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S. J. ELLIOTT ET AL

2,775,407

## DRIVING AND BRAKING SYSTEM FOR REELING MECHANISM

Filed June 15, 1953

2 Sheets-Sheet 1

FIG. 1

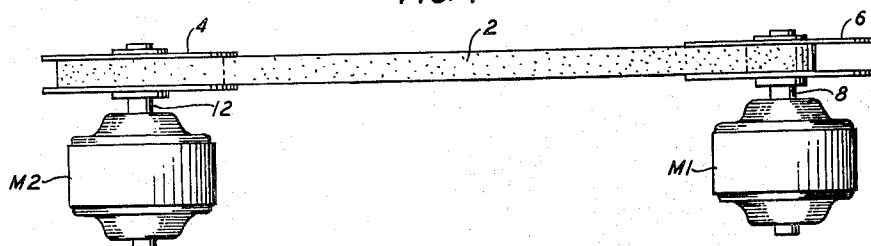


FIG. 3

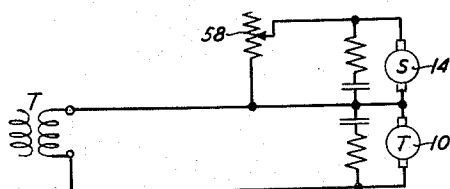


FIG. 4

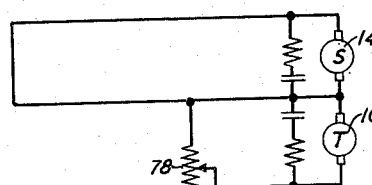


FIG. 5

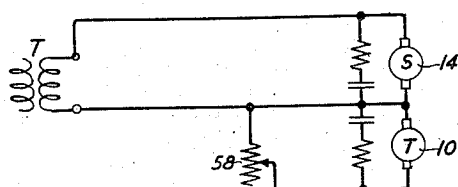


FIG. 6

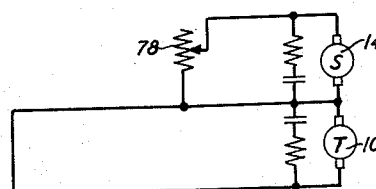


FIG. 7

|    |          | FAST           |               |               |                | STOP | SLOW           |
|----|----------|----------------|---------------|---------------|----------------|------|----------------|
|    |          | FORWARD        | FORWARD BRAKE | REVERSE BRAKE | REVERSE        |      |                |
| M2 | FIELD 40 | VOLTS 115 A.C. | D.C.          | D.C.          | VOLTS 115 A.C. | —    | —              |
| M1 | FIELD 30 | VOLTS 115 A.C. | D.C.          | D.C.          | VOLTS 115 A.C. | —    | VOLTS 115 A.C. |
| M2 | ARM 14   | RESISTOR 58    | SHORT         | RESISTOR 78   | VOLTS 9 A.C.   | —    | —              |
| M1 | ARM 10   | VOLTS 9 A.C.   | RESISTOR 78   | SHORT         | RESISTOR 58    | —    | VOLTS 3 A.C.   |
|    | CAPSTAN  | —              | —             | —             | —              | —    | VOLTS 115 A.C. |

KEY "A" IN  
NEUTRAL POSITION

S. J. ELLIOTT  
F. M. THOMAS  
O. C. WORLEY  
INVENTORS  
BY  
v. P. Priolo  
ATTORNEY

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2 Sheets-Sheet 2

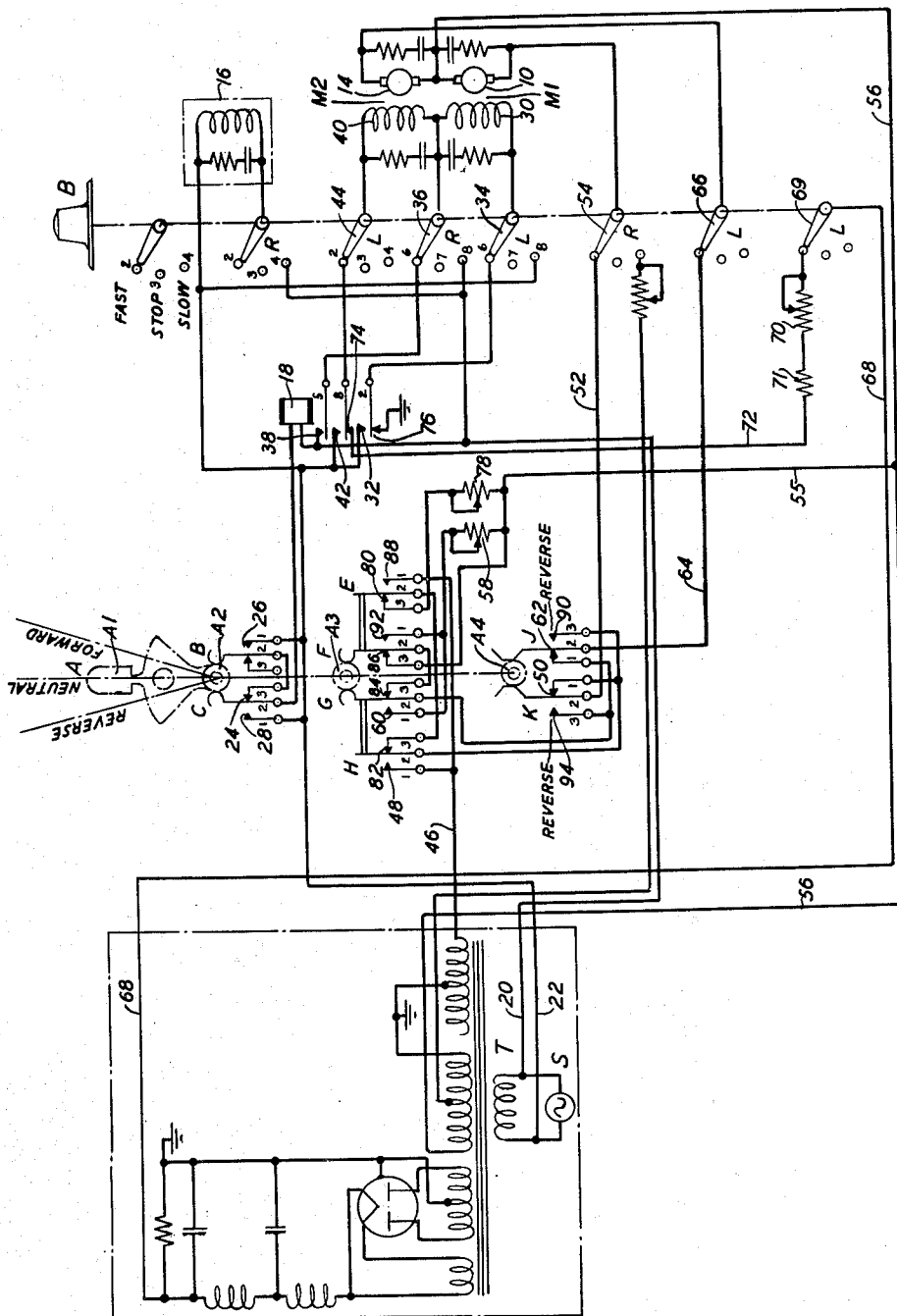


FIG. 2

S. J. ELLIOTT  
F. M. THOMAS  
Q. C. WORLEY  
INVENTORS  
BY  
V. P. Priolo  
ATTORNEY

2,775,407

## DRIVING AND BRAKING SYSTEM FOR REELING MECHANISM

Stanley J. Elliott, Summit, N. J., Frank M. Thomas, Port Washington, N. Y., and Osborn C. Worley, Whippany, N. J., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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4 Claims. (Cl. 242—55)

This invention relates to reeling apparatus comprising feed and take-up reels.

It is an object of the present invention to provide means for controlling the tension on the flexible element transported between the feed and take-up reels of a reeling apparatus to prevent the rupturing or throwing of said element when it travels at high speed and when its high speed motion is arrested by braking.

The present invention may be employed with particular advantage in a magnetic recorder-reproducer of the type in which a magnetic record wire or tape is transported between feed and take-up reels.

In accordance with the general features of the invention, when the flexible element is transported at high speed, the motors which are coupled to the feed and take-up reels are differentially energized. The high speed motion of said element is arrested by differentially braking the feed and take-up motors.

The nature of the invention and its distinguishing features and advantages will be more clearly understood from the following detailed description and the accompanying drawings in which:

Fig. 1 is a view in front elevation of a reeling apparatus to which the present invention is applicable;

Fig. 2 is a schematic of the mechanical and circuit components employed in the present invention to control the motion and speed of the feed and take-up reels shown in Fig. 1;

Fig. 3 is a diagram of the feed and take-up motor armature circuits when the components shown in Fig. 2 are arranged to impart fast forward motion to the reeled element;

Fig. 4 is a diagram of the feed and take-up motor armature circuits when the components shown in Fig. 2 are arranged to arrest the high speed forward motion of the reeled element;

Fig. 5 is a diagram of the feed and take-up motor armature circuits when the components shown in Fig. 2 are arranged to impart fast reverse motion to the reeled element;

Fig. 6 is a diagram of the feed and take-up motor armature circuits when the components shown in Fig. 2 are arranged to arrest the high speed reverse motion of the reeled element; and

Fig. 7 is a chart of the field and armature power supplies for the feed and take-up motors employed to provide slow forward motion, fast forward and reverse motion and fast forward and reverse braking in accordance with the present invention.

Referring now to the accompanying drawings, the flexible element 2 may be reeled from reel 4 to reel 6 or vice versa. When the element 2 travels in the forward direction reel 4 acts as the feed reel and reel 6 acts as the take-up reel. Motion is imparted to the element 2 by reel 6 which is driven by motor M1 through the spindle 8 coupled to reel 6 and to the armature 10 of motor M1. When the element 2 travels in the reverse direction reel 6 acts as the feed reel and reel 4 acts as the take-up reel.

Motion is imparted to the element 2 by reel 4 which is driven by motor M2 through the spindle 12 coupled to reel 4 and to the armature 14 of motor M2.

In the preferred embodiment of the present invention the element 2 is a magnetic record tape and it will be understood that signals are recorded thereon and reproduced therefrom only when it travels in the forward direction. The speed of travel of the tape is referred to as slow when the apparatus is employed to record and reproduce signals, and as shown in Fig. 7 motion at slow speed is imparted to the tape in the conventional manner by means of the motor M1 and the capstan motor 16. The speed of travel of the tape is referred to as fast when the tape is scanned in the forward direction and when it is rewound. As already noted, the present invention is directed primarily to the operation of and the braking of the reeling apparatus under fast speed conditions.

As shown in Fig. 2, the key switch A and the selector switch B are employed to combine the specific circuit elements and motor power supplies specified in Fig. 7 for the slow speed operation and each of the fast speed operations. For slow speed operation during the recording and reproductions of signals the ganged arms of switch B are set to the slow position shown in Fig. 2 and switch A is maintained in the neutral position. To arrest the slow speed motion of the apparatus, selector switch B is thrown to the stop position while switch A is maintained in the neutral position. It will be understood that switch A requires manipulation for "fast speed" operations only.

In the preferred embodiment of the present invention, as shown in Fig. 2, switch A comprises the operating member A1 which may be actuated manually, and the contact actuating members A2, A3 and A4 which follow the movement of the operating member A1. The operating member A1 has a normal or neutral operating position and is operable to a first off-normal or forward position and a second off-normal or reverse position. The contact actuating members A2, A3 and A4 will simultaneously follow the movement of the operating member A1 during the movement of said member A1 from one off-normal position directly to the other off-normal position. The members A2 and A3 will simultaneously follow the movement of member A1 during the movement of said member A1 from the normal position to either one of the off-normal positions and from either one of the off-normal positions to the normal position. The contact actuating member A4, which is of the locking type, will be retained in the off-normal position it occupies when the operating member A1 is moved from said off-normal position to the normal position. The member A4 will remain in said off-normal position until it is moved to the other off-normal position by the movement of the member A1 to said other off-normal position. There is no neutral position for member A4, since it will occupy only a forward or reverse position. The locking feature of member A4 is used to advantage to preset the circuit conditions required for fast forward and fast reverse braking. The presetting of member A4 in the braking position maintains the tension of the flexible element at the level required to prevent the rupture and throwing thereof while switching from the forward or reverse transporting operation to the braking operation. With the selector switch B thrown to the fast position, only the single switch A need be manipulated to provide the four fast speed operations listed in Fig. 7. In Fig. 2, member A4 is shown locked in the forward position.

Since the invention is directed primarily to the operation of the apparatus under fast speed conditions, detailed description of the schematic shown in Fig. 2 will be limited to the specific circuit arrangements provided for the fast speed operations listed in Fig. 7.

In the preferred embodiment of the invention power is

furnished to the primary winding of the transformer T from an alternating-current source S. The source S provides a supply of 115 volts. The secondary winding of transformer T provides alternating-current supplies of 3 volts and 9 volts for the armatures of the motors M1 and M2 as shown in Fig. 7. The output of transformer T is also rectified in the conventional manner to provide a direct-current supply of 400 volts which is applied through resistors 70 and 71 to the fields of motors M1 and M2 for fast forward and reverse braking.

When switch A is thrown either to forward or reverse position, the relay 18 is energized by voltage applied from the source S over lines 20 and 22, through switch contact 28 (forward), or switch contacts 24 and 26 (reverse).

With switch A in forward position, voltage is applied from the source S to the field 30 of motor M1 over line 22, through contact 32 of relay 18, arm 34 of switch B, arm 36 of switch B, contact 38 of relay 18 and line 20. The field 40 of motor M2 is equally energized by voltage from source S over line 22, through contact 42 of relay 18, arm 44 of switch B, arm 36 of switch B, contact 38 of relay 18 and line 20. As shown in Fig. 3, voltage is applied from the secondary of transformer T to the armature 10 of motor M1 over line 46, through contacts 48 and 50 of switch A, line 52, arm 54 of switch B and line 56. The armature 14 of motor M2 is shunted by resistor 58, one end of which is connected to armature 14 by lines 55 and 56, the other end of which is connected to armature 14, through contacts 60 and 62 of switch A, line 64 and arm 66 of switch B. With this arrangement motor M1 is energized to impart forward motion to the flexible element and motor M2 operates as a braking generator driven by the flexible element. The shunting impedance is of such value as to maintain the tension of the flexible element at the level required to prevent the rupture and throwing thereof while being transported.

With switch A thrown from forward to neutral position relay 18 is deenergized and rectified voltage is applied to the fields 30 and 40 of motors M1 and M2 over line 68, arm 69 of switch B, resistors 70 and 71, line 72, contact 74 of relay 18, arm 44 of switch B, arm 34 of switch B and contact 76 of relay 18 to ground. As shown in Fig. 4, the armature 10 of motor M1 is shunted by resistor 78, one end of which is connected to armature 10 by lines 55 and 56, the other end of which is connected to armature 10, through contacts 80, 82 and 50 of switch A, line 52 and arm 54 of switch B. The armature 14 of motor M2 is short-circuited through arm 66 of switch B, line 64, contacts 62, 84 and 86 of switch A and lines 55 and 56. With this arrangement motors M1 and M2 operate as braking generators to differentially brake the reels coupled thereto and arrest the fast forward motion of the flexible element. The shunting impedance is of such value as to maintain the tension of the flexible element at the level required to prevent the rupture and throwing thereof during the braking operation.

With switch A in reverse position, voltage is applied from the source S to the fields 30 and 40 of motors M1 and M2 in the same manner and over the same paths as it is applied with the switch A in forward position. As shown in Fig. 5, voltage is applied from the secondary winding of transformer T to the armature 14 of motor M2 over line 46, through contacts 88, 82 and 90 of switch A, line 64, arm 66 of switch B and line 56. The armature 10 of motor M1 is shunted by resistor 58, one end of which is connected to armature 10 by lines 55 and 56, the other end of which is connected to armature 10, through contacts 92, 84, 94 of switch A, line 52 and arm 54 of switch B. With this arrangement motor M2 is energized to impart reverse motion to the flexible element and motor M1 operates as a braking generator driven by the flexible element.

With switch A thrown from reverse to neutral position, relay 18 is deenergized and rectified voltage is applied to the fields 30 and 40 of motors M1 and M2 in the same

manner as it is applied when switch A is thrown from forward to neutral position. As shown in Fig. 6, the armature 14 of motor M2 is shunted by resistor 78, one end of which is connected to armature 14 by lines 55 and 56, the other end of which is connected to armature 14 through contacts 80, 82 and 90 of switch A, line 64 and arm 66 of switch B. The armature 10 of motor M1 is short-circuited through arm 54 of switch B, line 52, contacts 94, 84 and 86 of switch A and lines 55 and 56. With this arrangement motors M1 and M2 operate as braking generators to arrest the fast reverse motion of the flexible element.

In the preferred embodiment of the invention, the motors M1 and M2 are of the universal type and possess similar characteristics, and the shunting resistors 58 and 78 are adjusted to values of 5 and 30 ohms respectively. If the motors selected have characteristics which are different from those of the motors used in the preferred embodiment of the invention, it may be necessary to make one or the other of the shunting resistors larger, or to make them equal. The motors are differentially energized by applying 9 volts to the take-up motor armature while shunting the feed motor armature with a 5-ohm resistor. Differential braking is applied to the motors by shunting the take-up motor armature with a 30-ohm resistor while short circuiting the feed motor armature, and applying 400 volts from the direct-current source through resistors 70 and 71 to the motors fields. The use of resistors 70 and 71 in combination with a high voltage supply shortens the time required to attain steady state current in the field windings.

Alternating current was employed for driving the motors in order to avoid the use of a heavy duty rectifier, and direct-current braking was employed because it is more rapid than alternating-current braking. However, either alternating current or direct current may be employed for both driving and braking.

After the motion of the reeled element 2 is arrested by the braking operation, the rectified voltage applied to the motor fields is removed by throwing the switch B to the stop position.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A reeling apparatus comprising a pair of reels, a flexible element disposed on said reels in such manner as to be transportable from either one to the other of said reels, a motor coupled to one of said reels, another motor coupled to the other of said reels, each of said motors comprising an armature, said armature having two terminals, a source of potential, a first impedance, a second impedance, a switch including a first contact actuating member having a normal position and first and second off-normal positions, a second contact actuating member having off-normal positions corresponding to those of said first member, a group of contacts individually associated with each of said members, and locking means for retaining said second member in the off-normal position it occupies when said first member is moved from said off-normal position to said normal position, one terminal of each of said armatures being connected to contacts associated with said second member, the other terminals of said armatures and one terminal each of said impedances being connected to a common point, the other terminal of each of said impedances being connected to contacts associated with said first member, said contacts being disposed in such relative positions by the contact actuating members associated therewith that when said switch is operated to an off-normal position the armature of one of said motors is connected to said source of potential to energize said motor and thereby impart motion to said flexible element, and the armature of the other

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of said motors is shunted with said first impedance whereby said other motor operates as a braking generator driven by said flexible element, said shunting impedance being of such value as to maintain the tension of said flexible element at the level required to prevent the rupture and throwing thereof while being transported, and when said switch is operated to its normal position from said off-normal position said source of potential is disconnected from said one motor, the armature of said motor is shunted with said second impedance and the armature of said other motor is short-circuited, both of said motors thereby operating as braking generators to differentially brake the reels coupled thereto, said shunting impedance being of such value as to maintain the tension of said flexible element at the level required to prevent the rupture and throwing thereof during the braking operation, the pre-setting of said second switch member in the braking position conditioning said apparatus in such manner as to maintain the tension of said flexible element at the level required to prevent rupture and throwing thereof while switching from the transporting operation to the braking operation.

2. A reeling apparatus in accordance with claim 1

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wherein said second impedance is larger than said first impedance.

3. A reeling apparatus in accordance with claim 1 wherein said flexible element is magnetizable.

5 4. A reeling apparatus in accordance with claim 1 wherein each of said motors comprises a field and each of said fields is connected to an alternating-current source when said first switch member is in an off-normal position and to a direct-current source when said first switch member is in the normal position.

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