United States Patent [19]

Baker

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[45] **Jan. 23, 1973**

[54] HIGH SPEED IMPACTLESS DATA PRINTER

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[73] Assignee: **Datametrics Corporation,** Van Nuys, Calif.

[22] Filed: **May 27, 1970**

[21] Appl. No.: **40,892**

[52] **U.S. Cl.**.....**346/74 E,** 346/136, 346/145

[51] **Int. Cl.**.....**G01d 15/06,** G01d 15/24

[58] **Field of Search** ....346/74 E, 74 ES, 74 S, 74 SB, 346/74 SC, 74 CH, 25, 136, 139 DC, 145

[56] **References Cited**

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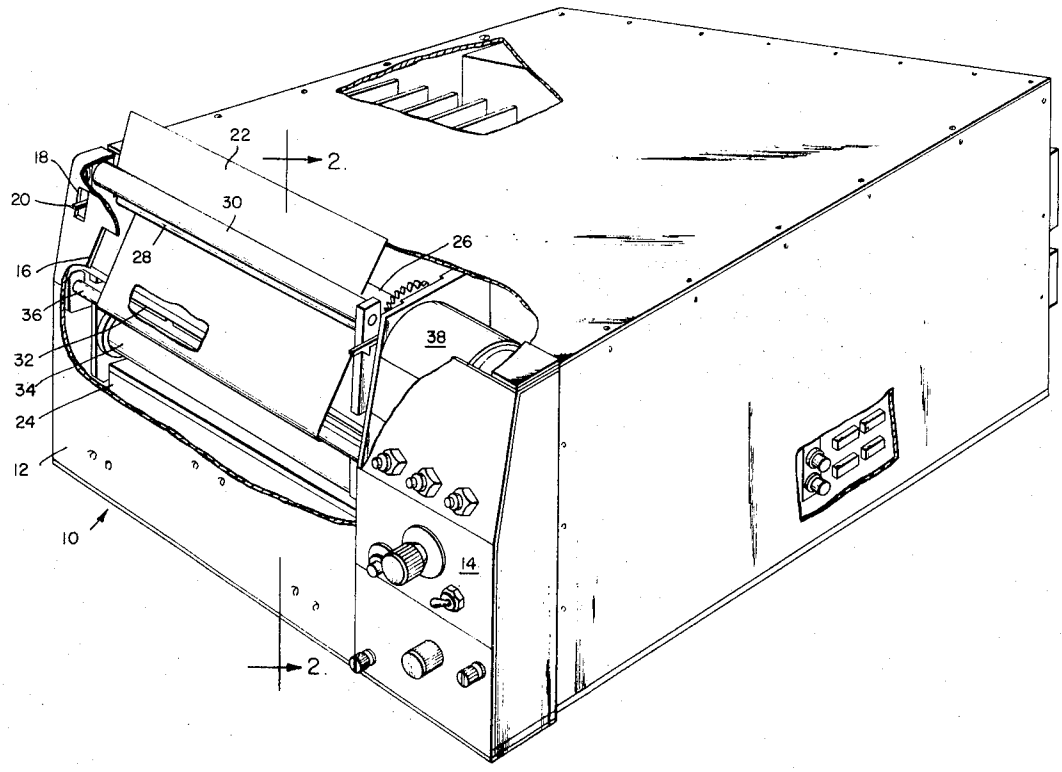
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Assistant Examiner—Jay P. Lucas
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[57] **ABSTRACT**

Electrolytic techniques are utilized in a high speed alpha numeric, impactless printer. A paper supply cassette maintains conductive paper in a moistened condition and includes a replaceable common electrode as an expendable item. Resistance detecting circuits check for the presence of paper of suitable conductivity before printing is enabled.

19 Claims, 9 Drawing Figures



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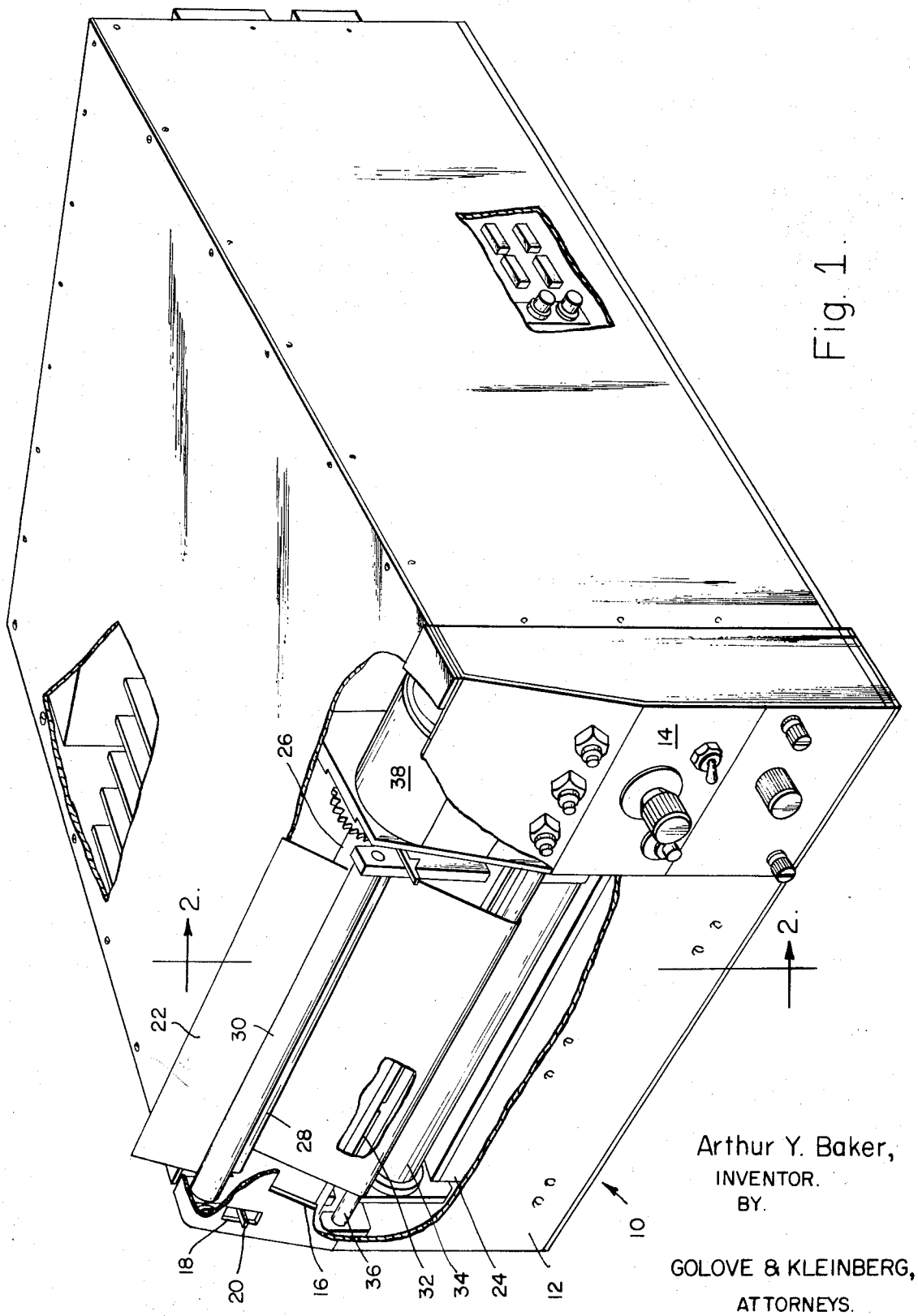


Fig. 1.

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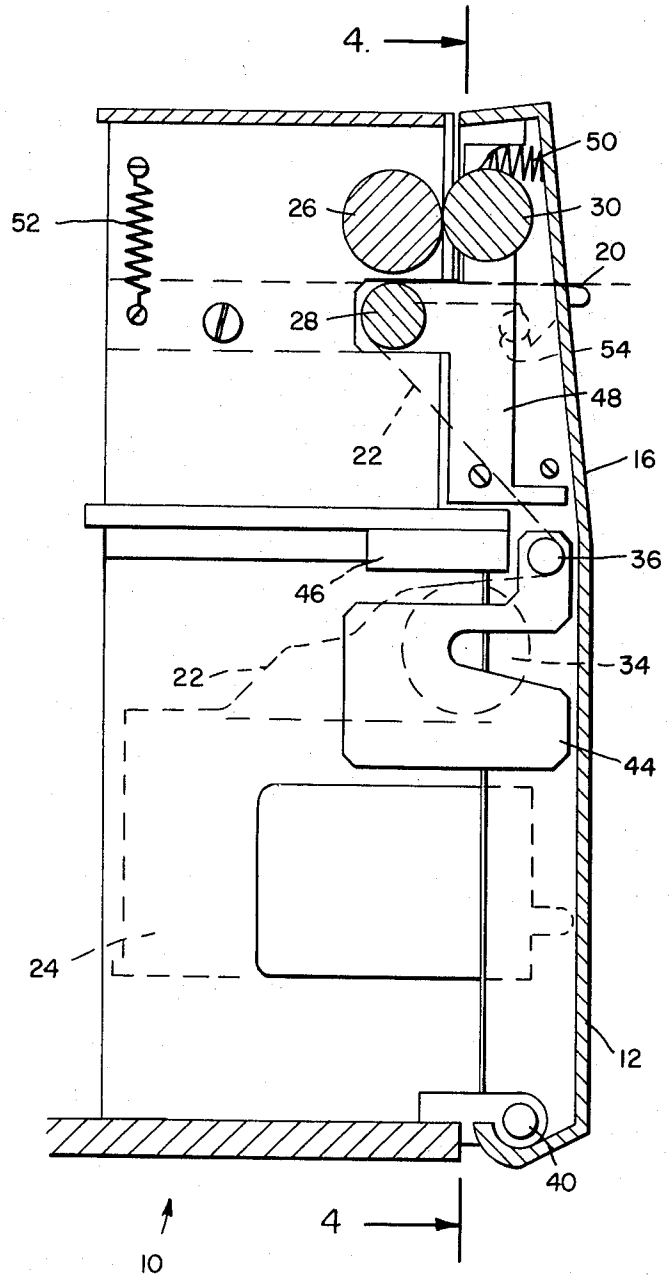


Fig. 2.

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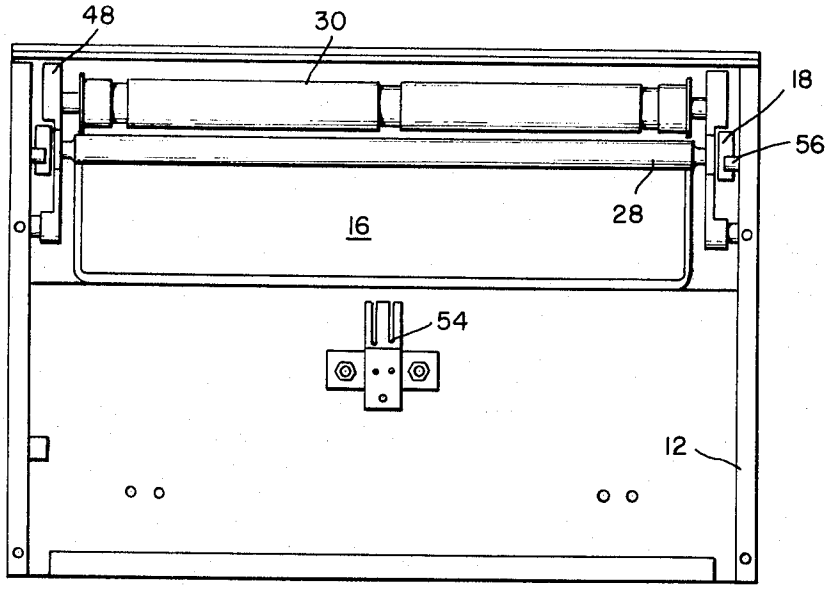
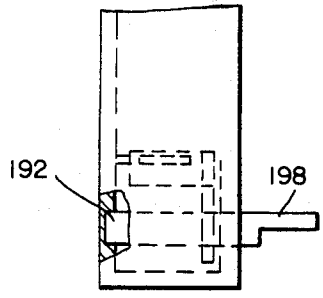


Fig. 3.

Fig. 9.



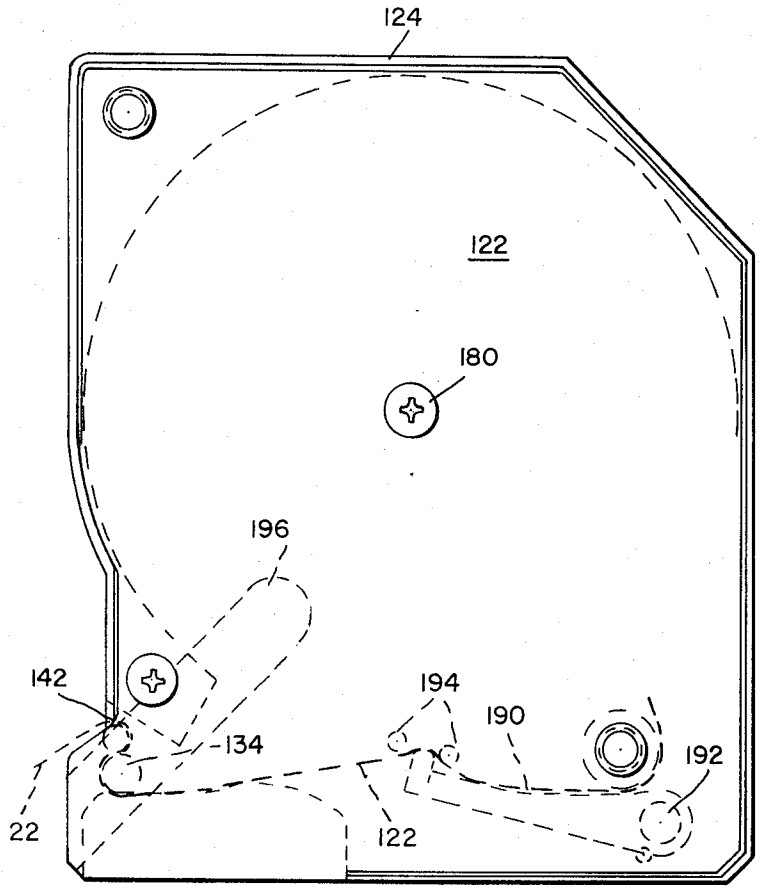


Fig. 8.

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Fig. 4.

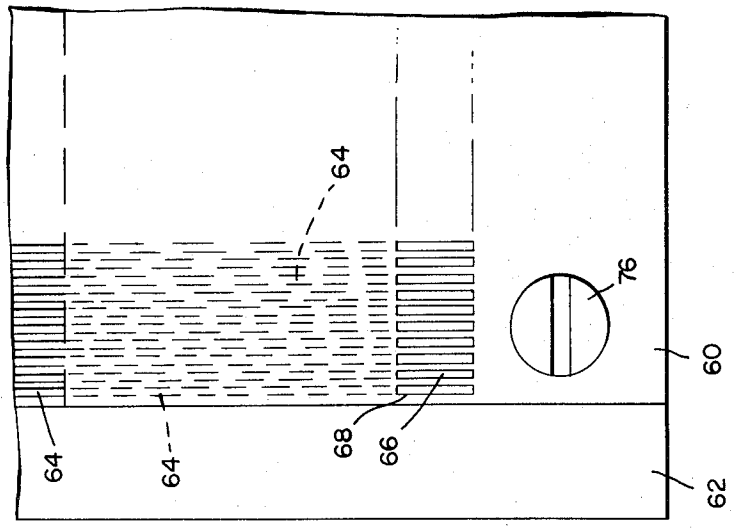
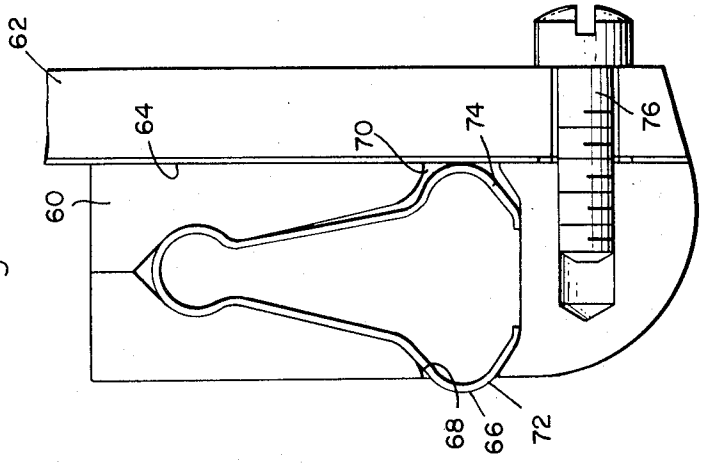


Fig. 5.



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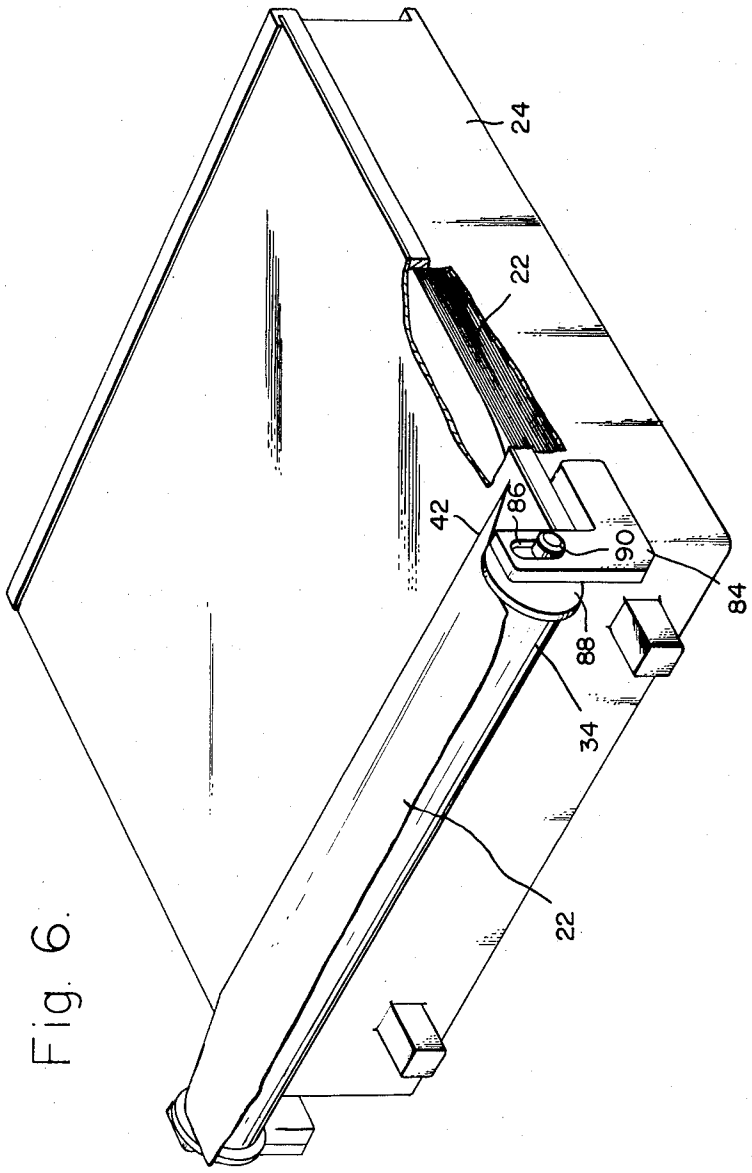
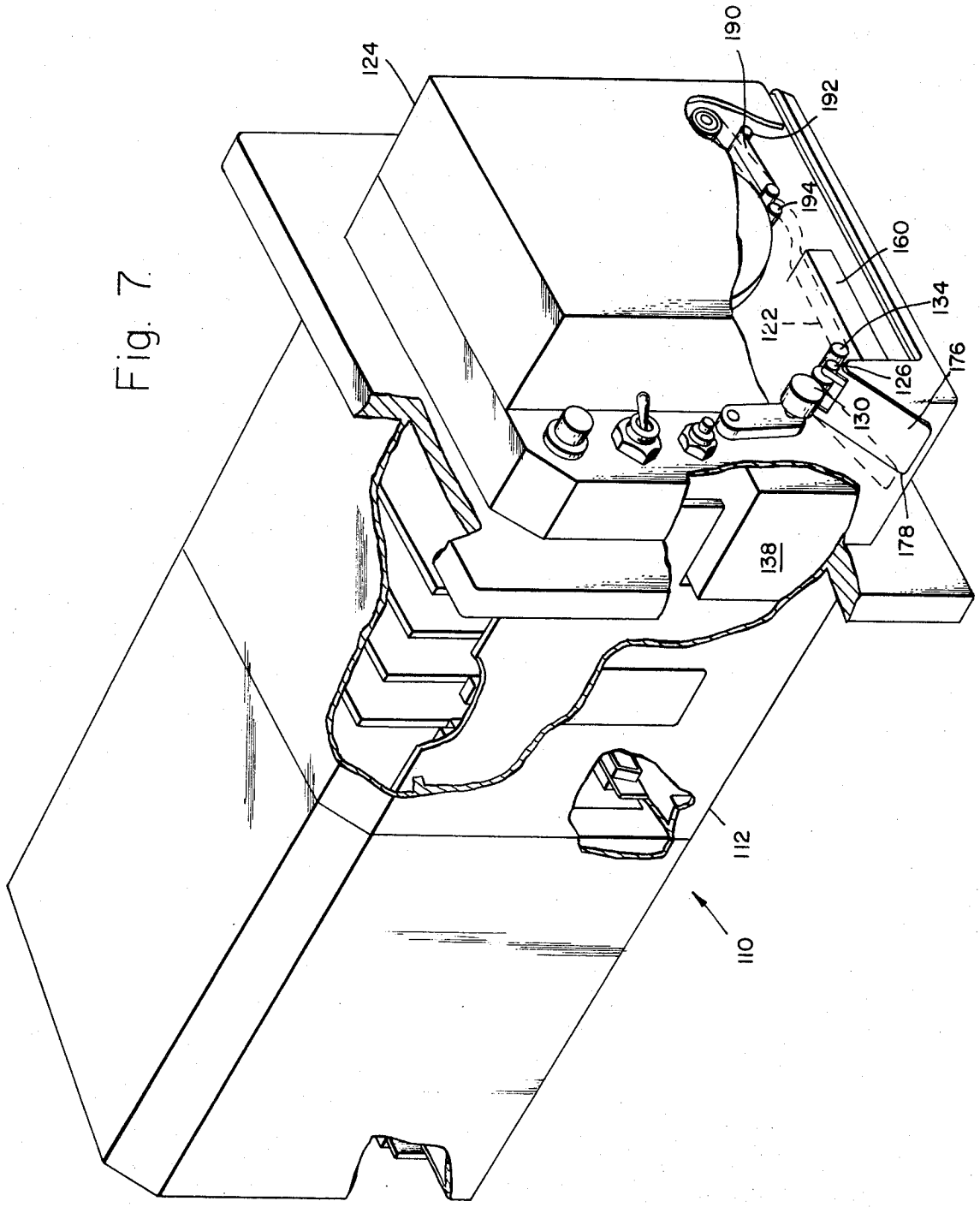


Fig. 6.

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Fig. 7.



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HIGH SPEED IMPACTLESS DATA PRINTER

The present invention relates to a graphic data output devices and more particularly, to a device for placing marks upon an electrolytic media, and a novel media supply element therefor.

In the field of data processing, one of the greatest obstacles to the most effective utilization of modern high speed computing devices has been the relatively slow data rates achievable with most output devices. In business applications, particulalry, a high volume of graphic output furnishes necessary information to the user.

Prior art output devices have included high speed, "on-the-fly" line-at-a-time, printers, "wire-printers," "-spark" printers and even high speed X–Y plotters. Most of these printers require, in addition to the printing element, some form of marking means which coacts with the printing element to provide a legible record. An inked ribbon, which must be periodically renewed, is frequently used between a marking element and the recording medium. Spark printers usually require a special record which responds to the spark and produces a contrasting mark.

Similar in some respects to spark printing, electrolytic recording, long employed for the reception of facsimile images, utilizes paper impregnated with an electrolyte, in cooperation with a pair of electrodes. One of the electrode pair is intended to erode or deplate, thereby depositing visible marks on the surface of the paper.

An early patent teaching such a recording technique and a suitable medium therefore, (U.S. Pat. No. 2,063,992) issued to Elsey describes an anode and a conducting solution that react with each other upon the passage of current to produce a permanent mark. A stationary bar electrode and a rotating helical electrode cooperate to afford line contact progressively across the face of the bar. In the later patent to Tyler, U.S. Pat. No. 2,710,786, a plurality of individual styli, each defining a marking point, selectively impress marks upon the paper record. By applying a potential to selected ones of the styli, a series of marks is applied to the paper. As the paper was transported between the styli and the cylinder, patterns of dots or lines result which constitute either alpha numeric characters or graphic representations.

While there are substantial advantages to the electrolytic recording techniques, such as "impactless" operation, the requirement that the record medium be maintained in a moist condition imposes limitations on the environment in which the device operates and the paper is stored.

On the other hand, the conventional, impact-type, printers impose no special requirement on the paper or its storage, but do, in the case of "ink" printers, require the provision of an inked ribbon, carbon ribbon or the like, which releases pigment upon impact.

In the prior art patent to Tyler, supra, the problem of the "eroding" stylus electrode was attached by providing an "eroding" "common" electrode. To extend the useful life of the common electrode, it was both rotated and reciprocated, thereby distributing the "wear" over most of its surface.

It has been deemed desirable by Applicant to retain the concept of the "non-eroding" stylus electrode in

combination with an "eroding," "common," rotatable electrode. However, Applicant has considered the common electrode as a consumable, expendable item which can be easily replaced. In addition, Applicant has deemed it desirable to provide some method for maintaining the paper in a moist and therefore conductive condition without resorting to a substantially closed humidor-type compartment, which would contain a liquid electrolyte supply, or an enclosure including the recorder, as well.

An improved printer system has been developed which includes a printer unit and a replaceable paper supply cassette. A plurality of stylus electrodes and a paper transport mechanism are an integral part of the printer. A cassette containing a supply of moistened paper and a consumable common electrode inserts into the printer and is operable therewith.

A significant and novel feature of this invention is the provision in the replaceable paper supply cassette of a new common electrode. Since the common electrode supplies material which is ultimately used to create marks on paper, the common electrode characteristically exhibits wear by erosion, a series of lines forming on the electrode. For this reason the common electrode must be replaced relatively frequently. In a preferred embodiment of the present invention, the common electrode is automatically replaced each time a new paper supply is introduced to the machine and need contain only enough material necessary to imprint the paper supplied in the cassette. This feature provides clear and dark markings for the life of the paper supply and reduces the cost of the common electrode and the time necessary to replace it.

The printer unit includes, in the paper transport portion, circuitry for either incrementally or continuously transporting the paper. The plurality of styli can, in a predetermined number of increments, create any alpha numeric character.

The printer can also be adjusted so that the electrical potential difference as between the styli and the common electrode can be varied in accordance with the speed at which the paper is transported. Acceptable copy can be produced at low potential differences with normal or moderate transport speeds or with high potential differences and higher paper transport speeds.

This variable feature permits the printer to be employed either as a remote unattended unit with low power requirements, which may operate at relatively low data rates for reasonably long periods of time, or, alternatively, the printer can be used as an ultra high speed data output device whose data rate can exceed 100 alpha numeric lines per second.

In a preferred embodiment of the present invention, a "line at a time" printer also has a plurality of styli which are not utilized for printing, but rather are utilized as impedance detectors to determine whether the medium can be utilized to produce good copy.

In alternative embodiments, a strip printer according to the present invention has a limited number of electrodes, for example, seven, which provides a printing capability comparable to the conventional "stock-ticker" type of printer.

In other embodiments, the printer can be adapted to operate with virtually any type of "electro-sensitive"

paper, such as the papers disclosed in the patents to Weis, U.S. Pat. No. 2,294,146; Ruderfer, U.S. Pat. No. 2,486,985; Ressler, U.S. Pat. No. 2,971,810; Dalton, U.S. Pat. No. 3,048,515; Clark, U.S. Pat. No. 31,38,547; or Reis, U.S. Pat. No. 3,299,433.

The replaceable paper supply cassette of the present invention is designed to be sold separately from the printer unit. The cassette contains a supply of paper and a new common electrode. When "wet" paper is used, the cassette maintains the "wet" paper in its moist condition and can be packaged in a sealed polyethylene container. The cassette would enable easy "threading" of the paper through the paper transport so that replacing the paper supply could be a relatively simplified task which could be rapidly carried out. Suitable "dry" paper can be used with the printer of the present invention, as well. The present invention is not to be limited to electrolytic technique but may extend to any impactless method utilizing an electrical path in the medium.

Accordingly, it is an object of the present invention to provide an improved electrolytic printer. It is a further object of invention to provide an improved printer which utilizes a replaceable cassette containing a paper supply.

It is yet an additional object of the present invention to provide an improved electrolytic printer with a consumable common electrode as an integral part of a replaceable paper supply cassette.

It is still further object of invention to provide an improved electrolytic printer with impedance detection circuits for checking the condition of the paper.

The novel features which are believed to be characteristic of the invention, both as to organization and method of operation, together with further objects and advantages thereof, will be better understood from the following description considered in connection with the accompanying drawings, in which several preferred embodiments of the invention are illustrated by way of example. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

FIG. 1 is a perspective view of a line-at-a-time printer system according to the present invention;

FIG. 2 is a side section view of the printer system of FIG. 1 taken along line 2—2 in direction of the appended arrows;

FIG. 3 is a view of the inside of the door panel of the printer, taken along line 3—3 of FIG. 2, in the direction of the appended arrows.

FIG. 4 is a top view of a portion of a print head and finger board suitable for use in a printer system according to the present invention;

FIG. 5 is a side section view of the print head and finger board of FIG. 4 taken along the line 5—5 in the direction of the appended arrows;

FIG. 6 is a perspective view of a paper supply cassette for the printer system of FIG. 1;

FIG. 7 is a side view of a strip printer system according to the present invention;

FIG. 8 is a side view of a paper supply cassette for the strip printer system of FIG. 7; and

FIG. 9 is an end view of a portion of the cassette of FIG. 8.

Turning first to FIG. 1, there is shown a line-at-a-time printer system **10** according to the present invention. The printer **10** is equipped with a hinged door panel **12** which is adjacent a control panel **14**. The control panel **14** contains the various knobs and switches that control the operation of the printer **10**.

The door panel **12** includes a transparent window **16** through which the printed record can be observed as it is being generated. The door panel **12** further includes a pair of openings **18** through which latch members **20** protrude. With the door panel **12** open, access may be gained to the paper **22** which is supplied from a cassette **24** that is inserted into the printer **10**.

The paper **22** is transported by means of a drive roller **26** against which the paper is held by a wrap around idler roller **28** and an idler roller **30** which are carried on the inside of the door panel **12**. These rollers are spring loaded to hold the paper **22** in firm contact with the drive roller **26**. From the cassette **24**, the paper **22** passes between a plurality of printing elements **32** and a common electrode roller **34**. A print head roller **36** redirects the path of paper travel toward the drive roller **26**.

The common electrode roller **34** is carried by the cassette **24** and is biased to engage the paper **22** and the printing elements **32** in a close contacting arrangement through the appropriate camming surfaces which are carried by the printer **10** and shown in greater detail in FIG. 2, below.

A motor **38** operates the drive roller **26** in either a continuous or incremental mode, depending upon the instructions received by motor control circuits. The rate of paper transport is determined primarily by the magnitude of the current that flows between the printing elements **32** and the common electrode **34** which, in turn, determines the rate at which material from the common electrode **34** is deposited on the paper **22**. To maintain optimum legibility, the speed of paper transport must be matched to the printing currents being employed. Higher currents require higher transport speeds and result in high data rates. Conversely, lower currents require lower transport speeds and result in low data rates. For low power, long term, remote, unattended operation, a low current setting combined with a slow speed paper drive would result in a long lived installation.

Usually, a printer is designed for a particular data transmission rate which would then determine the speed and current.

Turning next to FIG. 2, there is shown in greater detail, the paper transport path through the printer **10**. The door panel **12** is hinged at the bottom with an appropriate pivot assembly **40**, which is designed to permit the door panel **12** to swing to the horizontal position. With the door panel **12** open, a paper supply cassette **24** can be inserted into the body of the printer **10**. As will be shown in greater detail in connection with FIG. **6**, below, the supply of paper **22** is stored within the cassette and emerges from a narrow slit **42** and is directed over the rotatable common electrode **34**.

With the cassette **24** inserted in place, the common electrode **34** is engaged by a pair of biasing brackets **44** which urge the common electrode **34** into intimate contact with the printing elements **32**, including a print head **46**, shown in greater detail in connection with

FIG. 5 below. The paper 22 passes between the print head 46 and the common electrode 34 and is drawn over the print head roller 36, which is attached to the biasing brackets 44. The paper 22 is then drawn up against the drive roller 26 and out of the printer 10 through a slot provided between the top cover plate 47 of the printer and the inturned edge of the door panel 12.

When the door panel 12 is closed, the wrap around idler roller 28 urges the paper 22 into better contact with the drive roller 26. The idler roller 30 holds the paper 22 against the drive roller 26. Both the idler roller 30 and the wrap around idler roller 28 are rotatably mounted on a pivoted bracket 48 which is attached to the door panel 12, and which is urged toward the drive roller 26 by a pair of bias springs 50.

Each latch member 20 is pivotably mounted to the frame of the printer 10 and is urged into the locking position by a latch bias spring 52. A capture lug 54 extends from the side wall of the door panel 12 and is engaged by the latch member 20 to maintain the door panel 12 in the closed position.

In operation, as the drive roller 26 rotates, paper 22 is withdrawn from the cassette 24 and passes between the print head 46 and the common electrode 34. The paper 22, which is marked on the side in contact with the common electrode 34, is then drawn over the print head roller 36 and is extended between the print head roller 36 and the wrap around idler 28. Information printed upon the paper 22 can then be viewed directly through the transparent window 16 in the door panel 12. The relatively long distance between the print head roller 36 and the wrap around idler roller 28 provides a view of a substantial amount of graphic output.

In the preferred embodiment, the printer is intended to provide alpha numeric information. Accordingly, the printer operates in an incremental mode wherein the paper is advanced through nine increments of 20 mils each. Seven of the nine are used for printing and two represent the spacing between successive lines of print. In alternative embodiments, the rate of paper advance can be controlled in any desired fashion to provide continuous graphic data, or to provide alpha numeric characters of differing size and scale. For example, the size of the individual characters could be scaled up or down by providing greater or fewer increments of paper travel per character and assigning greater or fewer electrodes to the generation of each character.

Turning now to FIG. 3, there is shown the reverse side of the door panel 12 of the printer system of the present invention. The transparent window 16 occupies the upper central portion of the panel. The lower portion of the panel has a leaf spring member 54 which tends to hold the cassette 24 in place within the printer.

In the upper portion of the door panel 12, can be seen the pivoted bracket 48 upon which is mounted the idler roller 30 and the wrap around idler roller 28. There is also shown the latch opening 18 and a latching lug 56, which, in combination with the latch members 20, maintains the door panel 12 in the closed position.

In FIGS. 4 and 5, there is shown a portion of the printing element 32 which is comprised of a printing head 60 and a etched circuit board 62 to which the printing head 60 is mounted. As seen in FIG. 4, the etched circuit board 62 is provided with a plurality of conductive "lines" 64, which are preferably of copper. The board 62 is produced in the conventional manner, starting with a copper clad board.

Each of the conductive lines 64 is coupled to a stylus electrode 66. The printing head 60 includes a plurality of rectangular openings 68, through which the plurality of stylus electrodes 66 protrude, to make contact with the paper 22. On the reverse side of the head 60, similar rectangular cut-outs 70 are provided, enabling the stylus electrodes 66 to make contact with the conductive lines 64 of the circuit board 62, as well.

As may be seen from the side view of FIG. 5, a stylus electrode 66 is made of a resilient material in a substantially hairpin shape, with the ends turned under to provide a pair of opposed outward facing contact surfaces 72, 74. An electrode 66 has sufficient resiliency to spring outward relative to the printing head 60.

The flush mounting of the printing head 60 against the circuit board 62 establishes contact as between conductive lines 64 and the contact surface 74 of the stylus electrode 66. This applies a force to the electrode 66 which, in turn, strongly biases the printing contact surface 72 out of the opening 68 provided therefor to make a firm contact between the stylus 66 and the paper 22 which is backed by the common electrode 34. The printing head 60 can be fastened to the printed circuit board 62 with any fastening device, shown here as a screw 76.

When it is desired to place a mark on the paper, electrical power is applied to a conductive line 64 which transmits the power through the board contact surface 74 of the stylus electrode 66. The printing contact surface 72 applies the power through the paper 22 to the common electrode 34, thereby completing the circuit. The passage of current through the common electrode 34 results in a deplating of the common electrode 34 onto the paper 22, leaving a visible mark. Obviously, any pattern of marks can be deposited on the paper 22 by applying energizing current to selected stylus electrodes 66.

In one alternative embodiment, selected ones of the stylus electrodes 66 are utilized, not for printing, but rather as conductivity sensors. In this use, a stylus electrode 66 and its corresponding conductive line 64 on the printed circuit board 62 are connected to an impedance detecting circuit. The impedance as between the common electrode 34 and the stylus electrode 66 can be measured through the paper 22. If the impedance is either too high or too low, an appropriate alarm signal is provided, indicating that the paper supply is unsatisfactory and cannot be used to provide acceptable printing.

This detecting circuit can also indicate when the paper supply has become exhausted, permitting the printer to operate unattended. In the absence of paper, the impedance circuit will indicate a "short" as between the stylus electrode 66 and the common electrode 34 and an alarm signal can be provided, to stop the provision of data until the empty cassette can be replaced by a full one. Alternatively, too high an impedance results if the paper is insufficiently conductive for "good" printing, and the alarm signal can be given to stop the provision of data.

In yet another embodiment, the stylus electrodes can be alternatively utilized for printing and sensing. When

in the sensing mode, the detecting circuits are arranged to signal "wet," "dry" or "no" paper. If the paper is "dry," there being insufficient conductivity to enable printing, the paper is advanced until the "wet" or conductive condition is sensed. However, if "no" paper is signalled, corresponding to a short circuit, the printer is stopped and the alarm is energized.

In the preferred embodiment, however, the paper is tested after each incremental advance and before any current is applied to the electrodes. If the conditions for printing are not met, the information corresponding to the character line to be written is stored until the seven lines can be satisfactorily written in successive increments. If, after an incremantal advance and before the line is completed, the paper must be advanced to a region of suitable conductivity, the entire line of seven increments is repeated so as to lose no information.

In FIG. 6, there is shown in perspective, partly broken away, a supply cassette **24** suitable for use in the present invention. The cassette **24** is made to be substantially moisture proof. As is seen, a "fan-folded" supply of paper **22** is placed in the interior of the cassette **24**. A paper exit slot **42** enables the paper **22** to be withdrawn from the cassette **24**. The common electrode **34** is shown mounted upon an L-shaped bracket **84** that has an elongated slot **86**. The common electrode **34** is rotatably mounted in the elongated slot **86** by axial extensions **90** which permit some vertical motion of the common electrode **34**. The common electrode **34** includes at either end a guide hub **88** which tends to keep the paper **22** aligned with respect to the common electrode **34** and the printing elements **32**.

For storage purposes, the paper **22** can be provided with a leader tab (not shown) and the exit slot **42** can be sealed with a moisture proof adhesive tape (not shown). Alternatively, the entire cassette can be sealed in a plastic bag. Under these conditions, the paper supply **22** within the cassette would tend to remain in its moistened condition, without any substantial loss of moisture through the cassette **24**.

When the cassette **24** is inserted into the printer **10**, the biasing brackets **44** (best seen in FIG. **2** above) force the common electrode **34** upwardly into close engagement with the printing contacts **72** of the protruding styli **66**, "capturing" the paper **22** therebetween. As seen, marks are made on the "under" side of the paper **22**, adjacent the common electrode **34**. The paper transport path then allow the "under" side of the paper **22** to be visible through the transparent window **16** of the door panel **12**. The paper path extends up through the exit slit at the top cover plate **47** which also can function as a paper tear-off edge.

Since, in operation, the printer produces its marks by the deplating or eroding of the common electrode **34**, it will be obvious that over a period of time, a series of grooves can be "worn" into the common electrode **34** opposite each of the stylus electrodes **66**, resulting in a somewhat corrugated surface. To avoid this and to assure a smooth, common electrode surface for all printing operations, it has been deemed necessary to include the common electrode **34** as an integral party of the replaceable paper supply cassette **24**, assuring that a new common electrode **34** will be provided with a fresh supply of paper. The empty cassette **24** with its "used" common electrode **34** may then be considered an expendable, disposable item.

In alternative embodiments, the cassette **24** can be made to be refillable with either paper **22** or with a new, replaceable common electrode **34**. This would enable reuse of the cassette and, if experience proves that the life of the common electrode **34** can be extended through two or more refills of paper, **22**, the replacement of the common electrode **34** can be delayed until required.

The preferred embodiment of the printer system as illustrated in FIGS. **1** through **6**, has been a line-at-a-time page printer. In an alternative embodiment, the printer-cassette combination of the present invention has been adapted to function as a "strip" printer, as shown in FIG. **7**. A strip printer system **110** is provided with a replaceable paper supply cassette **124** which includes as an integral part thereof, a rotatable common electrode **134**.

The strip printer system **110** is intended to provide hard copy which resembles the conventional "stock-ticker" type of printed strip which provides data in a continuous line, one character at a time. For this application, a printing head **160** is provided with seven stylus electrodes **166**, which may be substantially identical to the electrodes **66** of the printer system **10**. A paper supply cassette **124** which includes a continuous paper strip **122** and a common electrode **134**, can be mounted on the printer **110** in cooperative engagement with the printing head **160**.

A drive roller **126** is connected to a motor **138**, which can be selectably energized to drive the paper strip **122** in increments or continuously. An idler roller **130** is mounted on a lever arm **148**, and is spring loaded against the drive roller **126**, pinching the paper **122** therebetween. A paper guide chute **176** terminates in a sharp edge **178** which serves as a tear off for the paper.

The printer system **112** also includes a circuit which signals when the paper supply is "low." This circuit may be simply a switch with a movable contact that is coupled to a lever arm **190** within the cassette **124**. With the arm **190** in a first position, a signal representing a "sufficient" paper supply can be provided while the switch in a second position would signal a "low" paper supply. The operation of this feature is explained in greater detail in connection with the cassette portion of this assembly which is shown more completely in FIG. **8**, below. The paper supply detector assembly includes the lever arm **190** which is mounted on a shaft **192** that is keyed to coact with a rotatable member (not shown) within the printer **110** that is connected to the sensing circuits. The rotatable member can be spring biased urging the lever arm **190** in the "up" direction, as viewed in the figure. A pair of guide posts **194** are provided, between which the lever arm **190** is urged.

The travel path for the paper **122** passes between the posts **194** and the lever arm **190**, and when the paper is taut, resists the urging of the spring bias. So long as there is sufficient mass and inertia in the paper supply reel to make the paper strip taut when the drive roller **126** is operated, the lever arm **190** is held in the "-down" position.

As the amount of paper in the supply diminishes, the mass and inertia of the supply reel are insufficient to maintain the paper strip sufficiently taut to prevent the lever arm **190** from traveling upward between the posts **194**. If the keyed shaft **192** is connected to a potentiometer-type switch, a continuous indication can be

provided, signalling the degree of tension in the paper strip, as it is being driven.

The paper supply circuits, particularly the potentiometer type switch mentioned above can also be used to monitor the status of the paper supply if the circuit is arranged to provide no signal when the lever arm **190** is in the "UP" position, and intermediate signals corresponding to intermediate positions of the lever arm **190**. Thus no signal would indicate a full or substantially full paper reel, a continuous high level signal would indicate an empty reel or a broken paper tape, and a varying signal would indicate by its magnitude a partially depleted supply of paper.

Turning next to FIG. **8**, there is shown a side view of the cassette **124**, according to the present invention. The cassette **124** which may be of a clear, transparent plastic material contains a spool of paper **122** which is rotatably mounted on a spindle **180**. A paper exit slot **142** is provided adjacent the common electrode **134** and the cassette **124** is relieved to receive the printing head **160**.

An alignment slot **196** is provided in the side of the cassette **124** to enable insertion of the cassette into the printer in correct, cooperative relationship. The slot **196** assures that the paper **122** is properly positioned between the common electrode **134** and the printing element **132**. A locking mechanism, (not shown) may be used to hold the cassette **124** in place, once it is inserted and properly aligned.

Turning finally to FIG. **9**, there is shown the lever arm shaft **192** and the keyed portion **198** thereof, which is adapted to fit into a complementary assembly within the printer to drive the paper sensing mechanism and circuits (not shown). Rotation of the shaft **192** is transmitted to such mechanism to generate the appropriate signals indicating the state of the paper supply.

What is claimed as new is:

1. An impactless graphic data output recorder comprising the combination of:

a plurality of first electrodes adapted to be selectively coupled to a source of electric current; a replaceable cassette, including a supply of electrically conductive paper and a second, common, depletable electrode adapted to be coupled to the source of electric current, said depletable electrode disposed adjacent said plurality of first electrodes with said paper disposed between said first and said second electrodes, for furnishing ions when coupled to the source of electric current, such that the flow of ions from said common electrode selectively produces visible marks on said paper; and paper transport means adapted to cooperate with said cassette, for bringing paper from said cassette between said electrodes.

2. Apparatus as in claim **1** further including resistance detecting means, and means for alternatively coupling selected ones of said first electrodes to said resistance detecting means for determining the resistance of the electrical path between said common electrode and said selected ones of said first electrodes, whereby the presence and absence of paper can be signalled.

3. Apparatus as in claim **1** further including resistance detecting means and means for alternatively connecting selected ones of said first electrodes to said resistance detecting means to determine the conductivity of the paper and its suitability for having visible marks produced thereon.

4. The impactless graphic data output recorder of claim **1**, wherein said paper transport means incrementally advances said paper between said electrodes in a predetermined, cyclical program; and further includes printing control means operatively cooperating with source of electric current and said paper transport means for selectively applying currents between said first and second electrodes during specified ones of the intervals between sucessive incremental advances.

5. In combination with an impactless graphic data output recorder having a plurality of first electrodes adapted to be selectively coupled to a source of electric current and a paper supply means for transporting electrically conductive paper into contact with the plurality of electrodes, a replaceable supply cassette comprising:

a cassette body adapted to be removably interfitted in the data recorder adapted to store a supply of paper of preselected electrical conductivity, for cooperating with the paper supply means, said paper being adapted to pass adjacent the plurality of first electrodes for completing an electrical circuit between the first electrode and a depletable common electrode, whereby electrical currents between the electrodes causes the common electrode to deplate onto the surface of said paper, producing visible marks thereon.

6. The cassette of claim **5** above, further including a replaceable, depletable, common electrode adapted to be coupled to the source of electric current and to be positioned adjacent the plurality of first electrodes.

7. The cassette of claim **6**, above, further including a supply of paper of preselected electrical conductivity.

8. The cassette of claim **6**, above, further including aligning means for cooperating with complementary members of the recorder, to maintain said common electrode in operating proximity to the first electrodes.

9. The combination with an impactless graphic output recorder having a plurality of first electrodes adapted to be selectively coupled to a source of electric current and a second, common, depletable electrode adapted to be coupled to the source of electric current, for producing visible marks on conductive paper, of:

resistance detecting and signalling means coupled to the electrodes for determining the conductivity of the paper and for providing first signals to represent the unsuitability of the paper for having visible marks produced thereon;

transport means coupled to said resistance detecting and signalling means, adapted to bring conductive paper from a supply source to operating proximity between the first and second electrodes, said paper transport means being energized in response to said first signals; and timing means coupled to said paper transport means and said resistance detecting and signalling means for deenergizing said paper transport means and providing an alarm at a predetermined time after said first signal is provided,

whereby additional paper is brought between the electrodes until said first signals cease, corresponding to the presence between the electrodes of paper suitable for having visible marks produced thereon.

10. The combination of claim 9, above, said resistance detecting and signalling means further providing a second signal representing the absence of conductive paper, said paper transport means being deenergized in response to said second signal.

11. An impactless graphic data output recorder comprising the combination of:

a plurality of first electrodes adapted to be selectively coupled to a source of electric current; a second, common, depletable electrode adapted to be coupled to the source of electric current, said depletable electrode disposed adjacent said plurality of first electrodes and adapted to receive electrically conductive paper between said first and said second electrodes for furnishing ions when coupled to the source of electrical energy such that the flow of ions from said common electrode selectively produces visible marks on the paper; paper transport means for bringing paper between electrodes; resistance detecting and signalling means, for determining the resistance of the electrical path between said common electrode and said selected ones of first electrodes, for alternatively signalling the presence of paper, the conductivity of the paper and its unsuitability for having visible marks produced thereon and the absence of paper; and printing control means coupled to said resistance detecting and signalling means and to said paper transport means, for selectively energizing said paper transport means and selectively inhibiting the coupling of said electrodes to the source of electric current in response to signals from said resistance detecting and signalling means, said printing control means further including timing means responsive to the energization of said paper transport means, for deenergizing said paper transport means and providing an alarm signal after a predetermined time interval, whereby printing is enabled only in the presence of paper of suitable conductivity.

12. The recorder of claim 11 above, wherein said paper transport means are energized to transport paper by signals representing the unsuitability of the paper and wherein said printing control means further include timing means responsive to the energization of said paper transport means, for deenergizing said paper transport means and providing an alarm signal after a predetermined time interval.

13. The graphic data output recorder of claim 11 above, wherein said paper transport means are coupled to said resistance dectecting and signalling means for inhibiting said paper transport means in response to signals representing an absence of paper.

14. For use in an impactless graphic data recorder, a printing head, adapted to be connected to a power supply comprising:

a printed circuit board having a plurality of independent conductive lines on one surface thereof, each adapted to be coupled to a source of electrical energy; a head cover member, adapted to be secured to said printed circuit board; and a plurality of substantially U-shaped electrode members, each having opposed substantially arcuate contact surfaces, held by said head cover member with one of said contact surfaces in electrical communication with a conductive line and with the other of said contact surfaces adapted to be in electrical communication with a source of electrical energy through conductive paper and a depletable common electrode, whereby the area of contact between said other contact surface and the paper determines the size of a visible mark produced by the depleting the common electrode on the passage of current therethrough.

15. The printing head of claim 14, wherein said head cover member includes a plurality of openings, each aligned with a different one of said conductive lines, and said other of said electrode contact surface protrudes through each of the openings of said plurality whereby said head cover member maintains said electrode members in proper registration.

16. In combination with an impactless graphic data output recorder having a plurality of first electrodes adapted to be selectively coupled to a source of electric current and a paper supply means for transporting premoistened electrically conductive paper into contact with the plurality of electrodes, a replaceable paper supply cassette comprising:

a substantially moisture proof cassette body adapted to be removably interfitted in the data recorder and a supply of premoistened paper of preselected electrical conductivity, for cooperating with the paper supply means, said paper being adapted to pass between the plurality of first electrodes and a common electrode for completing an electrical circuit therebetween, whereby said paper can be maintained in the moist condition for substantial periods of time prior to use with a recorder.

17. The cassette of claim 16, further including a common, depletable electrode adapted to be coupled to the source of electrical current for completing an electrical path through the paper for producing marks thereon.

18. The cassette of claim 17, further including aligning means for cooperating with complementary members of the recorder to maintain said common electrode in operating proximity to the first electrodes.

19. An impactless, graphic, alpha numeric data output recorder comprising the combination of:

a plurality of first electrodes adapted to be selectively coupled to a source of electric current; a second, common, depletable electrode adapted to be coupled to the source of electric current, said depletable electrode disposed adjacent said plurality of first electrodes and adapted to receive electrically conductive paper between said first and said second electrodes for furnishing ions when coupled to the source of electrical energy such that the flow of ions from said common electrode selectively produces visible marks on the paper; paper transport means for incrementally advancing paper between said electrodes in a predetermined, cyclical program; and printing control means operatively cooperating with the power supply and said paper transport means for selectively applying currents between said first and second electrodes to create a different portion of a desired alpha numeric character during specified ones of the intervals between successive incremental advances, whereby complete alpha numeric characters are created after a predetermined plurality of incremental advances.

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