May 25, 1965 H. F. BEAN 3,185,403

TAPE DRIVE

Filed Feb. 16, 1962 2 Sheets-Sheet 1

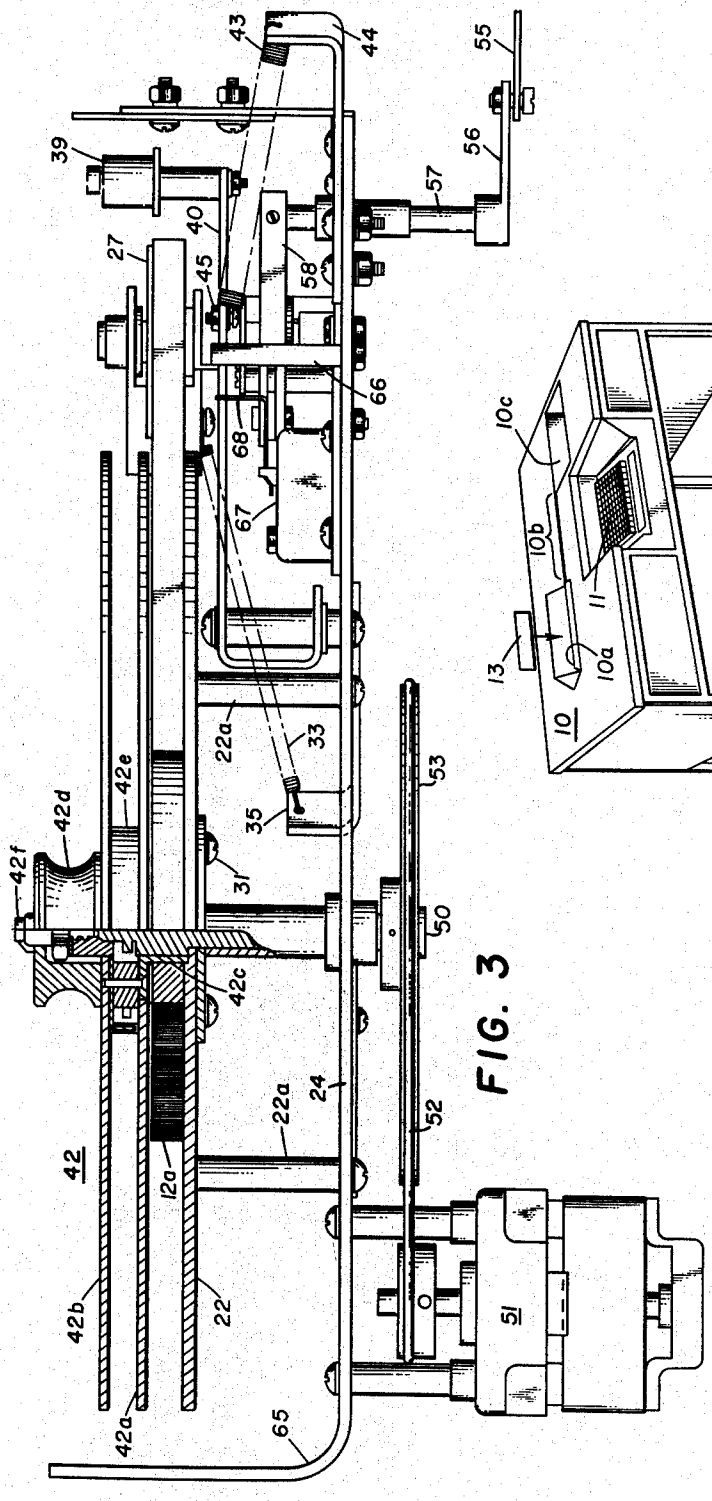


FIG. 3

FIG. 1

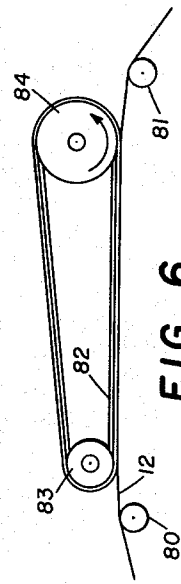


FIG. 6

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TAPE DRIVE

Filed Feb. 16, 1962 2 Sheets-Sheet 2

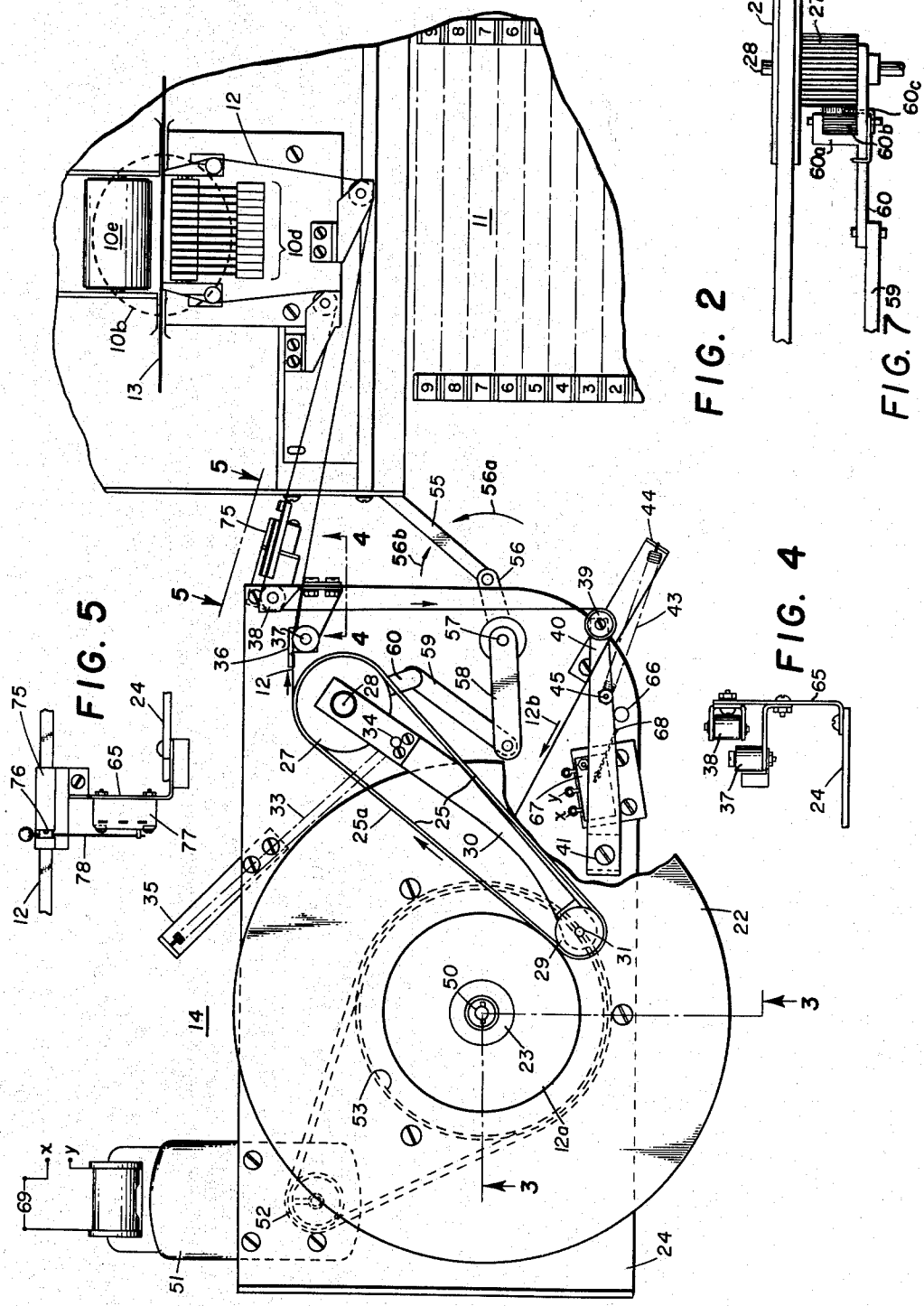


FIG. 5

FIG. 2

FIG. 4

FIG. 7

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TAPE DRIVE

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This invention relates to the utilization and control of delicate tapes and ribbons and more particularly to the metered delivery of a magnetic ink tape to a utilization device.

Tapes or ribbons of primarily dielectric materials are required in various types of systems. In the application of magnetic inks in magnetic ink character recognition systems (MICR), the magnetic ink is carried on one face of an electrically insulating tape. In order to provide clear and crisp impressions of the desired characters in magnetic ink transferred onto a document it is necessary that the tape be handled with utmost care. In the systems involving the delivery of typing ribbons and the like to a printing site the ribbon is passed through rollers or the like. Because of the character of the ribbon and the carbon there can be ignored, to large extent, any requirement for extreme care in the handling thereof. However, if the tape face carrying magnetic ink is smeared or mechanically worked to any substantial degree, the resultant characters are imperfect. Automatic reading of imperfect characters by data processing systems is difficult and involves a high rate of rejects. In systems for encoding various documents the operation generally is such that a plurality of characters is simultaneously impressed upon the document. In a usual case a word length is of the order of one and one-half to two inches. It is, therefore, required that the tape be delivered to the printing device stepwise where each step is at least of length equal to the word length. Fresh sections of tape unmarred by handling must be presented to the printing location in order for each new word properly to be imprinted on a document. The tape, therefore, is moved from a supply roll to the imprinting or encoding location in abrupt steps and thus is subject to substantial acceleration. This must be accomplished while preventing mechanical working of the ink face of the tape.

In accordance with the present invention there is provided a tape delivery system which provides for a stepwise delivery of a delicate tape without working the ink face thereof. More particularly, there is provided a delivery system in which an electrostatic force between the back of the ribbon and a non-conductive carrier is employed for imparting a moving force to the ribbon itself. In one form of the invention there is provided a holder for a supply roll of tape. A belt, supported for travel over an elongated path by a pair of guides, is positioned adjacent to the perimeter of the supply roll. A means is provided for guiding the tape leading from the supply roll along a predetermined path, at least a portion of which is parallel and closely adjacent to the surface of the belt. The electrostatic attractive force between the back of the ribbon and the surface of the belt causes adherence therebetween over the length in which they lie parallel to one another. The belt when driven carries the tape with it, moving the same from the supply roll to a utilization or encoding station.

In accordance with a further aspect of the present invention, there is provided a system for movement of delicate dielectric tapes which comprises means for guiding a tape along a predetermined path including a length thereof substantially linear, means for generating an electrostatic attractive force between the surface of said tape over the linear section of its path and a distributed carrier to establish a low level force between said tape and said

carrier over a substantial area of the carrier and tape for coupling one to the other. The carrier is driven to move the tape along with the carrier under the frictional force between the tape and carrier developed by adherence therebetween.

In accordance with a further aspect of the invention, there is provided a combination of a magnetic ink tape supply system and an imprinter which is operable successively to imprint words of a predetermined length at spaced time intervals on documents delivered to the imprinter. A roll of tape is positioned on a holder adjacent to the imprinter. Guide means are provided for routing the tape from the supply roll through the imprinter and to a take-up reel. A drive is provided for maintaining the tape leading to the take-up reel under predetermined tensile force. A belt is mounted on guides for travel in an elongated path. The guides are mounted for movement of the belt toward and away from the periphery of the tape roll. Resilient means are provided for urging the surface of the belt along one portion of its course toward the tape roll to maintain in parallel relation for a substantial portion of the path thereof the outer surface of the belt and the back of the tape as it is delivered from the tape roll. Drive means are coupled to the imprinter and to the belt for intermittently and alternately driving the same to move tape from the roll to the take-up reel stepwise under frictional forces developed by adherence of the back of the tape to the surface of the belt.

For a more complete understanding of the present invention and for further objects and advantages thereof, reference may now be had to the following description taken in conjunction with the accompanying drawings in which:

FIGURE 1 illustrates one form of an encoder;

FIGURE 2 is a top view of a tape transport showing a portion of the imprinter unit of FIGURE 1;

FIGURE 3 is a somewhat enlarged front elevation view of the transport of FIGURE 2 shown partly in section;

FIGURE 4 is a view taken along lines 4—4 of FIGURE 2;

FIGURE 5 is a view taken along lines 5—5 of FIGURE 2;

FIGURE 6 is a simplified embodiment of the invention; and

FIGURE 7 illustrates a ratchet drive.

Referring now to FIGURE 1, an encoder unit is illustrated which is housed in a desk-like structure. The encoder unit **10** includes a keyboard **11** such as ordinarily found in an adding machine. In this form, a document, such as a check **13**, is inserted into a slot **10***a* where it travels to an encoding or imprinting zone **10***b*. Actuation of selected keys from the keyboard **11** serves to impress on the document at location **10***b* one or more sets of numbers indicative of a bank transit number, for example, or a customer account number or the amount for which a given document is drawn. Following such encoding, the document is then driven into a stacking bin **10***c*. The present invention is directed primarily to the handling of magnetic ink tape employed to print characters on documents in such clear and distinct form as to permit ready identification thereof by an automatic reader. It may be assumed that the keyboard **11** forms a part of a conventional adding machine mechanism with a type font of any style which is compatible with the data processing system in which the encoder is employed.

In FIGURES 2 and 3 the tape metering system of the present invention is illustrated as employed in the machine of FIGURE 1. A set of type bars **10***d* and a platen **10***e* face one another and are operable under the con-

trol of the keyboard **11** to transfer magnetic ink from a tape **12** to a document **13**.

In accordance with the present invention the tape **12** is delivered from a tape storage system **14** in metered amounts and at predetermined times. Tape delivery is synchronized with the operation of the printing unit. In encoding machines such as these employed in data processing operations for handling of banking documents, the word length in a given printing operation occupies a space of the order of two inches in length. Since the printing operations are intermittent, it is necessary to deliver the tape to the printing site stepwise and in synchronism with the printing operation. The tape **12** ordinarily employed is characterized by iron particles suspended in a wax. Such magnetic ink must not be smeared or mechanically worked. Presentation of an unsmeared section of ribbon to the printing site has not heretofore been readily accomplished.

In accordance with the present invention, a magnetic tape is driven by applying a frictional driving force developed between the tape and a carrier over a substantial tape length. By use of certain materials, an electrostatic force is developed between tape and carrier, causing them to adhere to each other, the iron particles being electrically charged and thereby attracted to the surface of a carrier. The force developed per unit area is relatively low but with substantial area of contact between the tape and the carrier a force sufficient to drive the tape is developed without the application of excessive forces at any localized zone on the tape.

The tape delivery mechanism in one form is illustrated in FIGURES 2 and 3. A roll of tape **12***a* is mounted on a plate **22**. The tape roll is fitted over a pivot or center hub **23**. Plate **22** is mounted on a frame plate **24**. The tape lies on the plate **22**. In a preferred embodiment, plates **22** and **24** are horizontally disposed and are parallel to the top of unit **10**, FIGURE 1. The tape roll **12***a* is free to turn on the hub **23**.

The drive element employed for moving the tape is a belt **25**. Belt **25** is mounted on a drive wheel **27** and an idler wheel **29**. The drive wheel **27** is mounted on and keyed to a shaft **28**. An arm **30** is pivoted as to be freely rotatable relative to the axis of shaft **28**. The idler **29** is mounted on a shaft **31** at the end of the arm **30**. A spring **33** is anchored at one end to point **34** on the arm **30**. The other end of spring **33** is anchored in a bracket **35** which is secured to plate **24**. The spring **33** tends to rotate the arm **30** clockwise around shaft **28** so that the surface of the belt **25** is brought to rest upon contact with the outer layer of the tape on roll **12***a*. The belt **25** in a preferred embodiment is of rubber, having a flat outer surface. It is of thickness equal to the thickness of the tape from roll **12***a*.

The tape **12**, as it issues from roll **12***a*, passes along a path which is parallel to the belt **25** as it extends from idler **29** to the drive pulley **27**. The tape **12** leaves the drive wheel **27**, then passes through a guide **36**, over a roller **37**, and thence to a set of guides which define the path of the tape through the printing site. In a preferred form, the guide system includes stainless steel guides which serve to position the tape **12** vertically and horizontally. They serve to maintain the tape in the desired path without sagging or twisting.

The tape **12** follows a return path from the printing site passing over a guide pulley **38** and thence over a pulley **39**. Pulley **39** is mounted at the end of an arm **40** which is pivoted on shaft **41**. The tape **12** then passes onto a take-up reel **42** mounted above the plate **22**. The arm **40** is resiliently biased for clockwise rotation by a spring **43** which is anchored at the end of a fixed bracket **44** and at point **45** on the arm **40**. Spring **43** biases arm **40** continuously to apply a slight tensile force to the tape **12** in the direction of the arrow **12***b* to maintain the ribbon taut over that portion of the path thereof leading from the drive wheel **27**.

Take-up reel **42**, FIGURE 2, is mounted on a shaft **50**. The shaft **50** is provided with a pair of lugs on the upper end thereof to drive the take-up reel. The reel **42** has a lower plate **42***a* and an upper plate **42***b*. The lower plate is provided with a hub-like extension **42***c* which fits over the upper end of the shaft **50**. The lugs on the upper end of the shaft fit into a slot in the hub of the reel **42** to drive the same. The upper plate **42***b* is provided with a hub **42***d* which serves as a handle therefor. The disk **42***b* is provided with a central aperture slidably to receive the upper extension of the hub **42***c*. Disk **42***b* is latched to the disk **42***a* but is disengageable therefrom in order to permit threading the lead end of a tape onto the hub section **42***e* of the reel **42**. Normally if the handle or hub **42***d* is lifted upwardly, the disks **42***a* and **42***b* both will be removed from shaft **50** as a single unit. However, a latching mechanism operable by a push button **42***f* is provided so that when the button **42***f* is depressed and the hub **42** is lifted upwardly, only the disk **42***b* is removed.

The shaft **50** is driven from a motor **51**. The motor **51** drives a belt **52** intermittently, as will hereinafter be explained. Belt **51** is coupled to a large pulley **53** mounted on the shaft **50**.

The drive wheel **27** is actuated by a linkage leading from the printing system and includes the link **55** which actuates a crank arm **56** in the direction of arrow **56***a* when the print bars in the printing zone **10***b* start a printing stroke. Crank arm **56** moves in the direction of arrow **56***b* as the print bars return to rest. The crank arm **56** is keyed to shaft **57**. A second crank arm **58** also is keyed to shaft **57** to move with the crank arm **56**. A link **59** couples the crank arm **58** to a crank arm **60**. The arm **60** is coupled to shaft **28** by a suitable ratchet mechanism shown in FIGURE 7. The pulley **27** has a hub section **27***a* which is a pinion gear. Pulley **27** is rotatable on shaft **28**. Crank arm **60** includes a bracket **60***a* on which a dog **60***b* is mounted. The dog **60***b* is urged into contact with the gear **27***a* by a spring **60***c*. Thus, as the crank arm **60** moves clockwise as viewed in FIGURE 2, the dog **60***b* engages the gear **27***a* to rotate the pulley **27** clockwise. The linkages are so adjusted in dimension and as to the amount of rotation imparted thereto to move the belt **25** in steps at least equal to the word length in the printing device in zone **10**. In one embodiment of the system the crank linkage system served to rotate the drive wheel **27** about 280° per step. The diameter of the wheel **27** was such that the belt **25** was moved about 1¾". By this means there was delivered to the printing site a fresh length of tape for impression on a given document of a clear unambiguous set of characters.

It will be noted that the shaft **50** passes through and is mounted on the base plate **24**. Suitable bracket structures on the base plate **24** secure the same to the printing mechanism. As best shown in FIGURE 3, the plate **22** is mounted on spacers **22***a* and thus is positioned above and parallel to the surface of the plate **24**. The cross section of the belt **25** is of T-configuration with the outer surface **25***a*, FIGURE 1, planar. The belt **25** is of the same width as the tape **12** and substantially completely shields the rim of the idler wheel **29**.

FIGURE 4 illustrates the mounting of the guide pulleys **37** and **38** on a bracket **65** to support them in proper relation for removing tape from the tape roll **12***a* and for delivering tape via pulley **38** onto the take-up reel **42** mounted above plate **22**.

The roller **38** is mounted as to be above roller **37**. The elevations of rollers **37** and **38** above the plate **24** correspond with the levels of the tape roll **12***a* and the take-up reel **42**, respectively. In FIGURE 5 a control element is illustrated. The guide **75** mounted adjacent the roller **38** of FIGURE 2 is shown mounted on the bracket **65**. The guide **75** is provided with side walls to form a path for the tape **12**. The front wall as viewed in FIG-

URE 5 has a slot **76** extending transversely thereof. A control switch **77** is mounted on bracket **65** with a control arm **78** mounted thereon. Arm **78** extends upwardly from switch **77** and is in registration with the slot **76**. Arm **78** normally is biased away from guide **75** and tends to urge the tape **12** outward through the slot **76**. So long as the tape is taut within the guide **75**, the arm **78** will be restrained in the slot **76**. However, if the tape **12** should break, then the arm **78** will rotate outwardly, actuating an alarm circuit coupled to the switch **77**. The tape path is characterized, in accordance with the present invention, by at least one of the foregoing alarm and control elements including the switch **77** and its feeler arm **78**. It has been found that if a tape should break and if a suitable control and alarm function is not provided, the encoder may continue to operate without the printing. However, repeated actuations of the drive wheel **27** will continue to spool the tape out from the roll **12***a* as it adheres to the belt **25**. The switch **77** may be in a master control circuit to render the system inoperative when the tape supply is broken. Alternatively, it may be employed to control a signal lamp or alarm when the tape supply is not reliable.

It will be noted that a pin **66**, FIGURES 2 and 3, is provided to limit the clockwise rotation of the arm **40** as controlled by spring **44**. When the motor **51** drives the take-up reel **42** to the point that the arm **40** rotates away from the stop **66**, a microswitch **67** opens to de-energize the motor **51**. For aiding this control function, a feeler arm **68** extends from switch **67** into engagement with the edge of the arm **40**. The motor **51** is energized from a circuit **69** by way of the switch **67**. While the circuit has not been completed, the X-terminals should be understood as being electrically common terminals as are the Y-terminals. Thus, motor **51** is energized only when the circuit through the microswitch **67** is conductive. Switch **67** is closed only when the arm is rotated in a clockwise direction upon delivery of tape **12** from the printing zone.

FIGURE 6 illustrates a simplified embodiment of the invention in which the tape **12** is driven over guide rollers **80** and **81**. Tape **12** follows a path which is closely adjacent to the surface of the belt **82**. Belt **82** is mounted on rollers **83** and **84**. Where the tape **12** is adjacent to the surface of the belt **82** as it extends between the guide rollers, the tape will be attracted to the surface of the belt. The belt **82** may then be driven either intermittently or continously as the requirements of an associated machine dictate to move the tape **12** without the application of any substantial force to the ink face thereof. The frictional force developed between the belt **82** and the tape **12** by reason of the attraction therebetween is sufficient to move the tape **12** from a supply roll to a utilization site. Thus, the invention in this aspect is not limited to an intermittently operated machine but may find more general application to systems wherein the tape must be handled with the care above noted.

In the embodiment of the invention above described, the reels for handling tape were oriented with their axes vertical. Thus, the tape rolls, both supply and take up, lie horizontally. In other embodiments the reels are mounted on horizontal axes. Tape driven therefrom in accordance with the present invention provided satisfactory operation.

The invention, therefore, provides for a drive system for a tape in which the belt **82** is mounted for travel in an elongated path between the spaced guides **83** and **84**. The rollers **80** and **81** position the tape along a path which is adjacent and is substantially parallel to the surface of the belt in the region between the guides **83** and **84** for providing a contact by electrostatic attraction between the adjacent surfaces of the belt and the tape. Means are then provided for driving the belt by rotation of either of the guides **83** or **84**. By this means there is provided a method of driving a tape in which a low level force is developed between a working face of the tape and a carrier

by means of electrostatic attraction. The force is applied to one face only and is of low level per unit area. The total area of contact is such that a force applied to the carrier will move the tape. Since the holding force is applied to one side of the tape only, the ink face is free from damage.

Having described the invention in connection with certain specific embodiments thereof, it is to be understood that further modifications may now suggest themselves to those skilled in the art and it is intended to cover such modifications as fall within the scope of the appended claims.

What I claim is:

1. A system for transporting delicate magnetic ink tape stepwise from a supply roll to a document printing means, which comprises:

(*a*) a supply roll holder adapted to receive said supply roll,

(*b*) a take-up reel mounted on a shaft passing through said holder,

(*c*) normally de-energized drive means for said take-up reel,

(*d*) a drive pulley mounted on a second shaft to face the supply roll on said holder,

(*e*) means supporting an idler pulley for movement along an arc intersecting the supply roll on said holder at a distance from said drive pulley,

(*f*) an insulating belt encircling the pulleys,

(*g*) resilient means for urging said idler pulley toward said holder for contact by said belt with said roll,

(*h*) guide means for directing said tape along the face of said belt and thence through said printing means to said take-up reel,

(*i*) means synchronized with said printing means for intermittently actuating said drive pulley to advance said tape in steps,

(*j*) resiliently biased follower means engaging said tape between said printing means and said take-up reel for maintaining said tape under tension, and

(*k*) means responsive to movement of said follower means for selectively energizing and de-energizing said drive means.

2. A system for transporting delicate magnetic ink tape stepwire from a supply roll to a document printing means which comprises:

(*a*) a holder plate having a first shaft extending therethrough and adapted to receive and position a tape supply roll,

(*b*) a take-up reel mounted on said shaft spaced from said plate,

(*c*) a normally de-energized drive for said first shaft,

(*d*) a drive pulley mounted on a second shaft to face the supply roll on said plate,

(*e*) an arm rotationally mounted on said second shaft supporting an idler pulley at the end thereof,

(*f*) a belt encircling the pulleys,

(*g*) resilient means for urging said idler pulley toward said first shaft for contact by said belt with said supply roll,

(*h*) guide means for directing said tape along a length of said belt and thence through said printing means to said take-up reel,

(*i*) means for intermittently rotating said second shaft to move said belt and pull said tape from said supply roll in steps,

(*j*) a resiliently biased follower engaging said tape between said printing means and said take-up reel for maintaining said tape under tension, and

(*k*) a switch responsive to movement of said follower to one position upon movement of tape from said printing means to energize said drive and to a second position in response to collection of tape by said take-up reel to de-energize said drive.

3. A system for moving delicate magnetic ink tape stepwise from a supply roll to a document printing means, which comprises:

(*a*) a supply roll holder for receiving said roll,
(*b*) a tape take-up means,
(*c*) drive means for said take-up means to collect tape issuing from said printing means,
(*d*) a drive pulley in the same plane as said roll,
(*e*) means supporting an idler pulley for movement along an arc having its center at the axis of said drive pulley,
(*f*) a belt encircling the pulleys,
(*g*) resilient means for urging said idler pulley toward said supply roll holder for contact by said belt with said roll,
(*h*) guide means for directing said tape along a substantial straight line segment of said belt for electrostatic adherence therebetween and for directing said tape through said printing means to said take-up means,
(*i*) means for intermittently actuating said drive pulley to apply tensile force uniformly along said segment for advancing said tape in steps,
(*j*) means including a second idler pulley resiliently maintained in contact with said tape between said printing means and said take-up means for maintaining said tape under tension, and
(*k*) a switch responsive to movement of said second idler pulley to one position upon movement of tape from said printing means to energize said drive means and to a second position in response to collection of tape by said take-up means to de-energize said drive means.

4. A system for transporting delicate magnetic ink tape stepwise from a supply roll to a document printing means, which comprises:
(*a*) a supply roll holder for receiving said roll,
(*b*) a take-up reel mounted on the same axis as said holder,
(*c*) normally de-energized drive means connected to said take-up reel for rotating the same to wind tape thereon issuing from said printing means,
(*d*) a shaft having a ratchet and a drive pulley secured thereto mounted with its axis parallel to the axis of said holder with said pulley in the same plane as the supply roll on said holder,
(*e*) an arm pivotally mounted on said shaft and carrying an idler pulley spaced from said drive pulley,
(*f*) a flat-faced belt of T-section encircling the pulleys,
(*g*) resilient means for urging said idler pulley along an arcuate path toward the axis of said holder for contact by said belt with said roll,
(*h*) guide means for leading said tape over said drive pulley and through said printing means and thence to said take-up reel,
(*i*) means operable in response to actuation of said printing means for actuating said ratchet to advance said tape in steps,

(*j*) a spring-biased arm and a second idler pulley maintained in contact with said tape between said printing means and said take-up reel for maintaining said tape under tension, and
(*k*) a switch responsive to movement of said arm to control energization of said normally de-energized drive means.

5. A system for transporting delicate magnetic ink tape stepwise from a roll to a document printing means, which comprises:
(*a*) means including a flat plate having a hub thereon to hold said roll,
(*b*) a take-up reel mounted on and adjacent said hub on a first shaft extending through said hub,
(*c*) normally de-energized drive means connected to said shaft on the side of said plate opposite said hub for rotating said take-up reel to wind tape thereon issuing from said printing means,
(*d*) a second shaft having a ratchet drive and a driven pulley mounted for rotation thereon with its axis parallel to said first shaft,
(*e*) an arm pivotally mounted on said second shaft and carrying an idler pulley spaced from said driven pulley,
(*f*) a flat-faced belt of T-section encircling the pulleys,
(*g*) resilient means for urging said arm toward said roll for contact by said belt with said roll,
(*h*) guide means for leading said tape over said driven pulley and to said printing means and thence to said take-up reel,
(*i*) means responsive to actuation of said printing means for actuating said ratchet drive to advance said tape in steps,
(*j*) an idler means resiliently biased into contact with said tape between said printing means and said take-up reel for maintaining said tape under tension, and
(*k*) means responsive to movement of said idler means to control energization of said drive means.

References Cited by the Examiner

UNITED STATES PATENTS

1,482,354	1/24	Dausmann	226—94 X
1,916,109	6/33	Hall et al.	226—94 X
2,658,398	11/53	Masterson	242—55.14 X
2,891,736	6/59	Blaes	242—55.12
2,941,737	6/60	Jones	242—67.5

FOREIGN PATENTS

445,034	5/27	Germany.
860,272	2/61	Great Britain.

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