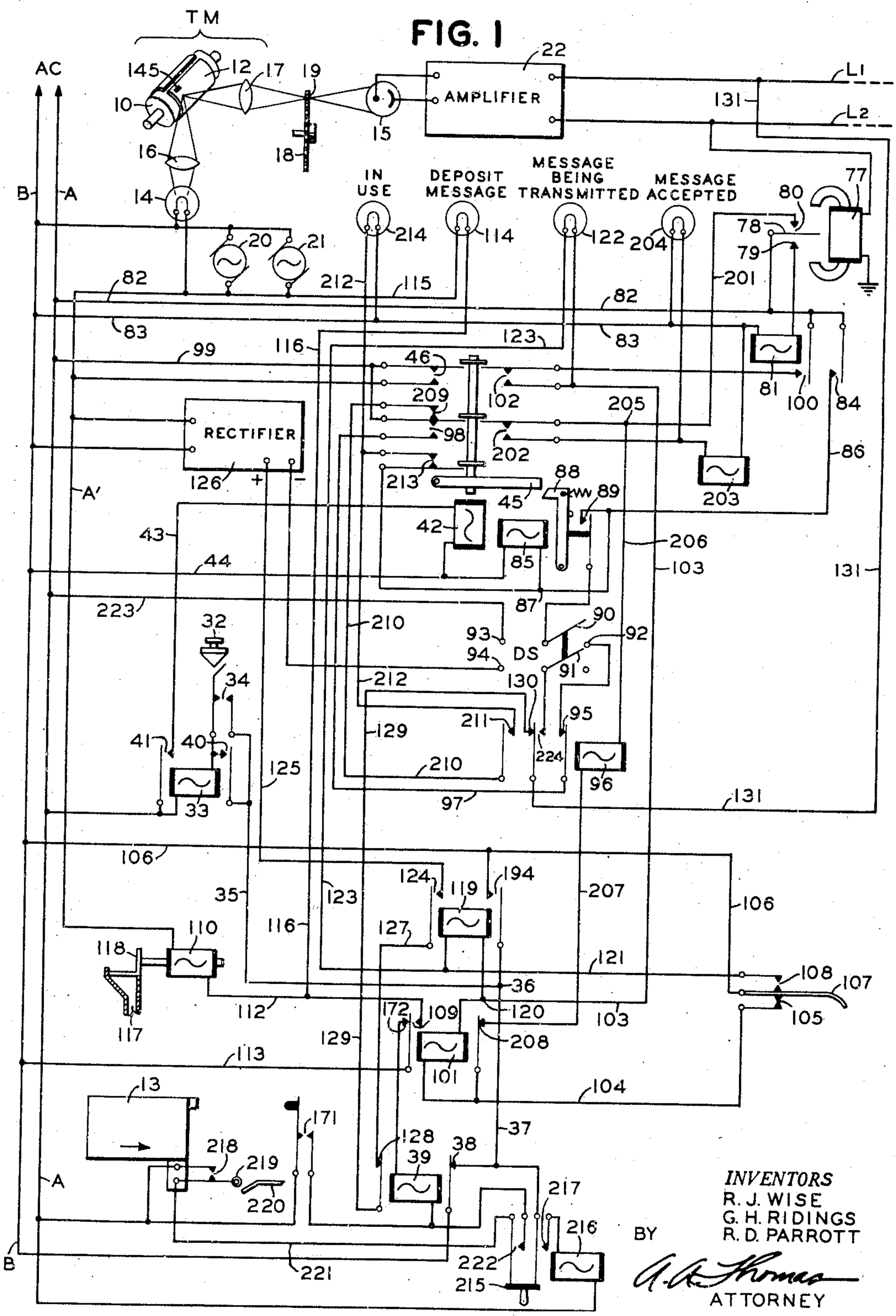
Oct. 4, 1949. R. J. WISE ET AL 2,483,449

FACSIMILE TRANSMISSION SYSTEM

Original Filed April 18, 1941 2 Sheets-Sheet 1

FIG. 1



INVENTORS
R. J. WISE
G. H. RIDINGS
R. D. PARROTT

BY A. A. Thomas
ATTORNEY

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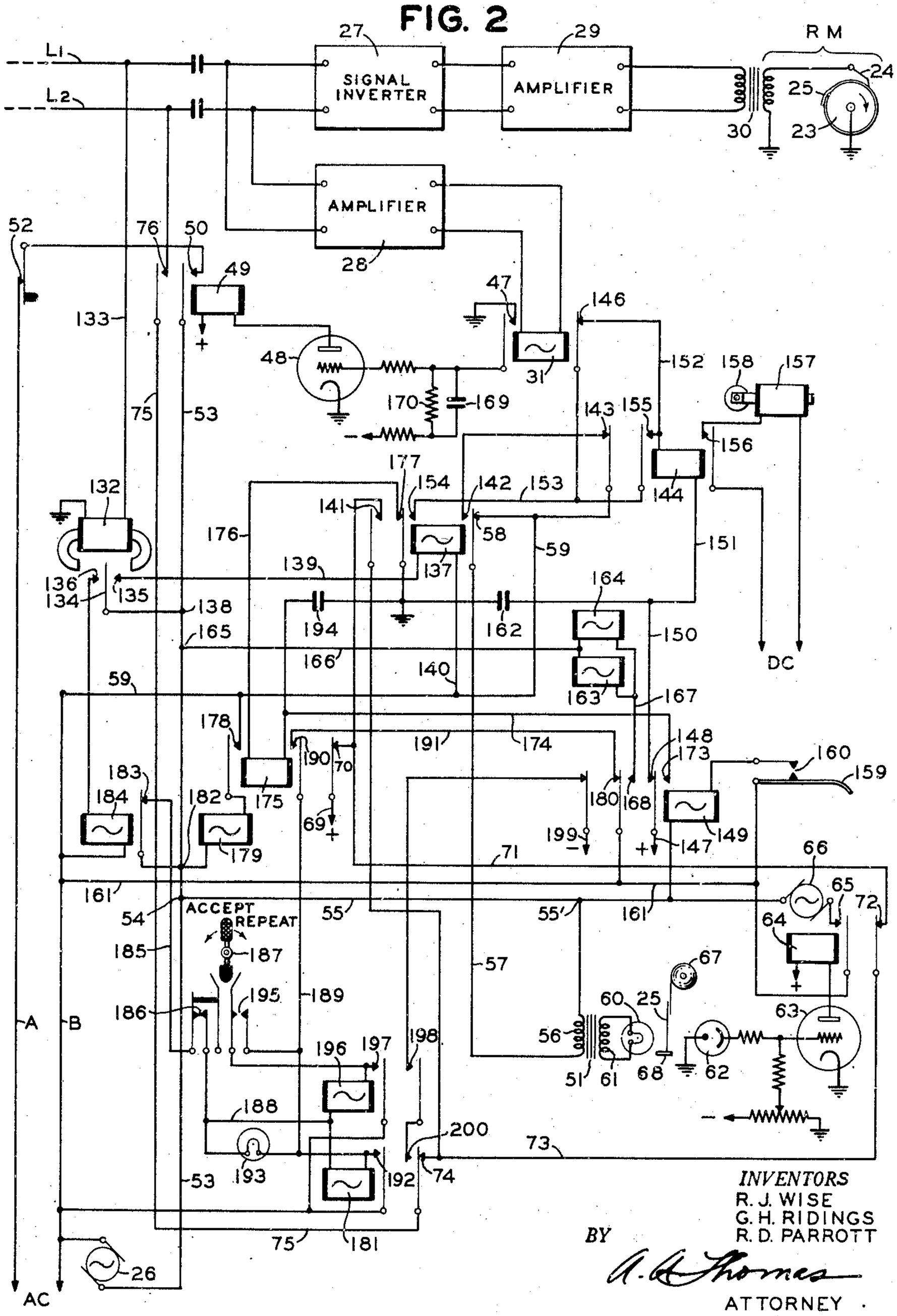
Original Filed April 18, 1941 2 Sheets-Sheet 2

FIG. 2



INVENTORS
R. J. WISE
G. H. RIDINGS
R. D. PARROTT

BY A. A. Thomas

ATTORNEY

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FACSIMILE TRANSMISSION SYSTEM

Raleigh J. Wise, Dunellen, Garvice H. Ridings, Summit, and Robert D. Parrott, West New York, N. J., assignors to The Western Union Telegraph Company, New York, N. Y., a corporation of New York

Original application April 18, 1941, Serial No. 389,164. Divided and this application December 9, 1944, Serial No. 567,418

36 Claims. (Cl. 178—6.6)

1

Our present invention relates to facsimile transmission systems and its object is to provide novel connections between the transmitter and the recorder for the automatic control of the recorder from the transmitter. This does away with certain manual operations heretofore required at the recorder in systems of this type. Conversely, certain operations at the recorder react automatically on the transmitter for controlling certain functions of the latter, as will be apparent from the description to follow.

According to one feature of this invention, the connection of the recorder to a source of power is automatically controlled by a carrier current generated by the transmitter. In other words, the recorder operates only during the period of generation of the carrier current. Upon cessation of the latter, as when the end of the transmitted message is reached, the recorder is automatically disconnected from its source of power. This simplifies the practical use of our system.

In a preferred form of our invention we provide means for enabling the attendant at the recorder to make one or more copies of the transmitted message. For this purpose the attendant simply operates a switch and the system automatically transmits the message again for another recording.

We may also provide means for selectively conditioning the system to transmit a single message or a series of messages deposited one after the other as each is recorded. That is, our system can be set for intermittent operation or for continuous operation, and this control is effected by merely operating a switch at the transmitter.

The foregoing and other features and advantages of our invention will be apparent from a description of the accompanying drawings, in which:

Fig. 1 is a wiring diagram of the control circuits associated with the transmitter; and

Fig. 2 is a diagram of the circuits associated with the receiver or recorder.

In these diagrams we have shown only such elements of the transmitting and recording apparatus as are necessary to explain the operation of the control circuits, which may be combined with any practical form of transmitter and recorder. For example, a suitable construction of transmitter and recorder is disclosed and claimed in our copending application Serial No. 389,164, filed April 18, 1941, now Patent No. 2,365,741, granted Dec. 26, 1944, of which the present case is a division.

2

In Fig. 1 (upper left corner) the transmitter mechanism TM is represented by a scanning cylinder 10 on which a message sheet 12 is properly mounted for the transmission operation. For convenience we shall speak of the subject matter on sheet 12 as a message, but obviously it may be any kind of intelligence adapted to be put on paper or like material, like a drawing or a picture. In shop parlance, the message sheet is usually referred to as copy. A suitable scanning carriage 13, shown in the lower left corner of Fig. 1, is operatively associated with cylinder 10 and carries the usual parts for scanning the message sheet 12. It will be sufficient to show an exciter lamp 14, a photocell 15, interposed lens systems 16 and 17, and a light interrupting disc or chopper 18. The disc 18 has peripheral holes or notches 19 for the interrupted passage of light to the photocell 15. A motor 20 rotates the cylinder 10 and moves the scanning carriage 13 axially of the cylinder through suitable driving connections. Another motor 21 rotates the chopper disc 18 at the proper speed to produce the desired carrier frequency.

In the operation of the transmitter TM a beam of light emitted by lamp 14 is condensed by lens 16 to a small spot on cylinder 10 or sheet 12 if the latter is mounted on the cylinder. The light reflected from that spot is directed by condensing lens 17 through the peripheral holes or notches of disc 18 to photocell 15. The output of this cell is passed through an amplifier 22 and impressed upon a pair of line conductors L1 and L2.

As will be understood, the action of exciter lamp 14 on photocell 15 generates a carrier current of a frequency depending upon the rotary speed of disc 18 and the number of its peripheral notches. The light reflected from the cylinder itself or from the background of the message sheet generates a carrier current of even tone and maximum value. When the scanning spot strikes the message bearing portion of the sheet, the carrier current will be modulated in accordance with the tone values of the copy.

Turning to Fig. 2, the receiving or recording mechanism RM is represented schematically by a rotary cylinder 23 and the recording stylus 24. The latter is suitably mounted for scanning movement in contact with the recording blank 25 on cylinder 23. It should be understood that when no recording is being done, the stylus is dissociated from the cylinder. For convenience we have assumed that the recorder RM is of the electro-chemical type, so the stylus 24 is connected in the recorder circuit. The recording cylinder

23 is operated by a motor 26 (see lower left corner of Fig. 2) through suitable driving connections, and this motor may also operate the scanning carriage in which the stylus 24 is supported. The mechanical connections between the motor 26 and the parts 23 and 24 need not be shown or described because such details do not form part of this invention and will be understood by those skilled in the art.

At the receiving station the line conductors L1 and L2, which carry the facsimile signals or impulses generated by the transmitter, are connected in multiple to a signal inverter 27 and an amplifier 28. The inverter 27 is connected to an amplifier 29 which is coupled through a transformer 30 to the recording circuit of stylus 24. By reason of its connection to line conductors L1 and L2, the amplifier 28 passes all of the facsimile signals to control the operation of a relay 31, the function of which will be described in due course.

The source of power for the transmitting station and the receiving station is indicated by a pair of bus bars A and B for each station. In this instance the source of power is alternating current. When the system is idle, the transmitting and receiving stations are not connected to their respective sources of power.

Suppose a person wishes to transmit a message inscribed on a suitable blank provided for that purpose. Before the copy can be deposited in the machine, it is necessary to operate a push button 32 at the transmitter. This energizes the relay 33 through a circuit extending from bus bar A through the winding of the relay, push button contact 34, wire 35 to point 36, wire 37, and through the break contact 38 of a relay 39 to the bus bar B of the alternating current supply. The energized relay 33 closes its contact 40 which is connected in parallel with push button contact 34, so that the relay becomes locked and permits release of the push button.

The make contact 41 of energized relay 33 connects one terminal of a relay 42 to bus bar A through a wire 43, and a wire 44 connects the other terminal of relay 42 to bus bar B. The relay 42 is thus energized to move its armature 45 downward for actuating a plurality of switch contacts associated therewith. The closure of one of these contacts 46 connects the main bus bar A to a secondary bus bar A'. Connected between bus bar A' and bus bar B are the exciter lamp 14, the driving motor 20 for the scanning cylinder 10, and the motor 21 for driving the light chopper disc 18. As previously mentioned, the motor 20 also operates the driving connections, usually including a feed screw, for the optical scanning carriage 13.

It will thus be seen that the optical scanning mechanism of the transmitter is energized for operation before the deposit of the message intended for transmission. The exciter lamp 14 causes the photocell 15 to generate an unmodulated carrier current of maximum amplitude by the reflection of light from cylinder 10. This carrier current is transmitted through amplifier 22, which is always conditioned for operation, over the line conductors L1 and L2 to the receiving station.

The received signals, suitably amplified by amplifier 28 and being of maximum amplitude, cause the operation of relay 31. Through a make contact 47 of this relay the input circuit of a vacuum tube 48 is energized to close the plate circuit thereof, thereby energizing a relay 49 connected in series with the output circuit of

the tube. The closure of make contact 50 of relay 49 connects a transformer 51 to the source of power through the following circuit from bus bar A, switch 52, contact 50, wire 53 to point 54, wire 55 to point 55', through the primary winding 56 of transformer 51, wire 57, closed contact 58, and wire 59 to bus bar B. The function of transformer 51 is to energize an exciter lamp 60 connected to the secondary winding 61, as shown in the lower right corner of Fig. 2. The closing of contact 50 also energizes the motor 26, which operates the recording cylinder 23 and the scanning carriage of stylus 24.

The switch 52 in the main power line may be controlled by a hinged panel of the recorder cabinet and is held closed until the panel is opened for access to the apparatus inside, whereupon the switch is automatically released to cut the power off. So far as the operation of this system goes, the switch 52 may be omitted and we mention it here only because it is described in our parent application.

If it be assumed that the recorder is in such condition that there is no recording blank in position to be placed upon cylinder 23, then the light from lamp 60 falls upon a photocell 62, thereby energizing the output circuit of a vacuum tube 63. A relay 64 connected to the output circuit of this tube becomes energized to close its contact 65, thereby connecting one terminal of the blank feed motor 66 to the bus bar B. The other terminal of this motor is connected to bus bar A through wires 55 and 53, the closed contact 50 of energized relay 49, and the panel switch 52.

The operation of feed motor 66 conveys one of the recording blanks 25 from a supply roll 67 into a position for mounting on the recording drum or cylinder 23. In this preliminary position the blank 25 rests on a suitable support 68 between the exciter lamp 60 and the photocell 62. The light falling on the photcell is thus interrupted and the vacuum tube 63 becomes inoperative, thereby releasing the relay 64 and stopping the feed motor 66.

We might mention that since the blank feeding mechanism associated with the recorder does not in and of itself form part of our present invention, we have not considered it necessary to show or describe any structural details thereof. Our parent application discloses a blank feeding mechanism suitable for use in connection with the system herein set forth.

When the relay 64 is released at the stopping of the blank feeding mechanism, as just described, a positive direct current potential is applied to the line conductor L2 through the following connections: from the positive terminal 69 of a direct current source, contact 70, wire 71, contact 72 of relay 64, wire 73, contact 74, wire 75, and through closed contact 76 of relay 49 to line conductor L2. Let us see what effect this has on the transmitter.

Referring to Fig. 1, there is a three-position polar relay 77 connected to line conductor L2. The armature 78 of this relay lies normally between two contacts 79 and 80. In response to positive potential applied to line conductor L2, the armature 78 is moved to contact 79. A circuit is thus provided for the operation of relay 81, extending from bus bar A, wire 82, armature 78, contact 79, through the winding of relay 81, and wire 83 to bus bar B. Closure of the make contact 84 of relay 81 energizes a locking solenoid 85 through the following circuit: from bus bar A,

wire 82, closed contact 84, wire 86 to point 87, through the winding of solenoid 85, and wire 44 to bus bar B.

The energized solenoid 85 moves its armature 88 to the left over the adjacent armature 45 which has previously been moved downward by the energized relay 42. In this way the solenoid 85 locks the armature 45 and its associated switches to operated position, even when the relay 42 is denergized. At the same time the make contact 89, closed by the operation of locking armature 88, connects the winding of solenoid 85 to one blade 90 of a double-throw switch indicated as a whole by DS. This switch has a second blade 91. When the switch is thrown to the right, the blade 90 engages a contact 92, but the blade 91 is idle. Throwing the switch to the left moves the blades 90 and 91 to contacts 93 and 94, respectively.

The purpose of switch DS is to condition the system for either intermittent or continuous operation. That is, either for a single message or a number of successive messages, as will be explained in detail hereinafter. At this point we need only mention that the switch is thrown to the right for intermittent operation of the system and is thrown to the left for continuous operation thereof.

For the present we shall assume that the switch DS is in its right-hand position with the blade 90 engaging the contact 92. The winding of solenoid 85 is thus connected to bus bar A through closed contact 89, switch blade 90 and contact 92, closed contact 95 of a relay 96, wire 97 to closed switch contact 98, and through wire 99 to bus bar A. This connection permits the subsequent release of relay 81 and insures that the switch contacts previously operated by the armature 45 of relay 42 remain locked in closed position as long as relay 96 is not energized.

The closing of make contact 100 of relay 81 energizes a relay 101 (see lower central part of Fig. 1) through the following circuit: from bus bar A, wire 82, relay contact 100, switch contact 102, wire 103, through the winding of relay 101, wire 104, switch contact 105, and wire 106 to bus bar B. The contact 105 is controlled by a movable switch arm 107 arranged to engage the scanning cylinder 10 to detect the presence or absence of a message sheet on the cylinder. In Fig. 1 the arm 107 closes the contact 105 because the copy or message sheet has not yet been deposited in the transmitter.

We have not shown any structural details of the mounting and arrangement of switch arm 107 in the transmitter scanning mechanism because they form no part of our present invention, such details being shown in our parent application, previously identified. It is sufficient to point out that when there is no copy on cylinder 10, the arm 107 is down and closes the lower contact 105. However, with a sheet mounted on the cylinder, the arm engages the sheet and is raised to close the upper contact 108 for a purpose that will be explained later.

The energizing of relay 101 closes its make contact 109 and thereby connects a magnet 110 to the power circuit as follows: from bus bar A through closed contact 46 to the secondary bus bar A', through the winding of magnet 110, wire 112, make contact 109, and wire 113 to bus bar B. At the same time the circuit of lamp 114 is closed from bus bar A', wire 115, through the lamp to wire 116, which is connected to wire 112, and

from there to bus bar B. The lighted lamp 114 illuminates a sign saying "Deposit message."

The transmitter cabinet has a chute 117 for receiving the prepared message sheets. When the magnet 110 is not energized, the cover 118 carried by the armature or plunger of the magnet closes the chute 117. Upon being energized, the magnet withdraws the cover 18 and opens the chute. This operation is visibly proclaimed by the lighted lamp 114 which tells you that now is the time to deposit the message. The interval between operating the push button 32 and clearing the machine for deposit of the message is only a few seconds, during which the system is automatically conditioned to transmit and record the message. The deposited message sheet is conveyed in any practical way to the rotating cylinder 10 and supported thereon for the scanning operation.

As soon as sheet 12 is mounted on cylinder 10, the arm 107 is raised to break the lower contact 105 and close the upper contact 108. The opening of contact 105 breaks the circuit of relay 101, whereby the contact 109 is opened to break the circuits of chute magnet 110 and lamp 114. This extinguishes the "Deposit message" sign and closes the chute 117 to prevent the insertion of other sheets. The closing of contact 108 by switch arm 107 energizes a magnet 119, which connects the scanning carriage 13 for operative movement axially along the cylinder 10 by the driving motor 20. The circuit of magnet 119 goes from bus bar A to wire 82, contact 100 of relay 81, switch contact 102, wire 103 to point 120, through the winding of magnet 119, wire 121, contact 108, and wire 106 to bus bar B. A lamp 122 is connected in parallel with the magnet 119 through wires 103 and 123. This lamp illuminates a sign having the legend "Message being transmitted."

When the magnet 119 is energized, it closes its make contact 124 which is connected by a wire 125 to the positive terminal of a rectifier 126. The negative terminal of this rectifier is connected to contact 94 of switch DS, but at this time the switch is in right-hand position, so the contact 94 is not in any circuit. The rectifier 126 is connected to bus bars A' and B, but the input circuit of the rectifier is not closed unless the switch contact 46 is in closed position, as it is now. The closing of contact 124 causes positive direct current potential to be impressed on line conductor L1 through the following connections: from the positive terminal of rectifier 126, through wire 125, contact 124, wire 127, break contact 128 of relay 39, wire 129, break contact 130 of relay 96, and through connection 131 to conductor L1.

Turning now to Fig. 2, let us see what happens at the recording station when the line conductor L1 receives the positive potential of rectifier 126. A three-position polar relay 132 is connected to conductor L1 by wire 133. The armature 134 of this relay normally lies between two contacts 135 and 136. In response to the positive potential on line conductor L1, the armature 134 engages contact 135, whereby a relay 137 is energized to operate its contacts. The circuit of relay 137 goes from but bar A to closed contact 50 of energized relay 49, wire 53 to point 138, through armature 134 and contact 135, wire 139, through the winding of relay 137, wire 140, and wire 59 to bus bar B. The make contact 141 of relay 137 is connected to shunt the break contact 72 of relay 64 for a purpose to be more fully de-

scribed. Even though the break contact 58 of the energized relay 137 is opened, the transformer 51 remains energized through the make contact 142 of relay 137 and the break contact 143 of a relay 144.

With the message sheet 12 in position on cylinder 10 of the transmitter, the scanning operation begins. Before the light point from exciter lamp 14 reaches the message itself, a black spot 145 printed on the sheet is scanned to generate a carrier current signal of minimum amplitude. The reception of this signal at the recorder momentarily deenergizes relay 31. In other words, the scanning of spot 145 on the message sheet produces such modulation of the carrier current signal as to cause the deenergization of relay 31 for a sufficient interval to close its break contact 146. A circuit is thus completed for the operation of relay 144, extending from the positive terminal 147 of a convenient source of direct current through the break contact 148 of a relay 149, wires 150 and 151, through the winding of relay 144, wire 152, break contact 146 of relay 31, wire 153, and through the make contact 154 of energized relay 137 to ground. The closing of make contact 155 by relay 144 locks this relay in energized condition, so that upon the re-operation of relay 31 in response to carrier current signals of greater than the minimum amplitude, the relay 144 is maintained energized independently of relay 31. The opening of break contact 143 of relay 144 deenergizes the transformer 51 and extinguishes the exciter lamp 60.

The energized relay 144 closes another make contact 156 to complete a direct current circuit from a convenient source through a magnet 157, which is assumed to be properly mounted in the recording mechanism. This magnet actuates a roller 158 which forces the blank 25 from its preliminary position, as indicated in Fig. 2, into a position where it is gripped by the recording cylinder 23 and wrapped around it in recording position. The removal of blank 25 from between the lamp 60 and the photocell 62 does not produce any result at this time, because the lamp is extinguished.

The recording mechanism has a movable switch arm 159 arranged to rest on the cylinder 23 when no blank is mounted thereon. In this lower position of arm 159, the associated contact 160 is open. As soon as the advancing edge of the blank wrapped around cylinder 23 reaches the arm, the latter is raised to close the contact 160. This operation connects the winding of relay 149 to the source of power from bus bar A, contact 50, wire 53 to point 54, wire 55, relay 149, contact 160, switch arm 159, and wire 161 to bus bar B.

The energized relay 149 opens its break contact 148 and thereby deenergizes the relay 144. However, the condenser 162 connected in parallel with relay 144 is of sufficient size to delay the release of the contacts of this relay until the recording blank 25 is fully mounted on cylinder 23. After this operation has been completed, the contacts of relay 144 are released, thereby deenergizing the magnet 157. The closure of break contact 143 of relay 144 again energizes the transformer 51 and operates the light 60 to excite the photocell 62. This initiates the operation of the blank feeding motor 66 to convey another blank into position to be transferred to the recording cylinder when required. The excited photocell 62 also energizes the relay 64 which opens the break contact 72 and disconnects the latter from the positive terminal 69 of a source

of direct current potential. However, this potential is not disconnected from the line conductor L2 because of the shunt path provided through the make contact 141 of relay 137.

Another function performed by the operation of relay 149 in response to the mounting of the recording blank on cylinder 23 is the energization of two magnets 163 and 164, which are connected in parallel. The circuits of these magnets can be traced from bus bar A through closed contact 50, wire 53 to point 165, wire 166, through the windings of both magnets, wire 167, make contact 168 of relay 149, and wire 161 to bus bar B. These two magnets when energized place the recording stylus 24 in operative condition through any practical connections, not necessary to show or describe. Let it suffice to say that the magnet 163 adjusts the stylus into recording contact with the blank on cylinder 23 and the magnet 164 connects the scanning carriage of the stylus with the driving motor 26.

We now have the recorder in condition for receiving the message from the transmitter. As the facsimile signals generated at the transmitter are received at the recorder, they are applied, after inversion and amplification, to the recording blank on cylinder 23 for reproduction of the subject matter that is being scanned at the transmitter. These signals also are applied to the relay 31, which responds in accordance with the signal modulations produced by the scanned message. In the illustrated embodiment, the two armatures of relay 31 will vibrate as the amplitude of the signal varies between maximum and minimum values. However, the closure of the break contact 146 of relay 31 is ineffective to operate the relay 144 because the operating circuit of the latter relay is open at the break contact 148 of the energized relay 149.

The opening and closing of contact 47 of the vibrating relay 31 alternately energizes and deenergizes the input circuit of vacuum tube 48, but this circuit is provided with means for delaying the deenergization thereof during the interval of time that the relay contact 47 is open. This is accomplished by providing a condenser 169 between the grid of the tube and a source of negative potential. When the contact 47 is closed, this condenser is charged to a potential whereby the input circuit of the tube 48 is energized. As soon as the contact 47 is opened, the charge on the condenser begins to dissipate through a leak resistor 170. After the lapse of a predetermined time, the potential of the grid of tube 48 becomes sufficiently negative with respect to its cathode whereby the plate current is reduced to a value which is insufficient to maintain the relay 49 in energized condition. However, the values of condenser 169 and leak resistor 170 are so chosen that the plate circuit of tube 48 draws sufficient current during the normal operation of recording to keep the relay 49 energized.

At the transmitter, when the carriage 13 containing the scanning apparatus has advanced to the end of its movement after transmission of the message, the contact 171 operated by the carriage is closed, thereby closing a circuit from bus bar A through the winding of relay 39 and through the break contact 172 of relay 101 to bus bar B. The relay 39 is thus energized to open its break contact 128 and thereby disconnect positive potential from the line conductor L1. It will be remembered that this positive potential was previously applied to conductor L1 when the

magnet 119 was energized to connect the scanning carriage 13 for operative movement.

At the recorder, the disconnection of positive potential from the line conductor L1 disengages the armature of polar relay 132 from its contact 135 and thereby opens the operating circuit of relay 137. The release of this relay closes a circuit from positive potential at 147 through the make contact 173 of energized relay 149, wire 174, through the winding of relay 175, wire 176, and the break contact 177 of deenergized relay 137 to ground. The operation of relay 175 closes a circuit through its make contact 178 to connect the winding of the blank stripping magnet 179 between the bus bars A and B.

It is assumed that the energized magnet 179 operates suitable means, not necessary to show or describe, for stripping the record bearing sheet 25 from cylinder 23, whereby the switch contact 160 is opened. The relay 149 is thus released and the closure of its break contact 180 completes the power circuit through a relay 181 (at the bottom of Fig. 2) as follows: from bus bar A, contact 50 of energized relay 49, wire 53 to point 182, break contact 183 of a relay 184, wire 185, the normally closed contact 186 of a key switch 187, wire 188, through the winding of relay 181, wire 189, make contact 190 of energized relay 175, wire 191, break contact 180 of relay 149 (now released), and wire 161 to bus bar B. The operation of relay 181 closes its make contact 192, whereby the relay is locked in energized condition. At the same time a lamp 193, connected in parallel with relay 181, is lighted to signal the attendant at the recording station that a message has been received. The lamp 193 thus operates as the "End of message" signal for the recording station.

Still referring to Fig. 2, it will be observed that the operating circuit of the stripping magnet 179 includes the make contact 178 of relay 175, which is deenergized by the opening of make contact 173 of relay 149 when the latter is released by the opening of contact 160 upon removal of the record bearing sheet from cylinder 23. However, the relay 175 is provided with a condenser 194 connected in parallel with its winding and this condenser delays the release of contact 178 until after the sheet has been completely removed from the cylinder.

While these functions are being performed at the recorder, it should be pointed out that immediately upon the operation of relay 175 the positive potential which was connected to line conductor L2 during the recording operation is removed therefrom by the opening of break contact 70 of this relay. Also, by the time this contact is permitted to reclose upon the deenergization of relay 175, the circuit of this positive potential is opened at the break contact 74 of relay 181, which has operated in the meantime.

At the transmitter the removal of positive potential from conductor L2 produces a response in the polar relay 77 whereby its armature 78 disengages the contact 79 and thus releases the relay 81. The opening of make contact 100 of this relay deenergizes the scanning magnet 119, thus opening the contacts controlled thereby and permitting the return of carriage 13 to its original position.

As long as the magnet 119 of the transmitter is energized during a scanning operation, its make contact 194 is closed and shunts the break contact 38 of relay 39. Therefore, when the latter is energized to open its break contacts in response to the closing of the carriage control con-

tact 171, a locking circuit for the relay 33 is maintained through the magnet contact 194. But when the positive potential is removed from line conductor L2 upon receipt of the end-of-message signal 193 at the recorder to release the relay 81 at the transmitter and thereby release the scanning magnet 119, then the make contact 194 of this magnet is opened to deenergize the relay 33. This relay remains in that condition until the push button 32 is again operated.

We now have come to the point where the received message has been stripped from the recording cylinder 23 and is in the hands of the attendant at the recorder. Suppose the attendant for any reason wants to make another recording of the same subject matter. To do this it is only necessary to move the handle of key switch 187 momentarily to the right. This opens the contact 186 and releases the relay 181, at the same time extinguishing the lamp 193 which signaled the end of the message. The release of relay 181 again connects positive potential through its break contact 74 to the line conductor L2. At the transmitter, where the message is still on the scanning cylinder, the polar relay 77 is again operated to close the lower contact 79. The transmitting mechanism is thereby started upon the same cycle of operation as previously described to make a second recording of the message. Obviously as many copies of the same message can thus be made as are required.

When the attendant at the recorder has made sufficient copies of the message, he throws the handle of key switch 187 to the left to close a contact 195. This energizes a relay 196 through the following circuit: from bus bar A to wire 188, as previously described for relay 181, through the winding of relay 196, switch contact 195, and through make contact 192 of relay 181 to bus bar B. The relay 196 is thereby operated and is locked in energized condition through its make contact 197. Closure of the make contact 198 of relay 196 connects negative potential to line conductor L2 from the negative terminal 199 of a source of direct current through contact 198, make contact 200 of energized relay 181, wire 75, and through make contact 76 of relay 49 to line conductor L2.

At the transmitting station the negative potential connected to the line conductor L2 causes the armature 78 of polar relay 77 to engage the contact 80. A circuit is thus established from bus bar A through wire 82, relay contact 80, wire 201, switch contact 202, through the winding of a blank stripping magnet 203, and through wire 83 to bus bar B. A lamp 204 connected in multiple with magnet 203 is also energized to illuminate a sign bearing the legend "Message accepted." When the magnet 203 is energized, it operates suitable means for stripping the message sheet 12 from the scanning cylinder 10 of the transmitter. A practical form of blank stripping means being disclosed in our parent case, we need not say anything more about it here. It should be noted that the scanned message is not stripped from the transmitting cylinder until the attendant at the recorder operates the switch 187 to the "Accept" position.

Still referring to the transmitter, as soon as the message sheet 12 has been removed from the cylinder 10 after the transmission and acceptance of the recorded copy, the switch contact 105 is reclosed to establish a circuit from bus bar A, wire 82, contact 80 of polar relay 77, wire 201 to point 205, wire 206, through the winding

of relay 96, wire 207, break contact 208 of relay 101, wire 104, and through contact 105 to bus bar B. The relay 96 is thus energized and opens the break contact 95, thereby opening the locking circuit of solenoid 85. The armature 45 of relay 42 is thus released and permits the associated switch contacts to resume their respective normal positions.

The opening of contact 46 disconnects the auxiliary bus bar A' from the main bus bar A, thereby deenergizing the rectifier 126, the driving motor 20 of the scanning mechanism, the motor 21 that drives the chopper disc 18, and the exciter lamp 14. In other words, the removal of the message from the transmitting cylinder automatically disconnects the scanning apparatus of the transmitter from the source of power.

The release of armature 45 of relay 42 closes a circuit from bus bar A through wire 99, switch contact 209, wire 210, make contact 211 of energized relay 96, wire 212, and the switch contact 213 to reenergize the locking solenoid 85. The operation of the solenoid armature 88 at this time prevents the movement of armature 45 in response to any possible reenergization of relay 42. If we connect several transmitting stations to a single receiving station, we may provide each transmitting station with a lamp 214 to illuminate a sign "In use" as a warning or busy signal to the idle stations that one of the transmitters is being used. In that case the solenoid 85 is energized at the idle stations and locks the armature of relay 42 in normal open position during the busy or "In use" period. In the present instance the lamp 214 is energized simultaneously with solenoid 85 through the closed switch contact 213.

When the scanning apparatus of the transmitter is deenergized upon release of the switch contacts controlled by relay 42, the generation of carrier current ceases. At the recorder the absence of carrier current signals causes the release of relay 31, and at a predetermined time following the release of this relay, the timing apparatus associated with the input circuit of vacuum tube 48 becomes effective to open the plate circuit and cause the release of relay 49. The opening of contact 50 of this relay disconnects the driving motor 26 and the primary winding 56 of transformer 51 from the bus bar A and also deenergizes the relays 181 and 196.

In this way the recording apparatus is automatically disconnected from its source of power and is restored to normal idle condition, in which it remains until the push button 32 at the transmitter is again operated. The opening of relay contact 50 also disconnects negative potential from the line L2, which restores the polar relay 77 at the transmitter to normal condition and thereby releases the relay 96 to deenergize the solenoid 85 and the "In use" lamp 214.

In the present embodiment of our invention we also provide means for adjusting the system to transmit a message without waiting for the scanning carriage 13 of the transmitter to reach the end of its normal path of travel. Such a facility is for the purpose of economizing on line time utilized for the transmission of facsimile signals when a relatively short message is to be transmitted. To this end the transmitter is provided with a switch 215 (at the bottom of Fig. 1), which has a handle accessible from the outside of the machine. In the case of a short message, you move the switch handle to the right. The switch is locked in this position by energization of a magnet 216 through a circuit which extends from bus bar A through the winding of the magnet, its make contact 217, and the break contact 33 of relay 39 (not energized now) to the bus bar B.

The scanning and transmitting operations take place as previously described until the carriage 13 has traveled a sufficient distance to close the contact 218. This may be effected in any practical way, as by a roller 219 mounted on the carriage in the path of a suitable member 220, which is adapted to engage the roller and move the contact 218 to closed position. This occurs before the carriage is at the end of its normal scanning movement but after scanning of a short message is completed.

The closure of contact 218 completes an operating circuit for the relay 39 extending from bus bar A through contact 218, wire 221, contact 222 of switch 215, through the winding of relay 39, the break contact 172 of relay 101, and through wire 113 to bus bar B. When the relay 39 is energized, it opens its break contact 128 and disconnects the positive potential from line conductor L1 to control the recording mechanism in the manner already described. The opening of break contact 38 of relay 39 opens the locking circuit of magnet 216, thereby releasing the switch 215 to its normal position. It should be noted that the roller 219 and its actuating member 220, which is shown as a small rail or bar, do not interfere with the free travel of carriage 13 to the end of its full normal movement to operate the contact 171 after the scanning of a long message.

In the preceding description of the operation of our system we have assumed that the double-pole switch DS at the transmitter was moved to the right for the deposit and transmission of one message. That is, after the satisfactory recording of the message, the system was shut down and the deposit chute closed. Now, by throwing the switch DS to the left, with the blades 90 and 91 engaging their respective contacts 93 and 94, the system is conditioned for continuous operation, so that a number of messages can be successively deposited and transmitted. This will be clear from the following explanation.

When the push button 32 at the transmitter is operated to energize the relay 33, the switch contact relay 42 is operated as before to start the transmitting mechanism, whereby a carrier current signal is generated. The recording apparatus responds to this signal as in the foregoing description and the locking solenoid 85 at the transmitter is energized in response to the signal transmitted over the line conductor L2 to the recorder. The solenoid is locked in energized condition by a circuit which extends from bus bar B through the winding of solenoid 85, the make contact 89, switch blade 90 and contact 93, through wire 223 to bus bar A. Once this circuit is closed, it cannot be opened by the operation of any of the relays as in the previous case. Consequently, the switch contacts associated with relay 42 remain in operated position to maintain the transmitting apparatus in continuous operation.

The opening of chute 119 and the subsequent transmission and recording of the message are accomplished in the same manner as previously described. When the recorded message is removed from cylinder 23, the relay 181 (at bottom of Fig. 2) is operated and locked, and the end-of-message signal 193 is energized. For this type of operation the key switch 187 may be left in its normal position, as shown, while the message is

being recorded. This enables the attendant at the recorder to make a second recording of the message, or he may accept it by manipulating the switch 187 as heretofore described. When the key switch 187 at the recorder is moved to "Accept" position to close the contact 195, the relay 196 is operated and locked as before to apply negative potential to line conductor L2. The polar relay 77 at the transmitter is thereby operated to close its upper contact 80 to remove the message bearing sheet 12 from cylinder 10, whereupon the relay 96 is operated as before. The closure of make contact 224 of this relay connects the negative terminal of rectifier 126 to line conductor L1.

At the recorder, in response to this negative potential, the polar relay 132 is operated to close its contact 136. A circuit is thus completed for the operation of relay 184. The opening of break contact 183 of this relay opens the locking circuit for relays 181 and 196, which are thereby deenergized. The opening of either of the make contacts 200 or 198 of these relays removes the negative potential from line conductor L2.

At the transmitter, in response to the removal of this negative potential, the polar relay 77 is deenergized and opens its contact 80. The sheet stripping magnet 203 is thereby deenergized, the "Message accepted" lamp 204 is extinguished, and the relay 96 is released. Thus the transmitter is ready for further operation if the recorder is in condition to record. If a blank 25 is positioned in the recorder in readiness for mounting on cylinder 23, the relay 64 will be released and positive potential applied to line conductor L2, as previously explained.

At the transmitter this positive potential produces a response by a polar relay 77 whereby the chute closure 118 is withdrawn to make the chute 117 accessible for the insertion of another copy. The apparatus remains in this condition until the next sheet is deposited in the transmitter chute, after which the operation of the apparatus is resumed in the manner described.

At the recorder the attendant may place the key switch 187 permanently in "Accept" position to maintain the contact 195 closed at all times. In this case, as soon as the sheet bearing the recorded matter has been removed from cylinder 23 to permit the release of relay 149, the relays 181 and 196 are energized and locked simultaneously, whereupon negative potential is applied to line conductor L2.

The sequence of operation at the transmitter in response to this negative potential is identical with that previously described and results in the application of negative potential to line conductor L1. At the recorder this effects the release of relays 181 and 196, thereby restoring the recording apparatus to a condition for making another recording.

It will be noted that with the key switch 187 locked in the "Accept" position it is not possible to obtain a second recording of the same message. The transmitting and recording machines will operate through their described cycles as long as additional copies are inserted in the transmitter chute 117.

The system is shut down by the opening of switch DS at the transmitter. This operation opens the locking circuit of solenoid 85 and permits the opening of the switch contacts associated with relay 42, thereby disconnecting the source of power from the transmitter. The absence of carrier current from the line conductors

L1 and L2 results in the disconnection of the recorder from its source of power, as previously pointed out.

In tracing the circuits we have used the convenient term "wire" to indicate any practical kind or form of electrical connection. The operative connections between the transmitting station of Fig. 1 and the recording station of Fig. 2, represented in the drawings by line conductors L1 and L2, need not be limited in all cases to metal conductors, for the facsimile impulses can be transmitted to the receiving station by radio waves.

It will be understood that the drawings which we have described in detail represent a typical embodiment of our invention and are not intended as a restriction thereof. Obviously it is not necessary that all the novel features of our invention be included in the same embodiment thereof, for certain features may be used without others. Various modifications are possible within the scope of our invention as defined in the appended claims.

We claim as our invention:

1. A facsimile system comprising a transmitter and a recorder adapted to be operatively connected for recording a transmitted message, said transmitter having scanning mechanism and means for supporting a message in scanning position, a switch operable at the recorder after the recording of a message for sending a signal to the transmitter, a device at the transmitter energized by said signal, and apparatus controlled by said energized device for operating the transmitter scanning mechanism to scan the same message again, whereby the recorder makes another copy of said message.

2. In a facsimile system, a transmitter having means for supporting a subject sheet in operative position, a recorder operatively connected with said transmitter for recording the transmitted subject matter, and selectively controlled means at the recorder for releasing the sheet from the transmitter after a recording thereof or maintaining the sheet in operative position therein for recording additional copies.

3. In a facsimile system, a transmitter and a recorder arranged to be operatively connected, respective sources of power for said transmitter and recorder, means at the recorder operative as a supervisory signal after the completion of a recording operation, and means at the transmitter responsive to the operation of said signal for automatically disconnecting the transmitter from its source of power.

4. In a facsimile system, a transmitter provided with an operative member which has a normal length of movement, switch means operable by said member upon completion of its movement, other switch means operable by said member at a predetermined point before it reaches the end of its movement, a signal circuit controlled by any one of said switch means, and manually operable means for selecting any one of said switch means to energize said signal circuit.

5. A facsimile system comprising a transmitter and a recorder adapted to be operatively connected, optical scanning mechanism in said transmitter adapted to generate a steady tone before scanning of copy, a magnet at the recorder energized by said steady tone, and a motor at the recorder automatically energized in response to the energizing of said magnet, whereby the deenergizing of the magnet automatically stops the motor.

6. A facsimile system comprising a transmitter and a recorder adapted to be operatively connected, scanning mechanism in said transmitter adapted to generate a phasing signal before scanning of copy, a cylinder in said recorder for supporting a blank in recording position, and a magnetic device in the recorder energized in response to said phasing signal for mounting a blank on said cylinder.

7. In a facsimile system, a transmitter and a recorder operatively connected, said recorder having mechanism for mounting a blank in recording position, and means controlled by the transmitter for automatically conditioning the recorder to record the transmitted copy, said conditioning means including a photoelectric element at the recorder for controlling the operation of said mechanism.

8. In a facsimile system, a transmitter having scanning mechanism for copy to be transmitted, means for operating said scanning mechanism, a recorder having mechanism for recording the transmitted copy, said recording mechanism including an electric motor, means at the recorder responsive to the operation of said scanning mechanism for automatically starting said recording motor and apparatus at the recorder responsive to the operation of the transmitter scanning mechanism for automatically placing the recording mechanism in condition for signal reception after the starting of said motor.

9. In a facsimile system, a transmitter having scanning mechanism and means for energizing said mechanism to generate signal impulses in accordance with scanned copy, a recorder operatively connected with said transmitter and having recording mechanism which includes an electric stylus adapted to remain in steady contact with an electrosensitive blank during a recording operation, connections for including said stylus in a recording circuit energized by said signal impulses, means for normally holding said stylus out of recording position, and means responsive to the operation of said scanning mechanism for automatically moving said stylus into contact with said blank and holding it steady in said contact position during a recording cycle.

10. In a facsimile system, a transmitter and a recorder having each a source of power from which they are normally disconnected, scanning mechanism in said transmitter and recording mechanism in said recorder means at the transmitter for connecting it to its source of power, means at the recorder activated by the transmitter scanning mechanism for automatically connecting the recording mechanism to its source of power, means at the recorder operable after a scanning operation for sending a direct current potential to the transmitter, and means at the transmitter responsive to said potential for disconnecting the transmitter from its source of power.

11. In a facsimile system, a transmitter and a recorder operatively connected, mechanism in said transmitter for generating current impulses prior to transmission of copy, a switch in the energizing circuit of said mechanism, an electromagnet at the transmitter for controlling said switch, means at the recorder responsive to said impulses for automatically starting the operation of said recorder, means controllable at the recorder for operating said electromagnet to open said switch and stop the transmitter, and means at the recorder responsive to the stopping of the transmitter for stopping the recorder.

12. In a facsimile system, a transmitter having scanning mechanism for copy to be transmitted, means at the transmitter for energizing said scanning mechanism to generate a carrier current of predetermined frequency, a recorder provided with mechanism for recording the transmitted copy, an electric motor for said recording mechanism, a local commercial source of power for said motor, means at the recorder responsive to said carrier current for automatically connecting said motor to said local source of power before scanning of said copy, and means for automatically disconnecting the motor from said local source of power at the close of a recording operation.

13. In a facsimile system, a transmitter and a recorder adapted to be operatively connected, said transmitter having a rotary cylinder adapted to support a sheet in scanning position, a normally closed chute at the transmitter for depositing sheets to be mounted on said cylinder, means responsive to an operative condition of the recorder for opening said chute, and means responsive to the presence of a deposited sheet on said cylinder for closing the chute.

14. In a facsimile system, a transmitter and a recorder operatively connected, said recorder having a rotary cylinder for supporting a blank in recording position and a stylus for recording on the supported blank, an electromagnetic device at the recorder, means at the transmitter for successively energizing and deenergizing said device before transmission of copy, means at the recorder responsive to the energized condition of said device for starting the operation of said cylinder, and means at the recorder responsive to the deenergized condition of said device for mounting a blank on said cylinder and moving the stylus into contact with the blank.

15. In a facsimile system, a transmitter having a cylinder for supporting copy in scanning position, a recorder having means for recording the copy transmitted, means at the transmitter for removing the scanned copy from said cylinder, and means controllable at the recorder for energizing said copy removing means.

16. In a facsimile system, a transmitter and a recorder operatively connected by a pair of lines, said recorder having a rotary cylinder for supporting a blank in recording position, means in said transmitter for generating carrier frequency which is sent over said lines, other means in said transmitter for imposing a direct current bias on one of said lines during the transmission of carrier frequency, and means at the recorder successively responsive to said carrier frequency and said imposed bias for automatically starting the operation of said cylinder and mounting a blank thereon.

17. In a facsimile system, a transmitter having a cylinder for holding copy in scanning position, a recorder having a cylinder for supporting a blank in recording position, means responsive to the absence of copy on said transmitting cylinder for starting the operation of said recording cylinder, and means responsive to the presence of copy on said transmitting cylinder for mounting a blank on the recording cylinder.

18. In a facsimile system, a transmitter and a recorder adapted to be operatively connected, said recorder having a recording cylinder and a motor for operating the same, a relay at said recorder, means activated by the transmitter to energize said relay and thereby energize said motor, means at the transmitter for deenergizing said relay,

and means at the recorder responsive to the deenergized relay for mounting a recording blank on the rotating cylinder.

19. In a facsimile system, a transmitter having scanning mechanism operated by an electric motor, a recorder having recording mechanism operated by an electric motor, said transmitter and recorder being operatively connected, means activated by the transmitter for energizing the recording motor, means controllable at the recorder for deenergizing the transmitting motor, and means responsive to the deenergization of the transmitting motor for deenergizing the recording motor.

20. In a facsimile system, a transmitter having means for holding copy in scanning position, a recorder having a cylinder for supporting a blank in recording position, means responsive to the absence of copy on said holding means for generating carrier current of maximum amplitude, means responsive to the presence of copy on said holding means for generating carrier current of minimum amplitude, means at the recorder responsive to the maximum current for operating said cylinder, and means at the recorder responsive to the minimum current for mounting a blank on the recording cylinder.

21. In a facsimile system, a transmitter provided with scanning mechanism which includes a member having a predetermined length of movement from original to final position, a recorder operatively connected to said transmitter and having recording mechanism provided with means for supporting a blank in recording position, means at the recorder automatically energized when said member reaches its final position for removing the recorded blank from said supporting means, and means at the transmitter responsive to the operation of said blank removing means for causing the return of said member to original position.

22. A facsimile system having a transmitter and a recorder operatively connected, means in said transmitter for generating current impulses in accordance with transmitted subject matter, an electromagnetic device automatically energized and deenergized by said impulses during the transmission of said subject matter, a second electromagnetic device controlled by said first device and adapted to remain energized during said deenergized intervals of the first device, a driving motor for said recorder, and means whereby said motor operates only when the second device is energized so that the energizing of the second device automatically stops the motor.

23. In a facsimile system, a transmitter provided with scanning mechanism which has means for supporting copy in scanning position, a recorder adapted to be operatively connected to the transmitter and having mechanism for recording the transmitted copy, a switch at the recorder adapted to occupy two operative positions, means at the transmitter responsive to one position of said switch for energizing said scanning mechanism to retransmit the supported copy, and means at the transmitter responsive to the other position of said switch for disconnecting the scanning mechanism from its source of power.

24. In a facsimile system, a transmitter and a recorder adapted to be operatively connected, scanning means at the transmitter for generating signal currents in accordance with the subject matter transmitted, means at the recorder

for recording the transmitted subject matter, a motor for operating said recording means, a normally open switch in the motor circuit, a relay adapted when energized to hold said switch closed, an electronic device connected with said relay, and means controlled by the signal currents from the transmitter for energizing said electronic device to energize said relay, which is deenergized at the close of a transmission cycle for automatically opening the motor switch.

25. In a facsimile system, a transmitter having optical scanning mechanism for the transmission of copy to a recorder operatively connected with the transmitter, said optical scanning mechanism being adapted when energized to generate a steady tone prior to the scanning of copy, said steady tone being transmitted to the recorder which is provided with recording mechanism, a motor for operating said recording mechanism, a source of power for said motor, and a device energized by said steady tone for connecting the motor to its source of power, whereby the deenergizing of said device automatically disconnects the motor from its source of power.

26. In a facsimile system, a transmitter and a recorder adapted to be operatively connected, said transmitter having a slot for inserting copy sheets to be scanned and having a rotary cylinder for supporting an inserted sheet in scanning position, a magnet which closes said slot when deenergized, apparatus at the recorder for sending a signal to the transmitter, a device at the transmitter energized in response to said signal for energizing said magnet to open said slot and permit the insertion of a sheet for mounting on said transmitter cylinder, a switch automatically operated by a sheet on said cylinder, and a circuit controlled by the operation of said switch for releasing said magnet and closing the slot to prevent the insertion of another sheet during the presence of a sheet on said cylinder.

27. In a facsimile system, a transmitter and a recorder adapted to be operatively connected, said transmitter having optical scanning mechanism which includes a rotary cylinder for holding a sheet to be scanned, means for energizing said scanning mechanism before a sheet is mounted on said cylinder which is optically utilized to generate a carrier frequency, a local commercial source of electric power for said recorder, and switch means at the recorder responsive to said carrier frequency for connecting the recorder to its local source of power.

28. In a facsimile system, a transmitter and a recorder interconnected for communication, means at said transmitter for generating a carrier current of predetermined frequency prior to a scanning operation, means at the recorder responsive to said carrier current for automatically connecting the recorder to a source of power and energizing its recording mechanism, and means for automatically signaling the energized condition of the recording mechanism to the transmitter.

29. In a facsimile system, a transmitter and a recorder adapted to be operatively connected, scanning mechanism for each of said machines, said recorder having a rotary cylinder permanently mounted in recording position and adapted to support a blank thereon for recording, a magnet for moving a blank into position for mounting on the cylinder during rotation thereof, and a signal generated by the transmitter scanning mechanism for causing operation of said magnet.

30. In a facsimile system, a transmitter and a recorder arranged to be operatively connected, a source of power for each of said machines, a movable member for normally preventing the insertion of copy into the transmitter, means for connecting the transmitter to its source of power to generate a control signal prior to a scanning operation, means at the recorder responsive to said control signal for automatically connecting the recorder to its source of power, and means responsive to the operative condition of the recorder for automatically operating said member to permit the insertion of copy into the transmitter.

31. In a facsimile system, a transmitter and a recorder arranged to be operatively connected and having each a source of power, means whereby said transmitter and recorder are automatically disconnected from their respective sources of power after transmission and recording of each message, connections for maintaining the transmitter and recorder in continuous operation for repeatedly scanning the same message in the transmitter to produce a plurality of facsimile copies thereof in the recorder, and selectively operable means at the recorder for controlling said connections to record the desired number of copies of the same message.

32. In a facsimile system, a transmitter and a recorder arranged to be operatively connected, said transmitter having a cylinder for supporting copy in scanning position and a slot for the insertion of sheets to be mounted on said cylinder, means for normally closing said slot, means at the transmitter for automatically conditioning the recorder to record the copy to be transmitted, means at the recorder responsive to its operative condition for sending a characteristic signal to the transmitter, and means at the transmitter responsive to said signal for opening said slot whereby the transmitter is automatically conditioned by the recorder to receive the copy to be transmitted.

33. In a facsimile system, a transmitter and a recorder arranged to be operatively connected, respective sources of power for said transmitter and receiver, scanning mechanism for said transmitter having a rotary cylinder for supporting a sheet in scanning position, a device for removing a scanned sheet from said cylinder, means controllable at the recorder for causing operation of said sheet removing device, means at the transmitter automatically responsive to the removal of a sheet from said cylinder for disconnecting said scanning mechanism from its source of power, and means at the recorder responsive to the absence of a sheet on said scanning cylinder for automatically disconnecting the recorder from its source of power.

34. In a facsimile system, a transmitter and a recorder arranged to be operatively connected, scanning mechanism in said transmitter adapted to generate unmodulated current impulses of certain frequency prior to a scanning operation, a relay at the recorder responsive to said unmodulated impulses for connecting the recorder to a source of power, said scanning mechanism causing said impulses to be modified in accordance with scanned subject matter, means at the recorder for recording said modified signal impulses, and means for maintaining said relay energized during the absence of impulses for less than a prescribed maximum interval, said last mentioned means including a vacuum tube adapted to act as a timing device for said relay.

35. In a facsimile system, a transmitter having optical scanning mechanism which includes a cylinder for holding a sheet in scanning position, a normally closed chute for guiding a deposited sheet to said cylinder for mounting thereon, a recorder arranged to be operatively connected with said transmitter, a source of power for said recorder, means for energizing said scanning mechanism while its cylinder is empty to generate a carrier frequency of maximum amplitude which is transmitted to the recorder, means at the recorder energized by said carrier frequency to connect the recorder to its source of power, and means at the transmitter automatically responsive to the operative condition of the recorder for opening said chute for the deposit of a sheet to be scanned.

36. In a facsimile system, a transmitter and a recorder adapted to be operatively connected through a transmission channel which includes a signal inverter at the recorder, a source of power for each of said machines, means at the transmitter for generating signal impulses of certain frequency and maximum amplitude prior to a scanning operation, said impulses constituting a carrier current which is modified in accordance with scanned subject matter, a signal amplifier at the recorder connected to said transmission channel in advance of and in shunt to said inverter, a relay connected to the output of said amplifier, whereby said relay is energized by signal impulses before they pass through said inverter, a switch controlled by said energized relay for connecting the recorder to its source of power, means for maintaining said power switch closed during the zero intervals of the signal frequency, and a recording circuit adapted to be energized by the inverted signals.

RALEIGH J. WISE.
GARVICE H. RIDINGS.
ROBERT D. PARROTT.

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