United States Patent [19]

Borelli

[11] **3,812,780**

[45] **May 28, 1974**

[54] **ELECTROGRAPHIC FORMS PRINT STATION**

[75] Inventor: **Ronald F. Borelli,** Edmond, Okla.

[73] Assignee: **Honeywell Information Systems Inc.,** Waltham, Mass.

[22] Filed: **Jan. 2, 1973**

[21] Appl. No.: **320,419**

[52] **U.S. Cl.**..... **101/216,** 101/DIG. 13, 101/92, 118/637, 101/375

[51] **Int. Cl.**..... **B41f 5/00**

[58] **Field of Search**..... 101/DIG. 13, 375, 426, 101/93 C, 212, 216, 92; 118/637, 638, DIG. 15; 346/74, 74 ES; 117/17.5, 37, 37 LE

[56] **References Cited**

UNITED STATES PATENTS

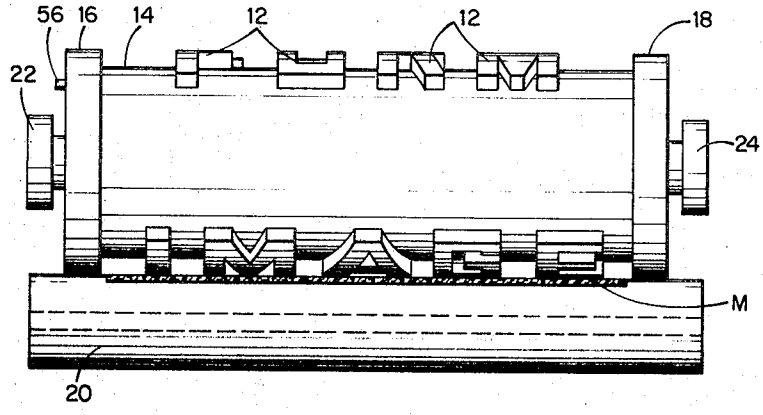
1,442,287	1/1923	Mattern	101/216
2,901,374	8/1959	Gundlach	101/DIG. 13
2,972,297	2/1961	Auerbacher	101/426 X
3,046,877	7/1962	Janke	101/93 C X
3,198,648	8/1965	Trimbur	101/DIG. 13
3,203,345	8/1965	Gibbons	101/216
3,383,697	5/1968	Rice et al.	101/426 X
3,414,723	12/1968	Pleitt et al.	346/74 ES X
3,532,054	10/1970	Zaphiropoulos	101/DIG. 13
3,697,268	10/1972	Wasaburo Ohta	101/DIG. 13
3,701,337	10/1972	Borelli	101/DIG. 13

Primary Examiner—Robert E. Pulfrey
Assistant Examiner—E. H. Eickholt
Attorney, Agent, or Firm—Aubrey Brine; Gerald R. Woods

[57] **ABSTRACT**

An electrographic printing device is provided with a forms print station including an electrode drum having forms information raised thereon which operates on a dielectric print medium. The forms print station provides means for the rapid printing of various size forms on the print medium which are then transported through the electrographic printing device for the addition of variable information at a print station downstream thereof.

9 Claims, 8 Drawing Figures



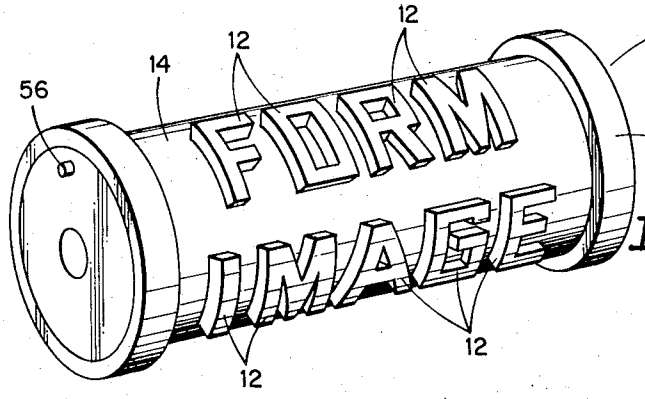


Fig. 1.

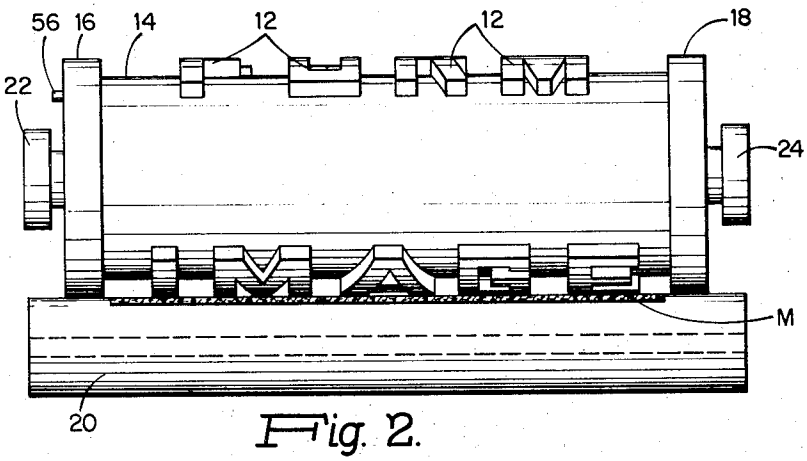


Fig. 2.

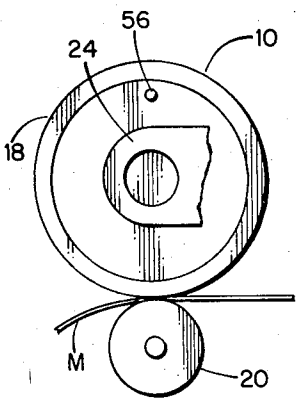


Fig. 2A.

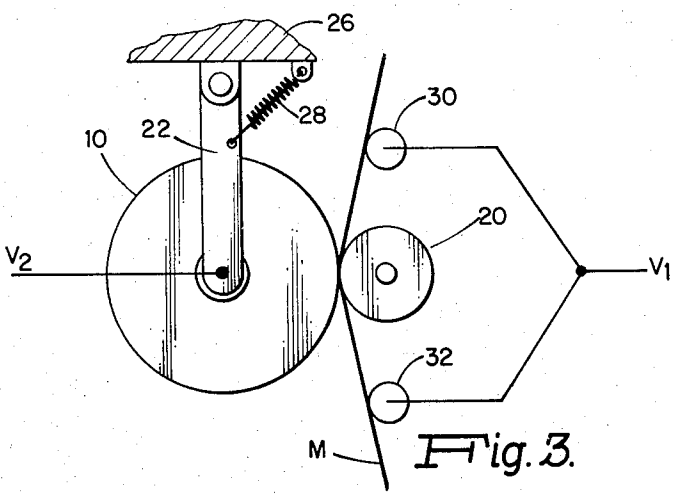


Fig. 3.

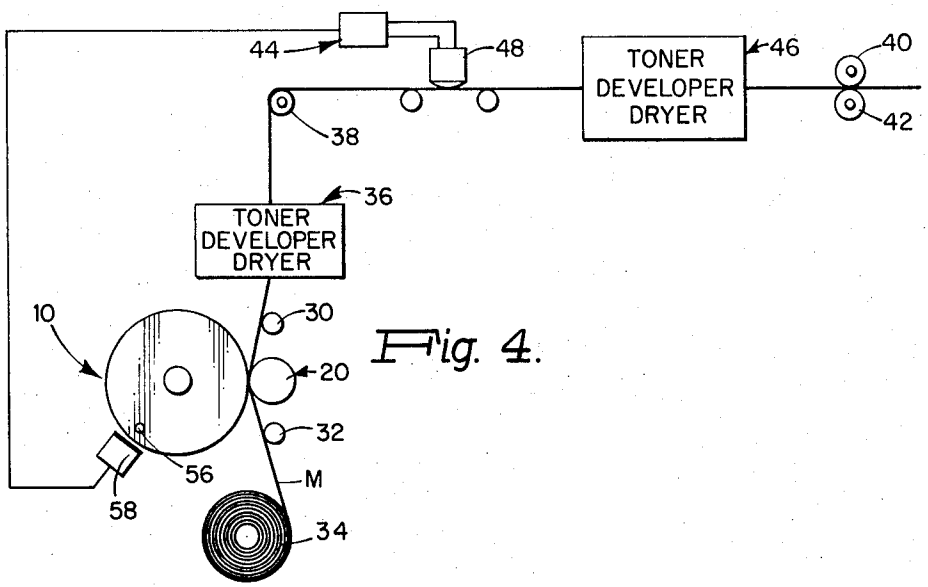


Fig. 4.

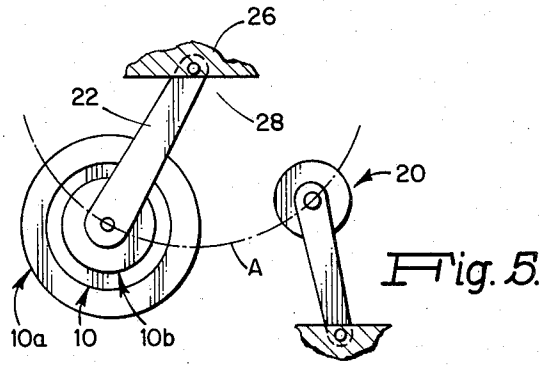


Fig. 5.

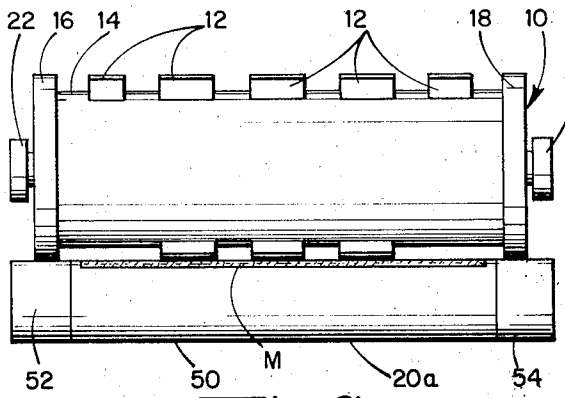


Fig. 6.

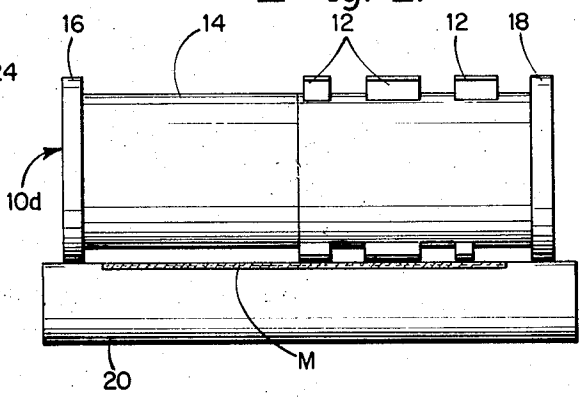


Fig. 7.

ELECTROGRAPHIC FORMS PRINT STATION

BACKGROUND OF THE INVENTION

The present invention relates to electrographic printing apparatus and more particularly to a forms print station for producing a fixed information forms to be subsequently provided with variable information in the electrographic printing apparatus.

In the field of electrostatic printing, devices are known which when connected to the output of data processing equipment, serve to provide rapid printout of information fed from the output of the data processor. One such device is disclosed in U.S. Pat. No. 3,624,661 to Shebanow and Borelli which is assigned to the assignee of the present invention. However, it has been found that in practice many such data processing installations employ standard forms of one type or another, on which the variable information retrieved from the data processor is to be printed. In such installations it becomes necessary, as a matter of routine, to transfer the information from the data processing printout to the desired forms by a secondary operation, which is both time consuming and costly. One might suggest as a solution to this problem that the forms be pre-printed on the rolls of paper in the printer, for use when particular forms are to be employed. However, this becomes relatively difficult when employing electrographic printing media, which is generally a dielectric coated electrographic paper. In many instances the paper must be kept in a controlled environment prior to its use in the electrographic printing device and in any instance, the changing of rolls of paper to provide various form sizes and form types would require lengthly shut down of the machine and a large storage area for the various forms to be used, if stored in paper rolls.

Another requirement often expressed by the user is that the forms be of various colors contrasting with the black and white printout of the variable information of the form. Thus, the problem of providing the variable information from an electrostatic printing device onto standard forms of various sizes, types and colors, is one of extreme importance to the manufacture of present day printers of this type.

The present invention therefore, has an object to provide an electrographic printing device having a forms print station which provides forms of various sizes for subsequent printing of variable information thereon.

Another object of the invention is to provide a forms print station in combination with an electrographic printer which will provide forms of differing color than the variable print produced in the variable printing operation.

A third object of the present invention is to provide printed forms in an electrographic printing apparatus which are inexpensively produced, according to user need.

SUMMARY OF THE INVENTION

The preceding objects of the invention as well as other objects which will become apparent as the description proceeds are achieved in the apparatus according to the present invention by providing a forms print station in the electrographic printing apparatus which station is located along the print medium path upstream of the variable print station. The forms print station is provided with a pair of arms, pivotably supported in spaced relation one with the other, on which a forms drum is supported. The forms drum is biased towards an insulated back-up roller, and conductive means is provided adjacent the insulated roller for forming the electrostatic charge between the forms drum and the conductive means to thereby deposit a charge on the dielectric surface of the print medium. By applying a voltage to the forms drum, a difference in potential is produced between the conductive means and the drum, which potential difference is effective to cause printing on the dielectric medium.

A separate toner station may be provided between the forms station and the variable printing station to preprint the forms prior to depositing the variable electrostatic charge patterns thereon, and to thus produce forms which may be of contrasting color with that of the variable printing to be provided thereon.

BRIEF DESCRIPTION OF THE DRAWING

The various objects of the invention together with the features and advantages thereof will become apparent from the following detailed description of a preferred embodiment, taken in connection with the accompanying drawing, wherein:

FIG. **1** is a perspective elevational view showing a print drum employed in the forms station according to the present invention;

FIG. **2** is an elevational view of the print drum of FIG. **1** as employed in the forms station showing details of construction;

FIG. **2***a* is an end elevational view showing the print drum of FIG. **1** employed in the forms station;

FIG. **3** is a schematic view of a forms station according to the teachings of the present invention;

FIG. **4** is a schematic view of an electrographic printing device having the invention embodied therein;

FIG. **5** is an elevational view showing details of the forms station and modifications of the print drum;

FIG. **6** is an elevational view similar to FIG. **2** showing an alternate embodiment of a print drum arrangement as employed in the forms station; and

FIG. **7** is an elevational view similar to FIGS. **2** and **6** showing a modified forms drum employed in the forms station of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, and in particular to FIGS. **1, 2** and **2***a*, there is shown an arrangement of elements for printing forms of various dimensions which is to be included in the forms station according to the present invention. As to theory of operation, the arrangement makes use of conventional electrographic printing techniques and includes an image generator in the form of a metal conductive drum **10** on which is formed the image of the desired forms to be printed. The lines, or alphanumeric characters may be formed on the drum by photoetching or other metal working techniques. As shown, the characters to be imaged are in the form of raised portions **12** which extend from a recessed portion **14** of the drum **10.**

In the structure described, the forms drum **10** is manufactured by photoetching a light weight cylindrical magnesium sleeve using an artwork which reflects the image of the desired form. The photoetching of the cylinder results in the desired forms image raised

10/1,000ths of an inch or greater above the etched out recessed portion **14**, which becomes the background of the printed form. In addition to forming the raised portions **12** of the image pattern, the network is designed to form a pair of narrow rings **16** and **18** at opposite ends of the drum **10**.

Referring to FIG. **2**, the rings **16** and **18** of the drum **10**, when located in the forms station, contacts a back-up roller **20** which is a cylinder of rubber or other insulating material. The electrographic medium M is wrapped around the back-up roller **20** with the conductive side of the medium in contact with he roller. As also shown, in practice the drum **10** is spring biased against the roller **20** with the electrographic print medium M disposed therebetween.

Referring now to FIG. **3**, the forms drum **10** and the back-up roller **20** is shown in a schematic presentation of a forms station according to the present invention. The drum **10** is seen to be supported for rotation by a pair of support arms **22** and **24** which are pivotably connected to the printer structure **26**. A spring **28** attached between the structure **26** and at least one of the arms **22, 24** serves to bias the drum **10** toward the roller **20** which is fixedly attached to the structure **26**.

The biasing force is generally of a value which would cause the surface of the roller **20** to be depressed in the order of **3** to **4** thousandths of an inch by the raised portions **12**, if the electrographic medium M were removed from between the drum **10** and the roller **20**. A pair of elongated rods **30** and **32** are connected to a voltage source + V and are disposed along the path of the print medium M at a location adjacent the roller **20** parallel to and in close proximity with the forms drum **10** but on the opposite side of the dielectric medium M. Thus, the dielectric medium M in its controlled movement through the apparatus passes over the rods **30** and **32** with the conductive side of the medium passing over the rods and the dielectric side of the medium passing over the forms drum **10**. The forms drum **10** is likewise connected to a voltage indicated as + V2, which may be applied to the drum by commutating brushes, or other means as well known in the art.

The location of forms station of FIG. **3** in the electrographic printing apparatus is best depicted from the schematic view shown in FIG. **4**. The dielectric medium M is stored on a roll **34** which is contained in the machine to provide for continuous operation of the electrographic printing process. The medium M, according to the present invention and as alluded to above, is a plane surface electrographic medium such as is known in the art, having a dielectric side and an opposite conductive side for receiving and retaining an electrostatic charge which is later developed into electrographic printing. The forms station, which is here depicted as the forms drum **10**, the back-up roller **20** and the rods **30** and **32**, is located downstream of the electrographic paper supply but prior to any other device for operating on the medium M.

Immediately after the forms station, a toner developer and dryer station **36** is located, such that the forms information is developed on the electrostatic medium prior to its receiving the variable information. The toner developer and dryer station **36** may include any type of such devices well known in the art or preferably may be of the type shown in U.S. Pat. Nos. 3,687,107 and 3,701,337 to Borelli et al., which are assigned to the assignee of the present invention. As a complete discussion of the elements and operation of such devices is to be found in these references, no further discussion of such is deemed necessary for an understanding of the present invention.

From the combination toner developer-dryer station **36**, the electrographic medium passes over a roller **38** and to the print station **44**. From the print station **44** where variable information is provided to the forms, the medium M passes through a second toner-developer-dryer station **46**, which may be of the same type and design as station **36**, and through a pair of driver rollers **40** and **42** which serve to move the medium through the apparatus.

The print station **44** is of the type which receives variable information from a data processor or other equipment, and through selective charging of a plurality of electrodes or excitation means disposed in a print head **43**, generates alphanumeric characters or other variable printing by electrostatic discharge onto the medium M. The details of the print station **44** have not been shown herein, however, the specific elements of such a device together with an explanation of its operation are shown and described in U.S. Pat. No. 3,624,661 to Shebanow et al., and therefore further discussion of the device is not deemed to be necessary for a complete description of the present invention.

In operation, with the medium M being fed from the supply roller **34** through the various stations described and shown in FIG. **4** and with the forms drum **10** biased against the back-up roller **20** as shown in FIG. **3**, the conductive side of the electrostatic medium is in contact with the two conductive rods **30** and **32** located on both sides, and in close proximity with the rubber back-up roller **20**. A relatively high potential, in the order of +700 volts, is applied at +V1 and imposed on the conducting rods **30** and **32**. Prior to the printing of a form, the forms drum **10** has a +700 volt potential applied at +V2 and no printing occurs because of the existence of the same potential at either side of the dielectric medium M. Imaging is generated by switching the conductive drum from the applied 700 volts, to ground potential, causing ionization to occur between the raised characters on the drum and the conductive side of the medium M.

It should further be understood as an alternate to the aforementioned employment of energy on the drum **10** and the conducting rods **30** and **32** that the rods may be held at ground potential and the drum **10** switched from ground potential to −700 volts to achieve the same effect, that of causing ionization between the raised characters on the drum and the conductive side of the medium.

In the present arrangement, the print medium M is held taut around a section of the back-up roller **20** and the conducting rods **30** and **32**, and is pulled by a drive mechanism attached to the rollers **40** and **42** forming a drive means. The medium in turn drives the roller **20** which drives the forms drum **10** by virtue of the continuous raised rings **16** and **18** being in forced frictional contact with the roller **20** at each end of the drum **10**. Slippage between the drum **10** and the print medium M is thereby limited, as the medium itself is effectively turning the drum, although not in contact with it.

The forms as printed now pass through the toner developer station **36** which may contain developer, in liquid or powder form, of color other than that to be used in printing the variable information on the form. Thus,

variable colored forms may be achieved through use of the combined forms station having its own separate toner developer station **36.**

The print medium M next travels through the electrographic printing apparatus wherein the variable information printed is thereon by the generation of characters at the print station **44,** and subsequently developed at the developer station **46,** to complete the printing process.

As previously alluded to, the present invention contemplates providing a forms station which is adaptable for various form lengths and widths. Referring to FIG. **5,** it will be observed that the arms **22** and **24** which support the drum **10** are pivotable and therefore the drum is pivotably supported such that its center of rotation is on an arc A coinciding with the center of rotation of the back-up roller **20.** Thus, to change the length of forms, it is only necessary to remove the drum **10** and replace it with a drum of lesser diameter, for instance as drum **10,** or a drum of greater diameter as drum **10**a, each of which contacts the back-up roller **20** at the same point, due to the coincident work the intersection of the arc A and roller **20.** This point of contact is critical as it establishes the location of the drum **10,** **10***a* or **10***b* relative to the rods **30** and **32,** which remain fixed. Thus, the present structure provides means for interchanging the print drum **10** with drums of varying diameters, and therefore provides for the production of forms of varying lengths.

Referring to FIG. **7** the formation of forms having various widths is likewise easily accomplished with the present arrangement by employing the interchangable drum structure as disclosed. In that figure, a drum **10***d* is provided having the raised portions **12** covering only a portion of the drum. The remainder of the drum is etched to form an extended recess portion **14** which provides no printing on the medium M. The roller **10***d* is also provided with rings **16** and **18** formed by etching, which contact the back-up roller **20** in a similar fashion to the previously described roller **10.** The roller **10**d may therefore be interchanged in the printing position with any of the previous rollers described with the result that only that area of the drum having raised portions **12** produced a printed form, which is of less width than that produced by roller **10.**

By using this expedient together with the use of different diameter rolls, forms of various width and length are provided, employing the same roll of print medium M, the same electrographic print structure, and without changing any other component of the forms station.

Referring to FIG. **6,** there is shown an alternate embodiment of the drum **10** and roller **20** arrangement which in effect eliminates the rods **30** and **32** from the form station shown in FIGS. **3** and **4.** In this alternate arrangement, the drum **10** is spring biased, as before, into pressurized contact with a back-up roll **20***a* which is of different construction than the back-up roll **20.** In this embodiment, the roll **20***a* contains a center section **50** over which the dielectric medium M passes and which is fabricated of a good conductive material, such as a conductive rubber. The high voltage V which previously was indicated as being transmitted to the conductive rods **30** and **32,** in this arrangement is directly transferred to the roller **20***a* and the cycle of printing is performed as previously described with reference to the embodiment of FIGS. **3** and **4,** with the voltage V_1 being imposed on the roller **20**a rather than on the conductive rods **30** and **32.** With this arrangement, the voltage V_1 is preferably a modulated D.C. voltage applied through a current limiting driver to avoid arcing through areas where pin holes might exist in the dielectric coating. End caps **52** and **54** are provided at each end of the back-up roller **20***a* which contacts the rings **16** and **18** of the drum **10,** and are fabricated of insulating material such that the drum will not short to the conductive roller.

Referring to FIG. **1,** it will be noted that a pin **56** extends from at least one end of the drum **10** and rotates therewith. The pin **56** is located at the head of the form to be printed by the forms drum **10,** and therefore gives an indication that a new form is initiated every time the pin **56** pases a fixed point. As shown in FIG. **4,** a sensor **58** which may be a magnetic or optical device as well known in the art is disposed in the path of the pin **56** and transmits a signal to the print station **44** every time the pin **56** rotates past the fixed point at which the sensor is located. As the distance between the forms drum **10** and the print head **48** of the print station **44** is known, synchronization of the variable printing at the print head is accomplished through pulses emanating from the sensor **58** and variable information is provided in proper locations on the printed form.

From the foregoing, the reader will no doubt appreciate that the present invention provides a system of electrographic printing with the capability of printing forms of various length and width. The drum concept makes for ease of fabrication in that artwork can be generated by photographing an existing form and reproducing it on the surface of a relatively inexpensive drum. With the "two conducting bar" approach, where the rods are located a short distance away from the back-up roller, current leakage through the dielectric and arcing (which can cause inability to generate the charged image) is minimized as the proper resistance is used as current limiting.

Also, by incorporating a sensing element on the forms drum itself to sense the head of form and for synchronizing the forms printing to the variable printing, and paper cutting if present, a simplified forms station design is presented which is adaptable to most electrographic printing apparatus.

In addition, from an operator's standpoint, the simplicity of changing forms by merely inserting replaceable form drums rather than an entire roll of forms in the apparatus, provides a device which is simple in operation and more flexible than present prior art electrographic printing arrangements.

What is claimed is:

1. An apparatus for providing electrographic printing on a flat flexible dielectric medium comprising driving means for moving said medium along a path, excitation means along the path for applying a latent charge to said medium in response to variable signals to form variable latent images on said medium and a forms print station located along said path upstream of said excitation means for successively forming the same latent image on said medium, said forms print station comprising roller means in frictional engagement with said medium and rotated about its axis by movement of said medium, a print drum having characters, extending from a surface thereof for forming said same latent image on each rotation of said drum which is rotatable about its axis, means for biasing said print drum toward said roller means, said drum further having ring means

disposed near the ends thereof for contacting said roller means whereby said print drum is rotated by said roller means and means for applying a voltage to said drum to establish a difference of potential across the surface of said dielectric medium to produce a latent charge on the surface of said dielectric medium in the form of said print drum characters.

2. The apparatus of claim 1 wherein said roller means is of an electrical insulating material and wherein said means for establishing a difference of potential across said medium comprises conductive means located adjacent said roller means and the opposite surface of said medium and a voltage source connected to said drum.

3. The apparatus of claim 1 wherein said roller means is of electrical conductive material and said means for establishing a difference in potential across said medium comprises a voltage source connected to said drum.

4. The apparatus of claim 1 wherein said print drum is pivotably supported for movement of its rotational axis along an arc intersecting the rotational axis of said roller means.

5. The apparatus of claim 4 which further includes means connected to said drum for indicating the beginning of each successive same image to be formed by rotation of said drum and stationary means adjacent said drum for sensing said indicating means and providing a signal to said excitation means in response to the sensing of said indicating means.

6. An apparatus for providing electrographic printing on a flat flexible dielectric medium comprising driving means for moving said medium along a path, excitation means along the path for applying a latent charge to said medium in response to variable signals to form variable latent images on said medium, a forms print station located along said path upstream of said excitation means for successively forming the same latent image on said medium and toner developer means disposed between said excitation means and said forms print station, for developing the latent images so formed at said station, said forms print station comprising a roller fabricated of electrically insulated material in frictional engagement with said medium and rotated about its axis by movement of said medium, a print drum having characters extending from a surface thereof for forming said same latent image on each rotation of said drums which is rotatable about its axis, means biasing said print drum towards said roller, said drum further having a pair of rings extending outwardly from said surface thereof, one located adjacent either end of said drum for contacting said roller whereby said drum is rotated by movement of said roller, and means for applying a voltage to said drum to establish a difference of potential across the surface of said dielectric medium to produce a latent charge on the surface of said dielectric medium in the form of said print drum characters.

7. The apparatus of claim 6 wherein said means for establishing a difference in potential across said medium comprises a pair of electrodes located one on either side of said roller along the path of said medium and a voltage source connected to said drum.

8. The apparatus of claim 7 wherein said print drum is pivotably supported for movement of its rotational axis along an arc intersecting the rotational axis of said roller.

9. The apparatus of claim 8 which further includes means connected to said drum for indicating the beginning of each successive same image to be formed by rotation of said drum and stationary means adjacent said drum for sensing said indicating means and providing a signal to said excitation means in response to the sensing of said indicating means.

* * * * *