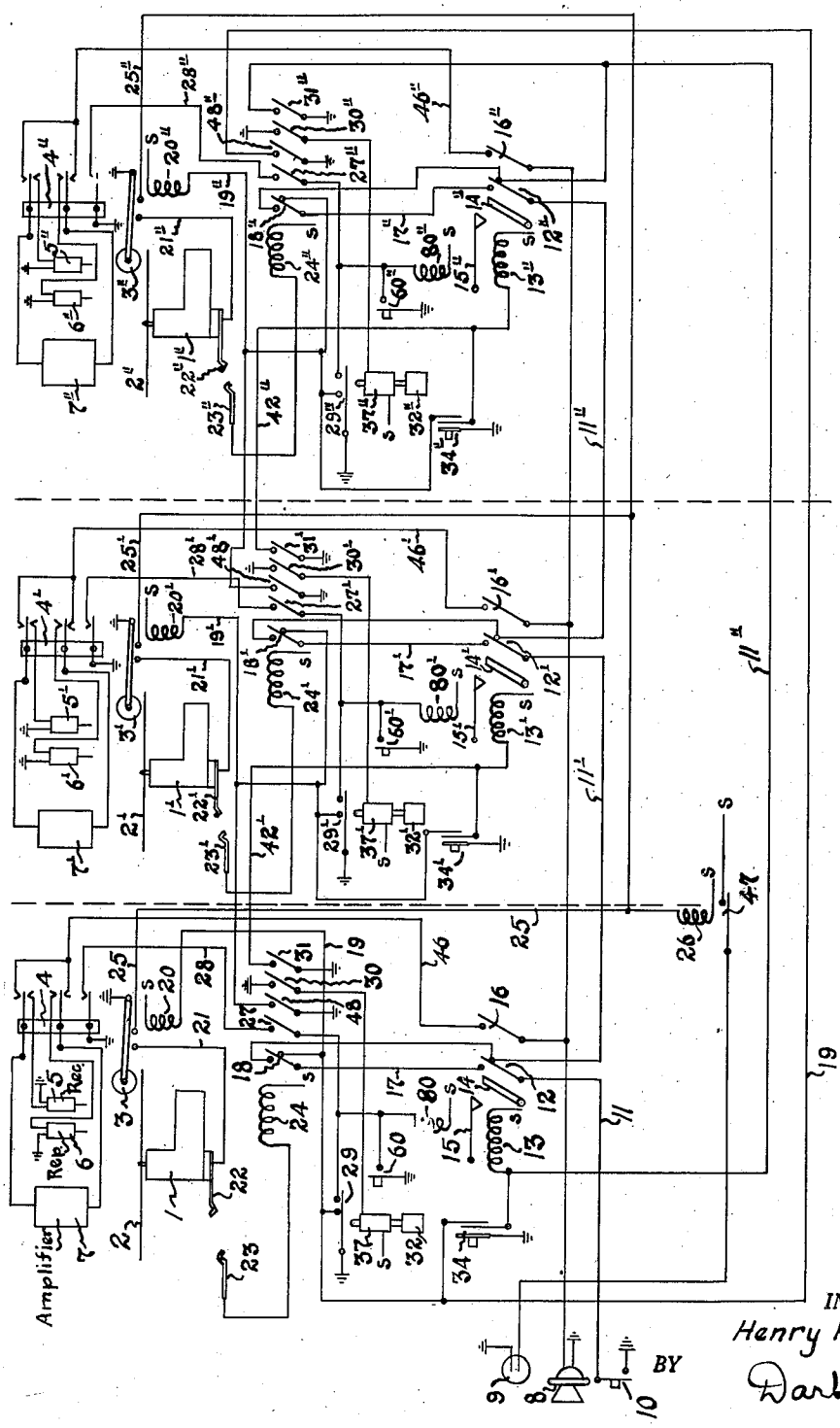
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CONTINUOUS SOUND RECORDING AND REPRODUCING SYSTEM

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CONTINUOUS SOUND RECORDING AND REPRODUCING SYSTEM

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This invention relates to improvements in sound recording and reproducing machines of the type in which the record produced is permanent and from which reproductions can be accomplished as required.

The subject matter of this invention is concerned with circuit relationships between two or more sound recording and reproducing machines whereby when recording or reproduction on or from one machine of the group is completed by reaching the end of the record thereon, recording or reproduction is automatically transferred to the next machine of the group and so on through the entire series, and if necessary back to the first machine of the group for repetition of the cycle as required.

An object of this invention is to provide automatically operating apparatus in a system of this type, wherein during recording a predetermined amount of terminal recording of one machine is simultaneously recorded as the initial amount on the next machine of the series, so that the recording may in effect be said to overlap.

A further object of this invention is the provision in such a system of an arrangement wherein each machine in use initiates the operation of the next machine of the series near the end of the recording on the machine in use.

A still further object of this invention is to provide in such a system means acting during reproduction to cause the immediate shut down of the machine in use when the next machine of the series starts up, so as not to cause distortion in the sound reproduction.

An important object of this invention is to provide in such a system means at the dictator station whereby starting and stopping of any of the machines may be effected by the dictator, and wherein this starting and stopping control is automatically shifted through the cycle, so that the particular machine in use can be started and stopped as required.

A still further object of the invention is to provide manually operated means whereby an attendant for the machines may at any time shift the recording or reproduction from the machine in use to the next machine of the series without interrupting recording or reproduction.

Many other objects and advantages of this invention will become apparent from the following detailed disclosure of one embodiment thereof.

It is to be particularly noted, as circuit technicians will recognize, the apparatus is arranged so that by simple cable and plug connectors any number of machines may be included in the system and may be added thereto or readily removed by the simple application or removal of the connector plugs. A particular advantage of this arrangement, and one of the objects of the invention, is to provide a sound recording and reproducing system particularly adapted to military purposes, and when required adapted to use in airplanes.

This invention resides substantially in the combination, construction, arrangement and relative location of parts, all as will be described in detail below.

In the accompanying drawing, the single figure is a schematic and diagrammatic illustration of the subject matter of this invention as applied to three sound recording and reproducing machines. Similar reference numerals have been used throughout to indicate the same or similar parts.

Those who are acquainted with the subject matter of this art will understand from this disclosure that the subject matter of this invention may be applied to many different forms and types of sound recording and reproducing machines. For purposes of illustration, however, the invention has been shown as applied to a sound recording machine which is of the type disclosed in the copending application of Proctor and Thiede, Serial No. 218,082, filed July 8, 1938, now United States Patent No. 2,296,870, issued September 29, 1942.

In a machine of this type the record tablet which is a thin disc of cellulose acetate or the like, is mounted upon the rotatable spindle of a carriage which is adapted to have rectilinear movement along guides in a direction radial of the record tablet. The sound recording and reproducing heads which may be alternatively applied to the record tablet are relatively fixed and the driving power for the device to cause movement of the carriage is applied to the record tablet itself by gripping it between a pair of friction rollers, one of which is power driven and the other of which is an idler. The rotation of the tablet causes rotation of the spindle upon which it is keyed, which in turn through suitable mechanism as disclosed in the above patent causes the movement of the carriage. Of course, it is apparent that it is immaterial whether the support for the record tablet moves or the sound recording and reproducing heads move, so long as relative movement therebetween is effected. In a machine of this type the recording begins near the center of the tablet disc and proceeds in

the form of a fine pitch spiral recording outwardly until the periphery thereof is reached.

Referring now to the drawing it is first to be noted that there is illustrated therein the mechanism necessary for the employment of this invention in a system comprising three separate sound recording and reproducing machines. Respective portions of these machines are separated by broken dash lines as shown, and, of course, the connections between the machines may be permanent or may be temporary by means of cables and suitable connectors as previously mentioned. Since the mechanism for each machine is a duplicate of every other machine, only a description of one machine will be given in detail. As illustrated diagrammatically, the carriage is shown at 1, and it may be assumed that in its motion will move back and forth between left and right in the plane of the paper. The record tablet is illustrated at 2 and is diagrammatically shown as self-supporting, although, as previously mentioned, it may be of the thin flexible type. It is keyed to the vertical spindle journaled on the carriage, and is rotated by means of a power driven wheel, not shown, which will engage the record on its under surface below the point of contact between the record and the idler roller 3. The axes of these rollers will be in the plane of the paper, as is apparent from the above mentioned patent, but for the sake of simplicity not illustrated and shown. The friction idler roller 3 is rotatably mounted on the end of a pivotally mounted lever which is grounded as shown. The power driven roller engages the under surface of the record tablet at all times, and will not drive unless the record is clamped between it and the idler roller 3 by moving the idler roller 3 down into engagement with the upper surface of the record tablet.

Included as part of the machine and connected in any suitable manner with the lever provided to shift from recording to reproduction, is a switch 4 which includes a movable member having three switch blades mounted thereon, as indicated by small circles in the drawing. This switch is shown in neutral position, at which time neither the recorder nor the reproducer engages the record tablet. Two of the movable contacts are connected to the input and output of a suitable amplifier 7 which is preferably a multi-stage vacuum tube amplifier of the proper characteristics. Single wire circuits are illustrated for the sake of simplicity. It is to be noted, however, that the lower contact of this pair of contacts is connected to the input of the amplifier, and the upper contact is connected to the output. These two movable contacts cooperate with a pair of fixed contacts as shown, provided with a common connection 40 to the fixed contact of a switch 16. The third movable contact of the switch 4 is grounded as shown, and cooperates with the fixed contact which is connected by wire 28 to the fixed contact of switch 27. The upper contact of the amplifier pair cooperates with a fixed contact connected to the grounded recording head 5, which may be of any form suitable for this purpose. The other fixed contact cooperating with the amplifier pair is connected by wire to the grounded sound reproducing head 6, likewise of any form suitable for the purpose.

While the subject matter of this invention is not particularly concerned with such details, the switch 4 may be mechanically or electrically associated with the mechanism for shifting the recorder and reproducer into use, so that the switch will be properly positioned depending upon the recording or reproducing function.

At the dictator's station, which may be at the machines, or remote with respect thereto, is a combined microphone-loud speaker unit 8 which has one terminal grounded and its other terminal connected by wire as shown to the movable contact of switch 16. It is mentioned, although apparent from the drawing, that this connection similarly connects to each of the switches 16 of the other machines in the system, as for example switches 16' and 16''. At the dictator's station is a start-stop switch 10, one contact of which is grounded and the other contact of which is connected by wire 11 to the movable contact of switch 12. This movable contact cooperates with a front and a back contact and the former is connected by wire 11' to the movable contact of switch 12' of the second machine, and so on through the series. Switches 12 and 16 are part of a relay having the energizing winding 13 and including a latch 14 which cooperates with a catch 15 so that when the winding 13 is energized the switches shift to their other position and are locked in that position by engagement between latch 14 and catch 15.

At this point it will be noted that the system as illustrated is shown as a grounded system for simplicity. All the live or positive terminals of the various devices are indicated by the letter S and it will be understood that the power system, not shown, will be grounded at one terminal and its other terminal will be connected to all of the terminals of the system marked S.

The back contact of switch 12 is connected by wire 17 to movable contact of switch 18 which includes a front and back contact. The former is connected by wire 19 to one terminal of a magnetic actuating device 20 for raising and lowering the lever which supports the idler roller 3. There are many suitable forms of magnetic actuators so that this element has only been diagrammatically illustrated. Any type of device which will move the lever down upon one energization, where it will remain until the next energization, whereupon it will be raised, is suitable for the purpose. This arm or lever cooperates with a pair of fixed contacts so as to engage them when the lever is in its down position. One of these contacts is connected by wire 21 to a contact finger 22 mounted upon but insulated from the carriage 1, so as to travel with it. The contact finger 22 cooperates with a fixed contact finger 23 which is positioned so that these fingers engage when the recording or reproduction comes within a predetermined distance from the end of the record. Contact finger 23 is connected to the operating winding 24 of a relay which includes the switches 18, 27, 48, 30 and 31.

The other fixed contact controlled by the lever of idler roller 3 is connected by wire 25 to one terminal of the operating winding 26 of a relay which includes a switch 47. Switch 47 is in a circuit including a signal lamp 9 at the dictator's station, which may be of any suitable type, but which is illustrated as of the glowlight or neon lamp type.

Switch 27 of the relay 24 has one terminal connected by wire 28 to the fixed contact which cooperates with the third movable contact in switch 4. This movable contact is grounded as shown. The other contact of switch 27, illustrated as a movable contact, is connected by wire to one of the fixed contacts of a pair in the switch 27 and by branch connections to the fixed contact

of a switch 60 to the unlatching winding 80 of the relay 13. The other contact of switch 60 is grounded as shown. The second contact of the pair of switch 29 is connected by wire 19, and the movable contact of this switch is grounded as shown.

The fixed contact of switch 30 is grounded and its movable contact is connected by a wire to one terminal of a solenoid 37 whose plunger is connected to a dash-pot 32 biased so that the plunger will ascend slowly upon the energization of the solenoid 37 to return quickly upon its de-energization. This plunger is positioned so that at the end of its upward stroke it will engage switch 29.

The movable contact of switch 48 is grounded and its fixed contact is connected by wire 19' to the magnetic starting device 20' for the second machine and by branch connections to the back contact of switch 18', one of the fixed contacts of switch 29' and the fixed contact of switch 34'. At this point it may be noted that the fixed contact of switch 34 is connected to wire 19. The movable contact of switch 31 is grounded and the fixed contact connected by wire 42' to the winding 13' of the relay of the second machine and by a branch connection to one of the movable contacts of switch 34'. At this point it will be noted that one of the movable contacts of switch 34 is also connected to the winding 13. The movable contacts of switch 34 and its equivalent switches in the other machines is grounded, as shown.

The front contact of switch 12 is connected as shown to the back contact of switch 18.

While it is of no importance to an understanding of this invention, it will be understood that most of the control equipment for each machine may be embodied in a single compact unit which may be provided with receptacles for cable and plug connection for facilitating in connecting in to the recording and reproducing machine with which it is to be associated, with the control unit of the next machine and with power circuits. Likewise, each machine may be readily provided with connectors for the relay 26, signal light 9, transmitter-reproducer 8 and start-stop switch 10. Likewise, it is apparent that these control units may be completely uniform and each may be provided with a signal light, a relay for the signal light, and a start-stop switch. These minor variations will be apparent to those skilled in the art and do not affect the nature of the scope of the invention.

A description of the operation of this system will now be undertaken. It will be assumed that the particular installation to be described includes, as shown, three sound recording and reproducing machines and three control units connected up as shown. It will further be assumed that the machines have all been prepared for recording either by the dictator or an attendant, so that each machine is provided with a fresh record tablet and each machine is conditioned so as to start recording at the beginning of the record. It will be assumed that the power disc roller, not shown, is in operation or the control for its driver is tied in with switch 4, so that when switch 4 is shifted to recording position the drive roller will be in operation. It may be noted that switch 4 is shifted to recording when it moves downwardly, in which case the uppermost movable contact thereof engages the fixed contact connected with the recorder 5. The middle movable contact of switch 4 is connected to wire 46, and the lowermost movable contact is out of engagement with the contact connected to wire 28. The dictator, in order to start the machine merely momentarily closes switch 10, which completes a circuit from ground through that switch, wire 11, front contact of switch 12, wire 11', front contact of switch 12', wire 11'', front contact of switch 12'', and back through wire 11'' to winding 13, and thence to the power source through connection S. The result of this is the momentary energization of the winding 13, causing switch 12 to shift to its back contact, switch 16 to close, and latch 14 to be engaged by the catch 15, so that switches 12 and 16 remain in actuated position. The circuit from wire 11 then passes through the back contact of switch 12, wire 17, front contact of switch 18, wire 19 to the start-stop winding 20. If switch 10 is held closed for several seconds, the circuit will then shift to the winding 20, pulling the lever for idler friction roller 3 down into driving position. If the closing of switch 10 was only momentary, it will then require a second closing to actually start the first machine. No other circuits from wire 19 are completed at this time.

The downward movement of the lever supporting the roller 3 completes a circuit from ground through wire 25, through relay 26, closing switch 7 and energizing the signal light 9 showing the dictator that a machine is ready for recording. The dictator need then only speak into the microphone 8, the circuit for which is completed from ground through the microphone to switch 16, and thence by wire 46 to the input contact of switch 4 for amplifier 7, through the amplifier to the output circuit, through the output contact, and thence to the recording head 5 and to ground, as will be apparent. As the dictation continues, carriage 1 moves slowly to the left. At any time the dicator may stop the machine by again momentarily closing switch 10, which again completes a circuit through the back contact of switch 12 as before, to again energize the start-stop winding 20 which will actuate the lever for roller 3 to the upward position. This extinguishes light 9 in the obvious manner.

Assuming, however, that recording continues, as the stylus of the recording head comes within a predetermined distance of the end of the record, spring finger 22 engages spring finger 23. A circuit is then completed from ground through the lever from roller 3, wire 21, fingers 22 and 23 to the relay winding 24. A number of new circuits are now established. Instantly the control by switch 10 through wire 17 shifts through the working contact of switch 18 to wire 11' and by it to the movable contact of switch 12'. At the same time the closing of switch 31 completes a circuit from ground through that switch and by wire 42' to relay winding 13'. The energization of the relay 13' immediately closes switch 16' and shifts the movable contact of switch 12' to its back contact. These switches are latched up in this position by the engagement of catch 15' with latch 14'. The shifting of the control switch 10 to switch 12' makes it immediately possible to start and stop the second machine from the dictator's station through wire 17', the front contact of switch 18' and wire 19', to start-stop the winding 20' of the second machine. However, this machine has already been started by the closing of switch 48 to set up a circuit from ground through wire 19' so that at the instant of energization of relay 24 the lever for roller 13' descending and the second machine starting to record. It will, of course, be apparent that switch

4 will have previously been moved down to recording position since we assume that all of the machines were set for recording when required.

Also, at the instant of energization of relay 24, switch 30 was closed, completing a circuit from ground to the solenoid 37, so that the plunger under the bias of the dash-pot 32 began to rise slowly. After a few seconds, as determined by operating conditions, this plunger will close switch 29, which will accomplish several operations. The first of these is to complete a circuit to the unlatching winding 80, so that switch 16 opens and switch 12 shifts to its front contact. At this time the control circuit for switch 10 by-passes switch 18 and goes directly to wire 11'. The function of the back contact of switch 18 will thus be seen to be that of providing a control circuit by way of switch 10 for the next machine of the series during the period of overlapping or conjoint recording on the two machines. It will likewise be seen that one of the functions of the solenoid dash-pot arrangement 37—32 is to determine the length of period of overlapping recording which may be adjusted as required. A further function of this combination is accomplished at switch 29 by completing a circuit for the start-stop winding 20 from ground through left hand contact of switch 29 and wire 19 to stop the first machine at the end of the period of overlapped recording. As an incident to this operation the lever for roller 3 now moves upwardly, breaking the circuit for relay 26 at this point. However, the circuit for this relay has in the meantime been completed through wire 25' so that signal light 9 indicates that a machine is in operation. The circuit for relay 24 is also broken at this time at the left hand contact with the pair controlled by the lever for roller 3, which is desirable because the carriage of the recording machine moves very slowly and would not move enough in the time represented by the period of overlapped recording to cause disengagement between contacts 22 and 23.

In one practical form of machine of this type the radial spacing between the successive convolutions of the spiral recording is about five one-thousandths of an inch, so that this auxiliary arrangement is provided to stop the first machine after a sufficient amount of overlapped recording has been accomplished.

At this point it may be noted that the attendant or the dictator may at any time during recording on the first machine, shift to the second machine by the simple expedient of momentarily actuating the switch of the second machine, or the desired machine of the group. Thus, if recording is going on on the first machine and the attendant or dictator sees that there is some trouble with the mechanism, he may press the switch 34 of some other machine, as for example the switch 34' of the second machine, to complete an obvious circuit to the relay 13' to set the machine up for control by switch 10 or switch 34'. It will be noted that switch 34' also completes a circuit to the start-stop winding 20', so that it will serve to start the second machine promptly and prepare the control circuit through switch 10 for subsequent stopping and starting. The attendant may then service the first machine, stopping it in any suitable manner, as for example by momentarily closing switch 34 of that machine. Switch 60 is merely provided as a convenient means for the attendant to unlatch relay 13 at any time by completing a circuit to the unlatching winding 8. The unlatching of relay 13 will not be accomplished by the closing of switch 34.

It will not be necessary to explain how recording is transferred to the third machine from the second near the end of the recording on the second machine, since this is accomplished in exactly the same way as the shift was accomplished from the first to the second machines. It is to be noted that the cycle may be repeated if in the meantime machine 1 is prepared for recording, since the third machine will automatically shift recording to the first machine near the end of the recording on the third machine. This is accomplished through switch 31'' in an obvious manner, back to relay winding 13 when the contact fingers 22'' and 23'' engage.

A description of the operation during reproduction will now be given. This operation is characterized by the fact that there is no overlap of reproduction in shifting from one machine to the other because of the fact that undesired distortion would be introduced in the sound reproduction were double reproduction allowed to occur simultaneously. It is assumed that the machines are conditioned so that they are ready to start reproduction from the beginning of each record and that, of course, the record blanks on the machines contain recordings. In order to reproduce, the next most important operation is to shift switch 4 from its lowermost position or its neutral position, depending upon which it is in at the time, to its uppermost position so that, as is obvious, the input contact of the pair for the amplifier is connected to the reproducer 6, the output contact of the pair is connected to wire 46, and the lowermost movable contact is connected to wire 28. Reproduction can then be started by momentarily closing switch 10 to operate switch 13 and set the machine in motion as before. Reproduction continues until spring finger 22 engages spring finger 23, in which case the relay 24 is energized and the switches forming part thereof are all operated as described before. The only different result in this case is that the latch releasing relay 80 is immediately energized through wire 28 and switch 27 so that at the very instant that the second machine starts up the connection to the loud speaker 8 through switch 16 is broken so that reproduction from the first machine is instantaneously stopped. Since the records have overlapped recordings there is no discontinuity in the sound reproduction notwithstanding any physical variation in the relationship of the parts and the record tablets that might be inherent in such apparatus. Of course, the second machine has started at the time the circuit 46 is interrupted, in the manner in which the second machine is started during recording, and therefore these operations will not be retraced. Under reproducing conditions, as in recording, the solenoid 37 will be energized so that the first machine will stop when the plunger of the solenoid closes switch 29 in the manner previously described. Thus during reproduction the circuit 46 from the first machine to the loud speaker is interrupted at the same instant that it is established through switch 16' and circuit 46'.

From the above description it will be apparent to those skilled in the art that the subject matter of this invention may be embodied in other physical combinations and elements comprising the same, and I do not, therefore, desire to be strictly limited to the disclosure given herein in

an illustrative sense, but rather to the scope of the claims granted me.

What is claimed is:

1. In a system of the type described, the combination comprising a plurality of machines for recording sounds on a record and reproducing sounds therefrom, control means interconnecting said machines and respectively controlled by said machines for causing during recording a machine in operation to start another machine near the end of the record of the former to overlap recording for a time interval and for interrupting reproduction of one machine near the end of its record and simultaneously initiating it from another machine.

2. In a system of the type described, the combination comprising a plurality of machines for recording sounds on a record and reproducing sounds therefrom, control means interconnecting said machines and respectively controlled by said machines for causing during recording a machine in operation to start another machine before the end of recording by the former and for interrupting reproduction of one machine near the end of its record and simultaneously initiating it from another machine, and means for stopping the preceding machine a predetermined period of time after reproduction from the next machine has been initiated.

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