

PATENT SPECIFICATION

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- (21) Application No. 40111/71 (22) Filed 26 Aug. 1971
 (31) Convention Application No. 67325 (32) Filed 27 Aug. 1970 in (19)
 (33) United States of America (US)
 (44) Complete Specification published 26 June 1974
 (51) International Classification G11B 15/44, 15/48, 15/62//15/34
 (52) Index at acceptance
 G5R B189 B264 B27X B373 B38Y B476 B478 B484 B512
 B544 B58Y B59X B59Y B612 B613 B61Y B788
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(54) SOUND TRANSDUCER

(71) We, EASTMAN KODAK COMPANY, a Company organized under the Laws of the State of New Jersey, United States of America, of 343 State Street, Rochester, New York 14650, United States of America do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates generally to sound systems employing strip material and more specifically to an improved device for such systems for permitting reverse movement of the strip material.

It is an object of the present invention to provide an improved sound transducer wherethrough a strip material may be fed in either direction.

According to the present invention, there is provided a sound transducer having a mechanism for handling strip material having a sound track and for moving the strip material through a threading path in either of two opposed directions comprising means for converting information carried on the strip material sound track to electrical impulses including two members positioned on opposed sides of the path, at least one of the members being movable toward and away from the other member, spring means coupled to the one member for biasing the member toward the other member to apply a pressure to strip material therebetween, drive means positioned along the threading path for selectively pulling strip material past the members in a first of the directions wherein sound may be read from the sound track, the drive means being spaced from the members in the first direction, and for pushing the strip material past the members in the second opposite direction, there being means actuable for moving the one member away from the other member against the bias of the spring means to relieve the pressure on the strip material therebetween,

[Price 25p]

and means for actuating the member moving means when the drive means pushes the film strip past the members.

The invention will be described further, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a schematic drawing of a portion of a motion picture projector showing a sound transducer incorporating a strip material handling mechanism of the present invention; and

Fig. 2 is a schematic drawing of a portion of a motion picture projector showing the strip material handling mechanism of Fig. 1 in another position.

Because sound projectors are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. It is to be understood that all projector elements not specifically shown or described may take various forms well known to those skilled in the art.

Illustrated in Fig. 1 is a portion of a film threading path of a sound projector, identified generally by numeral 10. In the forward project mode, strip material such as film 11 is pulled by a rotatable sprocket wheel 13 having teeth 39 engaging perforations in the edge of film 11. Film 11 is advanced from a film supply reel (not shown), past a projection gate (also not shown), through a linear sound gate or transducer 12 for converting information on a sound track into electrical impulses and a capstan drive assembly 20. After passing sprocket wheel 13, film 11 is wound on a conventional film take-up reel (not shown). In a sound projection system of the type to which this invention is most applicable, the sound is coded directly on the film such as by magnetic and/or optical means. Sound is "read" from film 11 in a known manner as the film moves past sound gate 12.

Sound gate 12 is represented in Figs. 1 and

2 as having a stationary lower pressure pad 14 and movable upper pressure pad 16. However, it will be understood that either or both pressure pads may be movable. Lower pad 14 and upper pad 16 can be thought of as representing the sound transducer for a magnetic and/or an optical sound system. In the case of a magnetic system, lower pressure pad 14 would contain a suitable magnetic material such as ferric oxide and upper pad 16 would contain suitable magnetic to electric transducer means. In an optical sound system, lower pressure pad 14 would contain a suitable light source for transmitting light through a sound track portion of film 11 to upper pad 16 which would contain a suitable electrical-optical device, such as a photocell, for converting the recorded audio signals on film 11 to appropriate electrical signals.

Capstan drive assembly 20 includes a capstan 21 and a pressure roller 22. Capstan 21 is in the form of a cylindrical shaft which is rotatably mounted on the projector housing immediately beneath the film threading path so that film 11 passes essentially tangential to the uppermost portion of capstan 21. Capstan 21 is driven by frictional contact with film 11 which is in turn driven by sprocket wheel 13. Speed variations of film 11 are smoothed out by a flywheel (not shown) which is attached to capstan 21 in a known manner.

Pressure roller 22 is located above the film threading path. Roller 22 comprises a cylindrical shaft 23 having a cylindrically shaped jacket 25. The jacket 25 is preferably made of a non-abrasive material, such as rubber, so as not to scratch the film. Shaft 23 is rotatably mounted at one end to a right angle bracket 24. Jacket 25 has an axial length sufficient to span the width of film 11.

A lever arm 26 is rigidly secured to one side of upper sound pad 16 and extends in the direction of film travel during forward movement. Arm 26 carries a downwardly extending tab 27 at the opposite end. Tab 27 extends from arm 26 into the center portion of a helical spring 28 so that the top portion of spring 28 engages the underside of arm 26. The bottom portion of spring 28 is disposed against a stationary member (not shown). Spring 28 biases lever arm 26 for rotation about a pivot 40 in a counterclockwise direction as viewed in the drawings, thereby urging upper sound pad 16 toward film 11.

A solenoid 30 is mounted above the end portion of the lever arm 26 opposite sound pad 16. The solenoid has an armature 31, the axial length of which is substantially at right angles to that portion of arm 26 immediately beneath solenoid 30. When voltage is applied to solenoid 30, armature 31 strikes lever arm 26, rotating the lever arm in a clockwise

direction to open sound gate 12.

An adjusting screw 34 is threadably carried in a tapped hole 32 in leg 33 of bracket 24. Screw 34 and lever arm 26 are in the same plane, and the screw is adjusted so that upon clockwise movement of arm 26, the arm strikes an end portion of screw 34. A pivotal lever arm 35 is rigidly secured to the end of leg 33. Arm 35 is pivotally mounted on the projector at 36. Extending from the lower side of arm 35 is a tab 37 positioned, in the lengthwise direction on arm 35, so that pivot point 36 is between tab 37 and that portion of arm 35 secured to leg 33. Tab 37 extends into a helical spring 38. The upper end of spring 38 engages the underside of arm 35 and the lower end engages a fixed member (not shown). Spring 38 biases pivot arm 35 in a counterclockwise direction to urge pressure roller jacket 25 against film 11. When jacket 25 bears against film 11, the axis of jacket 25 is parallel with the axis of capstan 21.

In operation, rotary motion is imparted to sprocket wheel 13 by a power source such as an electric motor (not shown). In the forward project mode, sprocket wheel 13 rotates clockwise as shown in Fig. 1 to advance film from left to right. Teeth 39 of wheel 13 enter the perforations cut along the edge of film 11 and pull film 11 through sound gate 12 and capstan drive assembly 20. As brought out hereinbefore sprocket wheel 13 ordinarily may not provide a sufficiently smooth film drive. The speed of film 11 as it passes through sound gate 12 is smoothed by capstan roller assembly 20. Capstan 21 is rotated by frictional contact with moving film 11 as the film moves past the capstan. A high inertia flywheel (not shown) is secured to one end of capstan 21. The flywheel damps out transient variations in the angular velocity of capstan 21 and hence in overall film speed.

With the apparatus in the forward project mode, the parts are positioned substantially as shown in Fig. 1. In these positions, armature 31 of solenoid 30 is spaced from lever arm 26. Springs 28 and 38 are effective to keep lever arms 26 and 35 in the counterclockwise position shown. Upper pressure pad 16 is substantially parallel with the film plane and with lower pressure pad 14. Pressure roller jacket 25 bears against film surface 29 and the axis of capstan pressure roller 22 is substantially parallel with the axis of capstan 21.

In reverse project mode, film 11 is moved from right to left as viewed in Figs. 1 and 2. In this mode, sprocket wheel 13 rotates counterclockwise and pushes film 11 past capstan roller assembly 20 and film sound gate 12 as opposed to the forward project mode where film 11 is pulled through assembly 20 and

gate 12. Because film 11 is pushed past capstan assembly 20 and sound gate 12 during any reverse mode and because of the flexibility of film 11, the film would buckle at the entrance to the capstan roller assembly 20 or sound gate 12 if they were not opened.

In accordance with the present invention, this problem can be circumvented because it is not necessary that the sound retrieval mechanism contact the film during reverse projection since the recorded sound is not being "read" from the film. Since capstan drive assembly 20 is not needed to smooth film velocity transients and sound gate 12 is not needed to read the recorded sound, gate 12 and assembly 20 can be opened.

Referring to Fig. 2, pressure on film 11 in the sound gate 12 and at the capstan assembly 20 is removed by lifting upper pressure pad 16 and capstan pressure roller 22. To lift these elements, a voltage is applied to solenoid 30 impelling plunger 31 downward, striking the end of the arm 26. The upward force applied by spring 28 is overcome and arm 26 pivots in a clockwise direction about pivot 40. As arm 26 pivots, upper pressure pad 16 swings away from film surface 29, thereby removing the pressure normally applied to the film from pad 16. Additionally, as arm 26 pivots, the uppermost portion of arm 26 engages adjusting screw 34, driving the screw and bracket 24 upward to pivot lever arm 35 about pivot point 36, overcoming the opposing force applied by the helical bias spring 38. As lever arm 35 pivots, sleeve 25 of capstan pressure roller 23 is lifted free of film surface 29.

With pressure roller 22 and pad 16 both free of surface 29 of film 11, sprocket wheel 13 can move film 11 in a reverse project mode without buckling of the film at assembly 20 or gate 12.

It will be noted that there is a certain amount of lost motion between lever arms 26 and 35, the amount of which can be adjusted by means of screw 34. By applying film pressure in the forward mode through independent lever arms 26 and 35, pressure pad 16 and the pressure roller 22 can move independently in response to any variations of film thickness, such as a film splice or film tear. By enabling the film pressure devices to respond separately to film thickness variations, an enlarged section of film in gate 12 will force that gate open but will not relieve the pressure on the film surface applied by capstan roller 22. This ensures that the film is under the constant speed restraint of capstan roller assembly 20 even if gate 20 encounters a splice.

In the above description, solenoid 30 is actuated to open sound gate 10 and capstan drive assembly 20 only during reverse

projection. Of course gate 10 and assembly 20 must also be opened during high speed forward wind and rewind modes. However in these modes, all of the threading path defining members (such as the optical gate, the drive sprockets and the loop formers) must be opened and the same mechanism may be used to open everything. But it will be understood that the device of the present invention may also be used in these modes if desired.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the scope of the invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A sound transducer having a mechanism for handling strip material having a sound track and for moving the strip material through a threading path in either of two opposed directions comprising means for converting information carried on the strip material sound track to electrical impulses including two members positioned on opposed sides of the path, at least one of the members being movable toward and away from the other member, spring means coupled to the one member for biasing the member toward the other member to apply a pressure to strip material therebetween, drive means positioned along the threading path for selectively pulling strip material past the members in a first of the directions wherein sound may be read from the sound track, the drive means being spaced from the members in the first direction, and for pushing the strip material past the members in the second opposite direction, there being means actuable for moving the one member away from the other member against the bias of the spring means to relieve the pressure on the strip material therebetween, and means for actuating the member moving means when the drive means pushes the film strip past the members.

2. A transducer as claimed in Claim 1 further comprising a capstan drive assembly located along the threading path between the members and the drive means, the capstan drive assembly including a capstan on one side of the threading path and a movable pressure roller on the other side of the threading path, means biasing the roller toward the capstan, and means for moving the roller away from the capstan when the one member is moved away from the other member by the actuable means.

3. A transducer as claimed in Claim 2 wherein the actuable means comprises a first movable arm upon which the one member is mounted, the actuating means is adapted to move the arm in a direction

gate 12. Because film 11 is pushed past capstan assembly 20 and sound gate 12 during any reverse mode and because of the flexibility of film 11, the film would buckle at the entrance to the capstan roller assembly 20 or sound gate 12 if they were not opened.

In accordance with the present invention, this problem can be circumvented because it is not necessary that the sound retrieval mechanism contact the film during reverse projection since the recorded sound is not being "read" from the film. Since capstan drive assembly 20 is not needed to smooth film velocity transients and sound gate 12 is not needed to read the recorded sound, gate 12 and assembly 20 can be opened.

Referring to Fig. 2, pressure on film 11 in the sound gate 12 and at the capstan assembly 20 is removed by lifting upper pressure pad 16 and capstan pressure roller 22. To lift these elements, a voltage is applied to solenoid 30 impelling plunger 31 downward, striking the end of the arm 26. The upward force applied by spring 28 is overcome and arm 26 pivots in a clockwise direction about pivot 40. As arm 26 pivots, upper pressure pad 16 swings away from film surface 29, thereby removing the pressure normally applied to the film from pad 16. Additionally, as arm 26 pivots, the uppermost portion of arm 26 engages adjusting screw 34, driving the screw and bracket 24 upward to pivot lever arm 35 about pivot point 36, overcoming the opposing force applied by the helical bias spring 38. As lever arm 35 pivots, sleeve 25 of capstan pressure roller 23 is lifted free of film surface 29.

With pressure roller 22 and pad 16 both free of surface 29 of film 11, sprocket wheel 13 can move film 11 in a reverse project mode without buckling of the film at assembly 20 or gate 12.

It will be noted that there is a certain amount of lost motion between lever arms 26 and 35, the amount of which can be adjusted by means of screw 34. By applying film pressure in the forward mode through independent lever arms 26 and 35, pressure pad 16 and the pressure roller 22 can move independently in response to any variations of film thickness, such as a film splice or film tear. By enabling the film pressure devices to respond separately to film thickness variations, an enlarged section of film in gate 12 will force that gate open but will not relieve the pressure on the film surface applied by capstan roller 22. This ensures that the film is under the constant speed restraint of capstan roller assembly 20 even if gate 20 encounters a splice.

In the above description, solenoid 30 is actuated to open sound gate 10 and capstan drive assembly 20 only during reverse

projection. Of course gate 10 and assembly 20 must also be opened during high speed forward wind and rewind modes. However in these modes, all of the threading path defining members (such as the optical gate, the drive sprockets and the loop formers) must be opened and the same mechanism may be used to open everything. But it will be understood that the device of the present invention may also be used in these modes if desired.

The invention has been described in detail with particular reference to a preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the scope of the invention as defined in the appended claims.

WHAT WE CLAIM IS:—

1. A sound transducer having a mechanism for handling strip material having a sound track and for moving the strip material through a threading path in either of two opposed directions comprising means for converting information carried on the strip material sound track to electrical impulses including two members positioned on opposed sides of the path, at least one of the members being movable toward and away from the other member, spring means coupled to the one member for biasing the member toward the other member to apply a pressure to strip material therebetween, drive means positioned along the threading path for selectively pulling strip material past the members in a first of the directions wherein sound may be read from the sound track, the drive means being spaced from the members in the first direction, and for pushing the strip material past the members in the second opposite direction, there being means actuable for moving the one member away from the other member against the bias of the spring means to relieve the pressure on the strip material therebetween, and means for actuating the member moving means when the drive means pushes the film strip past the members.

2. A transducer as claimed in Claim 1 further comprising a capstan drive assembly located along the threading path between the members and the drive means, the capstan drive assembly including a capstan on one side of the threading path and a movable pressure roller on the other side of the threading path, means biasing the roller toward the capstan, and means for moving the roller away from the capstan when the one member is moved away from the other member by the actuable means.

3. A transducer as claimed in Claim 2 wherein the actuable means comprises a first movable arm upon which the one member is mounted, the actuating means is adapted to move the arm in a direction



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5 against the force of the spring means, and the roller is mounted on a second movable arm positioned with respect to the first arm to be engaged thereby as the first arm moves against the force of the spring means, whereby movement of the first arm and the one member away from the other member moves the second arm and the roller away from the capstan.

10 4. A transducer as claimed in Claim 3 further comprising means carried by one of the arms for defining and adjusting a space between the arms to permit a predetermined amount of movement of the first arm without corresponding movement of the second arm.

5. A motion picture projector having sound reproduction capabilities and comprising a sound transducer as claimed in any preceding Claim wherein the drive means comprises a sprocket wheel positioned along the threading path for selectively pulling the film strip past the transducer and for pushing the film strip past the transducer.

6. A sound transducer substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

7. A motion picture projector having a sound transducer as claimed in Claim 6.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1974.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.



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