at each end and the operators have retired from the circuit. Assuming also that for some cause subscriber A has recalled operator A by a means known and described elsewhere and that it is necessary for operator A to recall operator B, operator A will originate this call by operating key 23 which will apply ground through the contacts of key 24, contacts of relay 8, tip of plug 5, tip of jack 6, contacts of relay 25, winding of relay 2, to battery on the lower contacts of relay 3, relay 3 being operated. Relay 2 will operate, and lock up through the "off normal" contact 22. Relay 2, when operated, will apply battery to the tip or transmission lead looking toward the cord, and will complete the circuit for the T lead, through its own contacts and the contacts of relay 26. Relay 2 will also apply battery to the winding of relay 26 which will open the T lead, causing relay 1 to go to its contact 14. Relay 15 will release causing relay 26 to release. The release of relays 1 and 15 will, of course, cause the wipers of the selector to step to point 1, in a manner previously described. Relay 19 can not operate, however, because its winding is open at relays 2 and 3. Relay 2 also can not unlock because battery is held on its locking winding by wiper 2. The release of relay 26 will reclose the T lead, again operating relays 1 and 15, but the selector can not restore because the circuit of the release magnet 21 is open at the contacts of relay 2. The reoperation of relay 15 will again energize relay 26 which will reopen the T lead again releasing relays 1 and 15 which will step the selector to point 2. When wiper 2 reaches the second point, the locking circuit for relay 2 is open and relay 2 will release restoring the T lead circuit to the cord and closing it. This action reoperates relays 1 and 15 which restores the selector and causes relay 25 to operate through point 2 of bank 1 of the selector. The operation of relay 25 causes no action to take place in the cord at station A, it being assumed that operator A's typing key is thrown as will be brought out in the discussion under the next heading.

Thus two breaks of a definite duration are transmitted to the distant end.

Reception of a recall signal

The reception of the two breaks at central office B transmitted from operator A will release and operate relays 1 and 15 twice, stepping the selector wipers up to points 2. Wiper 2 will have no function as relay 2 is not operated. Wiper 1 will, however, connect the ground from the combination of released relay 16 and released relay 17 to operate relay 25. Relay 25 will apply ground to a circuit through the tip of jack 6, tip of plug 5, contacts of relay 8 which is operated, contacts of key 24, contacts of key 23, which is not operated, contacts of relay 27 to battery through the winding of relay 28. Relay 28 will operate, in turn operating relay 27. Relay 27 will lock up from battery 29 through resistance 30, another winding of relay 27, contacts of relay 9 to ground at the contacts of relay 8. When the selector returns to normal at the expiration of the two pulses relay 25 is released and relay 28 consequently releases. Under this condition, a circuit is formed from interrupter 31, contacts of relay 27, contacts of relay 28 and lamp 32, which causes lamp 32 to flash from the interrupter 31. Lamp 32 was, of course, maintained lighted while relay 28 was operated but only for a short time. The operator will answer this signal by operating her typing key 33, which applies ground from contacts of key 34 to short-circuit relay 27 thus releasing it and extinguishing lamp 32.

Transmission of a disconnect signal

Assuming the same initial condition that we had prior the transmission of a recall signal, if subscriber A disconects it will be necessary for operator A to notify operator B to remove her toll line plug. To do this, operator A operates key 23 which operates relay 2 which in turn locks up through the "off normal" contacts 22. In addition, however, she removes her plug which releases relay 3. The operation of relay 2 now actuates relay 26 causing the selector to step in the manner previously described. When the wipers arrive on point 1, relay 19 can not operate because its operating circuit is open at relay 2, and relay 2 will remain locked because of the battery on point 1 of bank 2. When the wipers get to point 2 relay 25 will operate but produce no result because the plug is out of the jack. Relay 2 will remain locked from point 2 of bank 2 because battery is now present on that point because relay 3 is released. When the wipers get to point 3, however, relay 2 will release and consequently the selector will release, it being noted that the circuit of point 3 of bank 1 is open at the contacts of relay 3. Thus, three pulses are transmitted to the distant end.

Reception of a disconnect signal

At station B, the three pulses will be received in the same manner as the two pulses for the recall signal were received. However, when the wipers get to point 3, the circuit through point 3 of bank 1 will be completed through the winding of relay 25, the contacts of relay 3, the winding of relay 17 to battery forming a locking circuit for relay 17 thus preventing its release and consequently the release of the selector. The wipers are in consequence held on point 3, relay 25 is held operated and ground is held steadily to complete the circuit through relays 27 and 28 of the cord. Lamp 32 is, therefore, lighted steadily. This is the signal for the operator to remove the cord. The removal of the cord releases relay 3, which releases relay 17 thus releasing the selector. The removal of the cord also removes the ground from relays 27 and 28. Relay 3 is also released deenergizing relay 27, thus the lamp 32 is extinguished.

It will be noted that in the transmission of either the recall or disconnect signals if the line is opened elsewhere in the circuit, this open impulse will simply be added on to an open pulse originating in the toll terminating circuit and the sequence of steps will continue as soon as this extraneous open of the line is closed.

The disconnect and recall signals referred to will appear at all stations on the line in the direction of transmission. Thus, if toll line stations A, B, C and D are connected in a circuit in the order named, a disconnect or recall signal transmitted from B toward C will appear at both stations C and D but not at station A, although the operator at station B could transmit the signals toward and to station A also by manipulating the splitting key in the cord circuit to apply ground to the tip of the cord extending toward the station in question.

What is claimed is:

1. A teletypewriter system comprising a line circuit over which telegraph impulses are transmitted, line terminating equipment at the end of said line and devices for sending or receiving supervisory signals thereover, comprising a stepping switch, relay means unresponsive to normal telegraph signaling impulses associated with said switch, devices whereby said relay means cause said switch to step once upon a single break impulse received over said line and twice upon two break impulses received over said line, etc., and means whereby when the line is not in use one predetermined number of break impulses produces the call signal and means whereby when the line is in use other predetermined numbers of break impulses, respectively, cause recall or disconnect signals.

2. A system comprising a line circuit over which telegraph impulses are transmitted comprising a line, line terminating apparatus therefor, and devices for sending and receiving supervisory signals comprising a cord circuit and a stepping switch, relay means unresponsive to normal telegraph signaling impulses associated with said switch, devices controlled by said relay means whereby said switch is caused to step once upon a single break impulse received over said line with said cord circuit unconnected to said line and twice upon two break impulses received over said line with said cord circuit connected to said line in combination with devices controlled by said switch whereby one signal is actuated as a result of a single step of said switch and another signal is actuated as a result of two steps thereof.

3. In a printing telegraph toll line system, a toll line terminating at a central office, line terminating equipment connected to said line for supervisory purposes, said equipment including a stepping switch and actuating relays, said actuating relays stepping said switch differently upon a given succession of line interruptions separated by a very short closure than if separated by a longer closure.

4. In a printing telegraph toll line system, a toll line terminating at a central office and extending to a distant office, toll line terminating equipment including supervisory relays and also a multiple point stepping switch connected to said toll line at said office, characterized in this that a line interruption of any length substan-

tially greater than a normal telegraphing impulse causes said stepping switch to step one step to give a call indication.

5. In a printing telegraph exchange system, a line connecting two central offices, a cord circuit at each office for connecting said line through to another line terminating at each of said stations, a key in said cord circuit, and terminal equipment for said line at each end thereof, said terminal equipment including stepping switches, relay means in said terminal equipment controlled by operation of said key when the cord circuit is connected thereto to cause said stepping switch to step twice and to send over the line two open conditions.

6. A system according to claim 5 wherein the two open conditions received at the distant end of said line when the cord circuit thereat is connected to said line cause the stepping switch thereat to step twice and whereupon upon reclosure of said line a circuit through a recall signal device is energized.

7. In a printing telegraph system, a line connecting two central offices, a cord circuit at each office for connecting said line through to another line terminating at each of said stations, a key in said cord circuit and terminal equipment for said line at each end thereof, said terminal equipment including stepping switches, relay means in said terminal equipment controlled by the operation of said key when the cord circuit is connected thereto followed by the immediate disconnection of said cord circuit therefrom to cause said stepping switches to step three times and to send over the line a corresponding number of open conditions.

8. A system according to claim 7 wherein the three open conditions received at the distant end of the line when the cord circuit thereat is connected to said line cause the stepping switch thereat to step three times, energizing a disconnect signal circuit and remaining stepped until the disconnection of said cord from said line deenergizes said signal circuit and restores said stepping switch.

9. In a printing telegraph toll line system, a toll line terminating at a central office, line terminating equipment connected to said line at each end thereof for supervisory purposes, said toll line terminating equipment being unresponsive to normal telegraph printer signals but responsive to predetermined numbers of line interruptions to produce recall or disconnect signals, said circuit having stepping switches responsive to said line interruptions of any length to produce said recall or disconnect signals, characterized in this that the stepping switches at the various stations are not synchronized whereby a great and abnormal time duration of an open impulse upon said line may delay but does not prevent proper stepping of said stepping switches.

FULLERTON S. KINKEAD.