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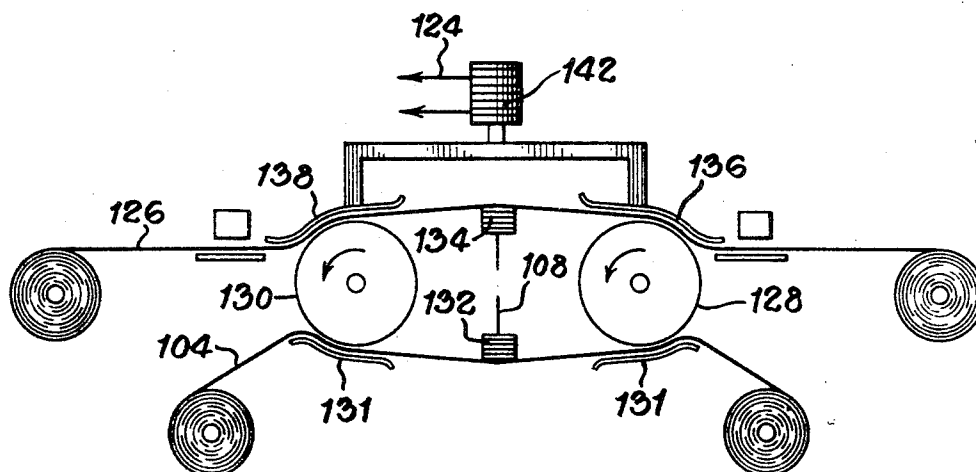
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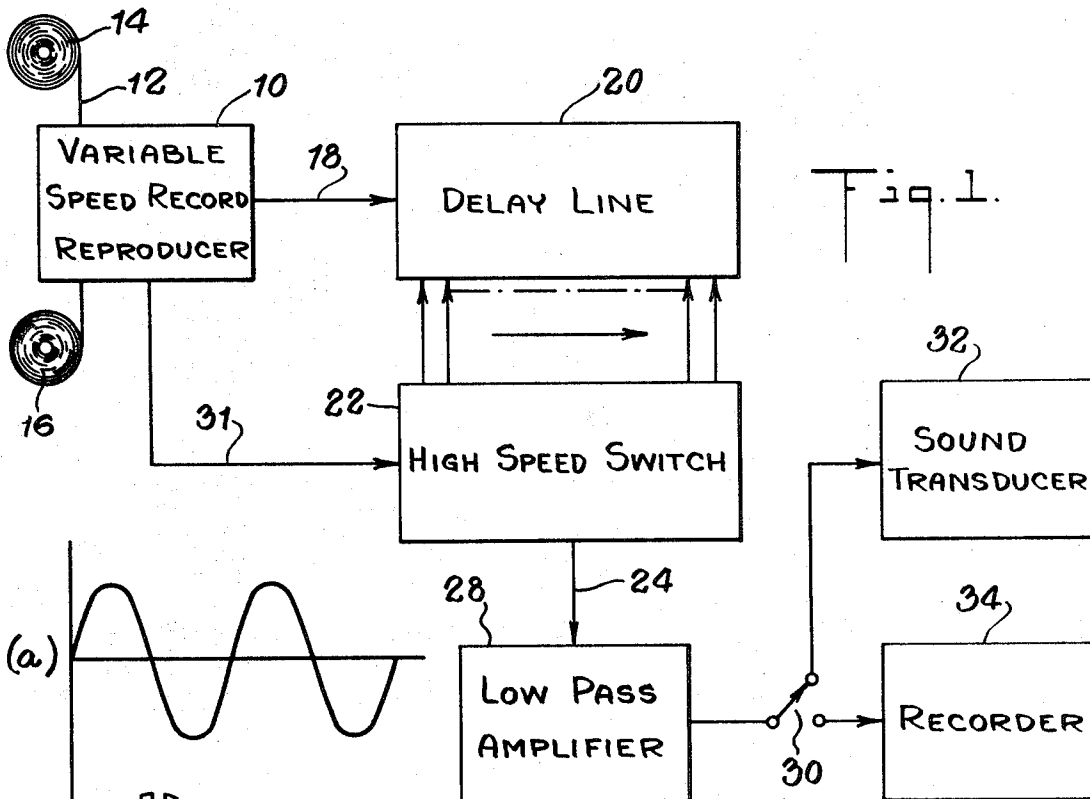
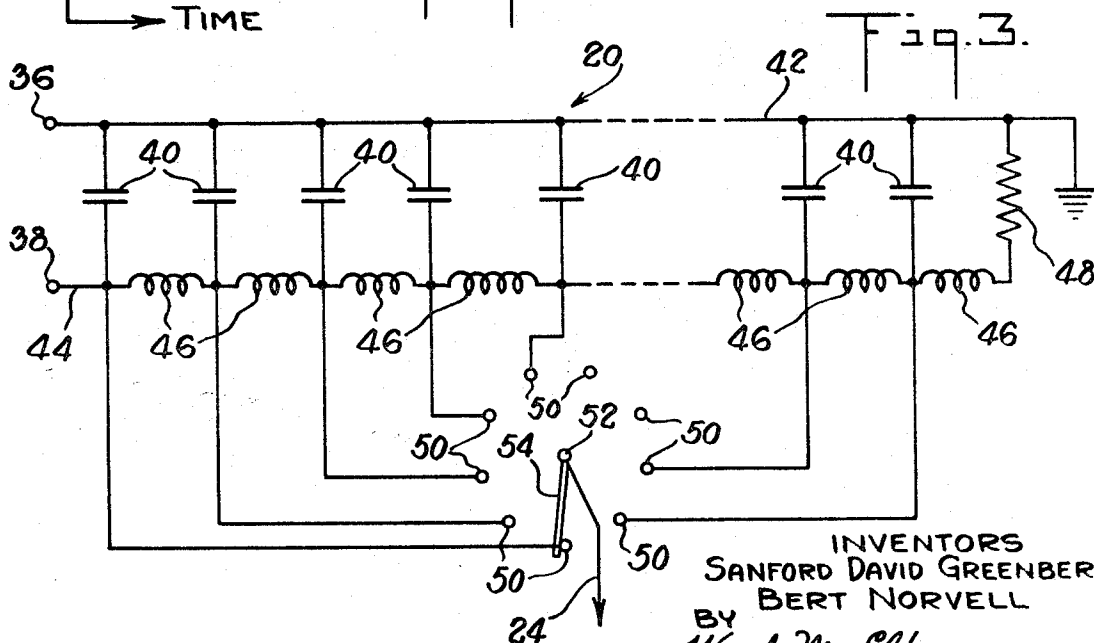
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[54] **APPARATUS FOR ELIMINATING SILENT**
INTERVALS BETWEEN SIGNALS
5 Claims, 9 Drawing Figs.

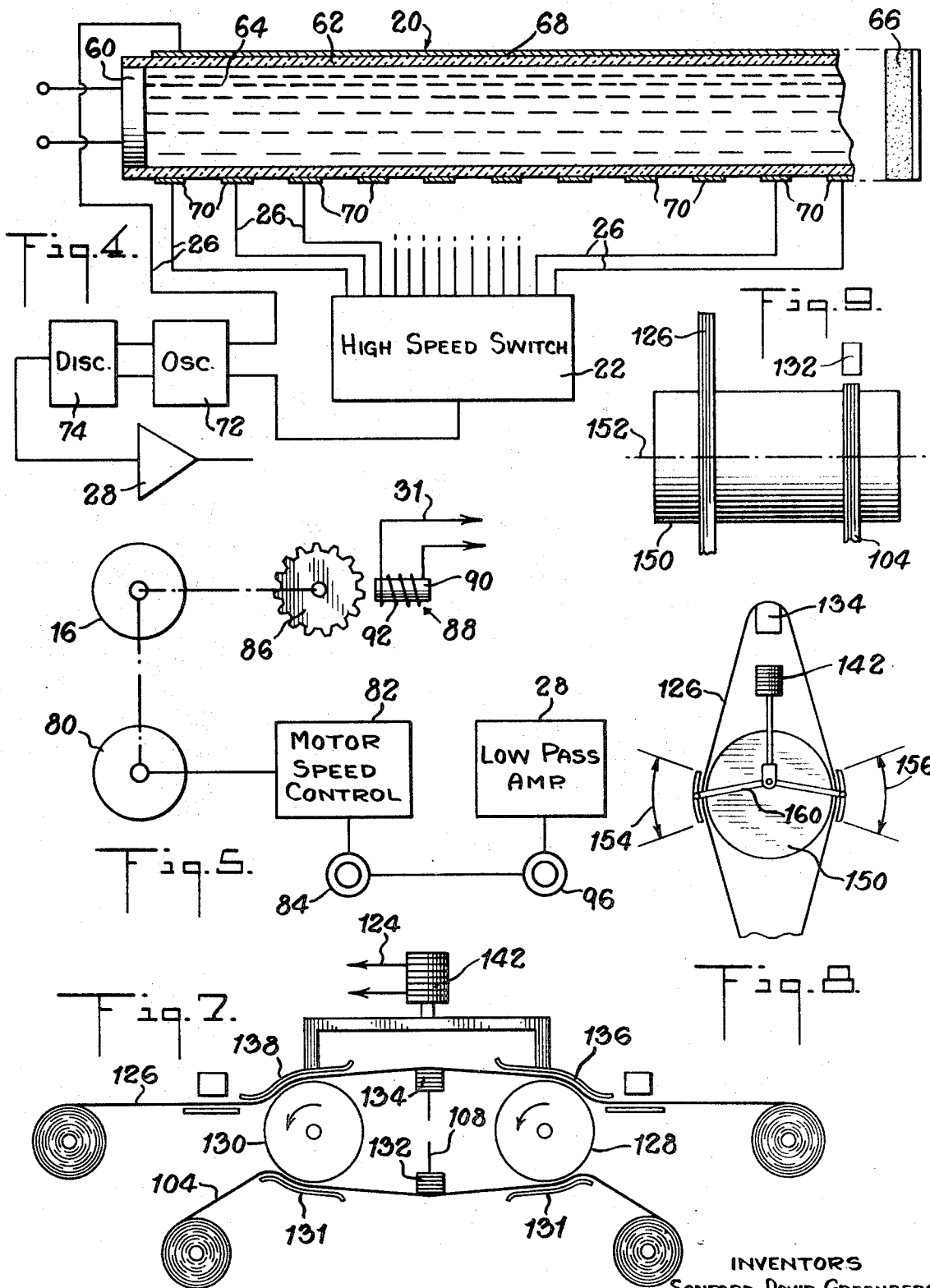
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ABSTRACT: Apparatus for transferring signals from a first magnetic tape to a second magnetic tape in different relative positions including a common capstan drive for both tapes with means controlled by the signals on the first tape for engaging the second tape with the capstan, a pickup head and a recording head associated respectively with the first tape and the second tape and means including a signal delay network coupling the two heads.



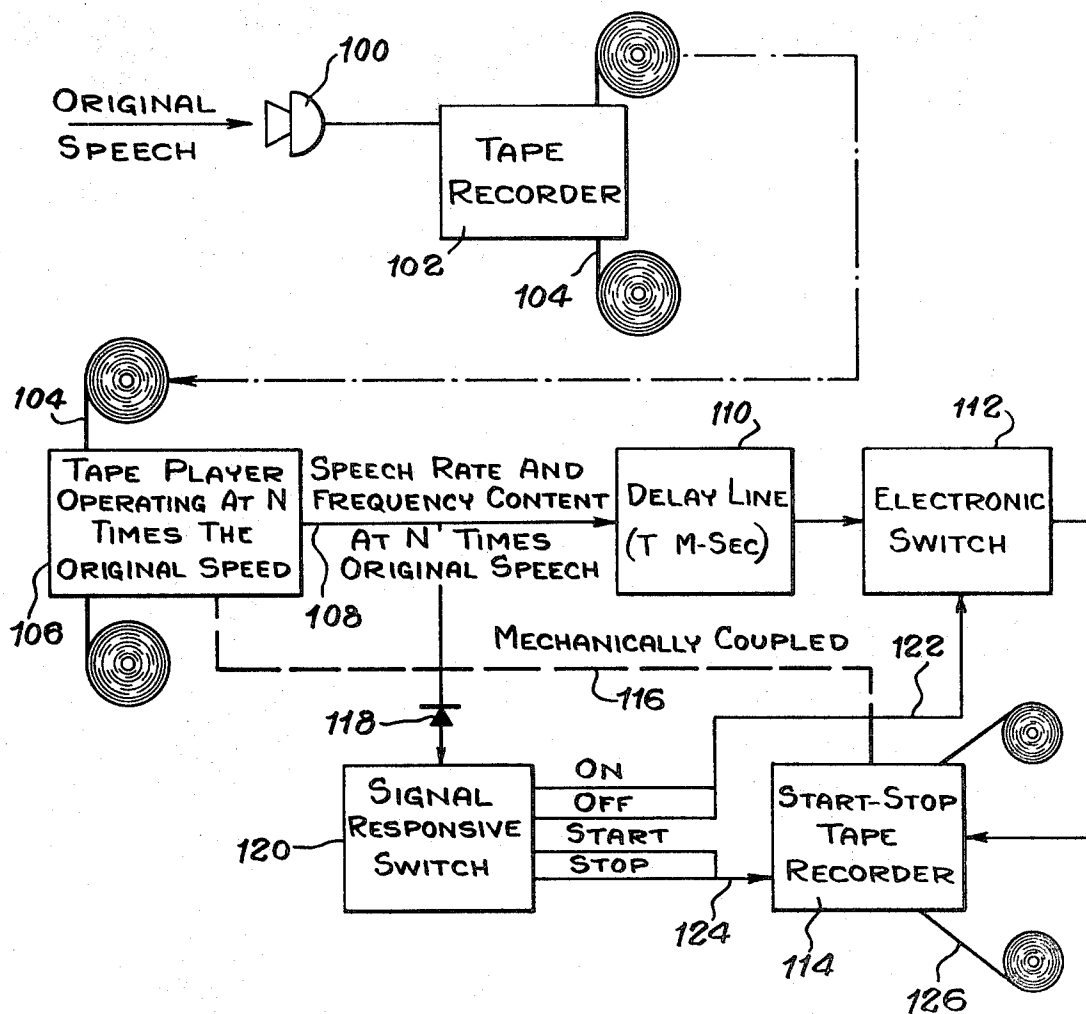


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Fig. 6.



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APPARATUS FOR ELIMINATING SILENT INTERVALS BETWEEN SIGNALS

This application is a division of our application Ser. No. 532,643, filed Mar. 8, 1966 and now Pat. No. 3,480,737.

This invention relates to information or data processing and more particularly it concerns the representation of wave bearing information on altered time scales.

The present invention is particularly suited to the compression of speech. It has been found that the speed with which spoken information can be conveyed is limited more by speaker capabilities than by listener capabilities. Thus, while the average person finds it difficult to say more than 150 words per minute, this and even greater rates of speech can easily be comprehended by the average listener. Further, because of physical limitations of the human speech mechanism, the amount of sound emitted in talking and the time required to formulate this sound is usually far greater than that required to actually convey the information contained in the speech sounds. Thus, if only selected portions of a person's speech could be extracted and run together, then the informational content of his speech could be preserved and maintained in intelligible form while the time required to present the information could be significantly reduced. This, of course, would be of considerable value in a number of fields such as education, news reporting, research etc.

Various techniques have been proposed to compress speech and other sounds while preserving their intelligibility. Such techniques usually involve transcribing the sounds on a magnetic tape and playing the tape at one speed while sampling different portions of the tape with magnetic pickup heads which move at a different speed. This technique, suffers from certain limitations in actual practice. In the first place, it requires the moving of rather bulky pickup and/or recording heads which are difficult to maintain in proper speed relationship to the moving tape. Also, due to the physical size of the heads, they must be displaced a certain distance from one another. As a result, a significant amount of informational material may become lost unless the amount of sound compression is kept to a low value.

According to the present invention, it is possible to alter the manner in which sounds or other modulated wave signal information is presented. Furthermore, such alteration may be accomplished to a greater extent and with a greater degree of smoothness than has heretofore been possible. Thus, for example, human speech may be compressed for presentation at rates higher than five times normal without loss of intelligibility or fidelity.

In one of its aspects the present invention achieves its improved results by causing wave signals to pass along a given path; and then during such passage, the path is scanned successively so that selected waves are extracted and collected. The scanning is carried out by sampling different portions of each selected wave in sequence at different locations along the path. The sampled wave portions are collected and then filtered to remove their sampling frequency components. By sequentially sampling different portions of a wave progressing along a given path, an effect can be produced which simulates the effect of a tape recorder pickup head which moves along at one speed while picking up signals from a magnetic tape moving at another speed. This simulated effect is made possible by the action of the filter which removes the sampling frequency components from the collected sampled wave portions and thus smooths the waves to a degree such that they appear as they would if a moving magnetic tape were scanned by a moving pickup head.

Scanning of the various sampling locations distributed along the wave path can be achieved by electronic switching means which as is known to those skilled in the art is capable of operation at rates far in excess of mechanically moving elements. Thus scanning can take place at a faster rate so that the sampled portions of the wave signals are made smaller but

more closely spaced. This, of course, reduces the likelihood of important portions of various syllables or other information being lost and yet maintains the same degree of compression.

The present invention also involves the use of special electromechanical wave delay lines with special integrated tape arrangements described more fully hereinafter.

In another of its aspects, the present invention comprehends the altering of wave signal information based upon the presence or absence of signals. According to this aspect of the invention, wave signals are monitored for the presence or absence thereof while they are being transcribed. During absence of signal information, relative movement between the transcribing element and the transcribing medium is halted, and during the presence of such information, the movement is restored. As a result the transcribed signals are run together on the transcribing medium. This arrangement is particularly effective when used as an integral part of the compression technique described above, for it provides a precompression effect which enhances the sampling compression. Thus, where speech is to be compressed, a precompression transcriber may be used to run words together by eliminating the time periods which separate them. Then upon sampling compression, no sampling is done on signalless waves. Thus the compression technique is rendered more effective.

There has thus been outlined rather broadly the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of the invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of the invention.

Specific embodiments of the invention have been chosen for purposes of illustration and description, and are shown in the accompanying drawings, forming a part of the specification, wherein:

FIG. 1 is a block diagram illustrating one embodiment of the present invention;

FIG. 2 is a graph useful in understanding the operation of the present invention;

FIG. 3 is an electrical schematic of a delay line and switching arrangement useful in connection with the present invention;

FIG. 4 is a section view, taken in elevation showing an alternate delay line;

FIG. 5 is a mechanical schematic illustrating a synchronizing arrangement useful in connection with the present invention;

FIG. 6 is a block diagram illustrating another aspect of the present invention;

FIG. 7 is a mechanical representation of a tape drive forming a portion of the arrangement of FIG. 6;

FIGS. 8 and 9 are end and side views, respectively, of an alternate tape drive arrangement.

The system shown in FIG. 1 includes a variable speed tape playing machine or player 10 through which a signal bearing tape 12 is run. The tape 12, which is supplied from a supply reel 14 and taken up on a takeup reel 16, is impressed, as by magnetization, with various configurations or signals which, when the tape is drawn through the player 10, result in the reproduction of modulated wave signals. In the present case, the player 10 may be of the conventional sound reproducing variety.

The tape 12, may contain sound signals in the usual configuration; and in such event, it is pulled through the player 10 at a rate which may be several times greater than normal. Conversely, signals may be put on the tape 12 while it is run more slowly than normal; and in such event the tape would be

played through the player 10 at its normal rate. In either case, the ultimate effect is to produce electrical wave type signals on a player output line 18 which are much higher in frequency than normal. At this point, the wave signals have been compressed by an amount corresponding to the difference in speeds undergone by the tape 12 in recording and in playback. This compression however is unsatisfactory for speech purposes for the compression equally affects all frequency components. Thus, the pitch of the resulting sound is so high as to make the sounds unintelligible.

The high frequency wave signals from the player output line 18 are supplied to a delay line 20, which in effect amounts to a wave propagating medium. The delay line 20, which will be described in greater detail hereinafter, serves to retard the waves so that they pass through it at a lower velocity than normal, while still maintaining their increased frequency.

A high speed switch 22 is provided alongside the delay line 20. The switch 22 serves to connect a common sampling line 24 successively to each of several tap lines 26 along the delay line 20. The resulting signal produced on the common sampling line 24 is applied to a low pass amplifier 28 and then supplied via a switch 30 to a sound transducer or speaker 32 and/or to a recorder 34.

As will become apparent, in order to preserve the basic pitch of the incoming signals, the switch 22 should operate in synchronism with the speed at which the tape 12 is moved through the player 10; or more precisely, the switching rate should be maintained proportional to the frequency increase produced by movement of the tape through the player. In order to maintain this synchronization, signals are produced in the player 10 and transmitted via a line 31 to the high speed switch 22. These signals cause the switch to operate at a rate corresponding to the rate at which the tape 12 is played.

The system of FIG. 1 produces and/or records output sound signals which are in effect composite signals formed by taking only selected portions of the input signals and then bringing these selected portions back together while discarding the remaining portions. The ratio of the discarded to the retained portions of the wave signals may be upwards of 5:1; and yet, the resulting sounds will remain intelligible. It has been found in fact, that with very little practice one can readily comprehend what is being said even though less than 20 percent of the original sounds are actually received by the listener even though the segments constituting this 20 percent is crowded together.

The manner in which the system operates to produce compression of speech and related sounds will now be described. As indicated, the frequency of the signals applied to the system is initially increased, either by passing the tape 12 rapidly through the player 10 or by previously having run it slowly through the recording machine. In either case, the signals and their frequency components become artificially compressed. The player 10 converts the signals to wave type electrical energy which then propagates through the delay line 20 at their increased frequency. During such passage, the waves are successively scanned from left to right by the high speed switch 22. That is, the switch sequentially makes and breaks contact between the common sampling line 24 and successive tap lines 26. The progressive sampling along the delay line produces an effect similar to the effect produced by a tape player pickup moving from left to right at the speed of progression along the tap lines when a tape being scanned by the pickup head moves from left to right at the speed of progression of waves through the delay line 20. In the present case however, very little time is required to complete a scan and a successive scan may follow very close behind. Thus a greater number of more closely spaced scans may be provided. This permits a more homogeneous sampling of the waves so that for a given amount of compression less information is lost.

FIG. 2 illustrates the manner in which output waves are generated on the common sampling line 24. Curve (a) in FIG. 2 represents the voltage wave of one frequency component

($F_{sig.}$) of a wave signal progressing through the delay line 20 at a velocity ($V_{sig.}$). Curve (b) represents the voltage produced on the common sampling line 24 as a result of the wave of curve (a) when the switch 22 is in operation.

It will be assumed that the signal compression produced by playing the tape 12 at a different speed than the speed at which it was recorded, was 2:1 so that the frequency of the wave of curve (a) is twice what it should be. In this case, the switch 22 is set to make successive connections from one tap line 26 to the next at a rate progressing down the delay line such that the wave of curve (a) as observed from each instantly connected tap line appears to progress at a velocity corresponding to its original frequency. The speed or rate of progression at which the scan of tap lines 26 should take place in order to restore the sampled high frequency wave component to its original frequency can be computed in the following manner:

The frequency ($F_{sig.}$) of a wave signal component which propagates through the delay line 30 at a velocity ($V_{sig.}$) can be expressed as:

$F_{sig.} = (V_{sig.} / \lambda_{sig.})$ where ($\lambda_{sig.}$) represents the wavelength of the signal component in the delay line 20.

Now the scan produced by the switch 22 progresses along the delay line 20 in the same direction as the signal component and at a velocity (V_{sam}) which is less than that of the signal component. Thus the relative velocity between the signal component and the scan is ($V_{sig.} - V_{sam}$). This also is the apparent velocity of the signal as observed from the tap lines 26 as they become connected. The apparent observed frequency (F_a) is thus:

$$F_a = \frac{V_{sig.} - V_{sam}}{\lambda_{sig.}}$$

The signal component wavelength ($\lambda_{sig.}$) can be stated as:

$$\lambda_{sig.} = \frac{V_{sig.}}{F_{sig.}} \text{ or } \frac{1}{\lambda_{sig.}} = \frac{F_{sig.}}{V_{sig.}}$$

Thus

$$F_a = \frac{F_{sig.}}{V_{sig.}} (V_{sig.} - V_{sam})$$

The expression $\frac{V_{sig.} - V_{sam}}{V_{sig.}}$ represents the factor of

compression or number of times greater than (F_a) that ($F_{sig.}$) is. Thus where ($F_{sig.}$) has been increased to a number (n) times its original frequency, then to obtain the original frequency at the output (F_a) should be $1/n$ times ($F_{sig.}$) or $1/n = V_{sig.} - V_{sam} / V_{sig.}$. Of these variables only V_{sam} can be controlled and this is done through the switch 22. (V_{sam}) should then be adjusted so that:

$$V_{sam} = (n-1)/n \cdot V_{sig.}$$

In attempting to visualize the relationship between the curves (a) and (b) of FIG. 2, it should be noted that curve (a) represents voltage or amplitude changes taken at a single location along the delay line 20 at different times. Curve (b), on the other hand, represents voltage or amplitude changes taken at various locations along the delay line 20 at different times. Thus while the amplitude of curve (a) rises rapidly in time at a single location, it does not rise so rapidly when viewed successively at different locations. Actually, if the viewer were to progress along the delay line at the rate of propagation of the wave, it would not appear to change in amplitude at all.

Since there are individual tap lines 26 at discrete locations along the delay line 20, the resulting output on the common sampling line 24 is actually a series of spikes or pulseline bursts whose envelope represents the desired signal component. These bursts or pulses contain many undesirable frequency components, however they are all much higher than the desired envelope component. Thus by passing the signals through the low pass amplifier 28 these undesirable high frequency components may be removed so that only the envelope component remains for broadcast in the transducer 32 or for transcription in the recorder 34.

FIG. 3 shows a wiring diagram for a delay line 20 and high speed switch arrangement 22 which may be used in connection with the system of FIG. 1. As shown in FIG. 3, there are provided a pair of input terminals 36 and 38 across which electrical wave-type signals from the tape player 10 are applied. The terminal 36, as shown, is grounded while the terminal 38 is connected to the player output line 18.

The delay line 20, as shown in FIG. 3, is comprised of a plurality of capacitors 40 which connect in parallel with one another between a ground line 42 and a signal line 44. The ground and signal lines are connected respectively to the terminals 36 and 38. A plurality of inductance coils 46 are connected in series along the signal line 44 between adjacent capacitors 40. An energy absorptive termination such as a resistor 48 having a matched impedance characteristic is connected at the right end of the delay line 20 across the ground and signal lines 42 and 44. The resistor 48 serves to dissipate all energy remaining in signals which have passed through the delay line 20 so that they will not become reflected back toward the input terminals 36 and 38.

The various tap lines 26 are connected to different junctions 49 along the signal line 42 between adjacent coils 46. The opposite ends of these tap lines are connected to corresponding switch contacts 50 which are arranged in circular formation about a central axis 52. A wiper arm 54 is mounted to rotate continuously about the central axis 52 and to sequentially contact each of the switch contacts 50 as it rotates. The common sampling line 24 is connected to the wiper arm 54 so that as the wiper arm rotates the sampling line 24 is effectively tapped into the delay line 20 at different locations therealong in sequence. The entire delay line 20 is thus scanned from left to right once for each rotation of the wiper arm 54; and upon completion of the scan a new scan is begun immediately, beginning at the left end of the delay line. The scanning speed (V_{sam}) depends, of course, upon the rotational speed of the wiper arm 54.

The time taken for a wave to pass from one end of the delay line to the other should be long relative to the wave length of the waves applied to the delay line. With an inductance-capacitance delay line as above described, it should take between 10 and 100 milliseconds for the wave to pass from one end of the delay line to the other and normally, the length of the line would be such that the time taken is between 20 and 40 milliseconds. This is, of course, assuming that the original waves which were recorded are in the speech frequency range, that is, approximately 300—3000 cycles per second. Preferably, the taps on the delay line should be about 50 microseconds apart.

FIG. 4 illustrates a different arrangement for the delay line 20 and the high speed switch 22. In this arrangement, the signal bearing waves are of the mechanical or vibratory as opposed to electrical or radiative. As shown in FIG. 4, there is provided an electromechanical transducer 60 which converts signals which appear on the player output line 18 to mechanical vibrations. These vibrations are launched into the left end of the delay line 20 and they propagate through the line as acoustical waves. The delay line 20 itself comprises an elongated tube 62 of insulated type material. The tube 62 is filled with a liquid 64 into which the vibratory waves are launched. These waves travel from the left to the right end of the tube 62 and then become dissipated in an acoustically absorbent material 66 at the right end of the tube. An electrically conductive strip 68 is affixed to the tube 62 and extends along its length on one side. A plurality of electrically conductive elements 70 are affixed along the opposite side of the tube. The elements 70 are connected by means of the tap lines 26 to the high speed switch 22. The common sampling line 24 from the high speed switch and a further line 24a from the conductive strip 68 are connected into the tank circuit of an oscillator 72. The oscillator output is connected to a frequency discriminator 74 and the output of the frequency discriminator 74 in turn is connected to the low pass amplifier 28.

The delay line arrangement of FIG. 4 operates in the following manner. Signals from the player output line 18 are converted to mechanical vibrations in the transducer 60 as above described and are launched into the tube 62 and propagate therethrough as acoustical waves. While passing through the line 20, the waves produce compressions and rarefactions in the fluid in directions both in and transverse to their direction of propagation. These compressions and rarefactions result in variations in the physical displacements between the elements 70 and the strip 68; and this in turn changes the electrical capacitance between the elements and the strip by corresponding amounts. As each element 70 becomes connected by the high speed switch 22 to the tank circuit of the oscillator 72, the oscillator will produce an output frequency corresponding to the value of the capacitance existing between the particular element 70 and the strip 68. The resulting variations in oscillator output frequency are detected in the frequency discriminator 74. The output of the discriminator 74 thus corresponds to the capacitance at the particular element 70 which happens to be connected at that instant to the sampling line 24 by the high speed switch 22. Accordingly as the high speed switch 22 operates, the acoustical waves which proceed through the tube are sampled and converted to corresponding electrical signals which are similar to the signals shown in curve (b) of FIG. 2. These signals are then passed through the low pass amplifier 28 where their high frequency oscillator and sampling components are attenuated relative to the remaining portions of the signals. The signals then proceed to the sound transducer and/or the recorder 34 as above described.

As indicated above, the scanning speed (V_{sam}) at which the high speed switch 22 makes contact from tap line to tap line, should be properly related to the propagation velocity ($V_{sig.}$) of the wave signals passing through the delay line 20 in order for frequency components of the output signals to be restored to their original condition. It will be recalled that the frequency components were increased by a factor n by moving the tape 12 through the player 10 at a rate greater than that at which it was moved when being recorded. Also, since the system operates to remove a considerable portion of the original input signals, it is important, in order to preserve intelligibility, that the remaining portion of these signals be as representative of their original condition as possible.

FIG. 5 illustrates schematically an arrangement which serves to maintain the scanning velocity (V_{sam}) in proper relationship with the signal velocity ($V_{sig.}$) even though the speed at which the tape 12 is drawn through the player 10 may vary. As shown in FIG. 5, the takeup reel 16 is driven by a tape drive motor 80. The speed of the tape drive motor 80 in turn is controlled by means of a motor speed control unit 82. The motor speed control unit 82 may be adjusted by means of a manual speed control knob 84. A toothed wheel 86 is mechanically linked to the takeup reel 16 and to the tape drive motor 80 so that it turns in synchronism with these elements. A magnetic head 88, which is comprised of a magnetic core 90 and a coil 92 would thereabout, is positioned in close proximity to the rotating toothed wheel 86. As the teeth of the wheel 86 pass in front of the core 90 they alter the magnetic flux in the vicinity of the coil 92 and produce electrical impulses upon the line 31 connected to the coil. As indicated previously, the line 31 is connected to operate the high speed switch 22. Thus as the tape drive motor 80 causes the takeup wheel 86 to pull the tape 12 at different speeds, the tooth wheel 86 will also operate at different speeds, thus producing a greater rate of impulses upon the line 31 to operate the high speed switch 22 in a corresponding manner.

Reverting to the curve (b) of FIG. 2, it will be noted that the width of the individual sampling impulses produced as a result of the operation of the high speed switch 22 varies in accordance with the speed of operation of the high speed switch 22. Accordingly, the frequency components generated as a result of the operation of the high speed switch 22 will vary in band width in accordance with the speed of operation of the

switch as well as the speed of movement of the tape 12 through the player 10. In order to compensate for this, there is provided, as illustrated schematically in FIG. 5, a ganged connection 94 between the speed control knob 84 and a band pass control knob 96 on the low pass amplifier 28. Thus as variations in the speed of the tape 12 occur and a corresponding change in the band width of frequencies generated as a result of the operation of the high speed switch 22 occur, such changes in band width are compensated for automatically by adjustment of the low pass amplifier 28.

As indicated above, the present invention in one of its aspects provides for precompression of wave signals by eliminating or reducing substantially the time periods during which no signals are being produced or emitted. As shown in FIG. 6, original speech is broadcast into a microphone 100 which is connected to a tape recorder 102, and the tape recorder in turn reproduces the speech signals upon a magnetic tape 104 which is pulled through the recorder. Thereafter, the tape 104 is replayed on a tape player 106. This tape player as indicated in FIG. 6 operates at (n) times the original recording speed in order to achieve a frequency compression effect as described previously. The electrical signal outputs from the tape player 106, are supplied via an output line 108 and a delay line 110 through an electronic switch 112 to the record head of a start-stop tape recorder 114. As shown in the dashed line 116, the tape player 106 and the start-stop tape recorder 114 are mechanically coupled so that the start-stop tape recorder 114 when operative, will operate at the same speed as the tape player 106, so that no change will be made to the various frequency component of the signals being transcribed. The signals present upon the output line 108 are also supplied to a detector 118, and from there they proceed to a signal responsive switch 120. Depending upon the presence or absence of a signal as detected in the detector 118, the signal responsive switch 120 will produce "on" or "off" signals on a line 122. These "on" and "off" signals control the operation of the electronic switch 112. The signal responsive switch 120 also produces "start" and "stop" signals on a line 124 for controlling operation of the start-stop tape recorder 114.

During operation of the above described precompression arrangement, the tape 104 is moved at constant speed through the tape player 106. At the same time, a second tape 126 is moved through the start-stop tape recorder 114. The second tape 126, during movement thereof, proceeds at the same speed as the tape 104; however, the tape 126 moves only when actual signals are proceeding into the start-stop tape recorder 114.

When no signals are present upon the output line 108, the signal responsive switch 120 operates to turn off the electronic switch 112 thus preventing the occurrence of signals into the start-stop tape recorder 114, and at the same time, it produces a stop signal on the line 124 to stop the movement of tape 126 through the recorder 114. On the other hand, when signals are present on the output line 108, the signal responsive switch 120 produces a signal on the line 122 to open the electronic switch 112 thus permitting the signals to pass into the start-stop tape recorder 114 and at the same time, it produces a signal on the line 124 to start movement of the tape 126 through the recorder 114.

Since a finite length of time is required to start and stop the start-stop tape recorder 114, due to the inertia of its moving parts, the delay line 110 serves to hold the back signals until the start-stop tape recorder is up to proper speed. The electronic switch 112 serves to insure that signals go into the start-stop tape recorder 114 only when the tape 126 is being moved through the recorder.

FIG. 7 illustrates a mechanical arrangement for the tape player 106 and the start-stop tape recorder 114. As shown in FIG. 7, the tape 104 passes over a pair of drive drums 128 and 130 and moves over a pickup head 132 located between the drums. The drums 128 and 130 are driven at constant speed and the tape 104 is held or crushed against the drums by

means of presser elements 131 so that it moves continuously over the pickup head 132. Electrical output signals are produced by the pickup head corresponding to the magnetic configurations on the tape; and these output signals are transmitted along the output line 108 as indicated above. At the same time, the tape 126 passes along over the opposite side of the drums 128 and 130 and over a record head 134, also located between the drums. A pair of movable pressure shoes 136 and 138 are mounted on a common yoke 140 and operate, when the yoke 140 is pressed downwardly to crush the tape 126 into the drums 128 and 130 so that it is driven by them across the record head 134. When the yoke 140 is lifted, the tape 126 will remain stationary as the drums 128 and 130 slip over it. The up and down movements of the yoke 140 are controlled by means of a solenoid 142 which receives signals via the start-stop line 124 connected to the signal responsive switch 120. As indicated above, when portions of the tape 104 having signals thereon pass by the head 132 to produce electrical signals on the output line 108, these signals serve also to cause the solenoid 142 to move the yoke 140 downwardly so that the tape 126 moves across the record head 134. However, when nonsignal bearing portions of the tape 104 pass over the pickup head 132 and no signals are present upon the output line 108, the signal responsive switch 120 operates through the line 124 to cause the solenoid 122 to lift the yoke 140 thus releasing the tape 126 from the action of the drums 128 and 130 so that the tape 126 does not move. As a result, while the tape 104 may have signal bearing portions and nonsignal bearing portions, the fully transcribed tape 126, which has moved only when signals were present, contains only signal bearing portions. There is thus effected a precompression of the signals originally on the tape 104.

FIGS. 8 and 9 illustrate an alternate form of tape player and start-stop recorder. As shown in these drawings there is provided a single drum 150 which rotates continuously about an axis 152. The tape 104, as shown in FIG. 9 passes around the drum 150 and moves continuously with the drum while the pickup head 132 monitors the signals on the moving tape. At the same time, the tape 126 passes around the drum 150 but extends a considerable distance out beyond the drum so that it contacts the drum only over two relatively small sectors 154 and 156. The portion of the tape 126 which extends out beyond the drum 150 loops over the record head 134. "Start" and "stop" signals from the signal responsive switch 120 are supplied via the line 124 to a solenoid 158. The solenoid 158 in turn operates through a linkage mechanism 160 to cause a pair of pressure shoes 162 and 164 to crush toe tape 126 against the drum to be driven thereby. When no signals are detected by the detector 118, the signal responsive switch 120 produces a "stop" signal which deenergizes the solenoid 158 so that it releases the linkage mechanism 160, allows the shoes 162 and 164 to release the tape 126 so that it will not move, although the drum 150 continues to rotate. Thus, while the tape 104 moves continuously along with the drum 150, the tape 126 will move only when signals are available to be recorded on it.

Having thus described the invention with particular reference to the preferred form thereof, it will be obvious to those skilled in the art to which the invention pertains, after understanding the invention, that various changes and modifications may be made therein without departing from the spirit and scope of the invention, as defined by the claims appended thereto.

What is claimed and desired to be secured by Letters Patent is:

1. Apparatus for transferring signals having predetermined relative positions on a first elongated signal bearing recording medium to a second signal receiving recording medium with different relative positions, said apparatus comprising a signal pickup head for generating electrical signals from said first medium, a signal recording head for recording signals on said second medium, a common drive means for driving said first medium past said signal pickup head and for driving said

second medium past said recording head, said drive means comprising rotatable means, first control means for maintaining said first medium in contact with said rotatable means and thereby continuously driving said first medium and second control means for selectively engaging said second medium with said rotatable means and thereby selectively driving said second medium at recording speed, a coupling means including signal delay means electrically coupling said pickup head and said recording head, and actuating means coupled to said pickup head and responsive to signals at the output thereof for actuating said second control means whereby said second medium is moved past said recording head at recording speed substantially only when signals are present at the output of said pickup head.

2. Apparatus as set forth in claim 1 wherein said rotatable means is a rotatable drum, said first and second mediums being engageable with spaced surface portions thereof, said second control means comprises means for pressing said second medium against the surface of said drum, and said actuating means comprises a solenoid for actuating said pressing means.

3. Apparatus as set forth in claim 1 wherein said rotatable means comprises a pair of rotatable drums mounted with their axes of rotation in parallel, spaced relation and on opposite sides of said pickup and said recording heads, each of said mediums being engageable with the surfaces of both said drums by said first and second control means.

4. Apparatus as set forth in claim 1 wherein said rotatable means comprises a rotatable drum and each of said mediums extends around a major portion of the periphery thereof, said second medium being spaced from said periphery but being engageable with spaced portions of said periphery by said second control means.

5. Apparatus as set forth in claim 4 wherein said second control means comprises a pair of shoes disposed adjacent said spaced portions and movable theretoward to press said second medium against said periphery and a pair of links connected to said shoes, and said actuating means comprises a solenoid connected to said links for moving said shoes toward said periphery upon energization of said solenoid.

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