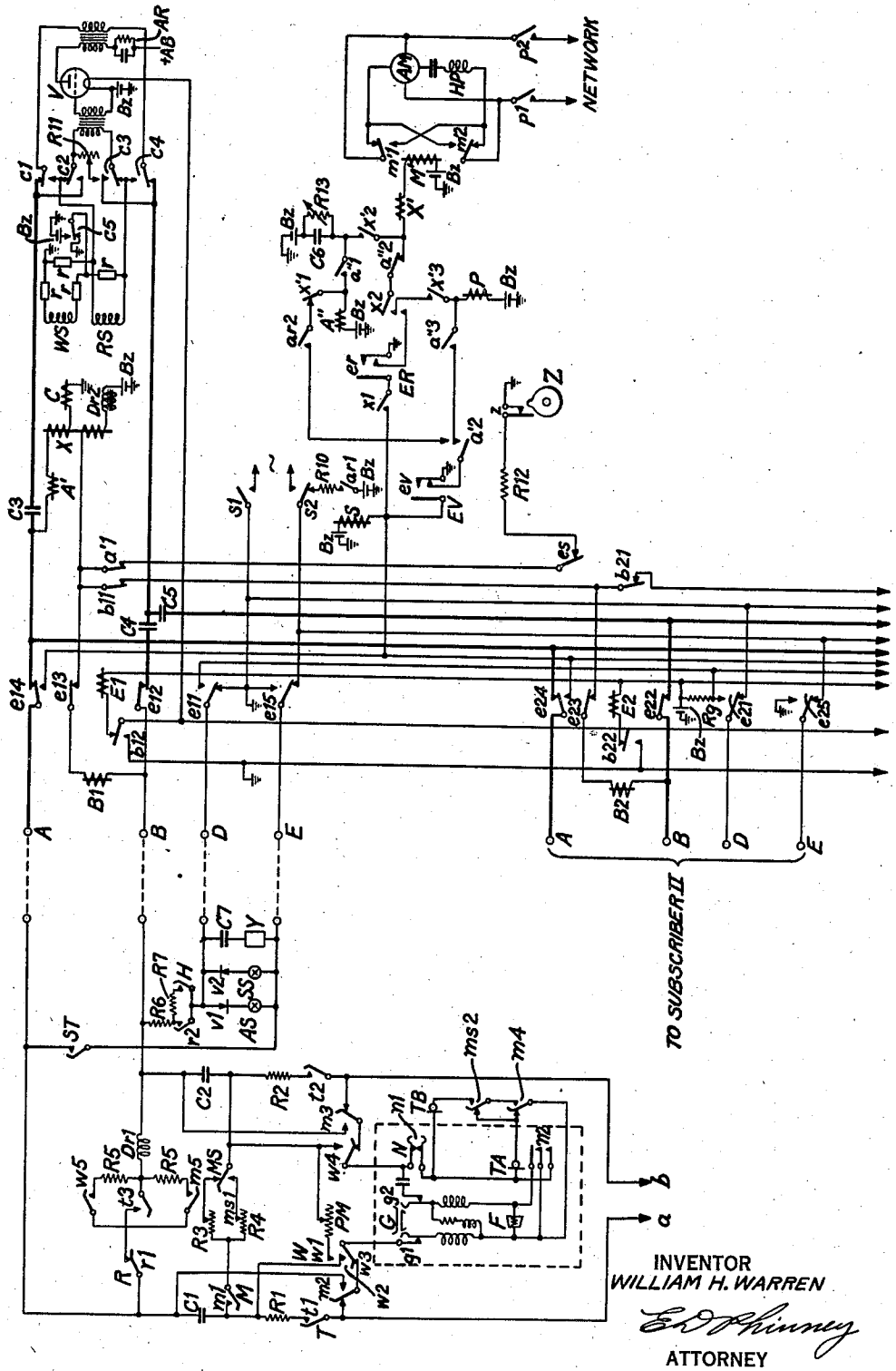
March 28, 1939. W. H. WARREN 2,151,951

ELECTROMAGNETIC RECORDING SYSTEM

Filed Sept. 28, 1936



Patented Mar. 28, 1939 2,151,951

UNITED STATES PATENT OFFICE

2,151,951

ELECTROMAGNETIC RECORDING SYSTEM

William H. Warren, San Francisco, Calif., assignor to International Standard Electric Corporation, New York, N. Y.

Application September 28, 1936, Serial No. 102,970
In Germany September 27, 1935

17 Claims. (Cl. 179—6)

(Granted under the provisions of sec. 14, act of March 2, 1927; 357 O. G. 5)

If sound recording and reproducing machines acting on the electromagnetic principle are to be employed for recording dictations to be typewritten, as for instance in the offices of work plants, administrations, etc., then in the first place circuit arrangements are provided which allow of operating the talking machine from the position of the dictating person. To such end the talking machines are preferably positioned in a central station, leads being provided which extend from this central station to the subscribers' positions. Each of the subscribers has a telephone apparatus of peculiar construction which in addition to the customary microtelephone, by which he can attain connection with the talking machine, has a number of keys serving to control the drive of the talking machine and to cut in or out the several means for operating this machine.

Such a dictation or recording machine has to fulfil many problems. It must record the dictation by magnetizing the record carrier, i. e. a steel wire or tape, with the aid of a recording magnet and in accordance with the telephone currents, and must also enable the dictating person to hear the record in order to examine his dictation. To such end the dictating person must be able at any time to effect the recoiling of the record carrier, that is to say, he must be able to subject the dictation machine, by means of the control device allotted to his talking station, to operating conditions whereby the direction of rotation of the wire coil is reversed while the recording and the reproducing magnets are cut out at the same time.

Remote control systems for use with dictation machines are known wherein the talking stations are connected with the dictation machine by the speech lines and also by a number of control lines, such control lines enabling the dictating person to establish these several working conditions.

To erect plants of this type is difficult to some extent if the dictation machine is to be located in the exchange of a telephone system and if the lines leading to the subscribers are of a certain length. It has been proposed to actuate the control arrangement of the dictation machine from the subscriber with the aid of a dial or number disc and also with the aid of those lines only which are employed for the other telephonic traffic. In order to perform this, current impulses are sent over the line of the telephone network by means of the dial, such impulses acting to establish the requisite working conditions with the aid of switching devices and relays. This arrangement, however, has the disadvantage that errors may occur in dialling so as to establish undesired working conditions.

In arrangements as provided by the invention the control actions are effected by means of push buttons while relays are employed for reducing the number of lines.

A control arrangement of this kind is described hereinafter by way of example, reference being had to the accompanying drawing which is a wiring diagram thereof. Relays are denoted by capital letters while their contacts are designated by the respective small letters, indices serving to distinguish between the contacts.

The control actions are as follows:

1. Recording a telephone speech.
2. Dictating either by means of the microphone of the normal telephone set or by means of a separate table microphone.
3. Coiling back.
4. Reproducing the dictation by the subscriber.
5. Maintaining the busy state of the machine without recording or reproducing being effected.
6. Releasing the dictation machine by depressing a release button.

If no key has been depressed a normal telephone traffic may take place over the apparatus of the subscriber.

One machine is allotted to several subscribers.

On the left in the drawing the station of a subscriber, for instance subscriber I, is represented. The station has keys T, M, W, R, H. The central station is shown on the right hand side of the drawing and is adapted to be connected with each subscriber over four lines A, B, D, E. In addition each subscriber has a buzzer key ST by which he may advertise a subscriber using the machine that he too desires to use it.

Recording a telephone speech

The operation in recording a telephone speech is as follows, for example. By depressing the key T the two lines *a*, *b* of the telephone network are connected to the lines A, B over the contacts *t1*, *t2* of this key and over resistances R1, R2 and condensers C1, C2. Further, in order to close the circuit of the battery Bz, on the subscriber side and in parallel with the telephone apparatus a choke Dr1 becomes connected to the condensers C1, C2 over a contact *t3* of the key T and also over a contact *r1* of a key R, this key being concerned with the coiling back of the record carrier, as will be described further on. The

resistances R1, R2 serve to diminish as far as possible the demand upon the telephone apparatus, i. e. the demand due to the dictation machine, that is to say, serve to prevent the sound intensity from decreasing too much after the dictation machine has been connected. The central station has two relays for each subscriber. One of these relays, which are hereinafter called operation relays, is concerned with the operation of the dictation machine whilst the second relay serves to block up the other subscriber. The operation relays are designated B1, B2, etc., the blocking relays designated E1, E2 etc. The contacts of the two relays allotted to subscriber I are denoted by *b*11, *b*12 etc. or *e*11, *e*12, *e*13, respectively, the relay contacts allotted to the other subscribers being distinguished by the respective indices.

The flow of current on depressing the key T is as follows. The circuit of the battery Bz is completed over a choke Dr2, one winding of the relay X, which is a differential relay, and contact *e*13, relay B1, choke Dr1, contact *t*3, contact *r*1, contact *e*14, relay A', the other winding of the differential relay X and then over relay C to earth. The arrangement is such that the originating current shall amount to 40 milliamperes. Under the action of this current the relays B1, A' and C respond. Relay X, however, does not respond because the action of each winding thereof annuls that of the other winding. Rest contact *b*11 disconnects the operation relays of all the other subscribers from the battery Bz while contact *b*12 acts to connect the blocking or E-relays of all the other subscribers to earth, thereby causing them to respond so as to interrupt the lines A, B of these subscribers. Choke Dr2 serves to balance the self-induction of the relays C, A'. Relay C by its contact *c*5 connects the battery over resistances *r* to the windings RS and WS of the talking head and to earth. At the same time to input circuit of an amplifier V is connected to the lines A, B by the contacts *c*3, *c*2 whilst the output circuit of the amplifier is by contacts *c*1, *c*4 connected to the talking head. A resistance R11 is connected in parallel with the input transformer of the amplifier and serves for adjusting the desired sound intensity. The heating circuit of the amplifier is closed by contact *b*12 of the relay B1. It is advantageous to use directly heated tubes for the construction of the amplifier in order to provide for an immediate operation. The anode current of the amplifier actuates relay AR, whose contact *ar*1 consequently connects the battery Bz over resistance R10, rest contacts *s*2, *e*15 and lines E, D to a signalling device AS which hereby indicates that the amplifier is ready for operation. A signalling device SS, connected in parallel with the device AS and serving as a block indicator can not become active because a valve V2 ensures that only a current flowing in the opposite direction can energize the device SS. Contact *ar*2 energizes relay A'' over contact *x'*1 and also over contact *a'*2 of the relay A', contact *a'*2 now having been closed. The motor AM which serves to move the record carrier is cut in by the response of a relay P which is excited over contacts EV, *a'*2, *a''*3 and therefore closes its contacts *p*1, *p*2. The auxiliary winding HP of the motor is connected over contacts *m'*1 and *m'*2 of the relay M' which are now in their at-rest state. Condensers C3, C4, C5 serve to block the several circuits with respect to each other. The motor is thus started and the dictation machine is now ready to record the telephonic speech of subscriber I.

Dictating

In order to have a dictation recorded the subscriber, such as subscriber I, has to depress the key M. As a result the telephone lines *a*, *b* are disconnected at *m*2, *m*3, *m*4 while one pole of the microphone TA of the telephone apparatus is connected to the appertaining line A after the telephone receiver has been removed from the cradle G, this connection being effected over contact *ms*2 of a switch MS, contact *m*4 of the key M, one winding of the repeater, contact *g*1 of the cradle, back contact *w*3 of the key W, front contact *m*2. The other pole of the microphone then is in connection with line B over the contact *n*1 of the dial N, back contact *w*4 and front contact *m*3. Resistance R3 is connected in parallel with the microphone over the condensers C1, C2 and serves for adjusting the desired sound intensity. In the central station the relays B1, A', C are again energized. The state of operation in the central station is the same as before, that is, the same as in the case of recording a telephone speech. If a table microphone is to be used the switch MS is reversed so as to insert microphone TB instead of the microphone TA. Instead of resistance R3 the resistance R4 is now connected in parallel with the microphone. When using the table microphone TB the telephone receiver must be removed.

Coiling back

Should the subscriber desire to examine his own dictation then he must in the first place cause the record carrier to be coiled back. This is effected by depressing the key R. Battery Bz is hereby connected to earth over choke Dr2, one winding of relay X, relay B1, resistance R6, contact *r*2 of the key R and line D. Resistance R6 is so dimensioned that again a current of 40 milliamperes is obtained. This current acts to energize relay B1 and relay X too, since only one winding of the latter is flown through. Contact *x*2 thus actuated connects the relays M', X' over the break contact *a''*2 to earth so as to energize them. Connected in parallel with the two serially arranged relays X', N' is a combination of a condenser C6 and resistance R13, this connection being effected over contact *x'*2. Relay M' by switching its contacts *m'*1, *m'*2 acts to reverse the polarity of the auxiliary winding HP of the motor, thus causing this to run backwards.

If now the forward movement of the motor is re-established, for example by depressing the key T, M or W, then relay X does not respond, relay A' being energized instead. The circuit of relays M', X' is therefore interrupted. Relay X', however, still holds itself as the condenser C6 is discharging slowly. Resistance R13 connected in parallel with condenser C6 serves for adjusting the release time of relay X'. At the very instant when X' releases so as to close contact *x'*1 relay A'' becomes inserted, condenser C6 and resistance R13 thus becoming connected to relay A'' by the contact *a''*1 thereof and in parallel with relay A''. On the release of A' also relay A'' will consequently slowly release its armature. Such retardation is necessary in order to prevent the motor being reversed too early, that is to say, being reversed before having been stopped. When the coiling back takes place, contact *x'*3 performs the function which

during the forward movement is accomplished by contact *a''3* and which consists in actuating the cut-in relay P of the motor.

Reproducing by the subscriber

In order to reproduce his dictation the subscriber has to depress the key W. Battery Bz causes a current of 10 milliamperes to flow over choke Dr2, one winding of relay X, relay B1, choke Dr1, resistance R5, switched contact *w5*, contact *r1*, contact *e14*, relay A', the other winding of relay X and over relay C. By this current the relays A', B1 are energized. As relay C does not respond the input circuit of the amplifier V is connected to the talking head over contacts *c3*, *c2* whilst the output circuit thereof is in connection with lines A, B. Relay A' causes the motor to run forward in the described manner, whereas relay B1 acts to block up all the other subscribers in a well-known manner. The telephone receiver F of the table apparatus is connected to lines A, B over the telephone coil, contacts *g1* and *g2*, contacts *w2* and *w4* and over condensers C1, C2. The magnetizing currents of the record carrier which are conveyed to the talking head are hence conducted to the subscriber's receiver after having been amplified by the device V. The subscriber can thus hear his own dictation or that of somebody else. In order to keep the sound intensity at receiver F within certain limits a regulating device PM is connected in parallel therewith over the contact *w1*, device PM being adjusted to originate the best sound intensity.

Maintaining the busy state

If a subscriber wishes to have the machine at his disposal so as to prevent another subscriber from using it, he has to depress key H. Battery Bz is hereby connected to earth over choke Dr2, one winding of relay X, relay B1, resistances R6, R7, line D and contact *e11*, a current of 10 milliamperes being obtained in this way. By this current relay B1 is energized whereas differential relay X is not actuated. Relay B1 acts to block up all the other subscribers over their E-relay and to cut in the amplifier V. With this state of operation the motor stands still. The signalling device AS indicates the amplifier V to be ready for operation.

Supervision

In order to announce to the subscriber the commencement or the end of the record carrier coiled on two drums in a well known manner two contacts ER, EV are provided which shall cause the motor to be disconnected in right time. When the motor is running forward and after the respective drum has been uncoiled to a certain extent, contact EV is opened, the circuits of the relays P, A'' becoming interrupted hereby. The motor is stopped in this way. At the same time contact *ev* is closed and relay S thus energized. This relay by switching its contacts *s1*, *s2* acts to connect the buzzer Y, located between lines D and E, to an alternating current source over contacts *e11*, *e15*. The buzzer thus announces to the subscriber that the record carrier is ending and that therefore a recoiling will be necessary. Instead of the buzzer any other suitable signalling device may of course be arranged. When the coil in moving backward is ending, contact ER is opened. Relays P and X' are thereby cut out and the motor is stopped hereby. At the same time contact *er* closes, thus causing relay S to respond over contact *x1*, whereby also in this case a buzzer signal is given to the subscriber.

If the dictation machine is being used by subscriber I, for instance, and if subscriber II desires to use it likewise then he can announce this to subscriber I by depressing his buzzer key ST. As the E-relay of subscriber II has been excited he connects relay S_a to earth over the switched contact *e24*, his line A, key ST and his E-line, thus actuating the buzzer of subscriber I. At the same time the signalling device AS is operated. In this way both acoustic and optical means serve to inform subscriber I of the fact that another subscriber wishes to use the machine. As regards subscriber II, by the energization of relay E2 the direction of the current passing through his lines D, E has been reversed, the blocking signal being actuated in this way, since, as stated before, owing to the valves V1, V2 the operation of the indicating devices AS, SS depends upon the direction of current. If subscriber II, although knowing from his signalling device SS that the machine is being used, should nevertheless depress one of his keys then this will be without result for a certain time, the arrangement governed by him not becoming connected to the machine until the other subscriber ceases from using this.

Partial retrograde movement

If there is a typist for several subscribers of a dictation machine then her control device is only provided with four keys, namely the keys R, E, W and a release key. The E-relay of this subscriber, i. e. the typist, is fitted with an additional contact *e5*. The purpose of this arrangement is as follows. If she has failed to comprehend a sentence she has to depress the key H. Hereby one winding of relay X is connected to earth over contacts *a'1*, *e5*, resistance R12 and a contact *z*. Relay X is thus caused to respond, resistance R12 allowing a sufficiently intense current to flow. Relay X causes the motor to run backward, and the motor does so until a cam disc Z clutched to the motor shaft will open contact *z* and thereby disconnect the motor. In this way the typist will have the last words repeated so that she may now be able to understand the dictation. The amount of retrograde movement of the motor is determined by the ratio of transmission between motor shaft and cam disc Z and may within narrow limits be varied by means of a headless screw.

Release of the keys

The control device of each subscriber is such that on depressing a key any other key that may have been actuated is released by a suitable mechanism. The release key does not operate electrical circuits but only serves to release the key depressed just before and then at once reassumes its normal position.

What is claimed is:

1. An electromagnetic recording system comprising an electromagnetic recording machine at a central station, a plurality of subscribers' lines connecting subscribers' stations to said central station over speech frequency paths, push button switches at each subscriber's station for completing various operating circuits over said speech path, and relays at said central station controlled by completion of said operating circuits for establishing different states of operation of said electromagnetic recording machine.

2. A system according to claim 1, further com-

prising a choke coil, and means for closing said subscriber's station circuits over said choke coil, said coils being connected to compensate self-induction of said relays and to balance the lines of said speech path.

3. A system according to claim 1, further comprising relays in each of said subscriber's line circuits, and means responsive to initiation of an operation by one subscriber for operating said subscriber's line relays to block the circuits of said other subscribers.

4. A system according to claim 1, further comprising means responsive to initiation of operations by one subscriber for blocking said other subscribers from effecting operating control, and means for signaling this blocking condition to said other subscribers.

5. A system according to claim 1, further comprising a key at each subscriber's station, and means under control of each key for indicating to other subscribers that the subscriber operating said key is occupying the recording machine.

6. A remote control recording system, comprising a recording machine having several states of operation including a reversing of said machine positioned at one station, a speech transmission path allotted to said recording machine, a plurality of push buttons positioned at another station, controlled relays at said first mentioned station for controlling operation of said recording machine, an operative connection between said push buttons and said control relays coupled to said transmission path to establish the several states of operation of said recording machine, means controlled by one of said push buttons for reversing said machine and a retarding means operatively associated with said reversing means for retarding the action of said reversing means.

7. An electromagnetic recording system according to claim 6, in which said retarding means comprises the combination of a resistance and a condenser.

8. An electromagnetic recording system according to claim 6, further comprising means for regulating the retarding effect of said retarding means.

9. A recording system comprising a recording machine at a central station, a plurality of subscribers' lines connecting subscribers' stations to said central station over speech frequency paths, push button switches at each subscriber's station for completing various operating circuits for said recording machine over said speech frequency path, relays at said central station controlled by said operating circuits for establishing the various operations of said machine, a typist's station connected to said central station over a speech frequency path, control apparatus for operation at said typist's station for controlling said recording machine, and means at said typist's station for blocking the control circuits at the subscribers' stations.

10. An electromagnetic recording means according to claim 9 in which said means for blocking said subscriber's control circuit comprises a push-button controlled relay, and further comprising a means controlled by said relay for recoiling said record carrier, a motor for operating said recording machine, a cam disc controlled by said motor for stopping said recoiling at a predetermined point, and a clutch for coupling said cam disc to said motor shaft.

11. In an electromagnetic recording system according to claim 1, an amplifier at said central station, and means controlled by said push buttons for inserting said amplifier in circuit during use of said recording machine.

12. In an electromagnetic recording system according to claim 1, including signalling means for cooperating with said recording machine, and means controlled by said recording machine for operating said signalling means in response to approach of the end of the record carrier of said recording machine.

13. An electromagnetic recording system according to claim 1 further comprising, a key at each subscriber's station, a relay at said central station controlled by said keys for indicating the use of said recording machine by one subscriber to other subscribers, and signalling means operative in response to the approach of the end of the record carrier of said recording machine to apprise said one subscriber of this condition, said signalling means being operated by said relay.

14. In a remote control recording system, a central station comprising a recording machine, means for selectively driving said recording machine forward or in the reverse direction, a record bearing means on said recording machine, means for selectively recording a message on said record bearing means or reproducing a recorded message therefrom during the forward operation of said recording machine, and a plurality of relays for controlling said driving means and said reproducing means, a voice frequency transmission line operatively connected with said recording means and said relays, at said central station, and a control station connected with said central station over said transmission line comprising, a plurality of push buttons, means selectively controlled by operation of said push buttons for selectively completing circuits for said relays at said central station over said voice frequency transmission line, to control said recording machine and said recording and reproducing means, and means for selectively coupling a voice frequency transmitter or a voice frequency reproducer to said transmission line for recording a message on or reproducing a message from said record carrier at said control station.

15. In a remote control recording system, a central station comprising a recording machine, means for selectively driving said recording machine forward or in the reverse direction, a record bearing means on said recording machine, means for selectively recording a message on said record bearing means or reproducing a recorded message therefrom during the forward operation of said recording machine, and a plurality of relays for controlling said driving means and said reproducing means, a voice frequency transmission line operatively connected with said recording means and said relays, at said central station, a plurality of subscribers' stations connected over separate transmission lines to said voice frequency transmission line, each of said subscribers' stations comprising a plurality of push buttons, means selectively controlled by operation of said push buttons for selectively completing circuits for said relays at said central station over said voice frequency transmission line, to control said recording machine and said recording and reproducing means, and means for selectively coupling a voice frequency transmitter or a voice frequency reproducer to said transmission line for recording a message on or reproducing a message from said record carrier at said control station.

16. A remote control recording system according to claim 15 further comprising means at each control station responsive to the control of said

recording machine from any one of said stations to indicate that said recording machine is in use, and means operative in response to said use of said recording machine by one of said subscribers' stations for blocking the other subscriber's station from controlling said recording machine.

17. A remote control recording system according to claim 15 further comprising a typist's station connected over a line to said voice frequency transmission line, means at said typist's station for blocking the control circuits of said subscriber's station, means at said typist's station for causing said record carrier to be recoiled, and means at said central station responsive to the recoiling of said record carrier for stopping said recoiling at a predetermined point.

WILLIAM H. WARREN.