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Platt

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[45] **Nov. 6, 1973**

[54] **WIRE TYPE TAPE PRINTING APPARATUS**

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[73] Assignee: **MSI Data Corporation,** Montclair, Calif.

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[21] Appl. No.: **104,352**

[52] **U.S. Cl.** ..... **197/1 R,** 242/68.3, 242/201

[51] **Int. Cl.** **B41j 3/10,** B41j 9/00

[58] **Field of Search** 197/1; 242/68.3, 242/210, 201

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[57] **ABSTRACT**

A portable strip printer for use in data collecting systems which is portable and requires small amounts of power, and may be operated from a battery. The printer includes a printing head having a plurality of independently actuated impacting elements spaced from an anvil and receiving the paper therebetween. The paper may be of the carbonless variety and is impacted "on the fly". The drive means for the printer is adapted to control the transfer of paper from one reel to another reel for printing purposes as well as controlling the transfer of tape in a "rewind" direction to allow any printed information on the paper strip to be searched and to re-transfer the tape in the reverse direction to place a "clean" strip in position for printing out further information.

6 Claims, 7 Drawing Figures

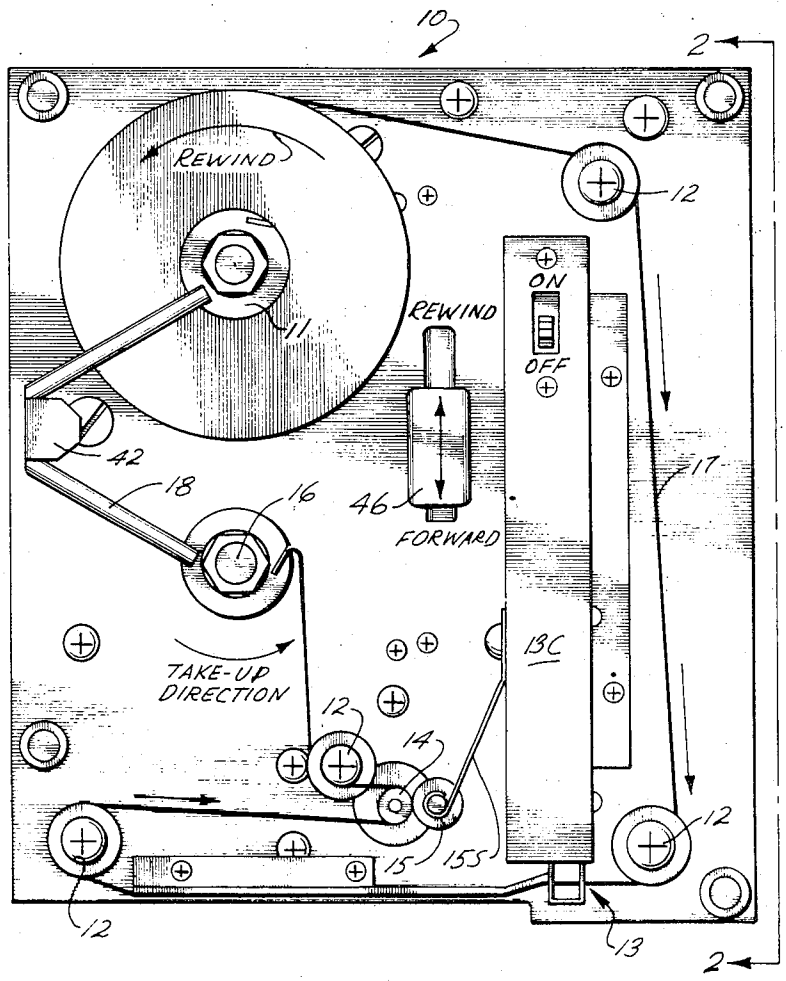


FIG_1

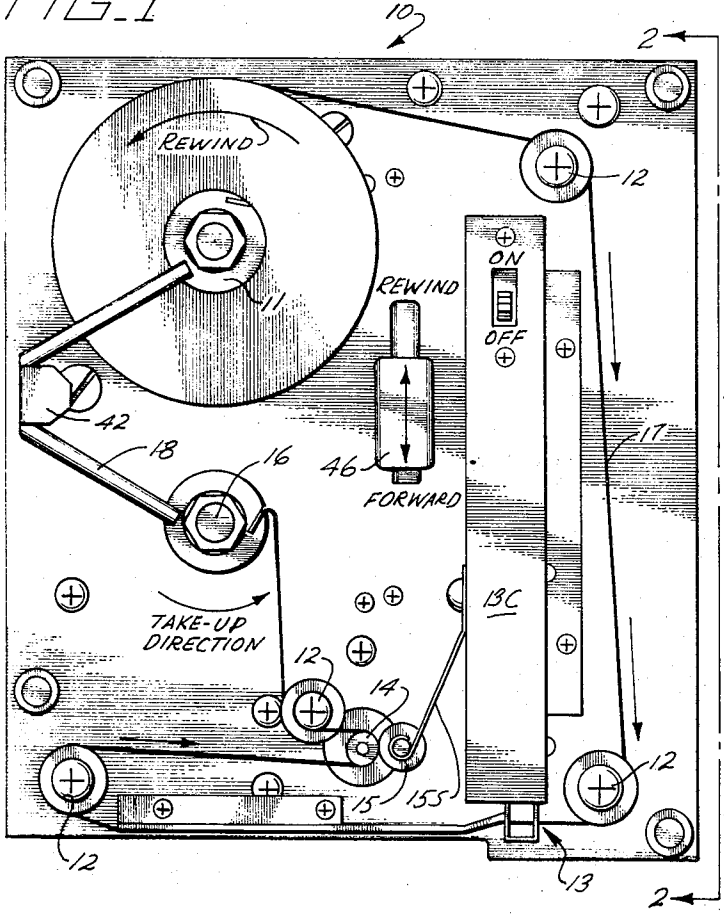


FIG_2

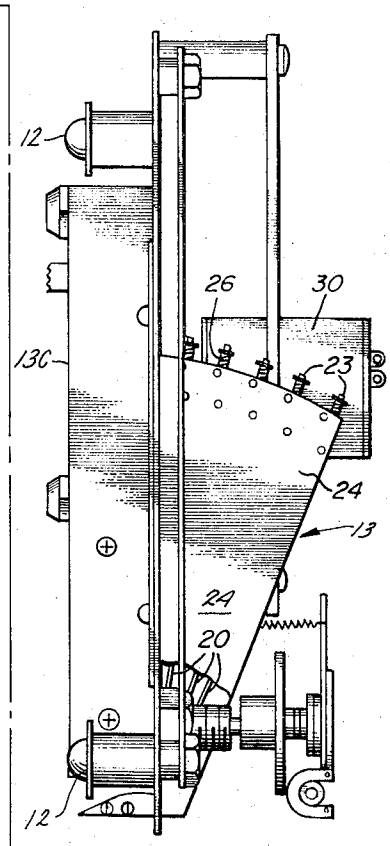


FIG_5

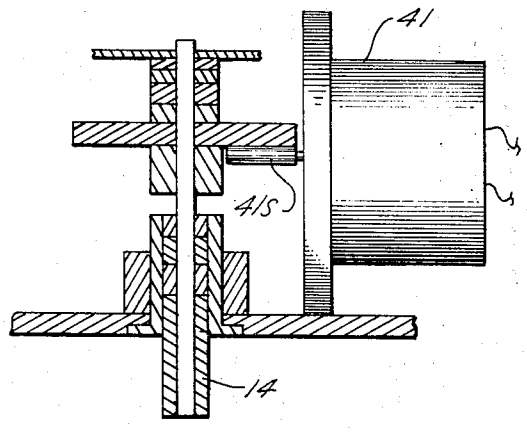
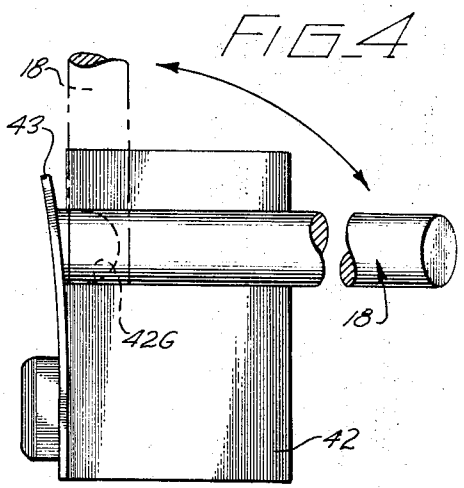


FIG_4



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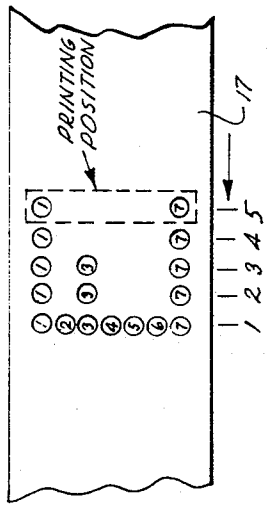
PRINTING POSITION
17
1 2 3 4 5

FIG. 7

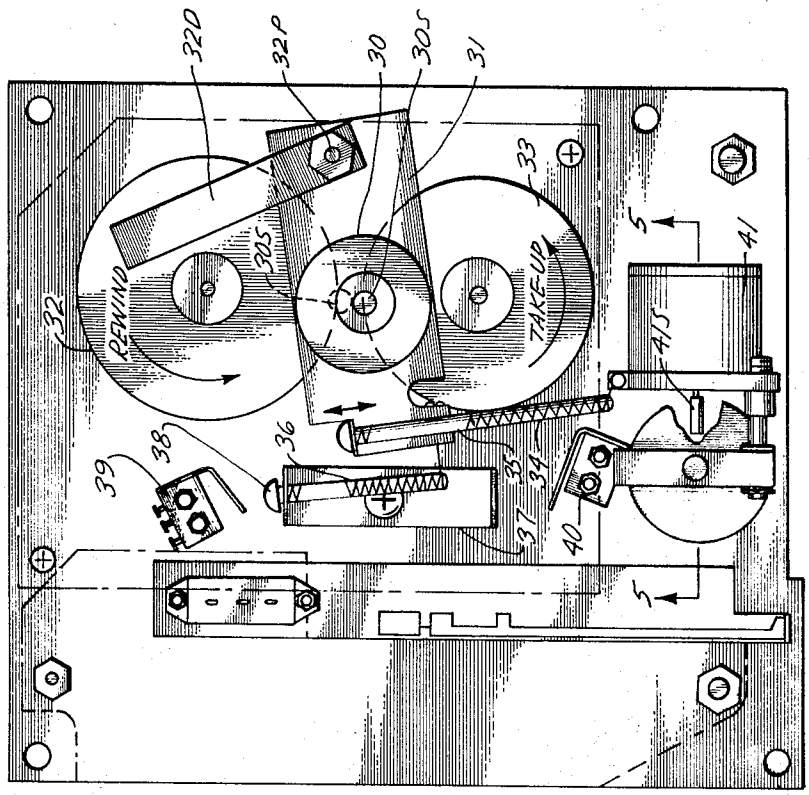
320
32P
30
30S
31
33
5
41
41S
REWIND
30S
TAKE-UP
32
36
38
39
35
34
37
40
5

FIG 3

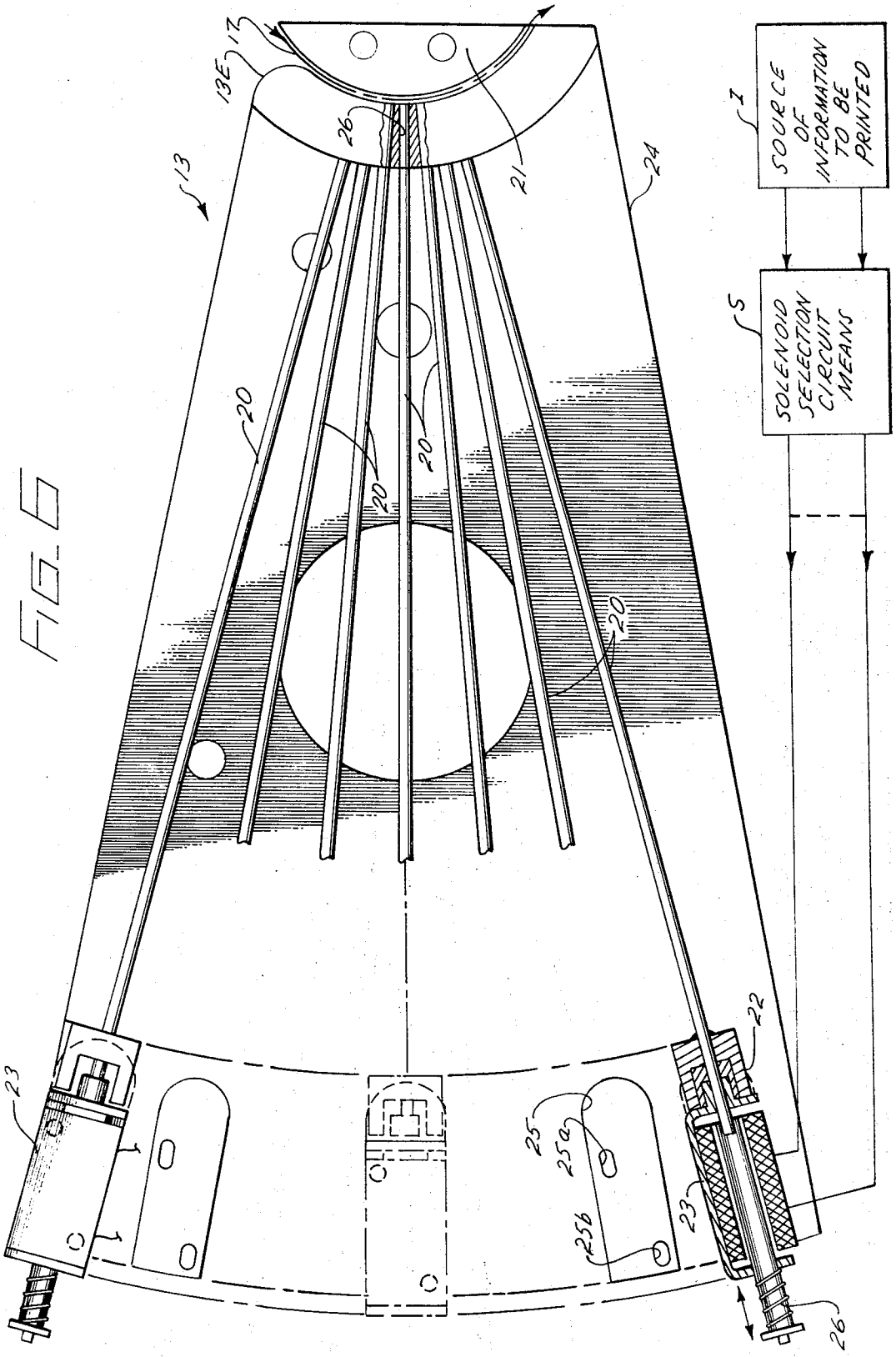
SOURCE OF INFORMATION TO BE PRINTED
SOLENOID SELECTION CIRCUIT MEANS
7
5
13
13E
17
21
24
26
20
22
23
25
25a
25b

FIG. 6

WIRE TYPE TAPE PRINTING APPARATUS

This invention relates to a printing apparatus and more particularly to a portable strip printer. At the present time there are various types of printing apparatus available including various types of strip printers. In general, the more compact printers employ a rotating printing wheel which is rotated to select characters for printing out the selected characters. These units vary in size although even the compact desk top units are not considered to be portable as they embody a large number of bulky elements. There is a need for a strip printer that is relatively inexpensive, reliable and yet portable that may be used in data collection applications.

The present invention provides an improved printing apparatus that is fast, simple, light in weight and portable that may be incorporated into present day data collections systems. The strip printer of the present invention may print out characters by means of marking on impact sensitive paper and defining alphanumeric characters in terms of marks arranged in a 5 × 7 matrix. The present invention is further characterized as being resistant to shock caused by handling the printer and has relatively low power consumption.

From a structural standpoint the present invention provides a portable strip printer that is adapted for marking impact sensitive paper of the "carbonless" variety or heat sensitive paper that is marked in response to being struck by a heated impact element. The paper is stored on a storage reel and advanced to a take-up reel by means of a capstan drive. In its travel from the supply reel to the take-up reel the paper is impacted by a plurality of impact marking elements at a printing head station. The printing head station may comprise seven impacting elements that may be independently actuated and selected for defining marks on preselected areas of the paper. Alpha-numeric characters may be defined by impacting certain areas on the paper and defining a character as a result of the marks produced in five sequential areas on the paper. The impact elements may all be arranged in a single plane in a fan-like fashion and actuated through individual solenoids to cause them to strike a particular area on the paper. When the paper is the carbonless type of paper the striking of the paper by the impact element results in a mark being produced at the impacted area. The invention is further advantageously defined through the provision of a single drive means that is pivotally mounted to be swingable in driving engagement with the storage reel and the take-up reel for transferring paper between the reels. When the printing apparatus is employed in combination with a data collection system it may be necessary to reverse the direction of the tape drive to allow the operator to read what has been marked or printed out on the paper. In addition, some control is required to return the paper to an unprinted or clean section for continuing the printing or data collection processes. A single drive means employed in the present invention allows this to be accomplished simply and inexpensively through the provision of control means for pivoting the single drive shaft between the two reels. The storage reels may each be provided with friction drive discs to allow the drive shaft of an electrical motor to be pivoted into engagement with each of the drive discs for selecting the direction of travel of the tape. The control means operable with the pivotal drive means may comprise electromechanical means for moving the drive shaft into driving engagement with a drive disc and electrically energize the motor in a preselected sequence.

These and other features of the present invention may be more fully appreciated when considered in the light of the following specification and drawings, in which:

FIG. 1 is a top plan view of the printing apparatus embodying the present invention;

FIG. 2 is a sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a bottom plan view of the printing apparatus of FIG. 1;

FIG. 4 is an enlarged front elevational view of the paper hold-down device and illustrating the alternate position of the device in dotted outline;

FIG. 5 is a sectional view taken along the line 5—5 of FIG. 3;

FIG. 6 is a top plan view, with portions broken away, of the printing head assembly and illustrating the control circuitry employed therewith;

FIG. 7 is a fragmentary view of a paper strip for illustrating the mode in which a character may be defined in terms of marks arranged in a 5 × 7 matrix.

Now referring to the drawings, the printing apparatus which is the subject of the present invention will be described employing carbonless paper of the type presently available from a number of commercial sources including National Cash Register Company and Minnesota Mining and Mfg. Company. The important characteristic of the paper is that upon being struck by a marking element with relatively low force, a visible mark will be produced on the paper at the impacted area. The marking can also be produced through the use of a heat sensitive paper. In that case the impact element need only be modified through the provision of some heat source to heat the marking or impacting element so that the heat may be transferred to the paper upon impact to produce the visible mark. The invention will also be described for printing out alphanumeric characters that are defined by the marking of selected areas on the paper in terms of a 5 × 7 matrix. Stated differently, the invention employs seven impact or marking elements that are arranged in alignment for marking selected areas in vertical alignment on a paper strip and through the selection of the marking elements in five sequential steps build up or define an alphanumeric character, as is well known in the art. It should be appreciated that any other type of marking, such as binary coded, may be implemented through the present invention.

The printing apparatus **10** comprises a supply spool **11** for storing the carbonless paper in the form of a narrow strip. The paper is guided by means of a plurality of idler rollers **12** from the supply spool **11** past a printing head **13** and advanced by means of a capstan **14** and pinch roller **15** arranged adjacent to the take-up spool **16**. The carbonless paper is identified by the reference character **17**. The paper is held on the spools **11** and **16** and guided onto and off of the two spools by means of a single hold-down device identified by the general reference character **18**.

The impact or marking elements can be best appreciated from examining FIG. 6. FIG. 6 illustrates the printing head **13** illustrating a plurality of impacting elements **20** coacting with an arcuate anvil **21** for marking the paper **17** between the marking elements **20** and the anvil **21**. In accordance with the present embodiment,

seven such marking elements are provided and are arranged in a fan-like configuration and spaced apart at approximately 5° to allow them to be readily mounted in the same plane for the purposes of simplicity. It will be recognized that the impacting elements **20** are arranged in this fashion for impacting or striking a selected area on the paper. The impacting elements **20** are defined as elongated, needle-like striking elements of lightweight construction and are mounted by means of a collar **22** to limit travel of the plungers for the energizable solenoids **23**; See FIG. **6.** The solenoids **23** and the associated impacting elements **20** are all mounted on a plate **24.** The plate **24** has a plurality of solenoid mounting sockets **25** defined thereon for receiving an individual solenoid **23** therein and secured thereto by means of the apertures 25^a and 25^b to the mounting plate **24.** The plate **24** also functions as a heat sink for the solenoids **23.** The solenoids **23** are all commercially available and may include a return spring **26** mounted for coacting with the solenoid to return the elements **20** to a normal retracted position after being actuated. The marking end of the elements **20** are guided into striking relationship with the anvil **21** by means of guide slots similar to the guide slots **26** illustrated in FIG. **6.** The anvil **21** is radiused to allow all of the solenoids **23** to be identical in length and allow the ends of the impact element **20** to be perpendicular to their lengths and to be free to rotate and preferably strike the anvil flat. In one practical embodiment of the printer **10**, the total stroke of the impact elements **20** is 0.040 inch.

The illustrated arrangement for mounting the solenoids **23** allows an infinitely variable position for each solenoid which is necessary so that each solenoid plunger will "bottom out" internally simultaneously with its impact element **20** striking the paper **17** thereby assuring maximum impact, regardless of tolerance build-up in individual solenoids. This arrangement also makes it possible to set the solenoid stroke outside the assembly and correcting the straightness of needles before assembly.

The information to be printed out on the paper **17** is considered to be electrically defined and is represented in block form and identified as **1.** This electrical information is coupled to the solenoid selection circuit means S having output circuits coupled to the individual solenoids **23** for selectively energizing the solenoids for actuating the impact elements **20** in a predetermined relationship for defining the alphanumeric character in terms of a 5 × 7 matrix. Such selection circuit means are well known in the art and a type of printer disclosing such circuitry and printing apparatus is disclosed in U. S. Pat. No. 3,012,839.

Briefly, to facilitate the understanding of the present invention the definition of an alphanumeric character in terms of a 5 × 7 matrix is illustrated in FIG. **7** on a strip of paper. The printing position is illustrated in dotted outline wherein the seven impact elements **20** are illustrated in vertical alignment for impacting and marking a particular area on the paper **17.** It should now be understood that the impact elements **20** when actuated strike the same vertical position on the paper each time as it travels by. The arrangement of the marks in FIG. **7** illustrates the definition of the letter E in terms of a 5 × 7 matrix. The aligned impact elements **20** are identified in FIG. **7** by the numbers **1–7** reading from the top to the bottom of the paper **17.** The impacting elements **1–7** which are actuated during the five sequential steps for printing out the letter E, as the paper moves from right to left through the area identified as the printing position, are also identified. In examining FIG. **7,** it will be noted that during the first printing interval all of the impact elements **1** through **7** are actuated in the first printing position, in the second and thrid printing positions **1, 3** and **7** are actuated and in the fourth and fifth positions the elements **1** and **7** are actuated so that as the paper **17** is advanced beyond the printing position the letter E will be visible.

An important feature of the present invention is the simple mechanical means for switching the direction of travel of the paper tape **17** between the two spools **11** and **16** of FIG. **1.** This arrangement is best appreciated from examining FIG. **3.** The important feature of this arrangement is the provision of a single drive means that is pivotably mounted between the supply spool **11** and the take-up spool **16** for controlling the direction of travel of the paper. The drive means is identified as an electrical motor **30** having a rotatable shaft **30S.** The motor **30** is mounted on a pivotable plate **31** that is pivoted about the shaft **32P** acting as a pivot. The plate **30** is arranged intermediate a rewind disc **32** arranged coaxially with the spindle for the supply spool **11** and a take-up drive disc **33** arranged coaxially with the take-up spindle for the take-up spool **16.** Each of the drive discs **32** and **33** have their outer peripheries provided with a friction surface. It will be recognized that with the rotation of the drive disc **32** or **33** the corresponding spools **11** or **16** are rotated. Accordingly, the plate **31** is arranged so as to be pivotable to place the drive shaft **30S** into driving engagement with either the drive disc **32** or the drive disc **33.** As illustrated in FIG. **3** the drive shaft **30S** is illustrated in its normal driving relationship with the take-up drive disc **33.** The position of the plate **31** is controlled by means of a control knob **46** arranged on the mounting plate for the printer **10**; see FIG. **1.** The position of the control knob **46** illustrated in FIG. **1** corresponds to the position of the shaft **30S** in FIG. **3** or the position identified as the "forward" position. This may also be referred to as the normal printing mode position of the knob **33.** In this position an extension spring **34** mounted with a fastener **35** to the free end of the plate **31** keeps the motor shaft **30S** in contact with the take-up drive disc **33.** The alternate position of the mounting plate **31** is controlled by means of a second extension spring **36** arranged on a mounting screw **38** secured to a U-shaped member **37** mounted to the bottom side of the control knob **33.** Associated with the spring **36** and its mounting screw **38** is an electromechanical switch **39** connected in circuit relationship for controlling the energization of the drive motor **30.** With the movement of the control knob **46** and the member **37** to the "rewind" position or upwardly towards the switch **39** as illustrated in FIG. **3,** the drive shaft **30S** will be placed into frictional driving engagement with the rewind drive disc **32** and subsequently with the continued travel of the member **37,** it will actuate the switch **39** and thereby energize the spool drive motor **30.** At this point it should be noted that a leaf spring **32D** is secured to the pivot **32P** and is provided with a light friction pad (not illustrated) to act as a light friction drag on rewind to prevent "backlash" of the paper **17.** The spring **32D** does not pivot with the motor **30.**

The other position of the drive motor **30** is for the purpose of defining the "fast forward" position. This

may be necessary, for example, when a clean paper is desired to be placed at the printing head **13** after searching through the printed information on the paper **17** in the rewind position. For this purpose, the control knob **46** is moved downwardly from the rewind position to the forward position. In this position the screw **38** for mounting the spring **36** is allowed to move freely in its retaining aperture on the U-shaped member **37** and travels towards the fast forward switch **40.** The switch **40** is electro-mechanical and is similar to the switch **39** for energizing the motor **30.** At the time interval that switch **40** is actuated, the motor shaft **30S** has been moved into engagement with the drive disc **33.** It will be recognized by those skilled in the art that the motor **30** in both the rewind and the fast forward positions are continuously energized as long as the control knob **46** is held in actuating position by the operator.

In addition to the drive motor **30,** a capstan drive motor **41** is adapted for driving a capstan **14** for incrementally advancing the paper between the capstan **14** and the pinch roller **15** onto the take-up spool **16.** The pinch roller **15** is mounted to the end of a leaf spring **15S** which is secured to the cover plate **13C** for the printing head assembly. The capstan motor **41** is arranged to be driven incrementally in any conventional fashion to allow the paper **17** to be incrementally advanced through the printing head **13.** For this purpose the capstan motor **41** may be de-energized between characters and the natural deceleration of the motor and other rotating element will prevent the paper **17** from actually stopping between characters and is therefore impacted "on the fly." If there are no further characters to be printed, the paper advancement is arrested. For the purposes of simplicity and reducing the cost of the printing apparatus the capstan motor **41** is arranged in a frictional drive arrangement with capstan **14.** It will be recognized, however, that the coupling of the motor shaft **41S** for the capstan motor **41** to the capstan **14** may be in any conventional arrangement as well as the control of the motor **41** to produce the incremental driving action.

The hold-down element **18** provided for the paper **17** wound on the spools **11** and **16** is of a unique and simple design that allows it to engage both the spools **11** and **16** at the same time. The hold-down element **18** is secured to a grooved post **42** and held in position by means of a leaf spring **43.** The post **42** is mounted to the supporting plate for the spools **11** and **16** intermediate the spools so as to be pivotable within the mounting groove **42G.** The hold-down element **18,** for this purpose, is defined in a V-shaped configuration with each arm of the V extending in engagement with one of the spools **11** and **16** and secured in the groove **42G.** It is held in this position by the pressure exerted by the leaf spring **43** secured to the outside of the post **42.** With the pivoting of the arms of the hold-down element **18** in a counterclockwise direction or upwardly as illustrated in FIG. **1,** the leaf spring pressure is overcome and the arms may be held in a substantially vertical position, as illustrated in dotted outline in FIG. **4.** In this position the leaf spring **43** functions to retain the element **18** in this upward position and allows the spools **11** and **16** to be removed from their spindles. It will also be noted that with the hold-down element **18** in operating position, it acts as a guide to the proper winding and unwinding of the paper tape **17** from the respective spools.

With the above structure in mind, the operation of the present invention can now be described. It will be recognized that a spool of the carbonless paper similar to the spool **11** will be mounted on the respective storage spool spindle and threaded around the guide rollers **12,** through the printing head **13,** through the capstan **14** and pinch roller **15** and around the guide **12** to be stored on the take-up spool **16.** With the energization of the capstan motor **41** and the position of the control knob **33** in its normal forward direction the paper **17** will be advanced from the storage spool **11** onto the take-up spool **16** as a result of the driving action of the capstan **14** and pinch roller **15.** At this time the drive motor **30** will rotate the take-up spool **16.** If the source of information I is coupled to the solenoid selection circuit means S, the solenoids **23** will be energized to cause their respective impact elements **20** to be moved into marking relationship with the anvil **21** for marking the paper **17** accordingly. The source I, then, will provide the necessary information to the selection circuit means S for actuating the impact elements **20** for marking the paper **17** as it is advanced through the printing head **13.** Under these conditions, this action will continue in response to the information to be printed out and the paper **17** will be continuously advanced from the spool **11** to the spool **16** as long as there is information to be printed out. During this printing mode it will be appreciated that the spring **34** will maintain the motor shaft **30S** in driving engagement with the disc **33** to advance the take-up spool **16** as the paper is printed. While in this mode the spring **36** is in a completely relaxed position. If, after the information is printed, the operator is required to read the original printed data, he may do so by simply moving the control knob **33** to the rewind position. In this arrangement, since the spring **36** is defined to be more stiff than the spring **34,** the movement of the control knob **46** causes the pivoting action of the plate **31** to move the shaft **30A** away from the drive disc **33** and towards driving engagement with the rewind drive disc **32.** The continuous movement of the control knob **46** will cause the operating arm of the switch **39** to be actuated and energize the drive motor **30** thereby rewinding the paper **17** from the take-up spool **16** back onto the spool **11.** This action allows the operator to examine the printed material. After this operation is complete and the operator has read the printed material or has determined that it is correctly printed out, he may move the control knob **46** to the fast forward position, to prepare the printer **10** to continue in the print mode by quickly advancing the paper **17** from the storage spool onto the take-up spool **16.** This results from the screw **38** sliding freely on the element **37** until it contacts the switch **40** for continuously energizing the motor **30.** This, of course, will allow spring **34** to cause the motor shaft **30S** to be pivoted from the rewind disc **32** to the take-up disc **33** and the paper **17** will be transferred until clean copy is presented to the printing head **13.**

What is claimed is:

1. A portable strip printer comprising a pair of spaced rotatable tape storage reels adapted for transferring a strip of tape stored on one of the reels to the other reel with the tape extending between the reels so that any printing on the tape is visible to the operator, one of the reels functioning as a tape supply reel for

clean tape to be printed with the other reel functioning as a tape take-up reel for receiving the tape from the supply reel including storing the printed tape thereon,

each of the tape storage reels being pivoted with a friction drive disc,

drive means including a single electrical motor having a drive shaft pivotably mounted to be swingable into driving engagement with each of the drive discs for controlling the rotation of said reels for transferring tape from one reel to the other reel in both directions, said means including means for controlling the coupling position of the drive means for controlling the transfer of clean tape from the supply reel in a forward direction to allow the advancing tape to be printed;

means for controlling the coupling position of the drive means for controlling the transfer of tape in a rewind direction opposite to the forward direction to allow any printing on the tape to be examined by the operator as it is transferred from the take-up reel back onto the supply reel;

means for controlling the coupling position of the drive means for controlling the transfer of tape in a fast forward direction to allow the tape to be rapidly advanced in the printing direction from the supply reel to the take-up reel until an unprinted section of the tape is observed by the operator to allow printing to continue, said control means including means for electrically energizing the motor in accordance with the selected forward, rewind, or fast forward directions,

means for withdrawing the tape from the supply reel to continuously advance it to the take-up reel to allow printing thereon,

the tape supply reel storing a strip of impact sensitive paper that will be visibly marked upon becoming impacted by a printing element,

a printing head mounted intermediate the reels for impacting the paper and serially marking it as it advances by the head, said printing head comprising an anvil and a plurality of independently actuated impacting elements spaced from the anvil and receiving the paper therebetween for marking, the impacting elements being lightweight, elongated, needle-like elements arranged in a plane in an arcuate configuration for impacting a preselected area of the paper strip as the paper strip advances thereby and each including an individual solenoid having a plunger mounting the impacting element and energizable for moving the impacting element against the anvil upon energization thereof for impacting the paper at a preselected area as it continuously advances thereby, the individual solenoids being selectively and successively energized for defining characters by printing successive serial marks on the paper, and

circuit means for selectively energizing the individual solenoids for selectively and successively marking the paper for printing out alphanumeric characters defined by the combination of marks on the paper.

2. A portable strip printer as defined in claim **1**, including means for continuously engaging the take-up reel drive disc to prevent backlash of the paper on tape rewind.

3. A portable strip printer as defined in claim **1** wherein said means for advancing the strip of tape includes a rotatable capstan arranged on one side of the tape intermediate the tape storage reels and a drive roller arranged on the opposite side of the strip of tape for frictionally engaging the tape at the capstan to cause the tape to be advanced in response to the rotation of the capstan, and means for intermittently actuating and de-actuating the capstan at a rate related to the printing rate of the characters on the tape.

4. A portable strip printer as defined in claim **3** wherein said impacting elements have a total stroke of approximately 0.040 inch.

5. A portable strip printer as defined in claim **1** including means coupled to the individual solenoids for limiting the travel of the solenoid plungers, and individual means for guiding the marking ends of the impacting elements for striking the anvil.

6. A portable strip printer comprising a pair of spaced rotatable tape storage reels adapted for transferring a strip of tape stored on one of the reels to the other reel with the tape extending between the reels so that any printing on the tape is visible to the operator, one of the reels functioning as a tape supply reel for clean tape to be printed with the other reel functioning as a tape take-up reel for receiving the tape from the supply reel including storing the printed tape thereon,

each of the tape storage reels being provided with a friction drive disc,

single, swingable means simultaneously engageable with each of the storage reels for holding the reels and any paper stored on the reels from slipping off of the spindles and to guide the paper in winding and unwinding of the paper onto a spool when swung to one position overlying the reels, said single means being swingable to another position out of engagement with the reels and releasably held in said other position for allowing the placement and removal of the reels onto and from their respective spindles,

drive means including a single electrical motor having a drive shaft pivotably mounted to be swingable into driving engagement with each of the drive disc for controlling the rotation of said reels for transferring tape from one reel to the other reel in both directions, said drive means including means for controlling the coupling position of the drive means for controlling the transfer of clean tape from the supply reel in a forward direction to allow the advancing tape to be printed;

means for controlling the coupling position of the drive means for controlling the transfer of tape in a rewind direction opposite to the forward direction to allow any printing on the tape to be examined by the operator as it is transferred from the take-up reel back onto the supply reel;

means for controlling the coupling position of the drive means for controlling the transfer of tape in a fast forward direction to allow the tape to be rapidly advanced in the printing direction from the supply reel to the take-up reel until an unprinted section of the tape is observed by the operator to allow printing to continue, said control means including means for electrically energizing the motor in accordance with the selected forward, rewind, or fast forward directions,

means for withdrawing the tape from the supply reel to continuously advance it to the take-up reel to allow printing thereon, said withdrawing means including a rotatable capstan arranged on one side of

the tape intermediate the tape storage reels and a drive roller arranged on the opposite side of the strip for frictionally engaging the tape at the capstan to cause the tape to be advanced in response to the rotation of the capstan, means for actuating and de-actuating the capstan at a rate related to the rate of printing of the individual characters on the tape,

the tape supply reel storing a strip of impact sensitive paper that will be visibly marked upon being impacted by a printing element,

a printing head mounted intermediate the reels for impacting the paper and serially marking it as it advances by the head, said printing head comprising an anvil and a plurality of independently actuated impacting elements spaced from the anvil for receiving the paper between the anvil and impacting elements for marking, the impacting elements being lightweight, elongated, needle like elements arranged in a plane in an arcuate configuration for impacting a preselected area of the paper strip as the paper strip advances thereby and each including an individual solenoid having a plunger mounting the impacting element and energizable for moving the impacting element against the anvil upon energization thereof for impacting the paper at a preselected area as it continuously advances thereby, the individual solenoids being selectively and successively energized for defining characters by printing successive serial marks on the paper,

means coupled to the individual solenoids for limiting the travel of the solenoid plungers and individual means for guiding the marking ends of the impacting elements for striking the anvil, and circuit means for selectively energizing the individual solenoids for selectively and successively marking the paper for printing out alphanumeric characters defined by the combination of marks on the paper.

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