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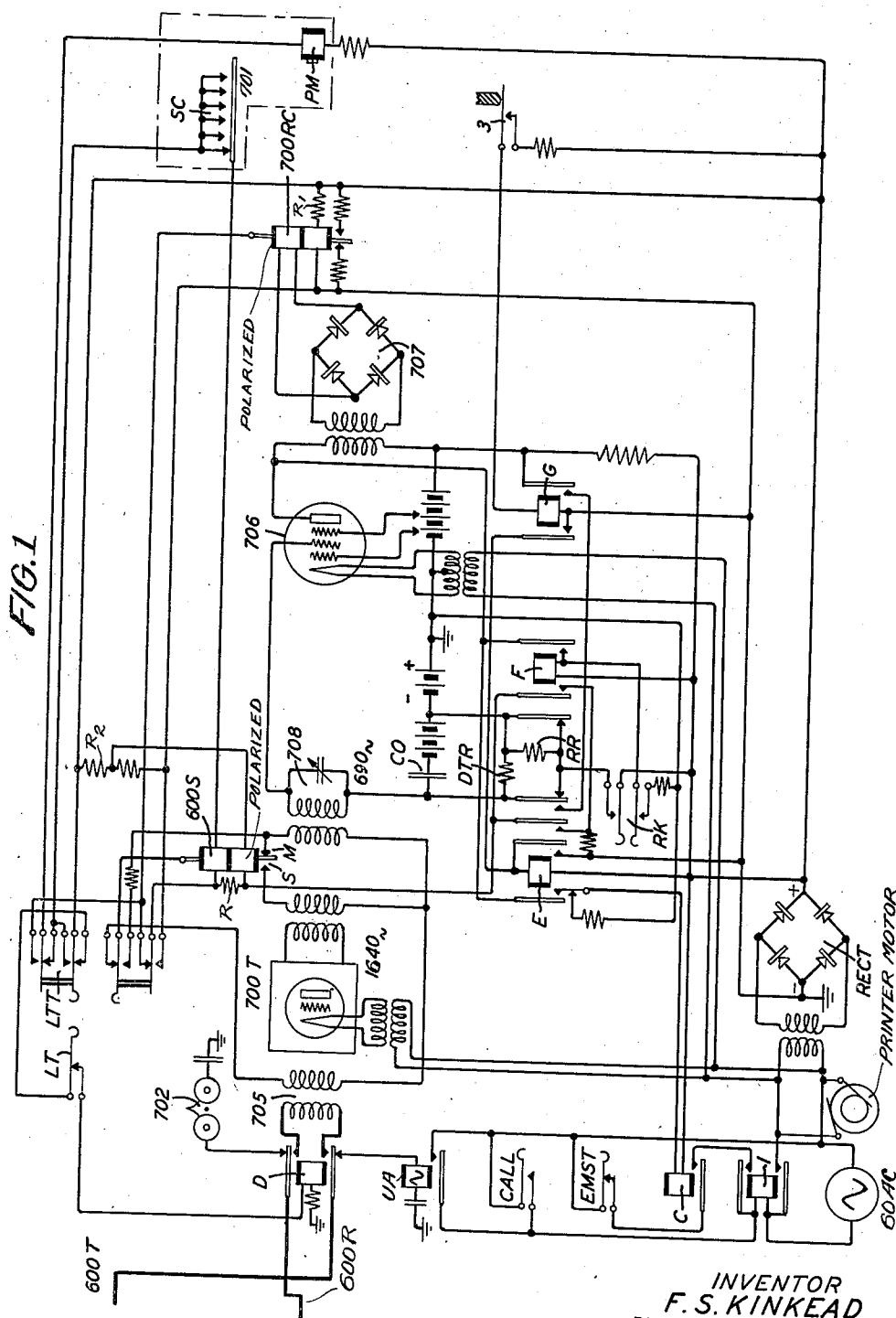
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2,106,352

TELETYPEWRITER STATION

Filed March 15, 1935

4 Sheets-Sheet 1



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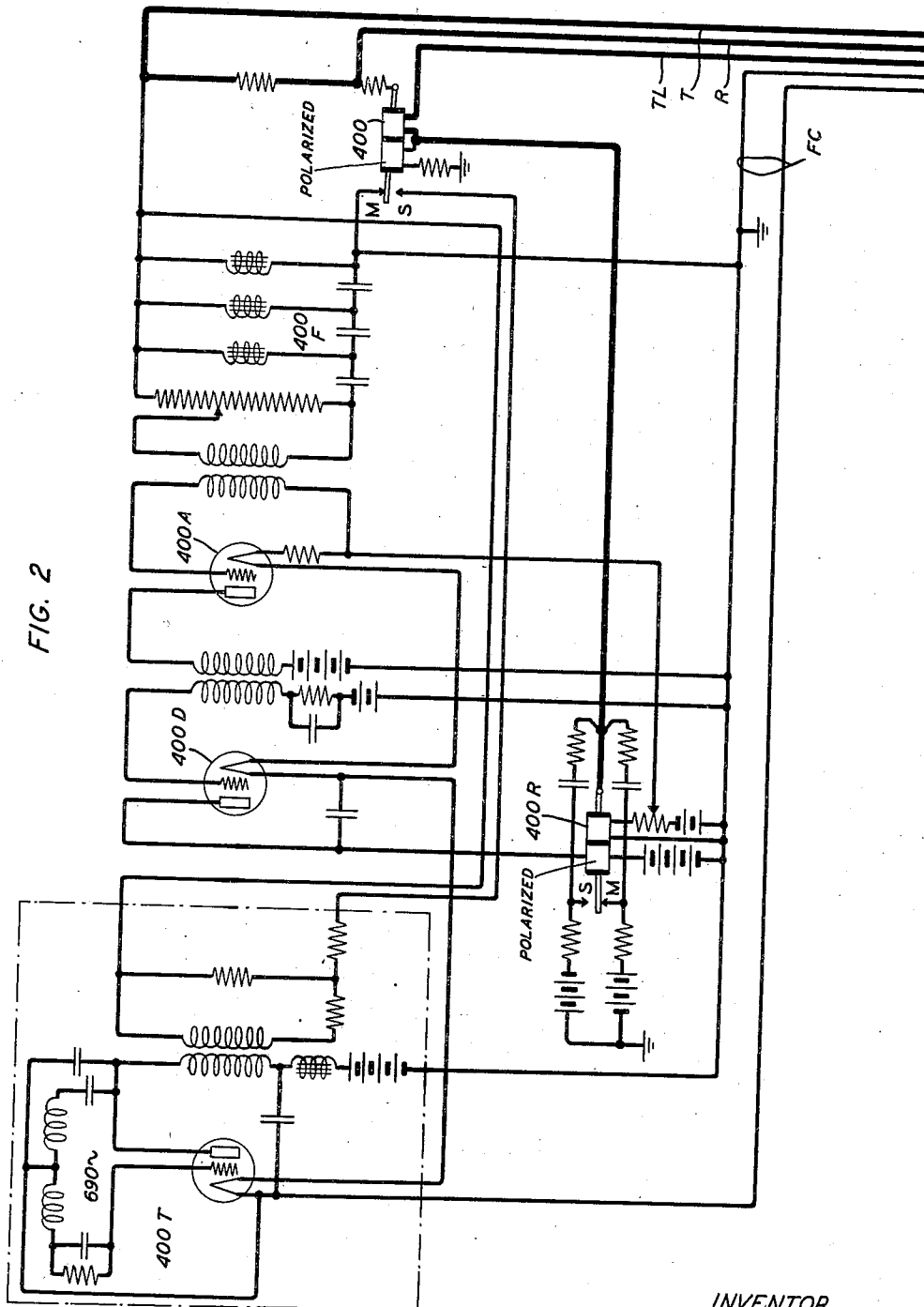
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TELETYPEWRITER STATION

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4 Sheets-Sheet 2



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TELETYPEWRITER STATION

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4 Sheets-Sheet 3

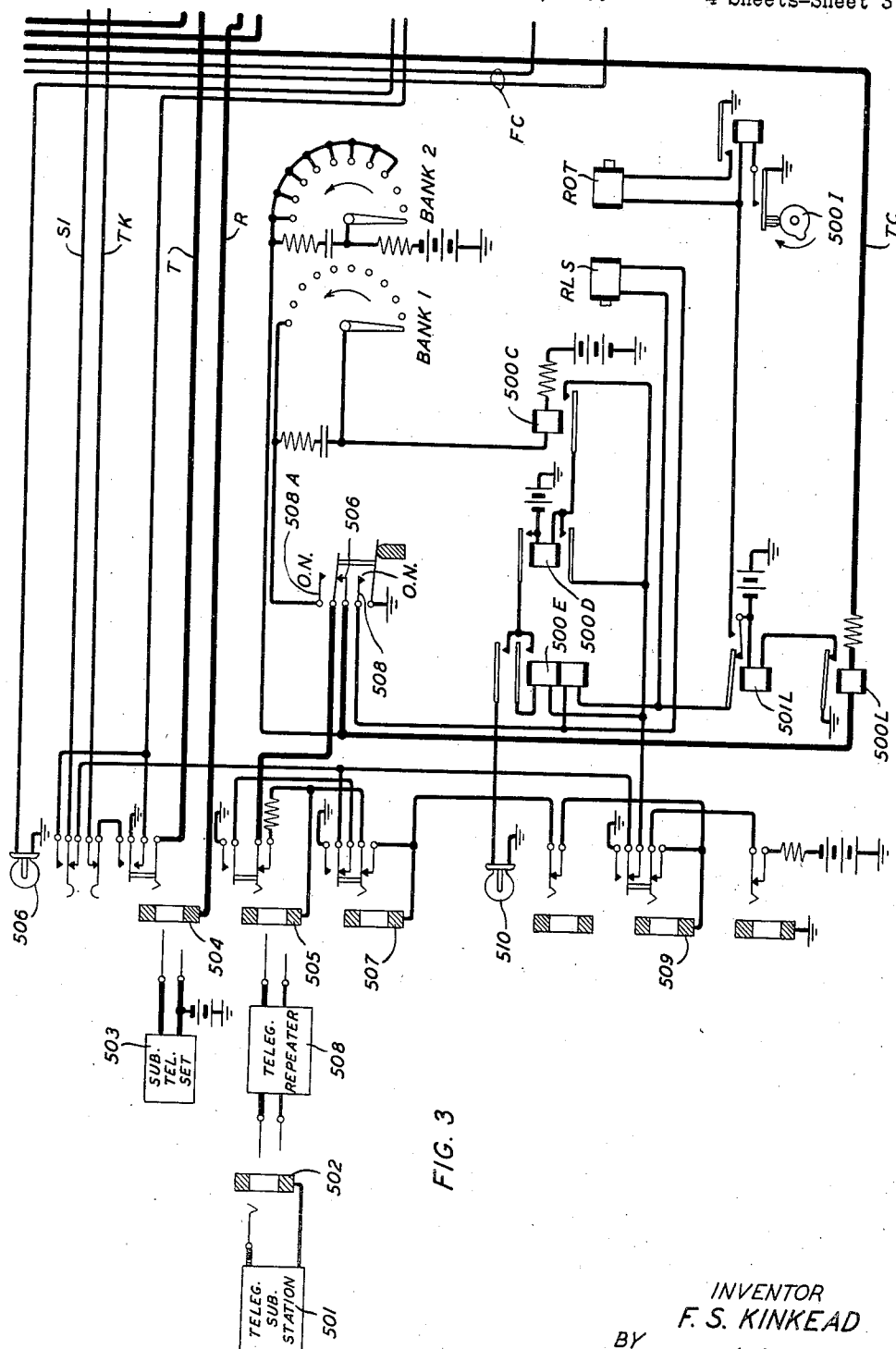


FIG. 3

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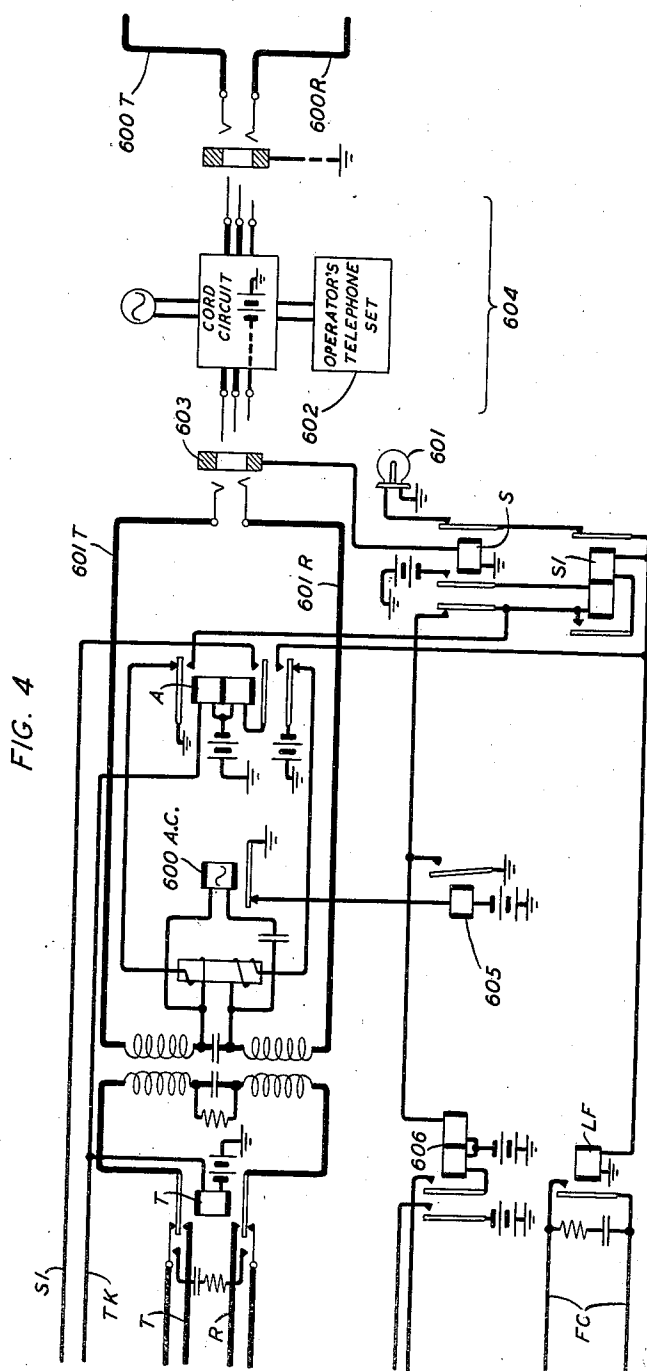
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TELETYPEWRITER STATION

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

2,106,352

TELETYPEWRITER STATION

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Application March 15, 1935, Serial No. 11,194

10 Claims. (Cl. 179—4.1)

This invention relates to station circuits for teletypewriter communication systems of the type whereby exchange service may be given to subscribers at outlying points from the nearest teletypewriter switching point over available telephone lines to the subscriber's station.

One object of the invention is to provide improved arrangements whereby recall and disconnect signals may be sent from such a station circuit.

Another object of the invention is to provide circuit arrangements whereby service may be given on an unattended basis, i. e., that messages may be recorded upon the subscriber's teletypewriter instrument when no person is present at the subscriber's station.

Another object is to provide circuit arrangements whereby interruptions upon the line for recording recall and disconnect signals at a teletypewriter operator's position are automatically caused to be of different durations so that different signals may be energized for recall and for disconnect indications.

Other objects are generally to improve terminal station arrangements of teletypewriter systems.

In the application of Hysko-Large-Munro, Serial No. 747,136 filed October 6, 1934, are disclosed the essential elements of a teletypewriter system for providing teletypewriter switching service to a subscriber without extending to his station a long telegraph line including expensive repeater and terminal equipment. In accordance with that system, a subscriber may be connected by a carrier channel extending through his local telephone exchange and other lines of a telephone exchange network to the nearest or other suitable teletypewriter exchange switching point. At the teletypewriter switching point is a teletypewriter jack circuit extending to a circuit consisting of oscillator - modulator - demodulator equipment which may be called a teletypewriter carrier terminal circuit. The carrier channel from said teletypewriter carrier terminal circuit extends to multiple jacks at a telephone toll board through a teletypewriter control circuit and thence through any number of telephone exchange offices to the office at which the subscriber's line terminates and thence to an oscillator-modulator-demodulator circuit at the subscriber's office.

At the teletypewriter switching circuit, a jack is connected to a conductor, lead or line extending, in general, to a teletypewriter exchange system. Means are provided whereby supervisory conversations between the teletypewriter and the

telephone toll operators, relative to putting through a teletypewriter call, proceed to the telephone toll board circuit over a voice circuit, but when the operator at the teletypewriter exchange switching point plugs a teletypewriter cord circuit into the teletypewriter trunk thereat, the telephone toll line circuit is seized for the transmission of voice frequency waves modulated in accordance with teletypewriter signaling impulses to the outlying subscriber.

Circuit arrangements embodying the present invention are shown in the accompanying Fig. 1;

Figs. 2, 3, and 4 show arrangements employed with Fig. 1 to constitute a complete system, said Figs. 2, 3, and 4 being essentially in accordance with application Serial No. 747,136 mentioned above;

Fig. 2 is a simplified circuit arrangement of the oscillator-modulator-demodulator unit which is connected at times in a telegraph trunk channel between a direct current telegraph line and the voice frequency telephone system;

Fig. 3 is a simplified diagram of the operating circuits of a teletypewriter trunk terminating equipment; and

Fig. 4 is a simplified diagram of a trunk control circuit.

A part of the system disclosed in said application Ser. No. 747,136 consists of the equipment at the outlying subscriber's station, said equipment being illustrated in Fig. 7. By reference to said Fig. 7 one observes that from the outlying subscriber's station equipment there proceed the tip and ring conductors 600T and 600R of the telephone line extending to a telephone exchange and terminating thereat in the usual supervisory equipment. It will be understood, however, that the operator at said exchange has no teletypewriter instrument for communicating with the outlying subscriber, her sole function with respect to a particular line being to pass the call on by telephone supervision to other operators so that a circuit may ultimately be set up to connect the outlying subscriber to a teletypewriter operator at a teletypewriter switching point. Communication over the telephone lines of the system is solely by voice frequency carrier current modulated telegraphically. The present invention relates particularly to features of the outlying subscriber's station shown in Fig. 1; the other parts of the system are described in only sufficient detail to indicate the nature and operation of the entire system.

A comprehensive view of the various components of the system may be gained by consid-

ering each principal component circuit thereof and its principal functions.

The teletypewriter trunk carrier circuit or oscillator-modulator-demodulator circuit accomplishes the following functions:

- (1) The generation of carrier current of a suitable fixed frequency in the voice range.
- (2) Modulation of the carrier current in accordance with printer signals supplied by the teletypewriter switching equipment connected to and associated with the telegraph switching point, which carrier current is to be transmitted over telephone lines to the outlying subscriber.
- (3) Demodulation of carrier current received over telephone lines from the outlying subscriber.
- (4) Repetition of the signal impulses, resulting from the demodulation, into the teletypewriter switching equipment looking towards the teletypewriter exchange network.
- (5) Transmission of break signals through the circuit in either direction.

The carrier teletypewriter trunk control circuit accomplishes the following functions:

- (1) The production of a visible indication of an outgoing call at the telephone toll switchboard.
- (2) The giving of a visible and audible indication of an incoming call.
- (3) Switching from telephone communication to telegraph communication.
- (4) The production of suitable supervisory signals at the toll switchboard.
- (5) The reception of incoming signals when the teletypewriter cord circuit is connected into circuit.
- (6) Suitable termination of the carrier telegraph circuit when the telephone network part of the system is used for telephone communication.
- (7) Closure of the filament heating circuit of the carrier oscillator-modulator-demodulator equipment whenever the telephone circuit is utilized at the telephone toll switchboard.

(8) Production of signal to the teletypewriter switching operator in case of an erroneous disconnect made by the telephone toll operator.

The carrier teletypewriter trunk jack circuit performs the following functions:

- (1) Gives a suitable signal proceeding from telephone toll operator.
- (2) Provides a talking channel to the telephone toll switchboard.
- (3) Provides switching and supervisory facilities for teletypewriter communication.
- (4) Distinguishes between the lengths of spacing impulses used for supervision on the teletypewriter circuits.
- (5) Furnishes supervisory signals back to the telephone toll operator.

The subscriber's set circuit of Fig. 1 performs the following functions:

- (1) Operates as a switching and interconnecting instrumentality to connect the subscriber's teletypewriter set to his local telephone office.
- (2) Permits the subscriber's station operator to call the teletypewriter operator by teletypewriter signals, to transmit and receive teletypewriter signals and to send recall or disconnect signals to the teletypewriter operator.
- (3) Permits the subscriber's station operator to operate his station locally without interfering with a call from the central office operator.
- (4) Amplifies and demodulates carrier telegraph signals impressed upon the circuit terminals to produce from carrier telegraph signals of a level lying within the working range

of the circuit direct current impulses suitable for operating the teletypewriter.

(5) Provides a suitable source of carrier frequency current preferably different from that used for reception and modulates this carrier current in accordance with the teletypewriter impulses.

(6) Furnishes power through suitable circuit arrangements to operate the subscriber's set and the teletypewriter.

(7) Permits the driving motor, the receiving amplifier and the detector to be energized under the control of ringing current from the subscriber's telephone office for the reception of messages when the subscriber's station is unattended.

(8) Permits the shutting down of the subscriber's station under the control of the central teletypewriter exchange operator or any other teletypewriter operator connected to the line after the completion of reception of a message.

(9) Permits the subscriber at the subscriber's teletypewriter station of Fig. 1 to send break signals on different appropriately selected lengths as recall and disconnect signals.

Systems in accordance with the invention may assume a variety of forms. In one form the teletypewriter call for communication with an outlying subscriber, or vice versa from the outlying subscriber for connection to a teletypewriter network, is assumed to arrive over or to the terminating point of a suitable telegraph line, which terminating point constitutes a station commonly known in telegraph parlance as a telegraph test board. With some modification the equipment at such a board is organized to perform the additional functions necessary to constitute a component part of a system to extend the call to the outlying subscriber. Such modified test board circuits are shown at the central portion of Fig. 3.

Let the telegraph subscriber's station 501 of Fig. 3 represent any subscriber upon a telegraph line however extended and which through one or more teletypewriter exchanges or not ultimately terminates at the jack 502. A suitable signal lamp, not shown, is associated with jack 502 in accordance with test board practice for informing the telegraph test board operator that a call is awaiting on the line connected to the jack 502. It may be considered that the call arrives at the test board over another circuit from another subscriber's station connected to the test board by a circuit of the same kind that leads to the subscriber's station of Fig. 1. The telegraph operator plugs an operator's teletypewriter circuit into the jack 502 and inquires telegraphically what is desired. The desired information may be received from a subscriber at station 501 or from an intermediate operator. We shall suppose that the call is for the subscriber at the station of Fig. 1 having a telegraph equipment 701 associable with a line which terminates at his nearest telephone office in a jack and supervisory lamp which is in all respects similar to a telephone line except that it has a line lamp of a special color for the information of the operator. (The call might be for any other subscriber having similar equipment.)

Having received the information the telegraph operator plugs into the jack 504 an operator's cord circuit 503 equipped with a telephone. Upon doing this ground upon the upper spring of the jack is supplied over the lead TK to relay A. The

relay A operates and supplies battery to the lamp 601 which lights. The relay T also operates over the lead TK which connects the leads T and R to the telephone toll operator who plugs her cord circuit into the jack 603 and connects her telephone set 602. The telegraph operator then passes orally to the telephone toll operator the information concerning the wanted subscriber who puts the call through the line 600T, 600R, which line may include none or any number of telephone exchanges 604. The last operator calls the subscriber at the set 701 by the ringer 702 in the manner common in telephone practice. Upon the ringing of the bell the subscriber is informed that he is wanted for a teletypewriter communication. The operation of the key CALL by the subscriber will actuate the relay I. The subscriber's station of Fig. 1 is then prepared for operation in the manner hereinafter described in the section entitled "Subscriber calls the central office."

Meantime the telegraph operator has placed a telegraph repeating cord into the jacks 502 and jack 505 and thereafter pulled out the telephone cord from the jack 504. Relay T releases. Ground is then supplied over the upper spring of the jack 505 to the lead S1 which closes a holding circuit for the relay A. In operating, the relay A had previously operated the relay S1 over an obvious circuit. When the telephone operator plugs into the jack 603 the relay S operated thereby locking up the relay S1 over the front contact of the relay S to ground on the upper inner contact of relay A. The relay LF operated and closed the filament circuit of the three tubes of the oscillator-modulator-demodulator circuit of Fig. 2. This allows the filaments to become heated so that by the time the subscriber at the station of Fig. 1 answers the tube circuit is ready for communication. The subscribers at stations 501 and Fig. 1 are now connected for telegraph communication by means of their respective teletypewriter machines over the circuits connecting them including the circuits of Fig. 2.

Oscillator-modulator-demodulator set between telegraph and telephone lines

Fig. 2 includes the sending oscillator tube 400T, an amplifier tube 400A and a detector tube 400D. When the filaments are heated by a circuit FC which is closed when the relay LF is actuated, the oscillator generates current of a suitable frequency in the voice range, for example 690 cycles per second. When a teletypewriter machine in the operator's circuit or a telegraph repeater 508 is plugged into the jack 505, battery is applied to one of the windings of the polar relay 400 over a path from the tip of the jack 505 to the normal selector contact 506, the relay 500L and conductor TL and winding of relay 400 through the other winding of relay 400 to ground. This current cooperating with that supplied from the marking contact of relay 400R actuates the armature of relay 400 to its upper position. Whenever the teletypewriter machine connected directly or indirectly to the jack 505 is operated to produce a spacing impulse upon the line, the relay 400 is actuated back to its lower position. Alternating current of 690 cycle frequency is therefore impressed upon a telephone line to represent spacing impulses and no current on the telephone line represents marking impulses. This current is received in the demodulating cir-

cuit of the subscriber of Fig. 1 provided with machine 701 as will be further discussed hereinafter. When signals are not being transmitted by the relay 400, it is at a standstill in the upper position and received impulses of alternating current of a suitable different frequency, for example, 1640 cycles per second, may arrive over the line from the oscillator 700T. This alternating current energizes the input circuit of the amplifier tube 400A and after amplification the energy is supplied to the detector tube 400D which is so adjusted that the rectified current in the output circuit actuates the receiving relay 400R to shift the armature thereof and supply marking and spacing conditions corresponding to marking and spacing current arriving in the detector tube over the tip of the jack 505 to the telegraph line or operator's instrument connected thereto. During the sending process a portion of the carrier current sent out on the line may be reflected back into the carrier terminal equipment due to imperfect balance at repeater points and for possible other reasons. If the time of return of the reflected current should be sufficiently long after the sending of the current into the line the part of the current sent during the spacing interval would be received when the relay 400 was connected to the receiving circuit during the marking interval. False operation might thus result and in order to prevent such false operation the input circuit is tuned or otherwise suitably provided with a filter 400F to prevent the passage of current of the frequency of 690 cycles per second but to pass freely received current of the frequency of 1640 cycles per second.

It will be understood that the line arriving at the subscriber's station has the transmission characteristics of a local telephone line, that the closure of the tip and ring at the subscriber's station operates a line signal at the subscriber's telephone exchange in accordance with telephone practice, that the operator at the subscriber's telephone exchange may apply ringing current to the ring side of the line to signal the subscriber, that the operator at the subscriber's telephone exchange may apply ringing current to the tip side of the line to start the motor of the local teletypewriter subscriber's station and perform other functions as will be described hereinafter, that carrier current waves arriving over the line represent spacing impulses sent under the control of distant telegraphic apparatus, that absence of carrier current on the line represents marking impulses sent under control of distant telegraphic apparatus, that carrier wave impulses applied to the line by the outlying subscriber represent spacing impulses and absence of carrier waves represents marking impulses which may be received and interpreted by distant telegraphic apparatus and that at a distant teletypewriter operator's position there will be found apparatus to give a recall or disconnect signal, which apparatus is selectively responsive to spacing signals of approximately seven or ten seconds duration sent by the outlying subscriber from his station. With the understanding of these matters, the following description may be confined to the equipment at the outlying subscriber's station.

The essential elements of such equipment are diagrammatically illustrated in the accompanying Fig. 1 which is a diagrammatic representation of the elements constituting the improved

subscriber's station in their circuitual relationship to one another.

The principal elements of the system in the specific embodiment shown, comprise a ringer 702 normally connected to the ring side 600R of the incoming line which has two sides, 600R, 600T; a transmitting relay 600S; a receiving selective circuit 708 tuned to 690 cycles; an amplifying tube 706; detecting rectifiers 707 of a suitable type; a transmitting oscillator 700T adjusted to transmit a frequency different from the incoming frequency, for example, in the present case, 1640 cycles; a suitable 60 cycle or other alternating current power source 60AC; a power rectifier RECT; transmitting contacts SC of the subscriber's teletypewriter instrument; a receiving printer or selector magnet PM of the subscriber's teletypewriter instrument; a call key CALL; an emergency stop key EMST; a recall key RK; certain high resistances connected with the receiving amplifying tube 706 for sending timed recall and disconnect signals in a manner which will be hereinafter described; and other control relays, keys, and equipment which will be described in connection with the detailed description of the operation.

Subscriber calls the central office

Normally the equipment is in unenergized condition but it is assumed that the source 60AC is a constantly available source of power such as an alternating current power line circuit. Let it be assumed that the subscriber wishes to call the teletypewriter operator in order to be connected through the teletypewriter switching point to some other subscriber. The local subscriber closes the call key CALL and relay I operates and supplies power to the rectifier RECT. The rectifier RECT is illustrated by a conventional diagram indicating the equipment ordinarily used for converting alternating current to direct current. The rectifier immediately energizes the relay C over an obvious circuit and relay C holds operated over an obvious circuit through a make-upon-release contact of relay E. The relay C, upon operating, causes the relay I to lock up over a path from source 60AC, through the winding of relay I, upper make contact of relay I, make contact of relay C, through closed emergency stop key EMST, back to the other side of source 60AC. Current is also supplied from the positive side of the rectifier RECT over a circuit extending through the contacts of the line test key LTT and the local test key LT and winding of relay D to ground. The source 60AC supplies heating current to the filaments of the tubes in the oscillator 700T and the amplifier 706. Furthermore, the rectifier RECT, upon being energized, supplies current over a path beginning at its positive output terminal, through the printer receiving magnet PM, thence through the contact of the line test key LTT and the printer contacts SC, relay 600S, other contacts of key LTT and armature and left contacts of 700RC to negative side of the rectifier RECT. The relay 600S will be held in its marking condition, which corresponds to no alternating current being upon the line, by this current flowing in the upper winding although a current one-half as great flows in the lower winding tending to operate the 600S relay to spacing. The circuit through which the current one-half as great flows in the lower winding is traced as follows; beginning at the positive terminal of the rectifier RECT, through a resistance R2, lower winding of relay 600S, resistance

R, a contact of LTT, armature of relay 700RC and the left-hand contact of relay 700RC to ground. When the relay D is energized, it connects the tip and ring side of the line to the repeating coil 705 and a circuit is closed through the repeating coil and the input transformer of the tuned circuit 708. When the tip and ring of the line are closed through the repeating coil, a supervisory calling signal lamp is lighted at a subscriber's local telephone office. The operator will recognize the line lamp either through special knowledge thereof, or because of its special color, as belonging to a teletypewriter subscriber rather than a telephone subscriber and the operator will cause the line 600T, 600R to be extended through to a teletypewriter switching operator at a teletypewriter exchange switching point.

The telephone toll operator plugs her cord circuit into the jack 603 and rings on the circuit toward the teletypewriter operator with alternating ringing current in the usual manner common in telephone practice. This actuates the relay 600AC which in turn releases the relay 605 and operates the relay 606 which locks up to ground on the upper spring of jack 504 and lights the teletypewriter toll lamp 506. The teletypewriter operator plugs her telephone cord circuit 503 into the jack 504. This removes ground from the locking winding of the relay 606 which releases and extinguishes lamp 506. The relays A and T operate. In operating, the relay A operates the relay SI and the relay LF. The relay LF closes a circuit which lights the filaments of the tubes 400T, 400D and 400A. The relay SI locks up under control of the relay A. The relay T transfers the leads T and R to the talking jack 504 and places a terminating impedance including a resistance and a condenser across the carrier circuit extending from Fig. 2. The telephone operator now gives orally to the telegraph operator the calling subscriber's number. The telegraph operator plugs an operator's teletypewriter cord circuit into the jack 505 and thereafter removes the plug from the jack 504. This releases the relay T but the relay A is held operated through its secondary winding and ground over the lead SI. The telegraph operator then receives from the calling subscriber at the station 701 information as to the party with which the subscriber at said station wishes to communicate. The telegraph operator plugs into the jack 502 which is connected to a line extending, in the general case, to a teletypewriter switchboard of any suitable type or, in the simplest case, directly to a teletypewriter subscriber's station and after the call is answered the connection is completed when the telegraph repeater 508 is plugged up between the jacks 502 and 505. The subscribers then communicate by teletypewriter.

Recalling the teletypewriter operator from the telephone toll position

If the telephone toll operator wishes to recall the teletypewriter operator, she may do this by ringing upon the circuit with her ringing key. The relay 600AC operates and lights the lamp 506 which stays lighted because the relay 606 locks up when no telephone set is in jack 504. When communication between the subscribers ends, the teletypewriter operator will be informed by a disconnect signal on the line connected to jack 502 or by other means as will be hereinafter described and will remove the plug from jack 505. When the teletypewriter cord is taken down from jack 505, the circuit relay A releases which places

battery on the ring conductor 601R and ground on the tip conductor 601T which lights the usual cord supervisory lamp (not shown) in the toll telephone operator's cord circuit. Such supervisory lamps and operating circuits therefor are disclosed in numerous patents and are well known to those skilled in the art. The operator takes down the cord circuit 602 which clears the telephone circuit in the usual manner.

10 Operation of the oscillator-modulator-demodulator conversion unit of Fig. 2

Fig. 2 comprises the oscillator tube 400T and its associated circuits, the detector 400D and the 15 amplifier 400A with an input filter 400F tuned to pass the carrier frequency to be received and to exclude the carrier frequency to be transmitted. The polar sending relay 400 normally stands on its marking contact during the operative condition of the circuit and the relay 400R likewise normally stands on its marking contact. The polar relay 400 is controlled from the teletypewriter or teletypewriter circuit connected to the jack 505 20 over a path extending from the tip of the plug, tip of the loop, contact 506, relay 500L, lead TL to the right-hand winding of relay 400, and thence to positive battery on the contact of relay 400R. When the teletypewriter interrupts the path just traced during a spacing impulse, the relay 400 is 25 actuated to its spacing contact and high frequency current is applied thereover to the tip and ring T, R of the voice frequency channel. Thus voice frequency carrier waves are transmitted to the line, the carrier waves being on the line for spacing signals and off the line for marking signals. 30

For reception from the outlying station of Fig. 1 the receiving circuit is connected to the line through the armature and marking contact of relay 400. Received waves traverse the filter 400F, are amplified by the amplifier 400A and rectified or detected by the detector 400D. The detector tube 400D is adjusted to such a negative grid potential that the anode current thereof is 35 substantially zero when no alternating current input is received. During the spacing impulse, i. e. carrier on the line, the current in the output circuit of the detector 400D rises sufficiently so that the relay 400R is actuated to its spacing contact and negative battery is impressed upon conductor TL. Because the conductor TL is connected to negative battery at its other end, the telegraph circuit is effectively open thereby causing the telegraph repeater to transmit a spacing impulse through the circuit connected to the jack 502. The battery polarities connected to relay 400R and the line at the repeater may be selected and the windings of relay 400 arranged in accordance with any well known repeater practice. 40

During sending by actuation of the relay 400, a portion of the carrier current sent out upon the line may be reflected back into the sending circuit due to imperfect balance at repeater points and to other possible causes. Where the time of return of the reflected current is appreciable due to transmission delay in the circuits, a part of this reflected current may arrive after the beginning of a marking interval during which the receiving current is connected to the line by the sending relay. If this reflected current reaches the detector, false operation of the receiving relay 400R might occur which would produce errors at both the sending and receiving teletypewriter instruments. This is one of the 45 reasons for the inclusion of the filter circuit 400F

which is designed to pass current of the frequency of 1640 cycles per second produced by the oscillator 700T but to attenuate and suppress current of the frequency of 690 cycles per second produced by the oscillator 400T. 5

As stated before, the receiving relay 400R has on its spacing contact battery of the same polarity as that which is applied to the other end of the circuit to which the lead TL is connected and upon its marking contact is battery of the opposite sign. 10

As will be readily seen, a break signal can be transmitted in either direction from the break key upon the teletypewriter instrument or by other suitable means. If printing telegraph signal impulses are being transmitted to the outlying station the outlying station may send a break signal by impressing carrier current on the line continuously for one or two seconds. This causes the receiving relay 400R to be operated to its spacing contact at any time the sending relay 400 is on its marking contact. When this occurs, it is impossible for the sending relay to be operated from marking to spacing and hence the receiving relay remains on its spacing contact as long as the continuous carrier current is being received. 15 During this condition current in the circuit connected to lead TR remains zero whether the loop is open or closed and the break signal is transmitted to the circuit connected to the lead TL. 20 In order to prevent the transmission of break signals long enough to operate the supervisory signals, the station operator may be specially instructed or provided with a device limiting the duration of break signals from the break key of the teletypewriter. 25 30 35

Communication between subscribers

The distant teletypewriter operator will now operate her sending machine which will cause the transmission of interrupted or modulated carrier current of 690 cycles, which interrupted carrier current will come in over the line 600T, 600R. This current will be amplified in the amplifier tube 706 after selection in the tuned circuit 708 and cause impulses of current corresponding to the modulating impulses to be supplied to the rectifier 707. The receiving relay 700RC will be actuated accordingly and will shift its armature from connection to the negative side of the rectifier RECT to the positive side thereof which will cause the relay 600S to move back and forth between its marking and spacing position in a corresponding manner over an obvious circuit. Of course, it will be noted that the path normally supplied to the relay 600S includes the fairly high resistance R and when the armature of the relay 700RC moves from its position shown to the other position, it connects the side of the resistance R which is directly connected to the upper winding of the relay 600S directly to the positive side of the rectifier RECT, thus reversing the current flowing in the lower winding to hold relay 600S marking, there being no current flowing in the upper winding at this time. Since the printer selector magnet PM is directly in series with the sending contacts SC, it will be correspondingly actuated to record the message corresponding to the received impulses upon the subscriber's teletypewriter machine. The subscriber, after reading this message, will operate the contacts SC to send a message to the teletypewriter operator indicating a readiness to receive or communicate. When the contacts SC are opened, the relay 600S will be caused to move its armature from mark- 50 55 60 65 70 75

ing to spacing condition and when the contacts are in spacing condition they will connect the oscillator 700T in a series circuit with the repeating coil 705 and transmit to the line impulses of alternating current representing the impulses induced by operation of the sending contacts SC. The local subscriber may thus communicate with the teletypewriter operator or with another distant subscriber upon the teletypewriter exchange network.

Local subscriber receives a call

Let us now assume that the apparatus is in normal idle condition and that a distant subscriber or the operator at the teletypewriter exchange switching point wishes to communicate with the local subscriber. Upon learning over a telephone trunk that communication with the particular local subscriber is desired, the subscriber's telephone operator at his local exchange applies ringing current to the ring side 600R of the line which causes the ringer 702 to sound. Upon hearing the ringer, the subscriber performs exactly the same operations as previously outlined in case he wished to make a call, starting by closing the start or call key CALL. After closing this key the same operations take place at the subscriber's station as in the case where he wished to make a call and communication takes place as before.

Unattended service

Let us assume now that the local subscriber's station is wholly unattended but that nevertheless he desired to receive any messages from any teletypewriter station on the communication network which might wish to send to him during his absence. When the subscriber's station is unattended he will fail to answer the ring of the ringer 702 and no indication will be given at the subscriber's local telephone office that the relay D has operated. When the subscriber's local telephone operator receives the information that the distant subscriber wishes to communicate upon an unattended basis, she will apply ringing current to the tip side 600T of the telephone line which will cause the operation of the "unattended" relay UA which is designed to be operated by alternating current of ringing frequency. When the relay UA operates, it will close a circuit through the winding of the relay I and the resulting operation at the local subscriber's station will be just the same as when the subscriber manually closed the call key CALL. All the apparatus will be properly energized for reception, and incoming messages of any length may be recorded on the local subscriber's teletypewriter instrument so long as the instrument is furnished with a suitable and sufficient paper supply and other accessories commonly utilized in such cases.

Subscriber sends a recall signal to teletypewriter operator

As previously stated, the line 600R, 600T ultimately terminates in a jack at a teletypewriter exchange, and the line equipment adjacent said jack may be of the type well known in the art in which a seven second interruption upon the line energizes a special recall signal and a ten or more second interruption thereof energizes a disconnect signal. It will be understood that these times are illustrative only and other numbers of seconds may be chosen in accordance with the needs of the particular case. We shall assume, however, that the subscriber at the station

illustrated is communicating with a distant subscriber and at the end thereof wishes to recall some teletypewriter operator in order to be connected to another distant subscriber or to inquire concerning the charges or for any other reason. In order to do this, the subscriber must send a spacing signal which, in the present case, corresponds to alternating current upon the line for some fairly accurately timed period, such as five seconds. To do this, the subscriber operates the recall key RK. This operation connects the positive side of the rectifier directly to the grid side of a large condenser CO in the grid circuit of the tube 706. Ground is also connected to the winding of the relay F which, upon operating, performs three functions. Its first function is to remove the short circuit around the resistance RR thereby putting said resistance in parallel with resistance DTR. The second function is that of locking itself up by connection to a point of positive polarity in the plate circuit of the tube 706. This point of positive polarity is of lower polarity than the positive side of the rectifier RECT and therefore current flows from the rectifier through the winding of relay F and its locking contact to ground through the tube 706. It will be understood at this time that the tube 706 is passing an abnormally large current due to the large positive potential of its grid with respect to the cathode. The other contact of the relay F closes a path from a point between the resistance R and the lower winding of the relay 600S to ground which causes the actuation of the relay 600S to spacing condition thereby impressing alternating current of 1640 cycles frequency upon the outgoing line. This alternating current will be impressed upon the outgoing line for a time determined by the capacitance of the condenser CO and the conductance of the combination of resistances DTR and RR. At the end of about seven seconds, or such other time as may be chosen in a particular case, the positive charge will leak off the condenser CO to such an extent that the polarity of the control grid of the tube 706 will approach its normal condition in which a relatively small space current will be flowing through the tube. When this occurs, the anode of the tube will become nearly of the same potential as the positive side of the rectifier RECT and the relay F will release because insufficient current will traverse its winding to enable it to hold up. When this occurs, the relay 600S will be operated to marking condition and the resistance RR will again be short-circuited. It will be understood that at some distant teletypewriter exchange station the seven second interruption on the line will bring up a supervisory signal known as a recall signal which will cause the operator to challenge upon the line and inquire concerning the wishes of the subscriber at the station under discussion. The apparatus by which the seven second interruption or break signal causes the appearance of a recall signal at the distant teletypewriter exchange is relatively immaterial but for illustrative purposes it may be assumed that the line to said station (which may be any teletypewriter exchange in the circuit at the particular time) is terminated in equipment such as is described in the application of applicant and another, Serial No. 704,380 filed December 29, 1933.

Termination of a communication

Let it be assumed now that the subscriber is in communication with a central teletypewriter of-

fice or with a distant subscriber over a circuit extending through a central teletypewriter office and that upon completion of the communication, one or both parties desire to terminate the communication in such a way as will cause the local subscriber's apparatus to be restored to normal. To do this, any teletypewriter machine operatively connected to the circuit may transmit the code combination corresponding to "upper case H". This will actuate a special pull bar which will close the contact 3. This will cause the relay G to operate over an obvious circuit and it will remain operated only for the relatively short time during which the pull bar maintains the contact 3 closed. Upon operating, the relay G closes a circuit through the winding of relay E which will operate and lock up over its inner lower make contact. The relay G also closes a path from the positive side of the rectifier RECT to the grid side of the condenser CO and charges the condenser to a high positive potential, this path extending over the upper outer make contact of the relay E. A contact of relay E upon operation thereof also disconnects the resistance RR from its parallel relation with respect to the resistance DTR. The middle right make contact of the relay E closes a path from ground to a point between the resistance R and the lower winding of the relay 600S and causes the relay to operate its spacing contact thereby impressing alternating carrier current of 1640 cycles frequency upon the line. The left contact of the relay E transfers the holding winding circuit of the relay C to a point of positive potential adjacent the anode of the tube 706. Inasmuch as the tube at this time is passing a relatively large current, its anode will be of lower positive potential than the positive terminal of the rectifier RECT to maintain the relay CO operated. After about ten seconds, the positive charge will leak off the condenser CO to a sufficient extent to cause the control grid of the tube 706 to assume a potential such as to cause the tube to pass a relatively small space current. The charge will leak off more slowly in this case since only the resistance DTR is connected across the condenser CO. When this occurs, the relay C is caused to release which opens the holding path through the winding of relay I and causes it to release. When relay I releases, the rectifier RECT and the printer motor are deenergized and the filaments of the tubes of the oscillator 700T and the amplifier 706 are deenergized. At the same time the relay D is deenergized and the line 600R, 600T is restored to its connection with the ringer 702 and the relay UA. When this occurs, a disconnect signal appears at the line jack of the subscriber's line indicating to his local telephone exchange operator that the cord circuit is to be disconnected therefrom. Obviously, also, the distant teletypewriter exchange operator will have received a disconnect signal due to the spacing current present upon the line for a period of ten seconds and she will be thereby notified to disconnect the teletypewriter circuit. The entire equipment is restored to the normal idle condition.

Operation of the teletypewriter trunk jack circuit

When continuous carrier current is placed upon the line for approximately ten seconds, the circuit devices of Fig. 3 will be operated to produce a supervisory signal at the teletypewriter opera-

tor's position. The operation by which this takes place will now be described:

There is provided a time limiting circuit whereby spacing signals sent to the telegraph network by the outlying subscriber cannot exceed a predetermined duration, for example, in the present case, five seconds. Upon reception of a spacing signal from the operator at the station of Fig. 1, the relay 500L (Fig. 3) releases. One reason why this is desirable is that the telegraph network may include exchanges whereat seven and ten second break signals may produce automatic recall and disconnect signals, respectively. Ground is removed from the relay 501L which also releases but it is a slow release relay and upon normal signaling impulses it does not release before relay 500L reoperates. In the case of a long spacing signal, relay 501L releases and battery is put on a rotating magnet ROT in series with interrupter 500I which operates at 120 interruptions per minute. On the first step of the rotary switch, the contact 506 is opened and contacts 508 and 508A which are the off-normal contacts of the switch are closed. The brush of bank 2 upon the third step of the switch supplies negative battery of signaling voltage over the brush through the winding of relay 500L to the lead TL which replaces the battery normally supplied for the telegraph repeater and provides battery to release the circuit when the marking condition is restored. If the circuit is held opened for five seconds or more, the brush of bank 1 steps to the tenth point and supplies battery through relay 500C toward jack 505 at the telegraph operator's position. The relay 500C, upon operating, operates the relay 500D if a cord is plugged into the jack 505 or the jack 507. The relay D locks up over contacts on the jack 509 if a cord is plugged into the jack 505 or the jack 507 and the telegraph lamp 510 is lighted. When the circuit closes, the relay 500L reoperates which reoperates the relay 501L. The circuit is then closed to the release magnet RLS from battery over the back contacts of relay 501L. In the meantime, the relay 500E has operated from battery on the make contact of relay 501L and it locks up under control of the relay 500D from battery over the upper make contact of relay 500D, inner make contact of relay 500E to ground on jack 505 or 507 over a contact of jack 509. The operator observes the lighted lamp 510 and challenges on the circuit by plugging a monitoring teletypewriter circuit into the jack 509. This releases the relays 500D and 500E and extinguishes the lamp 510. The operator then challenges upon the circuit and in the case of a recall signal she receives the necessary information transmitted from the subscriber's teletypewriter. In the case of a disconnect signal there will be no answer upon the circuit and the circuit will be pulled down and released.

What is claimed is:

1. A substation for use in a system of telegraph communication employing a subscriber's circuit which is effective for communication only when energized, a sending oscillator of carrier frequency at said substation, a control device thereat, means whereby ringing current transmitted from the subscriber's telephone exchange over one side of the connecting line actuates said control device at the subscriber's station to energize elements of the subscriber's circuit including said sending oscillator for unattended service.

2. A station for a system of telegraph communication, a line connected thereto, said station including a control relay, a teletypewriter including a motor, a special element in said teletypewriter selectable by suitable signal permutations, a relay operable by said element upon selection thereof, further relay means conditioned by operation of said relay, devices whereby conditioning of said relay means places a predetermined condition upon said line for the duration of said conditioning only, and time controlled means functioning after a time long as compared with several normal telegraphic impulses to remove the condition from said further relay means.

3. A teletypewriter subscriber's station for giving teletypewriter exchange service to a subscriber over a telephone network which comprises telephone equipment at a teletypewriter exchange for calling the subscriber through a telephone central office, an oscillator-modulator-demodulator circuit at the subscriber's station and a similar circuit between the teletypewriter exchange and the telephone office, said subscriber station including means under the control of currents arriving over the incoming line for seizing the line of said subscriber for teletypewriter communication and energizing said oscillator-modulator-demodulator circuits thereof.

4. In a teletypewriter system, a subscriber's circuit connected to the line for teletypewriter communication thereover by modulated carrier current, an oscillator-modulator-demodulator circuit at the subscriber's station for producing and modulating outgoing carrier current and receiving and demodulating incoming carrier current, a device under control of the operator for deenergizing said oscillator-modulator-demodulator equipment at the end of a communication, and other devices controlled by the actuation of said device for maintaining a spacing condition on the line for a period of time exceeding a normal break signal after the actuation of said device and before said equipment is deenergized.

5. A subscriber's station including a teletypewriter machine, an oscillator-modulator-demodulator circuit for generating and modulating outgoing carrier current in accordance with the operation of said teletypewriter instrument and receiving and detecting incoming carrier current to control said teletypewriter instrument, a communication circuit over which incoming and outgoing carrier current is transmitted, and instrumentalities whereby other current transmitted over a branch of said circuit starts the motor of said teletypewriter instrument and energizes the oscillator-modulator-demodulator equipment at said station.

6. A subscriber's station for teletypewriter communication, said station including sending and receiving instrumentalities, an oscillator for generating carrier current to be transmitted, connections whereby the sending instrumentality modulates the oscillator current, a detector for receiving incoming carrier current, connections whereby the detector actuates the receiving instrumentality, said circuit having a normal inoperative condition and an operative condition in which it is adapted to receive messages, further characterized in that means is provided whereby upon the transmission to said station of alternating or fluctuating current the circuit is caused to change from its inoperative non-receiving condition to its operative receiving condition.

7. A system, in accordance with claim 6, provided with further mechanism whereby upon the transmission from a distant station of a special signal the station apparatus is restored to its normal non-receiving condition.

8. A teletypewriter station having an incoming line and a discharge tube, said discharge tube being connected with a resistance-condenser combination, means for giving the resistance-condenser combination different time constants, two distinct instrumentalities operable to control the energizing of said line, and instrumentalities controlled by said resistance-condenser combination to delayedly de-energize said line at distinctly different times.

9. A teletypewriter station including telegraphic sending and receiving instrumentalities together with amplifying, detecting and oscillating instrumentalities for communicating telegraphically over a single pair of wires, characterized in that means is provided whereby suitable currents incoming over said pair of wires energize said sending and receiving instrumentalities and said amplifying and detecting instrumentalities for receiving messages conveyed to said station by suitable currents flowing over said wires.

10. A telegraphic station having devices for transmitting and receiving message impulses, said devices having a normally deenergized condition, a relay actuatable to energize said devices, a holding circuit for said relay energized upon the actuation of said relay, a control circuit for said holding circuit operable to open said circuit under the control of an element selectable by said impulses, and connections whereby operation of said control circuit transfers said holding circuit to a path which contains a device automatically opening said holding circuit after a time duration of at least a plurality of seconds.

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