

April 13, 1948.

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2,439,446

CONTROL CIRCUIT FOR SIGNAL RECORDING AND REPRODUCING SYSTEMS

Filed Nov. 29, 1944

3 Sheets-Sheet 2

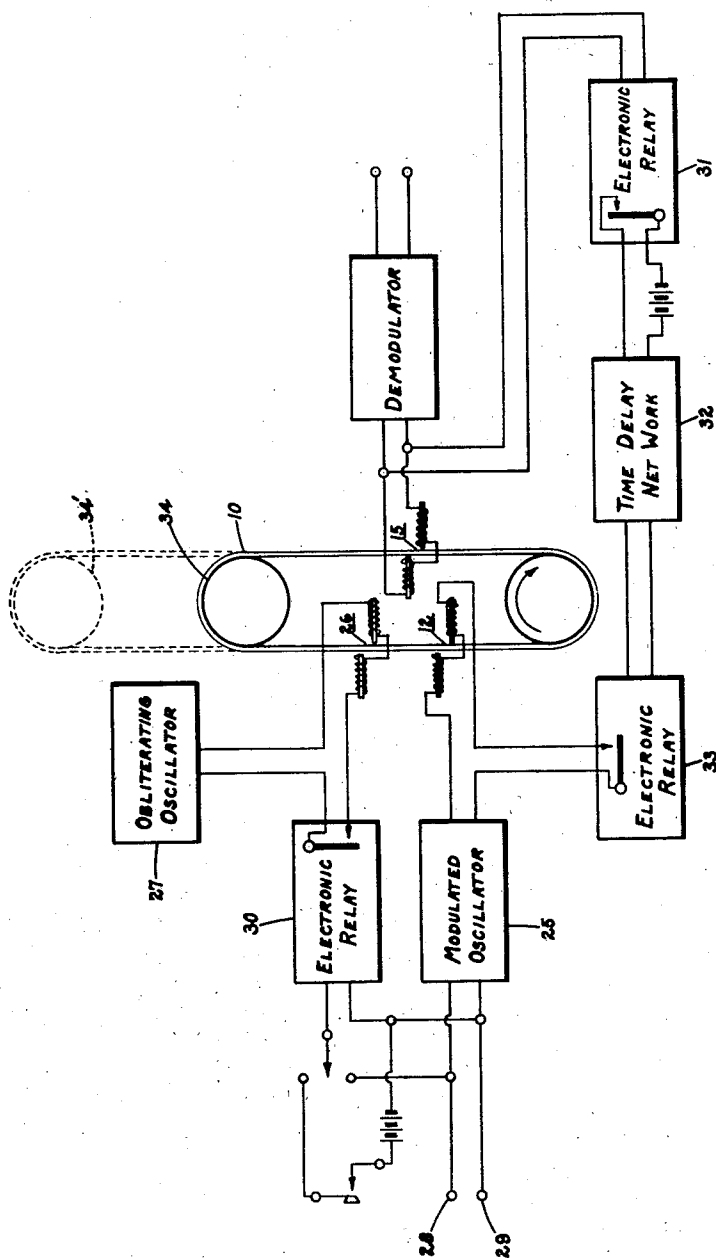


FIG. 3

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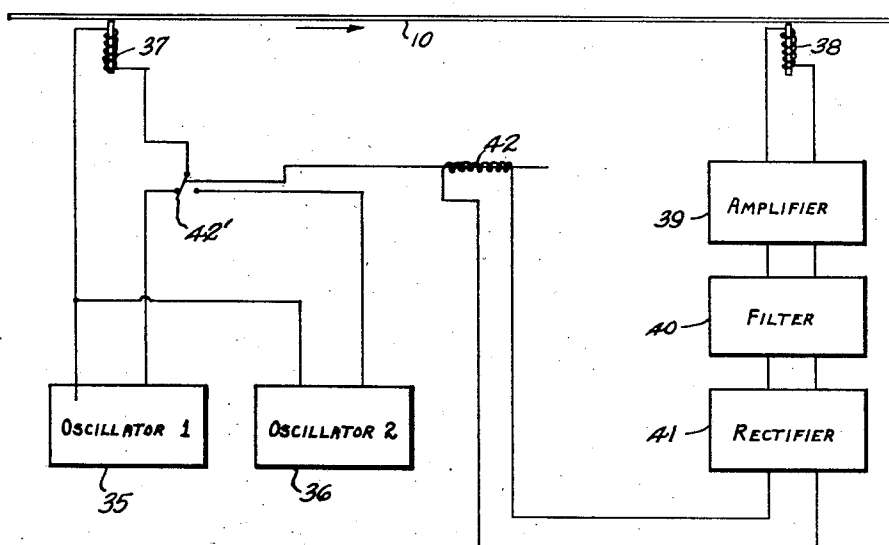


FIG 4

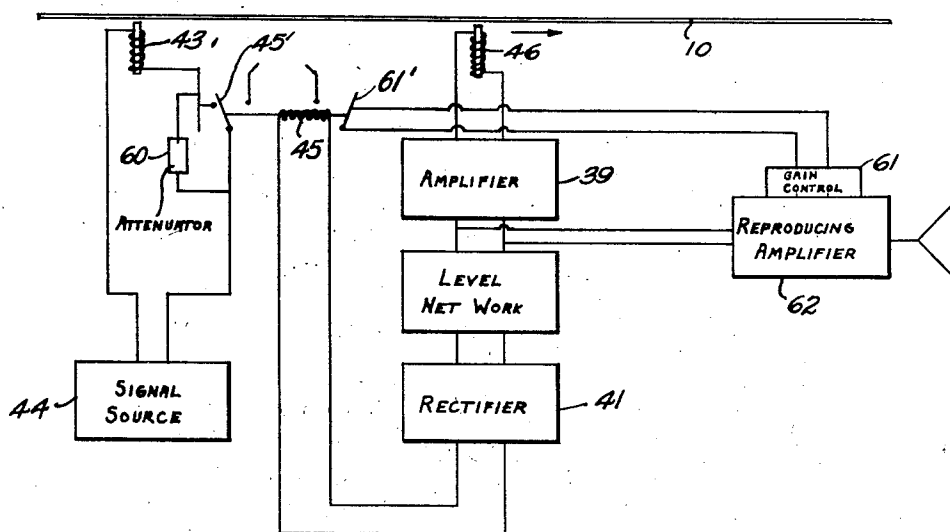


FIG 5

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CONTROL CIRCUIT FOR SIGNAL RECORD-
ING AND REPRODUCING SYSTEMSSemi Joseph Begun, Cleveland Heights, Ohio, as-
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Application November 29, 1944, Serial No. 565,736

2 Claims. (Cl. 234—1.5)

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My invention pertains to control circuits for use in signal recording and reproducing systems such, for example, as the magnetic, optic or mechanical systems.

This application is a continuation-in-part of my application Serial No. 455,646, which has issued as Patent Number 2,370,134.

An object of my invention is to provide a control circuit for a signal recording and reproducing system wherein the reproducing circuit exercises a function on the recording circuit.

Another object of my invention is to provide a control circuit for signal recording and reproducing systems wherein the reproducing circuit exercises a function on the recording circuit after an adjustable time delay.

A further object of my invention is to provide a control circuit as set forth in the next above object wherein the amount of delay may be adjusted by a number of different means.

Still another object of my invention is to provide a method of measuring distance or time by a signal recording and reproducing system.

It is also an object of my invention to provide a control circuit for a signal recording and reproducing system wherein the reproducing circuit is energized only while reproducing a recorded signal to cause the recording circuit to become inoperative.

Other objects and a fuller understanding of my invention may be had by referring to the following description, claims and drawings, wherein

Figure 1 illustrates a time interval measuring system utilizing my invention.

Figure 2 is a simplified schematic diagram of my invention.

Figure 3 is a block diagram of a device utilizing my invention.

Figure 4 is a schematic block diagram of another form of my invention, and

Figure 5 is a block diagram illustrating still another form of the invention.

In Figure 1 there is shown a disk 10 of magnetizable material which is rotated at a known and constant rate of speed by a motor 46. Associated with the disk 10 are two magnetic recording heads 47, 48, and two reproducing heads 49, 50. The recording head 47 and the reproducing head 49 are located on track A on the disk 10, and the reproducing head 49 is adapted to "pick-up" the signal which the recording head 47 impresses on the disk, and the recording head 48 and reproducing head 50 are on track B and are adapted to cooperate in the same manner as heads 47, 49. An obliterating head 51 is positioned between the reproducing head 50 and the recording head 48,

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and extends only across track B, thus preparing the track for a new record. The reproducing head 49 also serves part time as an obliterating head.

When a time interval is to be measured the motor 46 is started and the disk 10 is driven at a known and constant rate of speed. Switches 52, 53 and 59, are normally in the positions shown by dotted lines, switches 52 and 59 being open. At the start of the interval to be measured the switch 16 is thrown by external means to the left thereby closing all three switches 52, 53 and 59. Closing switch 52 connects the output signal from the oscillator 54 through the amplifier 55 to both recording heads 47, 48. Closing switch 53 connects the battery 56 to the head 49 thereby making head 49 an obliterating head. Closing switch 59 connects the output from a differentiating circuit 71 to a counter device 57. Trigger circuits of the general type which would be operable to actuate switch 16 are shown schematically in United States Patent Number 2,378,389, issued to S. J. Begun on June 19, 1945, for Recording-reproducing device, and in detail in United States Patent Number 2,378,388, issued to S. J. Begun on the same date, for Recording and reproducing device. A trigger circuit having input connections for five different types of input signals is shown in detail in United States Patent Number 2,395,127, issued to Otto Kornei on February 19, 1946, and assigned to the same assignee as the present invention. During the time that it takes the disk 10 to rotate through the angle α both of the recording heads 47, 48 are recording the signal from the oscillator 54. When the magnetic pattern of the signal recorded by head 48 on track B reaches the reproducing head 50, an electromotive force is generated which is amplified by the amplifier 58, and the output through the rectifier-integrator 70, the differentiating circuit 71 and the switch 59 is used to actuate the counter 57 and the output from the rectifier-integrator 70 is also used to reduce the gain in the amplifier 55 to prevent the heads 47, 48 from further recording for an interval of time t equal to the length of time it takes the disk to rotate through the angle α . Patent Number 2,378,388 described in detail how the gain of an amplifier connected to a magnetic transducer head may be reduced to prevent the recording head from recording on a moving magnetic member. When the magnetic pattern which was recorded on track A reaches the head 49 it is obliterated by magnetic flux set up by current from the battery 56.

Accordingly, reproducing head 50, after the start of an interval to be measured, does not pick up any signal for the time t , which is the time

necessary for the disk 10 to rotate through the angle α . Then for a period of time t it picks up a signal. For the next period t no signal is picked up etc. It will be seen, therefore, that the head 50 picks up a signal in the time intervals t to $2t$, $3t$ to $4t$, $5t$ to $6t$, etc., but does not pick up a signal in the time intervals 0 to t , $2t$ to $3t$, $4t$ to $5t$, etc.

From the amplifier 58 the signal passes to a rectifying and integrating device 70 to establish substantially a D. C. pulse having a duration corresponding to the duration of the alternating signal. This D. C. pulse blocks amplifier 55 and is also fed to a differentiating device 71. The output signal from the differentiating device consists of a series of pulses occurring at time intervals t , $2t$, $3t$, $4t$, $5t$, etc., and each pulse causes, by means of an electromagnet or the like, the counter 57 to move one step for each period of time during which the disk rotates through the angle α . The counter which is a special Veeder-Root step-by-step type of counter wherein the usual numbers 1, 2, 3, 4, etc., are replaced by the indications $0+$, $2-$, $2+$, $4-$ etc., starts with a reading of $0 (+)$ and the first pulse causes the counter to indicate $2(-)$, the second pulse actuates the counter to cause it to indicate $2(+)$, and the third pulse causes the counter to indicate $4(-)$ etc. Unless the interval to be measured is exactly as long as the length of time for a whole even number of revolutions of the disk 10 through the angle α there will be a signal recorded on track A which has not been obliterated by the head 49. The duration of this signal must be added to or subtracted from the interval indicated on the counter 57. The duration of this signal will be indicated on the scale of the indicating device 24, and will be subtracted from the counter indication if the counter says $(-)$, and added to the counter indication if the counter says $(+)$. The reason for the counter notation $0(+)$, $2(-)$, $2(+)$, etc., is as follows: The time interval from zero microseconds to something just less than t microseconds (t =time for disk to rotate through angle α) is measured by determining through what angle on the disk 10 a signal has been recorded. As there has been no whole time interval t the counter reads 0 and the interval must be added to 0 to get an accurate reading; hence the counter notation $0(+)$. For a time interval longer than t but less than $2t$ the duration is determined by reading the counter 57 which has been actuated once and by reading the meter 24 which indicates the angular amount of signal which had been applied to the disk 10 throughout the first time interval t and which had not been erased by obliterating head 49 during the second time interval t . Remember that the device operates to record a signal during the first, third, fifth, etc., intervals t and to erase the recorded signals during the second, fourth, sixth, etc., time intervals t , and that while it is recording it is not erasing and while it is erasing it is not recording. It will be appreciated, therefore, that during the second interval t the time interval (less than t) which remains unobliterated on the disk 10 must be subtracted from the counter indication, and if the counter indicated 1 the reading would be in error. Hence the counter is made to indicate $2(-)$ to show that the meter reading must be subtracted from the counter indication.

The head 49 serves as an obliterating head only during the interval to be measured. During the first time interval t the obliterating head

49 will be energized by the battery 56 but will not obliterate a signal from track A as there is no signal recorded on that portion of track A which is passing head 49. During the second time interval t the head 49 will obliterate the signal from track A. During the third time interval t there will be no signal obliterated, etc.

At the end of the time interval to be measured the switches 52, 53, and 59 are simultaneously thrown by the trigger circuit, switches 52 and 59 returning to their open position and switch 53 connecting the head 49 to a meter 24. The head 49 thereafter functions as a reproducing head instead of an obliterating head. Opening switch 52 breaks the connection between the oscillator 54 and the recording heads 47, 48 thereby terminating all recording. Opening switch 53 breaks the connection between the battery 56 and the obliterating head 49. Switch 59 breaks the circuit from reproducing head 50 to the counter 57 in order that there will be no further actuation of the counter which could arise from the end of the signal recorded on track B passing through the head 50. Without switch 59 the signal, if it occurred sometime during $2t$, $4t$, $6t$, or $8t$, would establish a pulse which would actuate the counter 57, thereby introducing an error. It is the function of the trigger circuit switch 16 to make certain aforescribed circuit connections at the start of the time interval to be measured, and to break those circuit connections and make other aforescribed circuit connections at the end of the time interval to be measured. During the time interval certain recording and obliterating functions take place from which it is possible to accurately measure the duration of the time interval, whether it be only a few microseconds or much longer in extent.

For reasons of simplicity I have shown switches 52, 53, and 59 as mechanical and actuated by the trigger circuit switch 16, but it is to be understood that electronic switches may be used, as a more rapid action could be obtained thereby reducing the amount of error due to time lag in switching. The details of the actual mechanism utilized to throw the switch 16 are not shown as they form no part of this invention and any one of a large number of mechanisms well known to the art may be utilized. For example, if the extreme accuracy of my mechanism is not required, the switch 16 could be thrown by hand, much in the same manner as a stop watch is utilized. However, if the inherent accuracy of my device is to be utilized more fully a much more accurate means and method should be used, and such a means and method is shown in Figure 2 where a mechanical switch 14 is electrically thrown by a solenoid 19, 20. A still further improvement is schematically illustrated in Figure 3 wherein electronic switches or relays are utilized.

The signal which was recorded on track A and was not obliterated by head 49 before switch 53 was opened will, upon repeated rotation of the disk past the pickup head 49, establish an electromotive force. The electromotive force is amplified by the amplifier 21, and passes through the limiter 22 and the detector 23, and is applied to the calibrated current averaging device 24.

The time interval is measured by the operator algebraically combining the readings on the counter 57 and meter 24. The counter indicates whole time intervals t , and the meter 24 indicates a portion of a time interval t . The meter indi-

cation is to be added to the counter indication if the counter says (+) and is to be subtracted from the counter indication if the counter says (-).

In order that my device may be clearly understood the successive operations will be described in connection with measuring a given interval. For example: Suppose it is desired to measure an interval of 275 microseconds, and the time of one revolution of the disk 10 is 100 microseconds. It is apparent that the time for the disk to rotate through the angle α , if α equals 270 degrees, is 75 microseconds. Before the start of the interval to be timed switches 52, 53, and 59 are open, the disk 10 is rotating, tracks A and B are erased, and the oscillator 54 is operating.

At the start of the interval to be measured switches 52, 53, and 59 are simultaneously closed thereby connecting the counter 57 (which registers 0+) to the reproducing head 50 and connecting the battery 56 to the head 49 to establish it as an obliterating head, and connecting the oscillator 54 to the recording heads 47, 48 to simultaneously initiate recording on both tracks A and B. After 75 microseconds the front of the record on track B starts to pass reproducing head 50 thereby simultaneously initiating two actions. One action causes the counter 57 to change its reading from 0+ to 2-, and the other action causes the amplifier 55 to be blocked to stop the recording on tracks A and B. As long as a recorded signal passes head 50 there will be no recording by heads 47, 48 as the blocking of amplifier 55 continues. At the same instant that the start of the signal on track B reaches reproducing head 50 the start of the signal on track A reaches the obliterating head 49. The record on track A will be obliterated by head 49 for 75 microseconds until the end of the signal on track B passes head 50, at which time amplifier 55 is unblocked and recording is again started at heads 47, 48, and the counter 57 is actuated to read 2+. By this time 150 microseconds have elapsed. The obliterating head 51 erases all records which pass under it. For the next 75 microseconds heads 47, 48 record on tracks A and B and when the front ends of the records reach heads 50 and 49 the counter is moved to 4- and the recording by heads 47, 48 is again blocked. 225 microseconds have now elapsed. For the next 50 microseconds until the switch 53 is opened by trigger circuit 16 at the end of the interval to be measured the obliterating head 49 obliterates the record on track A, thereby leaving a record only 25 microseconds long on track A. The end of the interval to be measured also opens switches 59 and 52. Switch 53, upon being thrown by trigger circuit 16, connects the head 49 to the meter 24 and it now functions as a reproducing head. Upon repeatedly reproducing the record remaining on track A the meter 24 will indicate 25 microseconds, and because the counter read 4- the 25 microseconds will be subtracted from 300 microseconds ($4 \times 75 = 300$) to give an interval time of 275 microseconds.

A condenser discharge type of obliterating device may be provided for rendering the magnetic condition of track A uniform before a new interval is measured. Normally the switch 75 is open. After an interval has been measured and the operator desires to clear track A, he presses push button 76 thereby closing switch 75 and connecting the battery 78 to the coil of the obliterating head 79. The current from the battery 78 is sufficient to saturate the portion of the disk 10

which is under the obliterating head 79 and is applied for at least one revolution, and when the push button is released the condenser 77, which has been charged by battery 78, discharges through the coil of the obliterating head thereby gradually reducing the flux which is applied to the magnetizable disk 10. This type of obliteration due to the condenser discharge does not leave a sharp change in the amount of magnetization in the portion of the disk which was under the head 79 when the switch 75 was opened, thereby preventing the actuation of the counter 57 by the sharp change in magnetization.

In Figure 2 there is shown a length of magnetic wire or tape 10 which is driven in the direction of the arrow 11 by any suitable driving means such as the variable speed motor M. The length of magnetizable material 10 may be endless as shown or it may be in the form of a length of round or flattened wire wound on one or more reels. A magnetic recording head 12 is positioned in magnetic flux linkage relationship with the magnetizable member 10 and is electrically connected to a signal generator 13 which is preferably an alternating signal generator, but may be a direct current generator. A switch 14 is in the circuit from the signal generator 13 to the recording head 12.

A magnetic reproducing head 15 is positioned in magnetic flux linkage relationship with the magnetizable record member 10 and is positioned a distance away from the recording head 12 in the direction of the motion of the record member. This distance between the heads is adjustable over a wide range. The reproducing head 15 is electrically connected to an amplifier 18 the output of which passes through a rectifier and is connected to a solenoid 19.

The plunger 20 of the solenoid is biased to normally keep the switch 14 closed so that the recording circuit through the recording head 12 is closed. Upon the start of the signal which has been recorded on the magnetizable member 10 by the recording head 12 passing the reproducing head 15 the solenoid winding 19 is energized by current derived from amplifier 18 and the rectifier. The solenoid plunger 20 is thereby actuated causing switch 14 to open and break the circuit to the recording head 12 with consequent termination of the recording. Upon the end of the signal which has been recorded on the magnetizable member 10 passing the reproducing head 15 the solenoid force is removed and the natural bias on the plunger 20 of the solenoid causes the switch 14 to close thereby remaking the recording circuit so that a further recording on the magnetizable member 10 is made possible. The plunger of the solenoid 19 is also connected to a counter mechanism 17 for actuating the counter each time it opens the switch 14.

By utilizing this system a signal will be recorded on the first length D of the magnetizable member and the next portion of the magnetizable member of length D will have no signal recorded on it. The third portion of length D will have a signal recorded on it and the fourth portion of length D will again have no signal recorded on it. The length of time T necessary for an incremental portion of the magnetizable member 10 to traverse the distance D depends upon two factors. The first is the distance D between the recording head 12 and the reproducing head 15 and the second is the rate of motion of the magnetizable member 10. Changing either one of these factors will change the time interval T.

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Accordingly, altering the speed at which the magnetizable member 10 is driven, or changing the spacing D of the heads 12 and 15, or both together will alter the time delay T. As has previously been stated, the counter mechanism 17 will be actuated each time an incremental portion of the magnetizable member which has the beginning of a recorded signal passes the reproducing head 15.

This device could be used to measure time intervals by energizing the generator 13 during the interval to be measured. Under these conditions the speed of the magnetizable member 10 must be known and must be constant and the distance D must be known. From the counter indication the time interval can be determined with any desired accuracy, the error being always less than the time interval $2t$. The same device can also be used to measure the length of the record medium. This measurement is independent of the speed of the member 10, the error will not exceed $2D$. Thus, if the system is to be utilized as a distance measuring device, the indication on the counter mechanism multiplied by the distance $2D$ will indicate the total amount of the magnetizable member which has passed the reproducing head 15.

A measuring system of this kind is valuable where it is desirable to wind onto a reel a definite amount of magnetizable member. For example, it may be desired to wind 5,000 feet of wire onto a spool or reel. The distance between the recording head 12 and reproducing head 15 may be set at 5 feet. When the counter mechanism 17 indicates 500 then 5,000 feet of wire has been wound onto the spool or reel.

Automatic control circuit means 9 are provided for stopping the motor which is driving the wire at the end of any adjustably set amount on the counter 17, and suitable obliterating means may be associated with the magnetizable member 10. It is also within the scope of my invention that electronic means may be used to make and break the connection between the generator 13 and the recording head 12.

Figure 3 is a block diagram illustrating the use of my invention in connection with a transient recorder somewhat similar to the type shown and described in my copending application Serial No. 425,304, filed January 1, 1942, which has issued as Patent 2,378,388.

The pole pieces of the recording and reproducing head (reference characters 12, 15) are shown offset for use of the longitudinal method of recording, but it is to be understood that the perpendicular and transverse methods which are well known alternatives may also be used. The recording head 12 is supplied with carrier current from an oscillator 25 tuned to 5,000 cycles. The oscillator 25 is arranged to be frequency modulated by the transient, but before occurrence of the transient unmodulated carrier is recorded on the tape or wire 10.

The tape 10 passes almost directly from the recording head 12 to an obliterating head 26. Within the obliterating head the newly recorded 5,000 cycle unmodulated carrier is removed by the action of a strong alternating field supplied by current from a 35 kc. oscillator 27. Most of the tape, including that part passing through the reproducing head 15, therefore, is kept in a demagnetized state and as a consequence, there is no carrier output from the reproducing head.

The transient input terminals 28, 29 are connected to the modulator input and to an elec-

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tronic relay 30. When a transient signal occurs in the test circuit connected to the input 28, 29, it frequency modulates the 5,000 cycle recording carrier. The start of the transient signal also actuates the electronic relay 30 which immediately shuts off the obliterating circuit to the obliterating head 26 so that the newly recorded frequency modulated carrier, plus the bit of unmodulated carrier that existed between the recording and the obliterating heads 12 and 26 at the moment the transient started, are not obliterated.

Now that the obliterating process has stopped, one element of the tape approaching the reproducing head 15 has on it the beginning of the recorded carrier (corresponding to the point at which obliteration stopped) and when this element reaches the reproducing head, the varying magnetic pattern on the tape induces in the head a corresponding carrier voltage. As soon as this carrier voltage appears, a second electronic relay 31 is energized. The relay 31 applies a predetermined D. C. potential to a time delay network 32. As the tape element bearing the beginning of the carrier progresses from the reproducing head 15 back to the recording head 12, the voltage across the output of the time delay network 32 builds up and just as the tape element bearing the first recorded cycle of the carrier arrives at the recording head, the time delay network develops sufficient voltage to actuate a third electronic relay 33 which shuts off the recording circuit. Thus recording of the carrier is automatically shut off just as the tape length is fully recorded.

The pulleys on which the tape or wire 10 is mounted are arranged so that various lengths may be accommodated. The distance from the reproducing head 15 back to the recording head 12 may be fixed. Thus a single time delay adjustment suffices for all tape lengths. The distance between the heads may be variable but then the amount of time delay of the time delay network 32 must also be correspondingly variable. Various tape lengths may be accommodated by shifting the pulley 34 at the other end of the loop.

During reproduction the tape loop is repeatedly driven past the reproducing head 15 so that the output of the head consists of a carrier frequency modulated in accordance with the original transient, which composite signal is repeated once for every revolution of the tape. The carrier output of the head is demodulated by the demodulator 9 so that facsimiles of the original transient are repeatedly reproduced at the output terminals 8. This signal may be observed on a cathode ray oscillograph having a sweep circuit synchronized with the rotation of the tape as is shown by United States Patents 2,378,388 and 2,378,389. Thus the transient recorder converts a transient which cannot readily be observed on a cathode ray oscillograph into a continuous sequence of signals each of which is a facsimile of the transient. This continuous sequence of signals is readily observed on an oscillograph in conventional manner or applied to analyzing apparatus; and the control circuit, which operates through a time delay circuit in addition to utilizing the inherent time delay necessary for an incremental portion of the tape to move from the recording head 12 to the reproducing head 15, functions to assure that substantially the entire length of tape is available for retaining a useful record.

In the three previous exemplifications of my invention I show that a signal picked up by the reproducing head controls the on and off recording operation of the recording head with a time delay corresponding to the distance between the recording and reproducing head and to the speed of the recording medium. It should be understood that the scope of my invention is not limited to stopping and starting the recording process, as it is applicable to any system in which the pickup head controls in any way the recording characteristics of the recording head.

For example in the system shown in Figure 4, instead of using one generator, two oscillators 35, 36 generating different frequencies may be provided, either of which supplies current to the recording head 37 in accordance with a time sequence. The amplifier 39, cooperating with the pickup head 38, may be so arranged by suitable filter networks 40 as to pass one frequency but to reject the other frequency. The signal of the one frequency which passes through the filter 40 will after rectification by the rectifier 41 control a relay 42. The relay 42 actuates switch 42' and when it is in its normal position it connects the first oscillator 35 to the recording head 37 and when in its other position it connects the second oscillator 36 to the recording head 37. Since this second frequency is not passed by the filter 40 the relay 42 will return the switch 42' to its normal position connecting the first oscillator 35 to the recording head 37. The relay therefore will act in the same manner as it would have acted had there not been any signal recorded on the medium by the second oscillator.

In another form of my invention, shown in Fig. 5, the recording head 43 may be supplied from one source 44 with signals of different intensity levels. As long as a relay 45 holds switch 45' in its normal or closed position the source 44 supplies the full recording level. However, when the relay 45 is energized to cause the relay 45 to open the switch 45' the recording level is reduced by a predetermined amount as it passes through the attenuator 60 to the recording head 43. The signal recorded with the reduced level, when picked up by the reproducing head 46, is not sufficient to supply the necessary operating current to cause the relay 45 to operate switch 45'. In such a system as just described the signal may consist of one frequency or may contain different frequency components.

The system which has just been described may be used for monitoring purposes, particularly if the signal source supplying the recording signal changes its level substantially so that it exceeds the volume range of the recording medium. An arrangement is provided in which by automatic means the recording level is reduced to the point where no overloading takes place. In this system shown in Figure 5, the attenuator 60 is connected into the recording circuit to reduce the recorded level to the desired amount and a gain control 61 is provided in the reproducing amplifier 62 to compensate for the reduction in the recording level. When the signal source 44 generates a signal at a high level and this high level signal is recorded unattenuated through switch 45' the high level signal which is picked up by the reproducing head 46 is supplied to the control relay 45 which opens switch 45' thereby causing all of the recording signal to go through the attenuator 60. Actuation of the relay 45 also increases the gain of the reproducing amplifier 62 through gain control 61. When the level of the signal source, 75

after attenuation, drops to such an extent that the signal impressed upon the signal carrier 10 reduces the signal-to-noise ratio in an undesirable manner, the relay 45 causes the attenuator 60 to be short-circuited and the full energy of the signal source is supplied to the recording head 43. This is automatically done in this system since the low voltage generated by the low level signal in the reproducing head is not sufficient to generate the current for energizing the relay and the relay returns to its normal position. The relay, therefore, releases its contact switches causing switch 45' to short-circuit the attenuator 60 in the recording channel and causing switch 61' to change the gain in the reproducing amplifier to compensate for the increased recording level. The switch 61' may be utilized to connect to ground a resistor between two stages in the amplifier 62, thereby altering the gain of the amplifier.

While I have shown and described my invention with a certain degree of particularity, it is to be understood that numerous changes in the various component parts and their arrangement may be made without departing from the spirit and scope of my invention as hereinafter claimed.

I claim as my invention:

1. A control system comprising, a record member, means for moving said record member, normally closed signal recording circuit means including recording head means, signal reproducing circuit means including reproducing head means spaced apart from said recording head means along the path of motion of said record member, circuit opening means in said normally closed signal recording circuit means, electrical circuit means interconnecting said signal reproducing circuit means with said circuit opening means for opening said circuit only while said signal reproducing means reproduces a signal recorded on said record member, and means for moving at least one of said head means with respect to the other head means for altering the time delay between the recording and the reproducing of a given signal on said record member.

2. A control system comprising, a record member, means for moving said record member, normally closed signal recording circuit means including recording head means, signal reproducing circuit means including reproducing head means spaced apart from said recording head means along the path of motion of said record member, circuit opening means in said normally closed signal recording means, electrical circuit means interconnecting said signal reproducing circuit means with said circuit opening means for opening said circuit only while said signal reproducing means reproduces a signal recorded on said record member, and means for changing the rate of motion of said record member for altering the time delay between the recording and the reproducing of a given signal on said record member.

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