United States Patent [19]

Bourgeois

[11] **3,784,129**

[45] **Jan. 8, 1974**

[54] **ALTERNATE WINDING AND UNWINDING OF A TWO-ENDED PROGRAM TAPE**

[75] Inventor: **Norbert Paul Bourgeois,** Troyes, France

[73] Assignee: **Etudes et Bonneterie S.A.,** Lausanne, Switzerland

[22] Filed: **Feb. 25, 1972**

[21] Appl. No.: **229,542**

[30] **Foreign Application Priority Data**

Mar. 5, 1971 Switzerland 3245/71

[52] **U.S. Cl.** ..... **242/201,** 179/100.2 S, 242/DIG. 1, 250/219 QA, 274/4 D

[51] **Int. Cl.** **B11b 15/32,** G11b 5/00, G03b 1/04

[58] **Field of Search** ..... 242/201-204, 242/188, DIG. 1; 274/4 D, 11 D; 179/100.2 S; 250/219 QA, 219 O, 219 R; 318/39

[56] **References Cited**

UNITED STATES PATENTS

2,535,486	12/1950	Dank	179/100.2 R
2,927,258	3/1960	Lippel	318/39
2,971,716	2/1961	Sampson	242/188

Primary Examiner—Leonard D. Christian
Attorney—E. F. Wenderoth et al.

[57] **ABSTRACT**

A two-ended program tape is alternately wound and unwound between two spools by a reversible motor, the spools being connected to this reversible motor via couplers and respective clutches so that the tape-receiving spool is also driven by the motor, and each spool also having a respective auxiliary motor. When a pre-reversal data on the tape passes under a reader, the clutch of the receiving spool is disengaged and its auxiliary motor supplied to rotate in the opposite direction thereby forming a length of loose tape between this spool and the reversible motor. A subsequent reading of a reversal data on the tape actuates reversal of the main motor and engagement of the clutch of the empty spool which is driven in the direction to wind tape thereon, supply to the auxiliary motor of the first spool being cut when the pre-reversal data passes back under the reader.

7 Claims, 4 Drawing Figures

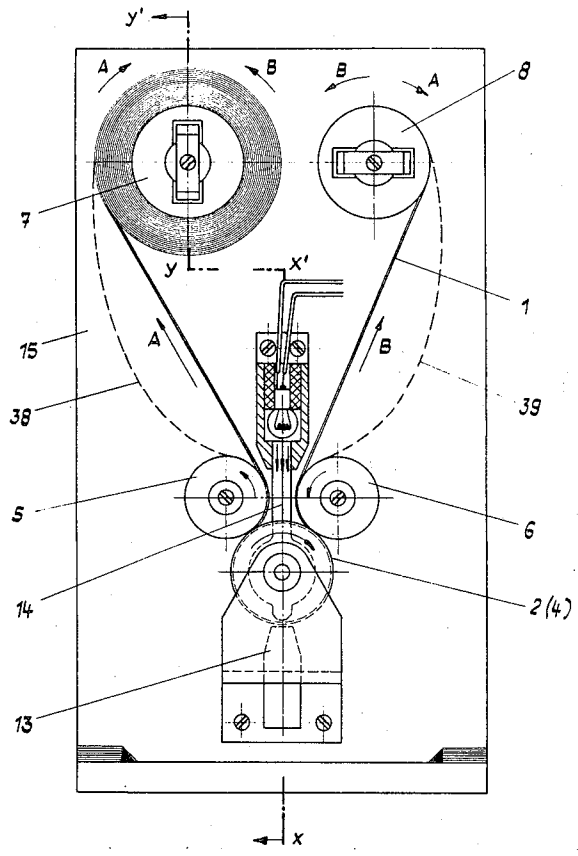


Fig. 1

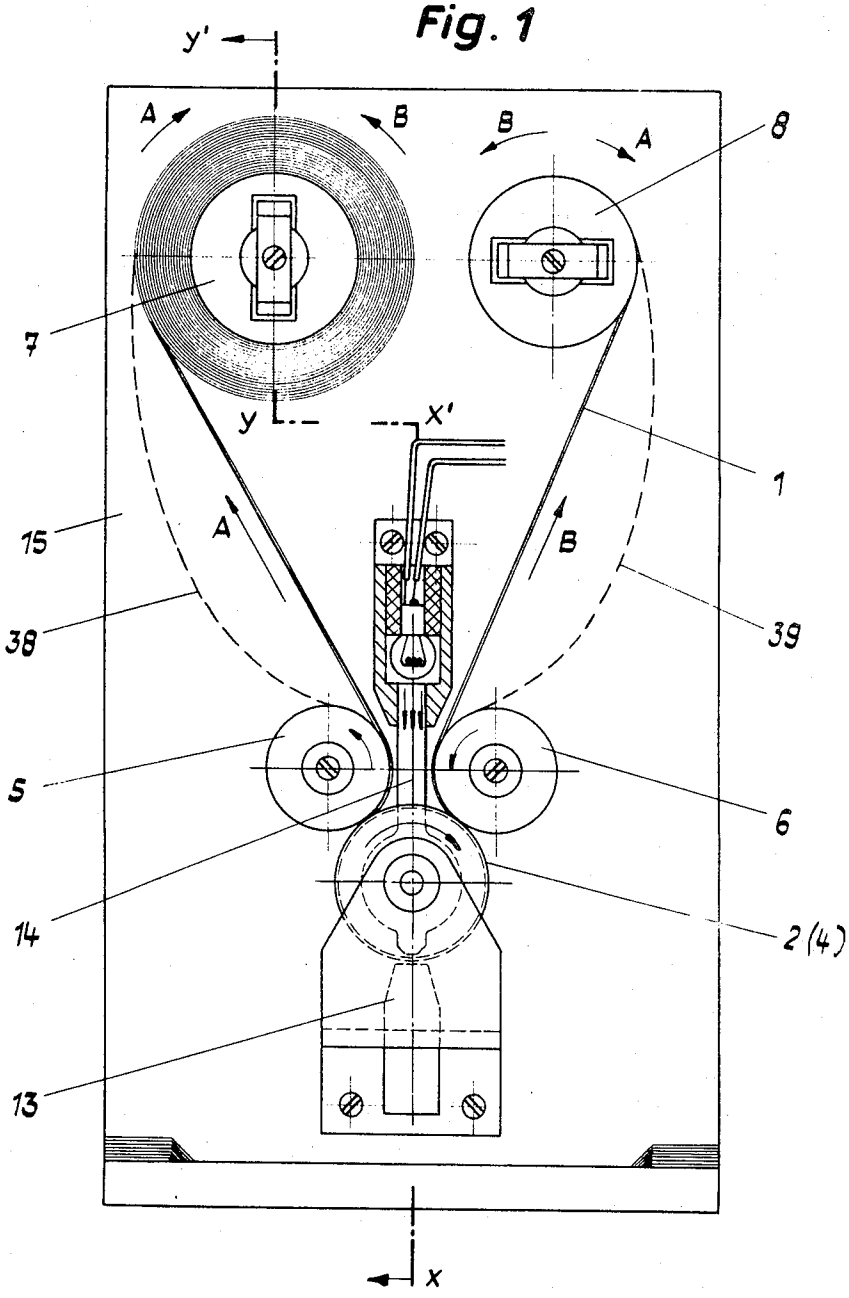


Fig. 2

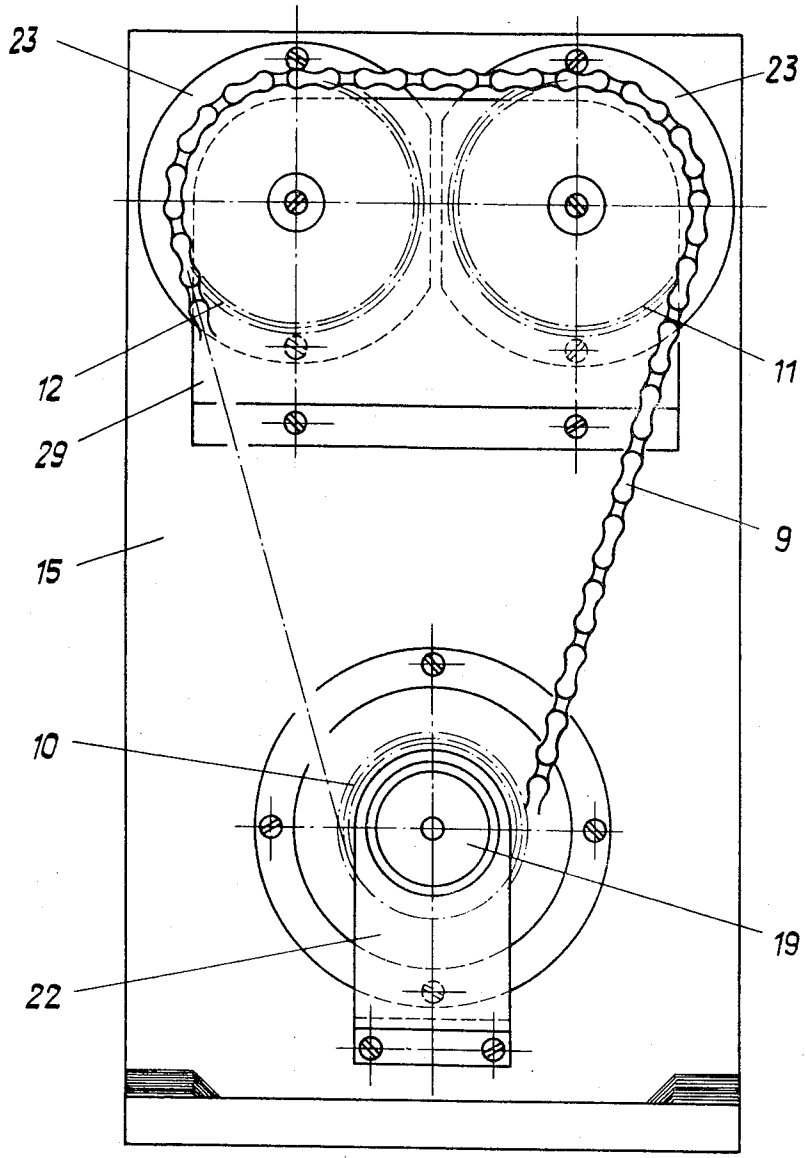
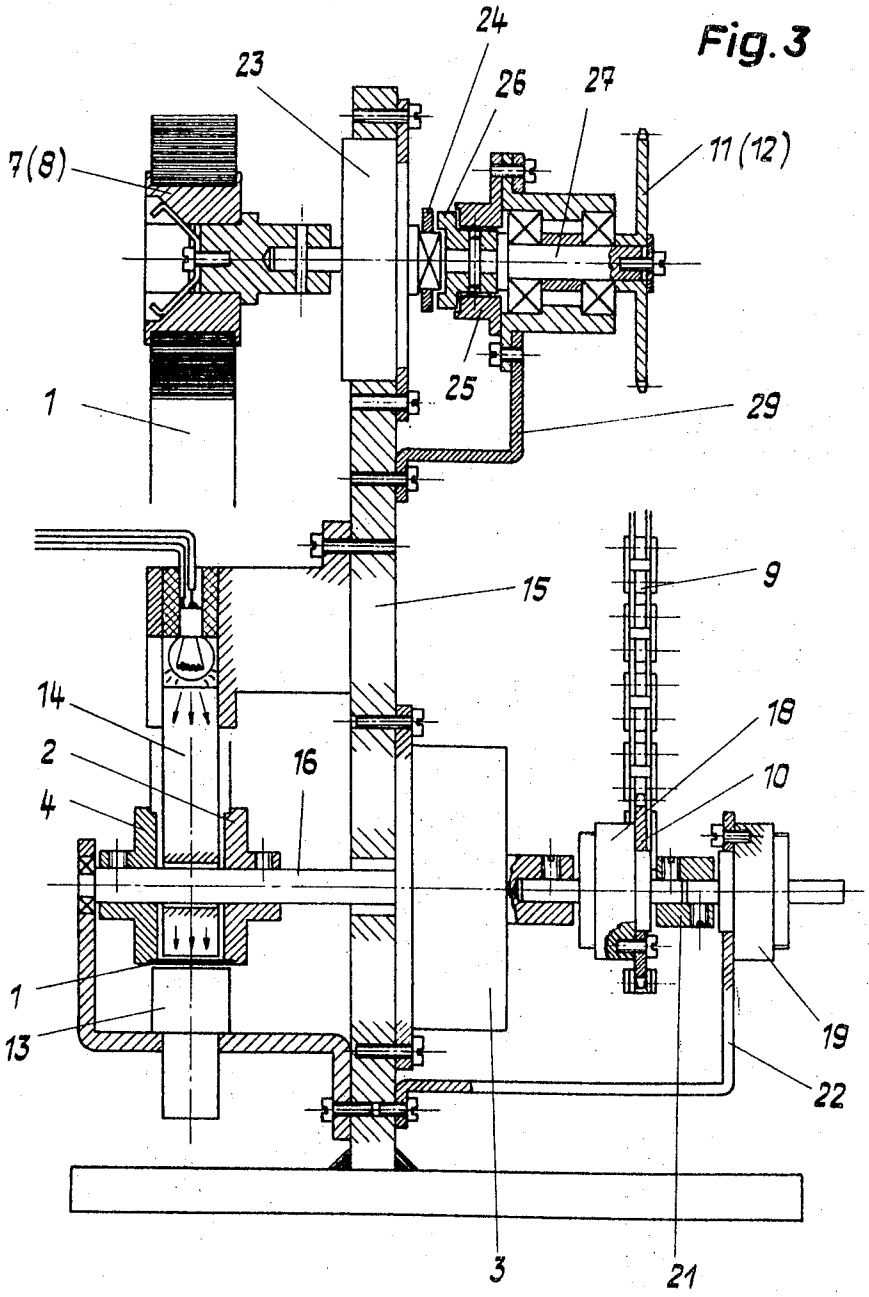


Fig. 3



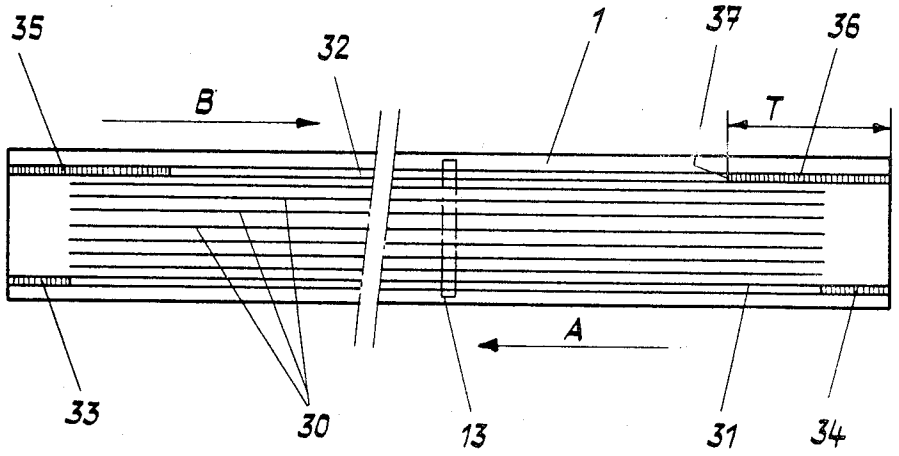


Fig. 4

ALTERNATE WINDING AND UNWINDING OF A TWO-ENDED PROGRAM TAPE

BACKGROUND OF THE INVENTION

The invention relates to the alternate winding and unwinding of two-ended program tapes carrying data for the control of machines, driven by means of a reversible motor in front of means for reading data on the tape.

A major problem occurs at the moment of changing the direction of motion of the tape. In effect, whilst it is relatively easy to abruptly reverse the direction of rotation of the motor, this is not so for the spools upon which the tape is alternately wound and unwound for which it is necessary to overcome a certain inertia, which varies according to the length of the wound tape.

This porblem becomes crucial for program tapes the data of which are intended for the selection of the knitting elements of knitting machines, in particular circular knitting machines with a high operational speed, for which the required continuity in the reading of the data necessitates a practically instantaneous reversal of the direction of motion of the tape.

At the moment of each reversal, between the spool which is to become the tape output spool and the driving motor, the tape risks being submitted to a tension which could cause its breakage or cause serious perturbations in the reading of the data.

A solution which enables a partial resolution of this problem consists in permanently providing, between each spool and the driving motor, a loop of loose tape of sufficient dimensions to form a reserve enabling the jerks which are inevitably produced during reversal to be supported. The variations in the length of these loops can be usefully employed to servo-control the speed of rotation of the spools, but such an arrangement requires the use of complex and delicate means, notably for ensuring guiding of the loops of tape which may attain appreciable lengths in the case of high speed tapes.

SUMMARY OF THE INVENTION

According to one aspect of the invention, a process for controlling the alternate winding and unwinding of a two-ended program tape between a pair of spools comprises selectively disposing auxiliary reversal data and pre-reversal data on the tape, alternately driving the tape by means of a reversible driving motor from one spool to the other past means for reading data on the tape, temporarily braking and reversing the direction of rotation of the tape receiving spool under the control of a pre-reversal data to form a length of loose tape between said receiving spool and the driving motor, and subsequently reversing the direction of rotation of the driving motor under contorl of a reversal data.

A device according to the invention for alternately winding and unwinding a two-ended program tape between a pair of spools comprises a reversible motor for alternately driving the tape from one spool to the other past means for reading data on the tape, the tape carrying selectively disposed auxiliary reversal and pre-reversal data, two auxiliary motors each for driving one of the spools, and means actuated upon reading of a pre-reversed data for temporarily controlling the auxiliary motor of the tape-receiving spool to brake such spool and make it turn in the reverse direction to form a length of loose tape between such spool and the driving motor, the reversal data being disposed so that the driving motor is subsequently reversed upon reading of thE reversed data.

BRIEF DESCRIPTION OF THE INVENTION

The accompanying drawings show, by way of example, an embodiment of a device according to the invention. In the drawings:

FIGS. **1** and **2** are respectively front and rear elevational views of this device;

FIG. **3** is a profile cross-section taken along the broken line *xx'—yy'* of FIG. **1**; and

FIG. **4** schematically shows a disposition of data on a program tape.

DETAILED DESCRIPTION OF THE INVENTION

The device shown serves for the alternate winding and unwinding of a two-ended program tape **1** carrying data intended for the selection of knitting elements of a circular knitting machine.

The program tape **1** is driven by its lateral edges by means of two control flanges **2** and **4**, mounted at the end of the shaft of a reversible motor **3**, and guided by two pressure rollers **5** and **6**. This driving assembly is disposed on the path of the tape **1** between two spools **7** and **8**, between which the tape **1** is alternately wound and unwound from one end to the other, and a liason is set up between these three members b a driving chain **9** passing about three toothed chainwheels **10**, **11** and **12**. The ratio between the number of teeth of the driving wheel **10** and that of the two driven wheels **11** and **12** is such that the maximum speed of rotation of each spool **7**, **8** is slightly greater than the speed required for winding the tape **1**, at a given constant speed, onto the smallest available diameter of the spools.

A multi-track optical reader **13**, located under the path of the tape **1** about the flanges **4**, detects the passage of the data on the tape **1** by transparency, the tape being illuminated by means of a light conduit **14**.

With reference to FIG. **3**, the various elements forming the device are carried by an upright support plate **15**, fixed to a stationary part of the knitting machine by means not shown.

At one end of the shaft **16** of the motor **3**, which motor is secured on the support plate **15**, are mounted the two flanges **2** and **4** controlling drive of the tape **1**. The other end of shaft **16** is connected to the inner mass of a driving coupler **18** of the permanent magnet type and providing a torque much less than that transmitted by the motor **3**. To the outer mass of the coupler **18** is fixed the chainwheel **10** controlling the chain **9** for driving the spools **7** and **8**.

An important function of the coupler **18** is to servo-control the speed of rotation of the receiving spool to the substantially constant speed of motion of the tape **1**, in a manner such that the tape being wound onto this spool is neither too tight nor too loose.

A second coupler **19** is disposed in axial alignment with the first coupler **18**. The inner mass of the second coupler is connected by a sleeve **21** to the inner mass of the first coupler and consequently to the shaft of motor **3**, whilst its outer mass is fixed to a support plate **22** connected to the plate **15**.

This second coupler provides a slightly greater torque than the first coupler and is intended to brake any unwanted racing which may be produced during

the short periods when the feed of the motor **3** may be cut off, particularly in the case where the speed of the latter is servo-controlled to the number of data counted at the input and the output of a memory.

The coupling of the spools **7** and **8** with the respective toothed wheels **11** and **12** is provided in the following manner. Each spool is mounted at the end of a shaft of a respective d.c. motor **23** whose stator is fixed onto the support plate **15.** The other end of each of the shafts carries a sliding armature **24** of an electromagnetic clutch **25,** the torque of which is greater than that of the first coupler **18.** An axially fixed armature **26** of clutch **25** is mounted on a shaft **27,** angularly fixed to the corresponding chainwheel **11** or **12.** These latter elements, as well as the excitation coil of the clutch, are supported by a bracket **29** fixed on the plate **15.**

The program tape shown in FIG. **4** has a series of longitudinal data tracks, schematically shown by lines **30,** and intended for the selective control of the knitting elements. Two auxiliary tracks **31, 32** are disposed on opposite sides of the tracks **30.** The track **31** comprises, at each end, a so-called reversal data **33** and **34** respectively which, by means of the optical reader **13,** has the function of controlling the reversal of the direction of rotation of the driving motor **3.** The track **32** comprises, at each end, a so-called pre-reversal data, **35** and **36** respectively, which begins slightly upstream of the corresponding reversal data **33, 34** and extends until it faces the latter. These two elements of pre-reversal data are intended, always by means of the reader **13,** for the control of the respective motors **23** and electromagnetic clutches **25** of the winding spools **7** and **8.**

The described device operates as follows:

Supposing to begin with that the program tape **1** is driven by the motor **3** in the direction of the arrows A (FIG. **1**), the electromagnetic clutch **25** associated with the receiving spool **7** is excited and the winding takes place under the control of the coupler **18,** whose action compensates for the variations of the diameter of the tape wound on the spool **7.** The clutch **25** associated with the output spool **8** is not excited.

Upon passage of the beginning **37** of the pre-reversal information **36** past the optical reader **13,** the signal produced is used to cut off excitation of the electromagnetic clutch **25** associated with the spool **7.** Simultaneously, the same signal actuates feed of the motor **23** also associated with the spool **7,** in a manner to control its rotation in the direction of the arrows B, that is opposite to the direction of winding of the film.

The spool **7** which is no longer driven by the motor **3** continues to turn for a certain time because of its inertia, driving with it the shaft of the motor **23** which is being fed for a rotation in the opposite direction. A braking results, the consequence of which is the formation of a loop **38** of loose tape between the spool **7** and the motor **3.**

Upon passage of the reversal data **34** past the reader **13,** the signal received is used on the one hand to control the practically instantaneous reversal of the direction of rotation of the driving motor **3** and, on the other hand, to cause excitation of the electromagnetic clutch **25** associated with the spool **8** which, through the driving of the chainwheel **12,** in turn becomes the tape receiving spool.

At this stage of the operation, the driving coupler **18** carries out a second important function. Because of the inertia of the spool **8,** this spool will not be instantaneously reversed. There is a resultant formation of a loop or length **39** of loose tape between the spool **8** and the driving motor **3,** which loop will be taken up without jerking under the action of the coupler **18** as soon as the spool **8** begins turning in the direction of the arrows B.

At the same time the driving motor **3,** which drives the tape **1** in the direction of the arrows B, begins to take up the initially formed loop **38,** whilst the motor **23** of spool **7** which is still temporarily fed, turns in the correct direction of rotation, driving with it the spool **7** which becomes the tape output spool.

Upon return before the reader **13,** the beginning **37** of the pre-reversal data **36** triggers cutting off of the supply to the motor **23** of spool **7,** without however excitation of the corresponding electromagnetic clutch **25** being re-established, this clutch remaining in its inoperative state until reading of the reversed data **33** during the next reversal operation.

The reversal of the direction of motion thus takes place without the driving motor **3** having to overcome the inertia of the spool **7** (or **8** as appropriate) and consequently without exertion of a traction on the program tape **1.**

At the moment of cutting off the supply to the motor **23,** it is advantageous for the angular speed of the spool **7** (or **8** as appropriate) to correspond closely to the linear speed of driving of the tape **1.** This correspondence can be obtained by selecting, on the one hand, during the disposition of the data on the tape, the distance T separating the beginning of the pre-reversal data from the corresponding reversal data as a function of the total length and more precisely the mass of the program tape wound on the receiving spool at the moment of reversal and, on the other hand, servo-controlling the value of the voltage supplied to the motors **23** to the speed of the tape. For each motor **23,** this servo-controlling can result from the frequency of reading the data of a part of one of the longitudinal tracks of the tape during the period of supplying the motor. The same cycle of operations will reoccur at the next reversal of the motor **3,** where this time it is the motor **23** associated with the spool **8** which once more becomes the tape output spool and is supplied to turn in the direction of the arrow A, under the temporary control of the pre-reversal data **35.**

During the periods of operation between the alternate reading of the pre-reversal data, the output spool is not driven by its motor **23** but rotates solely under the traction of the tape **1.** A sudden reduction of the speed of the driving motor **3,** or a sudden stopping of the machine, whether controlled by the operator or by the automatic actuation of various safety devices following certain occurences in the knitting, for example, would risk causing the formation of a loop or length of loose tape the taking up of which would inevitably cause a jerk at the moment of coming back to a normal rate of operation.

The association of a direct current motor with each spool enables this drawback to be avoided. It suffices, in the examples given, that the motor **23** associated with the tape output spool behaves as a generator, the current generated being passed through a resistor in a manner to cause a rapid braking of the spool to take up any such loose length of tape.

What is claimed is:

1. A device for alternately winding and unwinding a two-ended program tape, said tape having thereon program data and, adjacent each end of said tape, pre-reversal data and reversal date, said device comprising:

a pair of spools mounted to have alternately wound and unwound therefrom said tape;

reading means positioned in the path of said tape between said spools for reading said data on said tape;

a reversible driving motor mounted for alternately driving said tape past said reading means from one of said spools to the other;

a pair of auxilary motors mounted for selectively driving one of said spools;

means interconnected between said reading means and said auxiliary motors, and actuable upon reading of said pre-reversal data by said reading means, for temporarily controlling the one of said auxiliary motors operating the tape-receiving of said spools to brake said tape-receiving spool and to reverse the direction of rotation thereof, and thus for forming a length of loose tape between said tape-receiving spool and said driving motor; and

means interconnected between said reading means and said driving motor, and actuable upon reading of said reversal data by said reading means, for reversing the direction of rotation of said driving motor.

2. A device as claimed in claim 1, further comprising a pair of electromagnetic clutches each operatively connected to one of said auxiliary motors; and means for selectively driving each of said spools by said driving motor through the respective of said clutches; the clutch of said tape-receiving spool being disengaged upon reading of said pre-reversal date by said reading means.

3. A device as claimed in claim 2, wherein said driving motor and said clutches have shafts; and said driving means comprises three separate chainwheels operatively associated with the shafts of said driving motor and said clutches, and a driving chain passing around and engaging said chainwheels.

4. A device as claimed in claim 2, further comprising a driving coupler operatively positioned between said driving motor and said means for driving said spools.

5. A device as claimed in claim 4, further comprising a braking coupler operatively associated with said driving motor and disposed coaxially to said driving coupler, said braking coupler producing a greater torque than said driving coupler.

6. A device as claimed in claim 1, wherein said auxiliary motors are d.c. motors which, when not supplied with current, are generator means for producing a braking torque acting on the corresponding spool.

7. A process for controlling the alternate winding and unwinding of a two-ended program tape between a pair of spools, said process comprising:

providing a program tape having selectively positioned adjacent the ends thereof pre-reversal data and reversal data;

alternately driving said tape by means of a reversible driving motor from one of said spools to the other past a means for reading data on said tape;

detecting by means of said reading means said pre-reversal data, and temporarily braking and reversing the direction of rotation of the tape-receiving of said spools, thus forming a length of loose tape between said tape-receiving spool and said driving motor; and

subsequently detecting by means of said reading means said reversal data, and reversing the direction of rotation of said driving motor.

* * * * *