June 7, 1966 M. CAMRAS 3,254,856

TRANSDUCING MACHINE

Filed July 17, 1961 2 Sheets-Sheet 1

FIG. 1

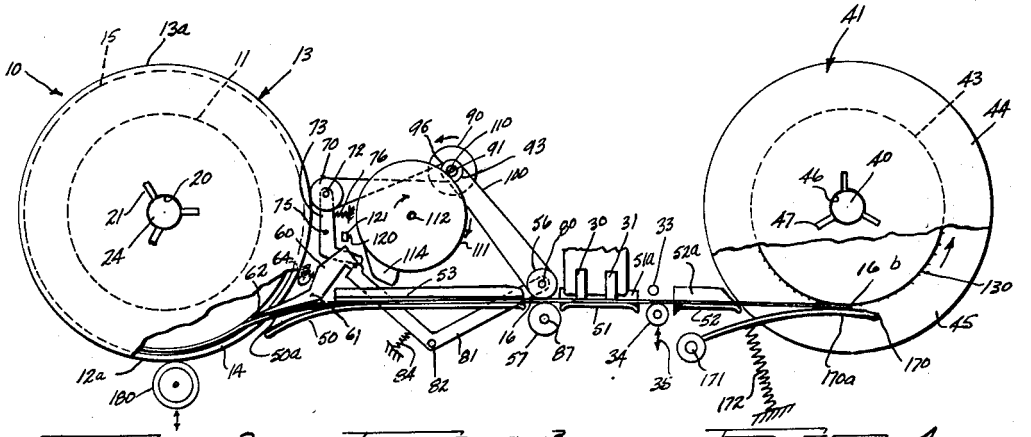


FIG. 2

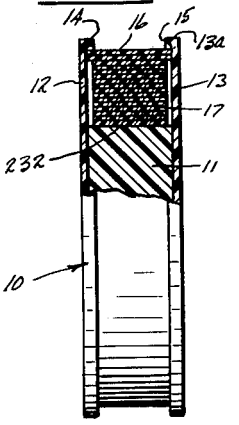


FIG. 3

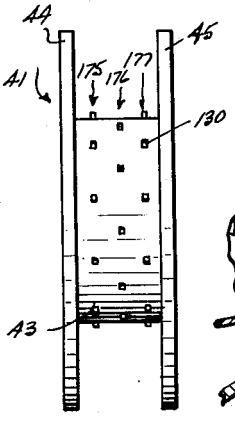


FIG. 4

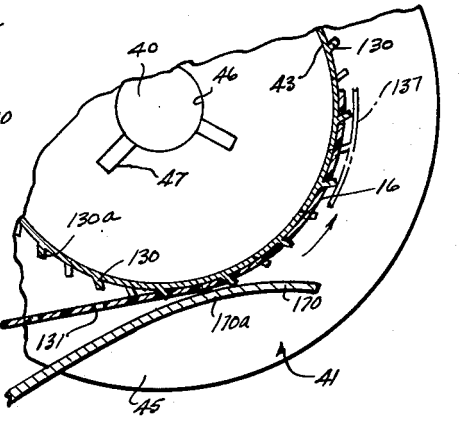


FIG. 5

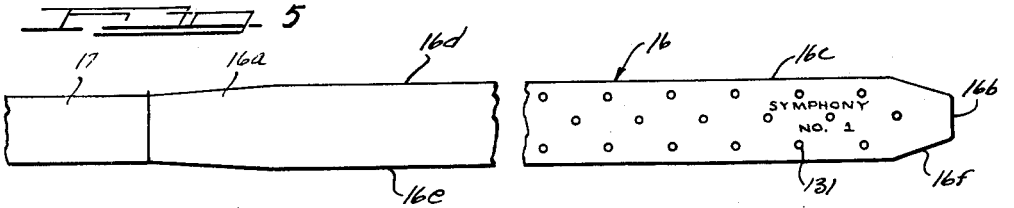


FIG. 6

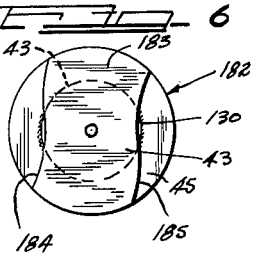
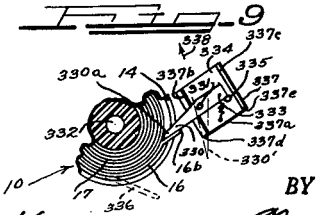


FIG. 9



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June 7, 1966 M. CAMRAS 3,254,856

TRANSDUCING MACHINE

Filed July 17, 1961 2 Sheets-Sheet 2

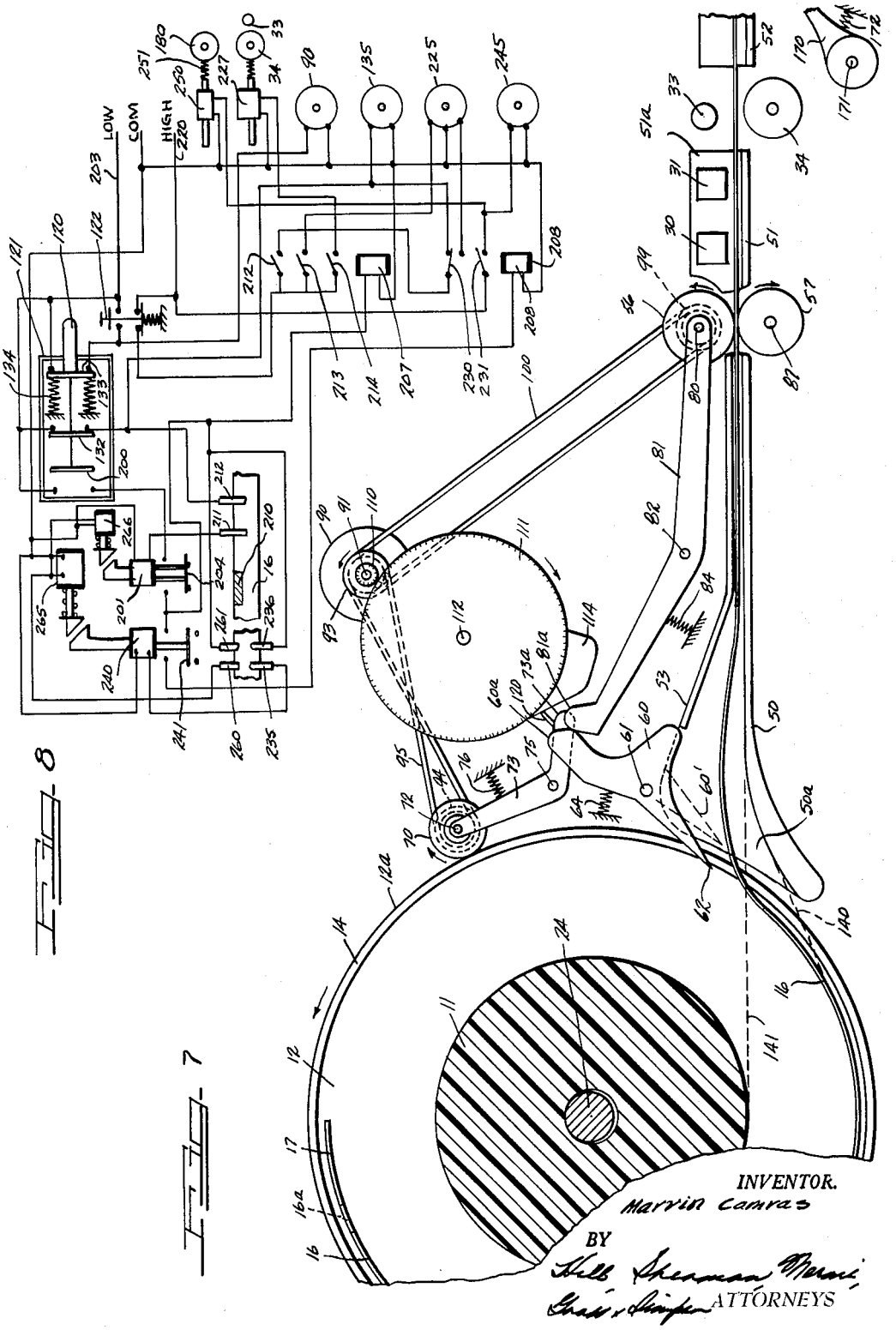

FIG. 8

FIG. 7

United States Patent Office 3,254,856 Patented June 7, 1966

3,254,856

TRANSDUCING MACHINE

Marvin Camras, Glencoe, Ill., assignor to IIT Research Institute, a corporation of Illinois

Filed July 17, 1961, Ser. No. 124,683
11 Claims. (Cl. 242—55.13)

This application is a continuation-in-part of application Serial No. 41,860, filed July 11, 1960, now Patent No. 3,197,150.

This invention relates to an automatic threading transducer machine and particularly to such a machine for automatically threading the record medium associated with a single spool cartridge such as disclosed in my copending application Serial No. 801,403 filed March 23, 1959, now Patent No. 3,025,011.

The single spool cartridge disclosed in my prior copending application is of a uniquely simple configuration and comprises an ordinary spool having means thereon for retaining the end of a record medium threading portion therewith regardless of the point about the periphery of the spool at which the free end of the threading portion is located. One embodiment of the invention involves a spool having peripheral shoulder portions projecting axially inwardly from the peripheral edges of the flanges and defining a slot narrower than the width of the threading portion of the record medium but greater than the width of the active portion of the record medium. Since the confronting peripheral shoulder portions are symmetrical about the central axis of the spool, the end of the threading portion may be located at any point about the circumference of the spool and still be effectively retained by the confronting shoulder portions.

Such a single spool cartridge has unique advantages over other types of magazines which have been proposed. For example, magazine units having two spools permanently therein are relatively bulky and costly and unreliable and are not compatible with existing conventional machines. An endless band type magazine has the disadvantage that the record must be run through entirely to return to the beginning of the record, that is the direction of movement of the record cannot be reversed. Records of any considerable length are likely to bind and jam the supply system, and the record must be hand threaded or else the magazine must be relatively costly and contain relatively unreliable parts. This endless band type magazine is also not generally compatible with conventional machines.

The single spool magazine of the type shown in my copending application has other important functional advantages in that the magazine may be of circular configuration and minmum overall dimensions, as compared with a single spool magazine requiring separate housing walls in addition to its spool mechanism. A particularly important advantage of the symmetrical type single spool cartridge as disclosed in my copending application resides in the fact that the cartridge may be inserted onto the transducer machine in any desired angular orientation and thus may be simply dropped into a slot or the like, for example while driving or carrying out some other function requiring constant attention. Such a single spool cartridge of the symmetrical type also has unique advantages in adapting itself to an extremely simple automatic changer mechanism such as disclosed in my copending application Serial No. 41,860, filed July 11, 1960, now Patent No. 3,197,150, and also has significant advantages in computer applications and the like where a large number of cartridges must be stored and rapidly selected as disclosed in my copending application Serial No. 97,590, filed March 22, 1961, now Patent No. 3,134,550.

In my previous automatic threading machines, a pre-

threaded tape-like leader has been arranged along the transducing path and connected to the take-up reel and has been adapted to be engaged with a suitable coupling part on the end of the record medium threading portion so as to lead the record medium from the single spool cartridge along the transducing path and onto the take-up reel. The present invention relates to mechanism for directly disengaging the threading portion of the record medium from the single spool cartridge and leading the threading portion to a take-up device without the necessity for a pre-threaded tape-like leader. By the construction of the present invention, much more rugged parts may be utilized and the pre-threaded leader which is subject to wear and deterioration with repeated use is eliminated. Further, by the present invention, the take-up device may be a single spool cartridge configuration identical to the cartridge configuration placed on the supply position of the machine. In this manner, the number of different parts to be produced is diminshed and at the same time the flexibility of the system is greatly enhanced. Furthermore, the system of the present invention is fully compatible with existing tape transport mechanisms and simply requires the addition of a few operating parts without any change in the existing tape transport mechanism itself.

It is therefore an important object of the the present invention to provide a novel automatic threading transducer machine which does not require a pre-threaded leader.

Another object of the invention is to provide a novel single spool cartridge for an automatic threading transducer machine.

A further object of the present invention is to provide an automatic threading mechanism which may be applied to existing tape transport mechanisms without requiring substantial reconstruction thereof.

Still another object of the present invention is to provide a novel mechanism for stripping the end of a threading portion of a single spool cartridge from the cartridge and conducting the same along a transducing path to a position for engagement with a take-up device, either manually or automatically.

A further object of the present invention is to provide a novel mechanism for automatically engaging a threading portion of a record medium with a take-up device.

Other objects, features and advantages of the present invention will be apparent from the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a somewhat diagrammatic top plan view of an automatic threading transducer mechanism in accordance with the present invention, the mechanism being particularly adapted to a magnetic transducing function by way of example;

FIGURE 2 is a side elevational view of the single spool cartridge for the embodiment of FIGURE 1, with a portion of the spool broken away and in section;

FIGURE 3 is an elevational view of the take-up reel of FIGURE 1;

FIGURE 4 is a fragmentary enlarged horizontal sectional view illustrating the manner in which the record medium threading portion is automatically engaged by the take-up reel;

FIGURE 5 is a fragmentary side elevational view of one form of tape threading portion for the embodiment of FIGURE 1;

FIGURE 6 is a diagrammatic view of a modified take-up reel construction;

FIGURE 7 is a fragmentary enlarged plan view of the automatic threading mechanism of FIGURE 1;

FIGURE 8 is a diagrammatic illustration of a suitable

electric control circuit for the embodiment of FIGURE 1; and

FIGURE 9 is a somewhat diagrammatic horizontal sectional view of a device for use with a manually threaded machine and which serves to strip the record medium from a single spool cartridge upon manual rotation of the cartridge as well as pressing the record medium back into engagement with the cartridge as the record medium is being rewound onto the cartridge.

A single spool cartridge **10** is illustrated in FIGURE 2 by way of example which is substantially the same as the cartridge illustrated in my Patent No. 3,025,011. This cartridge has a central hub portion **11** and a pair of end flanges **12** and **13** with confronting axially inwardly extending shoulder portions **14** and **15** defining an annular slot therebetween of width less than the width of an outer tape-like threading portion **16** of the record medium but greater than the width of the active portion of the record medium indicated at **17** in FIGURE 5 which is wound on the hub **11** inwardly of the outer threading portion **16**. The record medium **17** may comprise a tape base with a layer of magnetizable particles thereon and the tape base may be suitably secured to a gradually tapering portion **16***a* of the outer threading portion **16**.

In handling of the cartridge **10**, the free end of the threading portion or leader **16** which is indicated at **16***b* in FIGURE 5 is retained radially inwardly of the confronting shoulder portions **14** and **15** so as to prevent unwinding of the record medium from the cartridge. The threading portion **16** is preferably substantially thicker than the active portion of the record medium and while being sufficiently flexible to be readily wound onto the cartridge **10** has a substantial stiffness in comparison to the active portion of the record medium so as to facilitate its automatic threading by the mechanism of the present invention. The threading leader must also have sufficient flexibility so as to curl or bow across its width as it is pulled between the confronting shoulders **14** and **15**.

The hub portion of the single spool cartridge may be provided with a conventional central axial aperture **20** and with conventional radial slots such as **21** for engaging a driving tooth associated with the supply spindle **24**. Preferably the supply single spool cartridge is entirely symmetrical with respect to a central diametric plane at right angles to the axis of the cartridge so that the cartridge may be inverted and unwound from a take-up spindle of a conventional magnetic tape recorder, for example. The cartridge spool itself is, of course, symmetrical with respect to any central axial plane in the plane of the central axis of the spool so that the cartridge may be placed on the supply spindle **24** in any random orientation.

The illustrated transducer mechanism may utilize the tape transport of any conventional magnetic tape recorder, for example, and may include a suitable magnetic erasing head **30**, a suitable magnetic recording and/or playback head **31**, a suitable capstan drive shaft **33** and a suitable shiftable capstan pressure roller **34** which may be shiftable toward and away from the capstan shaft **33** as indicated by double headed arrow **35** to selectively engage the tape in driving relation to the capstan **33**. The transducer mechanism may also be provided with a take-up spindle **40** receiving a take-up reel **41**. The take-up reel may comprise a central cylindrical hub portion **43** and a pair of end flanges **44** and **45** which in the illustrated embodiment omit the confronting shoulder portions such as indicated at **14** and **15** on the supply cartridge **10**. In the illustrated embodiment, the flanges **44** and **45** are uniformly spaced apart a distance slightly greater than the width of the threading portion **16** so as to freely receive the threading portion between the flanges. The hub portion **43** is provided with a central aperture **46** and radial slots such as indicated at **47** for engaging with a suitable driving jaw associated with the take-up spindle **40**. The take-up spindle **40** may be of a conventional construction such as found on present magnetic tape recorders.

In order to provide an automatic threading function, a number of parts may be applied to a conventional tape transport mechanism including guide members **50**, **51** and **52** positioned along the transducing path at the inactive side of the tape and a guide member **53** adjacent the supply position and at the active side of the transducing path. The guides are of configuration and position so as to insure that the threading portion **16** of the record medium will be led along the transducing or threading path and into proximity to the take-up reel hub **43** during the threading operation. Ledges have been indicated at **50***a*, **51***a* and **52***a* on guides **50**, **51** and **52** at the level of the inner faces of lower flanges **12** and **45** of spool **10** and reel **41**, respectively, for underlying and slidingly supporting the lower edge **16***e* of threading portion **16** during its threading movement. If required, threading feed rollers **56** and **57** may be provided between the guides **50** and **51** for engaging with the free end of the threading portion **16** as it is led from the supply cartridge **10** and for thereafter impelling the threading portion along the transducing or threading path to a position adjacent the take-up reel **41**.

Referring to FIGURE 7, a finger **60** is illustrated pivotally mounted at **61** and having a relatively pointed end portion **62** which is adapted to fit in the slot between the confronting flanges or shoulder portions **14** and **15** of the cartridge so as to ride on the threading portion **16** of the cartridge and engage under the free end **16***b* of the threading portion to force the threading portion out of engagement with the cartridge shoulders **14** and **15** and along the threading path. A compression spring is illustrated at **64** tending to urge the finger **60** in the clockwise direction about pivot **61** so as to press the pointed end **62** against the outer layer of the threading portion **16** on the cartridge **10**.

Suitable means are provided for rotating the cartridge **10** in the counterclockwise direction during the threading operation, and in the illustrated embodiment, this drive means comprises a drive roller **70** having a frictional driving surface for engaging the rim portion **12***a* of the flange **12** so as to rotate the cartridge about the axis of spindle **24**. The cartridge drive roller **70** is rotatably mounted on a shaft **72** and is carried on a mounting arm **73** which is pivotal about a fixed pivot pin **75**. A compression spring **76** urges the mounting arm **73** to rotate in the counterclockwise direction about the pivot **75** so as to press the drive roll **70** into driving engagement with the rim **12***a* of the cartridge **10**.

The threading feed roller **56** is mounted by means of a shaft **80** on a mounting arm **81** which is pivotally mounted on a fixed shaft **82**. The arm **81** is urged to rotate in the clockwise direction about pivot **82** by means of a compression spring **84** so as to press the threading feed roller **56** toward the idler feed roller **57** which is rotatable on a fixedly mounted shaft **87**.

Drive roller **70** and feed roller **56** are illustrated as being driven by means of a suitable motor **90** having an output shaft **91**. The shaft **91** carries a V-pulley **93**, FIGURE 7, which is coupled to a V-pulley **94** by means of a suitable V-belt **95** for driving of the roller **70**. Similarly, a second V-pulley on motor shaft **91** drives a pulley **99** on shaft **80** by means of a stretchable rubber belt **100** so as to drive the feed roller **56**.

The motor shaft **91** also carries a drive pinion **110** which meshes with a large gear **111** mounted on a fixed shaft **112** so as to rotate a cam member **114** in the clockwise direction during the threading operation. The gear ratio between gears **110** and **111** is selected so that the cam member **114** makes one complete revolution during a threading operation. Thus, by the time the free end **16***b* of the threading portion **16** of the record medium reaches a position as indicated in FIGURE 1 in coupling relation to the take-up reel **41**, the cam portion **114**

engages the cooperating ends **60***a*, **73***a* and **81***a*, FIGURE 7, of mounting arms **60**, **73** and **81** so as to move the stripping finger **62**, the drive roller **70** and the threading roller **56** to inoperative positions. The cam portion **114** may also actuate a suitable switch operating button **120** of a switch **121** so as to deenergize the motor **90** at the end of the threading operation. This motor may be started by momentarily pressing a push button **122**, FIGURE 8, to initiate the threading operation, or automatically when a new cartridge is put into place by hand or by a changer.

Thus, feed of the threading portion **16** of the record medium from cartridge **10** is interrupted when the end **16***b* of the threading portion reaches the position shown in FIGURE 1. At this time, the take-up reel **41** has rotated so as to engage its teeth **130** in apertures **131** in the end of the threading portion **16**. The teeth **130** may have sloping leading edges as indicated at **130***a* in FIGURE 4 so as to force the end of the threading portion radially inwardly into conforming relation to the hub **43**.

When button **120** of switch **121** is actuated by cam **114**, switch contacts **132** and **133** are shifted to the left as seen in FIGURE 8 against the action of spring **134** to deenergize threading motor **90** and discontinue low speed energization of take-up motor **135**, and to operate the transducing machine for a normal transducing operation.

As indicated in FIGURE 4, teeth **130** may have a radial extent substantially greater than the thickness of threading portion **16**. The second layer of threading portion **16** on hub **43** will form a smooth cylindrical configuration by resting on the outer tips of the teeth as indicated at **137** in FIGURE 4. The teeth may be uniformly spaced about the entire circumference of hub **43** and apertures **131** will be limited to a length **16***c* of threading portion **16** equal to the circumference of hub **43**. The non-apertured part **16***d* of threading portion **16** may have a length exceeding the outer circumference of spool **10** to close all of the apertures **131** when threading portion **16** is on cartridge **10**, but in any event will have a length at least equal to one circumference of take-up reel hub **43**. Thus, leader **16** preferably has a length substantially equal to an integral number (two or greater) times the take-up hub circumference.

When the take-up reel has been properly engaged with the end of the threading portion **16**, the capstan pressure roller **34** may be shifted to press the record medium against the capstan **33** so as to begin the transducing operation, the take-up spindle **40** being driven at a sufficient speed to maintain an appropriate tension on the record medium beyond the capstan **33** as is conventional. Suitable felt pressure pads may be provided operating through windows in the guide **51** so as to press the tape into stable coupling relation to the heads **30** and **31** as in a conventional magnetic tape recorder.

The path of tape **17** from supply reel **10** is indicated at **140** in FIGURE 7 for maximum tape diameter on cartridge **10** and at **141** for minimum tape diameter with the finger **60** in its extreme counterclockwise position as determined by the action of the cam portion **114** and as indicated at **60'**. The spool shaft **24** may be located in relation to finger **60** so that the tape clears finger **60** even when the tape is at the level of the inner hub of spool **13** as indicated in FIGURE 7; but it has been found that the finger **60** may ride on the tape, especially if it is shaped so that a sharp bend does not occur in the tape as indicated in FIGURE 1.

As examples of modification of the preferred embodiment which may be suitable under certain conditions it may be noted that the single spool cartridge **10** may have only a single annular shoulder defining the slot such as shoulder **14** and that the other shoulder **15** may be omitted, flange **13** having a plane inner face.

As a further alternative, the take-up reel **41** may have a construction identical to supply cartridge **10**, and suitable means may be provided for forcing the end of the threading portion **16** between the confronting shoulders corresponding to the shoulders **14** and **15** in FIGURE 2. For example, the tape threading portion **16** may be led along a path tangential to the outer periphery of the take-up reel during threading operation. Thereafter a pivotally mounted finger may press the threading portion **16** radially inwardly between the confronting shoulders such as **14** and **15** of the take-up reel, the arm of course having a width less than the width of the slot between the confronting shoulders on the take-up reel. The threading portion **16** could be pressed against teeth **130** by means of the pivotally mounted finger as the take-up reel was rotated to initiate winding of the threading portion on the take-up reel as in the embodiment of FIGURE 1.

In FIGURE 1, a finger is indicated at **170** which is pivotally mounted on a fixed shaft **171** and is urged in the counterclockwise direction by compression spring **172**. The finger **170** may have longitudinal slots therein at portion **170***a* thereof which accommodate the moving rows **175**, **176** and **177**, FIGURE 3, of teeth **130**. In this case the finger **170** will directly engage the threading portion **16** and press the same against the surface of hub **43**. If finger **170** is of solid cross section at portion **170***a* thereof, it will ride on the tips of teeth **130** but still serve to engage threading portion **16** therewith.

As a further alternative, utilizing a take-up reel with confronting peripheral shoulders such as shoulders **14** and **15** of the supply cartridge **10**, the threading portion may be twisted by means of suitable retractible guides as it is fed along the path indicated in FIGURE 1 and between the flanges of the take-up reel **41**.

As a further modification, the take-up reel may have a suitable hook at the end of a short leader portion secured to the hub **43** so that the hook normally assumes a position near the outer periphery of the reel **41**. The leader portion would have a length equal to or less than the radius of the take-up reel, for example. The threading portion would then have a cooperating aperture or the like so as to engage with the hook during rotation of the take-up reel **41** after the threading portion had reached a position such as indicated in FIGURE 1.

Where both the supply and take-up reels are identical, threading portions such as indicated at **16** may be provided at each end of the active portion of the record medium and the supply cartridge and take-up reel may be inverted and interchanged to play a second channel on the record medium. In this case, the threading portions at the opposite ends of the record medium may have titles and the like printed thereon for example with a different color to distinguish each class of music so as to be visible when the corresponding channel is available for immediate play. One such title has been indicated on the leader of FIGURE 5. The label on the opposite threading portion would be upside down with respect to the label indicated in FIGURE 5 but would read from the free end of the threading portion in the same way as indicated in FIGURE 5.

During rewind operation, it will be apparent that a suitable tuck-in finger or roller such as indicated at **180** may be positioned to extend between the confronting peripheral shoulders **14** and **15** sufficiently so as to press the end **16***b* of the threading portion behind the confronting shoulders at the end of the rewind operation in the same manner as described in my copending application Serial No. 41,860. Or the finger **60** may be rotated slightly in a clockwise direction during rewind so that it extends inwardly enough to tuck in the leader. Or the shaft **24** may be moved downward slightly during rewind to bring finger **60** inside. After rewind these are restored out of the way to allow easy loading of the cartridge.

It may be noted that the system would still have substantial utility even if, after the automatic threading of the threading portion to a position adjacent the outer periphery

of the take-up reel, the tape were manually threaded with a take-up reel such as indicated in my copending application Serial No. 41,860, for example or engaged with teeth **130** by means of a manually operated pivotal finger such as finger **170** just described. In this event, the threading path would extend tangentially of but spaced from the take-up reel **41** for convenience of manual access to the end of the threading portion **16**. The threading portion may simply be an extra wide portion of the non-magnetic base of a tape record medium rather than a special extra thick leader material, for example in the case where a take-up reel as shown in Serial No. 41,860 is utilized.

FIGURE 6 illustrates a modified take-up reel **182** facilitating manual engagement of apertured end **16***c* of the threading portion **16** with teeth **130** on hub **43**. The top flange **183** is cut away as indicated at **184** and **185** to expose teeth **130** from above the reel. The reel is otherwise identical to reel **41**.

It will be noted that the automatic threading mechanism of FIGURE 1 is applicable to the case of a conventional spool of tape record medium where the end of the tape is self-adhesive to an adjacent convolution thereof, but may be stripped or peeled from such adjacent convolution by means of a finger as indicated at **60**.

As further possible modifications, a take-up reel such as indicated at **41** having a spacing between the flanges equal or greater than the width of the threading portion **16** may have at the innermost peripheral portion thereof adjacent the hub **43** a tapering width so as to be frictionally engaged with the threading portion when the threading portion is pressed radially into engagement with such tapering portion adjacent the hub by means of a pivotal finger for example. Many other means for engaging the threading portion with the take-up reel are of course possible.

The various automatic threading means of the present application are, of course directly applicable to the automatic changer mechanisms and to the automatic supply cartridge loading mechanism of my copending applications Ser. No. 801,403, Ser. No. 41,860 and Ser. No. 97,590.

Electric circuit

FIGURE 8 shows an electric control circuit for the embodiment of FIGURE 1 simply by way of example to illustrate the operation thereof. When the transducer mechanism is in a stop condition prior to receipt of a new cartridge, a portion of the surface of cam member **114** will be maintaining button **120** in its depressed position against the action of spring means **134**. In this condition, contacts **132** and **133** are open and contact **200** is closed. Relay **201** is unlatched to interrupt the circuit from low voltage line **203** at contact **204** to prevent energization of relays **207** and **208**.

When start switch **122**, FIGURE 8, is actuated, current is supplied from low voltage line **203** through the upper contact of the start switch to threading motor **90** to begin driving of timing gear **111**. As soon as cam member **114** moves out of engagement with plunger **120**, spring means **134** returns the plunger **120** to the right to close contacts **132** and **133** and open contact **200**. This supplies voltage to threading motor **90** through contact **133** so that start switch **122** can be released. Closure of contact **132** supplies voltage from line **203** to take-up motor **135** driving take-up shaft **40**, FIGURE 1, in the counterclockwise direction.

When threading portion **16** has reached a position approximately as shown in FIGURE 1, cam member **114** actuates plunger **120**, to interrupt the supply of voltage to threading motor **90** and take-up motor **135** from low voltage line **203**. Just prior to this time latching relay **201** is actuated to latched condition by any suitable means, for example a conductive film on the threading portion **16** such as indicated at **210** in FIGURE 8 bridging stationary contacts **211** and **212**. Thus, when contact **200** is closed, voltage is supplied from low voltage line **203** through contact **200** of switch **121** and through contact **204** of relay **201** to actuate relay **207** and close contacts **212**, **213** and **214** thereof. Voltage is now supplied from high voltage line **220** through the lower contact of start switch **122** and contact **213** to the forward energizing circuit of capstan motor **225**, and through the lower contact **214** of relay **207** to capstan roller shifting solenoid **227** which serves to resiliently press roller **34** against the capstan **33** to initiate capstan drive of the tape in the forward direction. High voltage is supplied from line **220** and upper contact **212** of relay **207** and upper contact **230** of relay **208** to the take-up motor **135** to drive the take-up shaft **40** at normal speed for a transducing operation to maintain the tape taut between the capstan **33** and the take-up reel **41**.

When the tape has been substantially completely wound on the take-up reel **41**, a conductive strip on an inner leader **232**, FIGURE 2, connected to the cartridge **10** may bridge between contacts **235** and **236** to actuate a latching relay **240** and close a contact **241** thereof. This in turn actuates relay **208** to energize a supply motor **245** driving supply shaft **24** and to drive capstan motor **225** in the opposite direction while deenergizing take-up motor **135**. Relay contact **231** may also control energization of solenoid **250** which when energized shifts tuck-in roller **180** in the upward direction as seen in FIGURE 1 or the right as seen in FIGURE 8 through the medium of compression spring **251**. When the threading portion **16** has been almost completely rewound on the cartridge **10**, conductive strip **210** bridges contacts **260** and **261** to momentarily energize release solenoids **265** and **266** unlatching relays **201** and **240** to deenergize all solenoids and relays and return the circuit to its initial condition.

Summary of operation

In operation of the embodiment of FIGURE 1, a single spool cartridge such as indicated at **10** in FIGURE 2 is placed on the supply spindle **24**. At this time, cam member **114** of gear **111** is actuating arms **60**, **73** and **81**. When the cartridge has been positioned either manually or mechanically, start switch **122**, FIGURE 8, is momentarily operated either manually or automatically to energize motor **90** and drive the gear wheel **111** in the clockwise direction to disengage the cam member **114** from its cooperating elements including button **120** of switch **121**. When this has occurred, motor **135** for the take-up shaft **40** is energized by a low voltage to begin slowly rotating reel **41** in the counterclockwise direction while roller **70** drives supply cartridge **10** in the counterclockwise direction and spring **64** causes stripping edge **62** to be pressed against the outer surface of threading portion **16** of the record medium on cartridge **10**.

Presently, leading edge **16***b*, FIGURE 5, of threading portion **16** comes into engagement with the stripping edge **62** to disengage the threading portion **16** from the confronting shoulders **14** and **15**, FIGURE 2. As the threading portion **16** is unwound from the cartridge **10** it is led along the threading path. Motor **90** may also drive a feed roller **56** to assist in movement of the threading portion **16** along the threading path until the end of the threading portion reaches the position indicated in FIGURE 1. At this time, cam member **114** moves stripping finger **60** to an inactive position such as indicated at **60'** in FIGURE 7 and disengages feed roller **56** and supply cartridge drive roller **70**. Also at this time, capstan pressure roller **34** is shifted to engage the tape with capstan **33** and normal driving torque is supplied to the take-up spindle **40** to begin a record transducing operation.

The leading edge of the threading portion **16** is tapered as indicated at **16***f* to facilitate movement of the threading portion between the flanges **44** and **45**, FIGURE 3, of the

take-up reel. A pivotal finger **170** is indicated for holding the apertured end portion **16***c* of threading portion **16**, FIGURE 5, against teeth **130** on the hub **43** of the take-up reel. Since the hub is rotating slowly in the counterclockwise direction during threading operation, the end of the threading leader **16** is fed between the hub **43** and the portion **170***a* of finger **170** and into engagement with the teeth to initiate winding of the threading portion onto the take-up reel **41**.

During rewind operation, a tuck-in roller **180** may be shifted upwardly as seen in FIGURE 1 to press the threading portion **16** behind the confronting shoulders **14** and **15**, FIGURE 2. At the end of the rewind operation, tuck-in roller **80** may be returned to its position shown in FIGURE 1 to facilitate removal of the cartridge **10** from the spindle **20**.

It may be noted that the take-up reel may be engaged with the threading portion **16** while rotating at its normal speed where the driving clutch for the take-up reel does not present an undue inertia and would allow the reel **41** to slow to a speed corresponding to the speed of movement of the threading portion **16** when the teeth **130** initially engage with the threading portion. Where low speed operation of the reel **41** is unnecessary during threading, the connection between contact **132** and threading motor **135** may be omitted, contact **212** of relay **207** may be omitted, and the high voltage line **220** may be connected directly to the take-up motor **135** under the control of contact **230**.

As a further modification, it may be noted that threading between a supply cartridge **10** and a take-up reel **41** may be effected above the transducer path of a transducing machine, after which the supply cartridge, the take-up reel and the length of record medium therebetween may be allowed to drop vertically downwardly onto the transducer mechanism. This type of an arrangement would be applicable to a transducer machine of existing design without any changes of the transducer machine itself since the automatic threading mechanism can simply comprise a casing placed on top of the transducer mechanism. Such an automatic threading mechanism may comprise a top cover plate generally coextensive with the side of the transducer mechanism having the supply and take-up spindles. The cover plate would have circular openings therein aligned with the supply and take-up spindles to accommodate insertion of the supply cartridge and take-up reel into positions directly above and aligned with the supply spindle and the take-up spindle respectively. Suitable means may initially retain the supply cartridge and take-up reel in spaced relation above the take-up spindle and the supply spindle and such means may comprise, for example, three rollers having lower flanges which normally underlie the respective supply and take-up reels and rotatably support the reels above the supply and take-up spindles. One roller associated with the supply cartridge may be driven to rotate the supply cartridge and the cover plate may carry a stripping finger such as indicated at **60** in FIGURE 7 for stripping the threading portion of the record medium from the supply cartridge as it rotates. The cover plate may also be provided with suitable guide members for guiding the threading portion along a path directly above the loading slot of the transducer mechanism and a suitable spring urged finger such as indicated at **170** in FIGURE 4 may serve to engage the end of the threading portion with suitable teeth on the take-up reel. One of the rollers supporting the take-up reel may cause the take-up reel to rotate in a direction to wind the record medium thereon. A shiftable bottom plate may normally close the bottom side of the threading path so as to support the record medium during the threading operation. This bottom plate may be shifted to register a slot therein with the threading path so as to allow the tape to drop into the transducing path of the transducer mechanism. At the same time, two or more of the rollers supporting each of the supply cartridge and the take-up reel may be shifted to allow the supply cartridge to drop onto the supply spindle and the take-up reel to drop onto the take-up spindle. The cover plate may be designed to provide manual access to the supply and take-up cartridges for removal of the cartridges from the supply and take-up spindles after play of the record medium. The supply and take-up cartridges may be of identical configuration and inverted and interchanged to play a second channel on the record medium if desired.

FIGURE 9 shows a tuck-in abutment finger **330** pivotally mounted at **331** adjacent a fixed supply spindle **332** of a conventionally threaded machine. The cartridge **10** on the spindle **332** is of the same construction as shown in FIGURE 2 and has a tape leader **16** which is to be tucked behind annular shoulders such as indicated at **14** and **15** in FIGURE 2 as the tape is rewound onto cartridge **10** from a take-up reel such as **182** in FIGURE 6. The operative end of finger **330** is of a height to fit between the confronting shoulders **14** and **15** of cartridge **10**. A spring **333** is connected between the finger **330** and a base plate **334** which carries pivot pin **331** to urge the finger in the clockwise direction. A stop pin **335** is carried by the plate **334** in such a position that end **330***a* will normally assume a position as shown in FIGURE 9 engaging the tape leader **16** radially inwardly of the outermost convolution thereof on the cartridge so as to be adapted to strip the free end **16***b* of the leader from the cartridge when the cartridge is manually rotated in the counterclockwise direction. During rewind the spring **333** will exert sufficient force to tuck the end portion of leader **16** which is wider than the record tape behind the annular shoulders **14** and **15**.

During loading of a cartridge on spindle **332**, finger **330** may be manually rotated in the counterclockwise direction to a position such as indicated in dotted outline at **330'**. After the cartridge is in place, finger **330** is released and the cartridge is manually rotated in the counterclockwise direction to cause the end of finger **330** to engage under end **16***b* of tape leader **16** and force the leader out from behind shoulders **14** and **15** where it may be conveniently manually engaged and threaded, the end of the leader being pressed into detachable engagement with a take-up reel such as **182** in FIGURE 6. The threading path is indicated at **336** in FIGURE 9. During rewind of the tape onto the cartridge **10**, the leader **16** is automatically pulled out of engagement with the take-up reel **182** and pressed behind the shoulders **14** and **15** by the action of tuck-in finger **330**.

If a larger spool is to be placed on supply spindle **332**, the plate **334** together with finger **330** may be removed from its mounting channel **337** in the direction of arrow **338**. The channel **337** may comprise a flat base portion **337***a* secured to the top panel of the machine, for example by double faced pressure sensitive tape. The base portion has flanges **337***b* and **337***c* defining opposed channels for receiving the edges of base plate **334** in sliding relationship. One end of each channel is closed by staking flanges **337***b* and **337***c* as indicated at **337***d* and **337***e*. The plate **334** may be held in place in channel **337** by friction or any other suitable means.

FIGURE 9 hereof corresponds to FIGURE 5*b* of my Patent No. 3,197,150.

It will be apparent that many further modifications and variations may be effected without departing from the scope of the broad concepts of the present invention.

I claim as my invention:

1. A transducing machine comprising means for rotatably mounting a cartridge having a record medium wound thereon including a threading portion at the outer end thereof, means cooperable with a cartridge on said mounting means for automatically disengaging said threading portion of the record medium from the cartridge, means located along a threading path of the machine for receiv-

ing the record medium from the automatic disengaging means and for guiding the threading portion of the record medium along the threading path to a take-up position, means for driving the record medium along the threading path during the threading operation, and means for automatically disengaging said driving means when the free end of the threading portion of the record medium reaches said take-up position.

2. A transducing machine comprising a supply reel drive, a take-up reel drive and elements defining a transducing path therebetween, a single spool cartridge disposed on said supply reel drive in coupled relation thereto and having a record medium wound thereon including a threading portion and having means retaining the free end of the threading portion in detachable engagement with the cartridge, disengagement means positioned adjacent the supply reel drive and cooperable with the free end of the threading portion of the record medium on the cartridge to disengage the threading portion from said detachable engagement means of the cartridge, guide means located along the transducing path for receiving the record medium from the disengagement means and for guiding the record medium toward the take-up reel drive for coupling to a reel on the take-up reel drive and winding thereon, means for driving the threading portion along the transducing path during the threading operation, and timing means responsive to the feed of the threading portion of the record medium along said transducing path for automatically interrupting the threading portion driving means when the end of the threading portion reaches a position in proximity to the take-up reel drive.

3. An automatic threading transducing machine comprising a single spool cartridge having a record medium wound thereon including a threading portion at the outer end thereof releasably held by said cartridge, means for rotatably mounting said cartridge, means for disengaging said threading portion from said cartridge and for moving said threading portion along a threading path in the transducing machine, means for automatically receiving and storing said record medium at the end of said threading path during the forward transducing operation and for supplying said record medium to the threading path for rewind onto said cartridge during a rewind operation, reengaging means for reengaging said threading portion with said cartridge during rewind operation and movable from an inactive position relative to said cartridge affording convenient loading of said cartridge on said rotatably mounting means to an active position relative to said cartridge for reengaging the threading portion with said cartridge, and means responsive to a predetermined condition of the record medium after unwinding thereof from said cartridge for automatically initiating rewind of the record medium onto said cartridge and for automatically shifting said reengaging means from said inactive position relative to said cartridge to said active position relative to said cartridge for reengaging the threading portion with the cartridge at the end of the rewind operation.

4. An automatic threading transducing machine comprising means for rotatably mounting a single spool cartridge having a record medium wound thereon including a threading portion at the outer end thereof releasably held by said cartridge, means for disengaging said threading portion from said cartridge and for guiding the same along a threading path to a take-up position, a take-up device adjacent said take-up position for receiving said threading portion in detachable engagement therewith and for winding said record medium thereon as it is unwound from said cartridge, said take-up device having means automatically engageable with said threading portion of said record medium at said take-up position for detachably coupling said record medium to said take-up device, means for initially driving said take-up device at a relatively low speed during coupling thereof with said threading portion, and means for driving said take-up device at a relatively higher speed after engagement of the threading portion with said take-up device.

5. A transducing machine comprising means for rotatably mounting a cartridge having a record medium wound thereon including a threading portion at the outer end thereof releasably held by said cartridge, means for automatically disengaging said threading portion of the record medium from the cartridge and for guiding the threading portion of the record medium along a threading path to a take-up position, auxiliary means for driving the record medium along the threading path during the threading operation, releasable capstan driving means for engaging the record medium and driving the same along the threading path at a transducing speed, and means responsive to the threading portion of the record medium reaching said take-up position for automatically disengaging said auxiliary driving means and for automatically engaging said capstan driving means to begin a transducing operation with respect to the record medium.

6. The machine of claim 5 with said responsive means comprising means rotatable in synchronization with said cartridge and operable after rotation through a predetermined distance to automatically disengage said auxiliary driving means and to automatically engage said capstan driving means.

7. A single spool cartridge transducing machine comprising a single spool cartridge having a record medium wound thereon including a threading portion at the outer end thereof releasably held by said cartridge, means for disengaging said threading portion from said cartridge and for guiding the threading portion along a transducing path to progressively unwind the record medium from said cartridge with the record medium occupying a locus of paths adjacent the cartridge as the record medium is progressively unwound therefrom, said threading portion disengaging means being located in spaced relation relative to said locus of paths and lying on the side of said locus of paths adjacent the path corresponding to a minimum amount of record medium on said cartridge.

8. The machine of claim 7 with said disengaging means comprising a member having a pointed end for stripping the free end of said threading portion from said cartridge.

9. The machine of claim 8 with means responsive to the threading portion being unwound from the cartridge a predetermined amount to automatically shift said member to a position clear of said cartridge but spaced from said locus of paths of said record medium adjacent said cartridge so that the record medium is out of contact with the pointed end of said member even when substantially completely unwound from said cartridge.

10. The machine of claim 9 with a reengagement member movable independent of said disengaging member and movable to a position to reengage the threading portion with the cartridge during rewind of the threading portion onto said cartridge while said disengaging member remains in said position clear of said cartridge.

11. An automatic threading transducing machine comprising means for rotatably mounting a single spool cartridge having a record medium wound thereon including a threading portion at the outer end thereof releasably held by said cartridge, means for disengaging said threading portion from said cartridge and for guiding the same along a threading path to a take-up position, a take-up device adjacent said take-up position for receiving said threading portion in detachable engagement therewith and for winding said record medium thereon as it is unwound from said cartridge, said take-up device having means automatically engageable with said threading portion of said record medium at said take-up position for detachably coupling said record medium to said take-up device, means for initially driving said take-up device at a relatively low speed during coupling thereof with said threading portion, means for driving said take-up device at a relatively higher speed after engagement of the threading portion with said take-up device, and means responsive

to travel of the threading portion a predetermined distance along said threading path for automatically shifting the driving of said take-up device from said relatively low speed to said relatively higher speed.

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