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ADJUSTABLE REVERBERATION DEVICE WITH MUTING SWITCH

Filed March 5, 1959

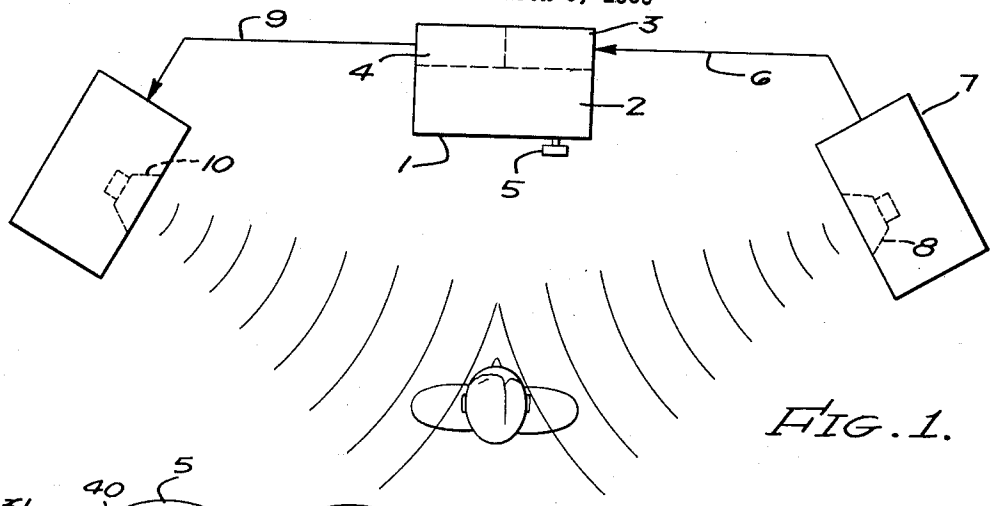

FIG. 1.

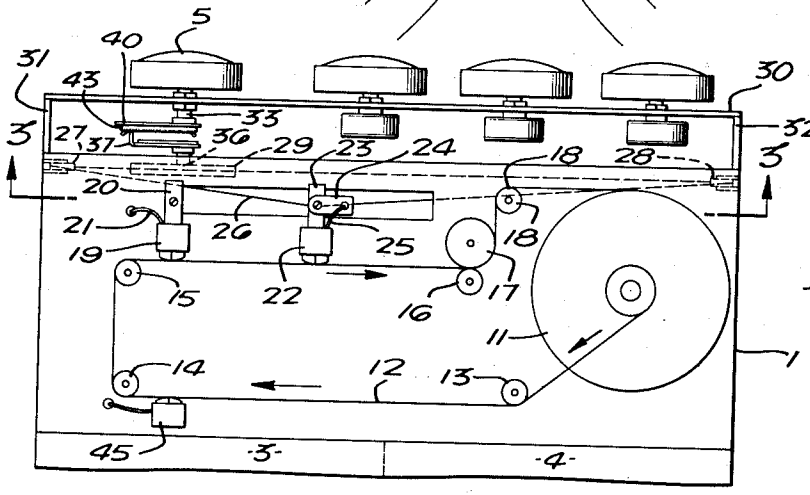

FIG. 2.

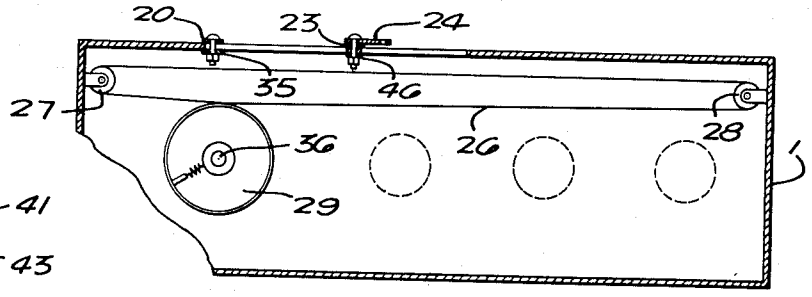

FIG. 3.

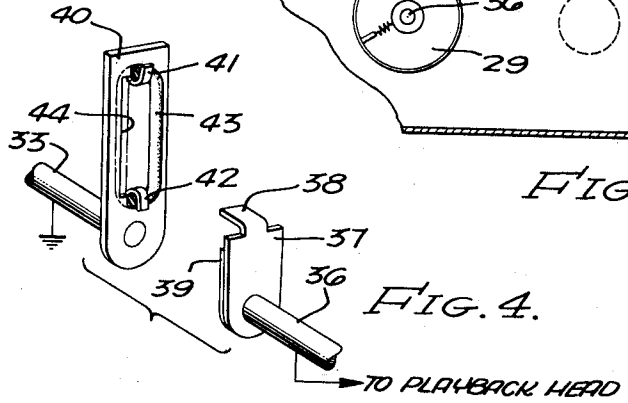

FIG. 4.

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ADJUSTABLE REVERBERATION DEVICE WITH MUTING SWITCH

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This invention relates to an electrical sound delay device useful in simulating stereophonic effects with single track radio, television, or phonograph units. The invention is characterized by a recording head for recording single track audio signals on magnetic tape, and a movable pickup head for reproducing the recorded signals at any desired time delay from the input signals. The invention is further characterized by a novel muting switch operable to mute the delayed sound output automatically whenever the amount of delay is changed.

In the conventional method of producing stereophonic recordings, two microphones are placed in front of the sound to be recorded, the microphones being spaced approximately 10 feet from each other. The output of each microphone is recorded on a separate track. In reproducing the recording, special equipment having two speakers and two separate audio channels is required. The speakers are placed approximately 10 feet apart, and each is driven by the recording from a corresponding microphone. The conventional stereophonic recordings achieve realism by means of time delay between the various components of the recorded sound. For example, if an orchestra is recorded, each microphone picks up the nearest instruments without any time delay, but the instruments further away are delayed by the amount of time required for the sound to travel from the instrument to the microphone. The time delays involved are quite small, but they have an important effect in imparting realism to the recording.

But in accordance with this invention it has been discovered that the realism of stereophonic recordings can be achieved very inexpensively by utilizing the time delay principle with a single track recording. In accordance with this invention a single track recording is re-recorded on magnetic tape, and a delayed output is picked up from the re-recording. The single track recording and delayed re-recording are fed to separate speakers as in the conventional method. The invention provides the realism of stereophonic recordings at a fraction of cost, and furthermore makes possible many effects which cannot be duplicated with conventional stereophonic equipment. The invention can be used with single track radio or television programs, while conventional stereophonic equipment cannot. Also, with this invention the time delay can be changed to suit the listener, whereas in conventional stereophonic equipment it cannot. And with conventional stereophonic equipment the listener must sit exactly between the two speakers to get full realism, while with this invention the time delay can be adjusted to give full realism at any point. In addition, the invention can be used to give unusual musical effects which cannot be duplicated by conventional stereophonic equipment. The time delay affects the quality of sound, and can be adjusted to give any desired sound effect. For example, increasing the delay on sacred organ music

gives a cathedral background effect, and increasing the delay on band music to produce a noticeable echo gives the effect of a stadium background.

Other advantages and novel characteristics of the invention will be apparent to those skilled in the art from the following description of one embodiment thereof, in connection with the attached drawings, in which:

FIG. 1 is a block diagram showing the invention in use.

FIG. 2 is a plan view of the invention.

FIG. 3 is an elevation section taken on the line 3—3 of FIG. 2.

FIG. 4 is an exploded perspective of the muting switch.

Referring to FIG. 1, the invention contains a delay portion 2, input amplifier portion 3, and an output amplifier portion 4 mounted on a common chassis 1. Audio frequency input signals are fed to the invention via input conductor 6 from a radio or phonograph 7, which has a speaker 8. The input signals are recorded in the delay portion 2 of the invention, and reproduced exactly as recorded except for a time delay set by a delay adjustment 5. The delayed output is amplified by output amplifier 4 and fed via output conductor 9 to a second loudspeaker 10, which is located in a different part of the room from the loudspeaker 8 of the radio or phonograph unit 7. The manual delay adjustment is a particularly important feature of the invention because it allows the depth quality of the reproduced sound to be adjusted to match the characteristics of the sound source. Sacred organ music, for example, would require a longer delay than would night club music, and football crowds an even longer delay. This is, of course, due to the characteristic difference in size between cathedrals, night clubs, and football stadiums. Each have a different characteristic delay in echos and reverberations, and although the listener does not perceive the reverberations as distinct from the main sound source, the delay has a very important effect on the quality of the sound.

The invention also contains a muting switch associated with the manual delay adjustment, and separate volume and tone controls to vary the output of speaker 10 independently from the output of speaker 8. The muting switch is another very important feature of the invention. When the delay adjustment is changed, unpleasant tonal qualities are generated. To avoid these unpleasant effects the muting switch automatically disconnects the delayed output while the adjustment 5 is being moved, and automatically reconnects the delayed output when the adjustment 5 is released. The muting switch will be described in detail in later paragraphs.

Referring to FIG. 2, the delay portion of the invention contains a magnetic tape spool 11 upon which magnetic tape 12 is driven by a drive mechanism not disclosed around capstan pulleys 13, 14, 15, and 18. Driving power is applied to the tape by capstan 16, the tape being held against this capstan by rubber roller 17. The tape is pulled from the center of the spool and returned to the outside of the spool as indicated by the arrows on FIG. 2, which show the direction of tape movement. Drive mechanisms for this type of magnetic tape loop are well known in the art, and any suitable mechanism can be employed with the invention.

The tape is driven first past an erasing head 45, which removes any signals or noise which may be impressed on the tape. The erasing circuit, which is not disclosed,

is well known in the art and may be of any suitable type. After being erased the tape passes a recording head 19 which is connected to input amplifier 3 by conductor 21. The input amplifier acts as a buffer between the source of the input signal and the recording head 19, and provides the power necessary to impress the input signal on the magnetic tape. It is possible, of course, to connect the input signal directly to the recording head 19 without amplification if the audio signal is taken from a suitable point in the radio or phonograph 7. But with some radios or phonographs this might degrade the output from the speaker 8, so generally speaking it is best to provide a separate input amplifier on the invention to act as a buffer. The input amplifier may also be of any suitable type.

After the audio input signal is impressed on the magnetic tape by recording head 19 it is detected by pickup head 22, which is connected by a conductor 25 to the output amplifier 4. The amplified output signal is then fed to speaker 10 via conductor 9, as disclosed in FIG. 1. The output amplifier may be of any suitable type, and is preferably equipped with volume and tone controls to vary the output quality and volume of speaker 10 independently of the output of speaker 8. This gives the listener a great flexibility in achieving stereophonic effects.

The audio output signal detected by the pick up head 22 is substantially identical with the audio input signal recorded by head 19 except for a time delay caused by the separation of the two heads. The exact amount of time delay is determined by dividing the distance separating the heads into the speed of the tape movement, which in this particular embodiment of the invention is 15 inches per second. The distance between the heads may be adjusted from ⅜ inch to 3 inches by moving pickup head 22 along a slot cut into the chassis.

The mechanical mounting and adjustment elements for heads 19 and 22 are further disclosed in FIG 3. Referring to FIGS. 2 and 3, recording head 19 is rigidly attached to the chassis 1 by upper bracket 20 and lower bracket 35 which extend across one end of the slot and are held pressed to the chassis by a bolt. Pickup head 22 is slideably attached to chassis 1 by upper bracket 23 and lower bracket 46, also extending across the slot and held together by a bolt, but with enough vertical and side clearance to permit easy movement of head 22 along the slot. Head 22 is moved along the slot by a dial cord drive comprising dial cord 26, pulleys 27 and 28, and dial cord drum 29. Dial cord 26 is attached to the mounting assembly of head 22, passed through pulleys 27 and 28, and looped around drum 29 with one end rigidly attached to the drum and the other end attached to a spring which maintains tension in the dial cord. Drum 29 is journaled to the front of the chassis on a shaft 36, which also acts as a part of the muting switch.

The muting switch is disclosed most clearly in the exploded perspective detail of FIG. 4. It comprises an arm 37 with projecting lug 38 rigidly attached to the end of shaft 36, and a slotted arm 40 rigidly attached to the end of a second shaft 33, and rubber ring 43 attached to arm 40 at each end of the slot by lugs 41 and 42. Shaft 33 is journaled to a front plate 30 which is held in spaced relation to the front of chassis 1 by posts 31 and 32. Delay adjustment knob 5 is rigidly attached to shaft 33 at its outermost end. Volume and tone controls, not numbered, are also attached to front plate 30.

The muting switch acts as a mechanical linkage between shaft 33 and shaft 36, and also as an electrical switch which closes whenever shaft 33 is moved. Rubber ring 43 is stretched between lugs 41 and 42 such that the space between the inside boundaries of ring 43 is less than the width of the slot cut in slotted arm 40. Lug 38 fits snugly through rubber ring 43, and is normally held separated from the sides of the slot by the tension in the rubber. When the delay adjustment knob 5 is rotated, the rubber ring 43 which is secured only at its upper and lower ends, is moved sideways until lug 38 contacts the side 44 of the slot in slotted arm 40. This makes a simultaneous electrical and mechanical contact between arms 37 and 40. After contact is made further rotation of the adjustment knob rotates shaft 36 and causes a sliding movement in the recording head via the dial cord linkage previously described. When the delay adjustment knob 5 is released the tension in the rubber ring 43 forces lug 38 out of contact with side 44, thus simultaneously breaking the electrical and mechanical contact between arms 37 and 40.

In this embodiment of the invention slotted arm 40 is made entirely of electrical conducting material and is connected to the chassis through shaft 33, while arm 37, which is also made entirely of conducting material, is connected to the first stage of the output amplifier 4 through shaft 36. Insulating material 39 attached to arm 37 prevents any electrical contact between arm 37 and lug 42. When arm 37 contacts arm 40 due to rotation of adjustment knob 5, the signal input to amplifier 4 is grounded, thus entirely muting the output from speaker 10 while the delay adjustment is being moved. The muting is automatically removed when the delay adjustment knob is released and the contact between arms 37 and 40 broken by the tension in rubber ring 43.

Two important considerations in the action of the switch are that the drag on shaft 36 be larger than the torque exerted on lug 38 by the tension in the rubber ring, and that the drag on shaft 33 be smaller than the torque exerted by the lug 38 on the rubber ring when contact is made between the two arms. If the drag on shaft 36 is not large enough shaft 36 may be moved by contact with the rubber ring alone without contacting arm 40 and if the drag on shaft 33 is too large, the force of the rubber may not be sufficient to move the two arms out of contact when the delay adjustment knob is released. The exact amounts of drag required cannot be specified in general since they will depend on the specific requirements of each embodiment of the invention. But the adjustment of drag in mechanical coupling systems is well understood and can readily be determined for each specific case by those skilled in the art.

It should be understood that while this invention has been described in connection with a specific embodiment, the invention is by no means limited to the specific details disclosed. Many modifications are possible which do not depart from the spirit of the invention, and this invention includes all such modifications falling within the scope of the following claims.

I claim:

1. An electrical sound delay device comprising moving magnetic tape means, a recording head operable to impress electrical signals on said magnetic tape means, a pick-up head operable to reproduce electrical signals impressed on said magnetic tape means, said pick-up head movable with respect to said recording head along the tape means, an erasing head operable to remove electrical impressions from said magnetic tape means, said erasing head located before said recording head and after said pick-up head with respect to movement of said magnetic tape means, manual adjustment means operable to move said pick-up head relative to said recording head whereby electrical output signals can be delayed by any desired amount of time from electrical input signals, said manual adjustment means including a first part mechanically linked with said pick-up head, a second part mechanically linked with a manual adjustment element, and a muting switch mechanically linking said first and second parts, said muting switch being operable to close whenever said manual adjustment element is moved and to open whenever said manual adjustment element is released.

2. The combination defined in claim 1 wherein the first part of said manual adjustment means comprises a first shaft journalled on the chassis of said device, said first shaft linked at one end to said pick-up head and the

other end of said first shaft adjacent and axially separated from a second shaft journalled on the chassis of said device, and a manual adjustment knob attached to the end of said second shaft furthest from said first shaft, and wherein said muting switch comprises a first electrical conducting element rigidly attached to said first shaft, a second electrical conducting element rigidly attached to said second shaft, a resilient insulating material normally separating said first and second electrical conducting elements but yieldable in response to force applied to said adjustment knob to allow simultaneous electrical and mechanical contact between said first and second electrical conducting elements, said resilient insulating element being operable to separate said first and second electrical conducting elements when said force applied to said manual adjustment element is removed, said first electrical conducting element comprising an arm adapted to be attached at one end to said first shaft to extend radially therefrom, said arm having a projecting lug at the other end thereof, said lug being made of electrical conducting material and projecting axially away from said first shaft when said arm is attached thereto, said second electrical conducting element comprising a slotted arm made of electrical conducting material adapted to be attached at one end to said second shaft to extend radially therefrom, said slotted arm having a slot cut therein adapted to receive said projecting lug with substantial clearance, the said resilient insulating material comprising in part a rubber ring attached to said slotted arm at both ends of said slot and stretched parallel with the sides of said slot, the inner side boundaries of said rubber ring inside of the side boundaries of the said slot and the space between the inner side boundaries of said rubber ring being adapted to receive said projecting lug snugly.

3. The combination as defined in claim 2 in which the said resilient insulating material comprises in part electrical insulating material attached to said arm on the face thereof adjacent to said slotted arms.

4. The combination as defined in claim 2 including an electrical conductor connecting said projecting lug to said pick-up head and electrical conducting means connecting said slotted arm to the electrical ground of the device.

5. An electrical sound delay device comprising magnetic tape means, a recording head operable to impress electrical signals on said magnetic tape means, a pickup head operable to reproduce electrical signals impressed on said magnetic tape means, said pickup head movable with respect to said recording head, an erasing head operable to remove electrical impressions from said magnetic tape means, said erasing head located before said recording head and after said pickup head with respect to movement of said magnetic tape means, manual adjustment means operable to move said pickup head relative to said recording head whereby electrical signals in said output conductors can be delayed by any desired amount of time from electrical signals applied to said input conductors, said manual adjustment means including a first portion mechanically linked with said recording head, a second portion mechanically linked with a manual adjustment element, and a muting switch mechanically linking said first and second portions, said muting switch operable to close whenever said manual adjustment element is moved and to open whenever said manual adjustment element is released, said muting switch comprising a first electrical conducting element rigidly attached to the first portion of said manual adjustment means, a second electrical conducting element rigidly attached to the second portion of said manual adjustment means, a resilient insulating element normally separating first and second electrical conducting elements but yieldable in response to force applied to said manual adjustment element to allow simultaneous electrical and mechanical contact between said first and second electrical conducting elements, and said resilient insulating element operable to separate said first and second electrical conducting elements when said force applied to said manual adjustment element is removed.

6. An electrical sound delay device comprising magnetic tape means, a recording head operable to impress electrical signals on said magnetic tape means, a pickup head operable to reproduce electrical signals impressed on said magnetic tape means, said pickup head movable with respect to said recording head, an erasing head operable to remove electrical impressions from said magnetic tape means, said erasing head located before said recording head and after said pickup head with respect to movement of said magnetic tape means, manual adjustment means operable to move said pickup head relative to said recording head whereby electrical signals in said output conductors can be delayed by any desired amount of time from electrical signals applied to said input conductors, said manual adjustment means including a first portion mechanically linked with said recording head, a second portion mechanically linked with a manual adjustment element, and a muting switch mechanically linking said first and second portions, said muting switch operable to close whenever said manual adjustment element is moved and to open whenever said manual adjustment element is released, the first portion of said manual adjustment means comprising a first shaft journaled on the chassis of said device, said first shaft linked at one end to said pickup head, and the other end of said first shaft adjacent to and axially separated from a second shaft journaled on the chassis of said device, and a manual adjustment knob attached to the end of said second shaft furthest from said first shaft, and wherein said muting switch comprises a first electrical conducting element rigidly attached to said first shaft, a second electrical conducting element rigidly attached to said second shaft, and a resilient insulating material normally separating said first and second electrical conducting elements but yieldable in response to force applied to said adjustment knob to allow simultaneous electrical and mechanical contact between said first and second electrical conducting elements, and said resilient insulating element operable to separate said first and second electrical conducting elements when said force applied to said manual adjustment element is removed.

7. A combined rotary mechanical linkage and electrical switch comprising a supporting structure with a first shaft journaled thereto, a second shaft journaled to said supporting structure and axially separated from said first shaft such that the adjacent end surfaces of said shafts are separated by an axial clearance, a first electrical conducting element rigidly attached to said first shaft adjacent said axial clearance, a second electrical conducting element rigidly attached to said second shaft adjacent said axial clearance, and a resilient insulating element normally separating said first and second electrical conducting elements but yieldable in response to torque applied to one of said shafts to allow simultaneous electrical and mechanical contact between said first and second electrical conducting elements, and said resilient insulating element operable to separate said first and second electrical conducting elements when said torque applied to said shaft is removed.

8. The combination defined in claim 7 wherein said first electrical conducting element comprises an arm adapted to be attached at one end to said first shaft to extend radially therefrom, said arm having a projecting lug at the other end thereof, said lug made of electrical conducting material and projecting axially away from said first shaft when said arm is attached thereto, and wherein said second electrical conducting element comprises a slotted arm made of electrical conducting material adapted to be attached at one end to said second shaft to extend radially therefrom, said slotted arm hav-

ing a slot cut therein adapted to receive said projecting lug with substantial clearance, the mentioned resilient insulating material comprising, in part, a rubber ring attached to said slotted arm at both ends of said slot and stretched parallel with the sides of said slot, the inner side boundaries of said rubber ring inside up the side boundaries of said slot, and the space between the inner side boundaries up said rubber ring adapted to receive said projecting lug snugly.

References Cited in the file of this patent

UNITED STATES PATENTS

2,105,318	Goldsmith	Jan. 11, 1938
2,235,132	Wooldridge	Mar. 18, 1941

2,254,347	Blakesley	Sept. 2, 1941
2,424,633	Rieber	July 29, 1947
2,804,499	Butts	Aug. 27, 1957
2,831,069	Snow	Apr. 15, 1958
2,942,070	Hammond	June 21, 1960
2,978,543	Kennedy	Apr. 4, 1961

OTHER REFERENCES

"Journal of the Audio Engineering Society, April 1958, Vol. 6, No. 2; pp. 74–79. Available in Scientific Library.

Vol. 7, No. 4 (presented at the Tenth Annual Convention, October 1959, October 3, 1958); pp. 228–234. Available in the Scientific Library.