

June 9, 1959

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2,890,343

XEROGRAPHIC DRUM CHARGING APPARATUS

Filed Dec. 27, 1957

2 Sheets-Sheet 1

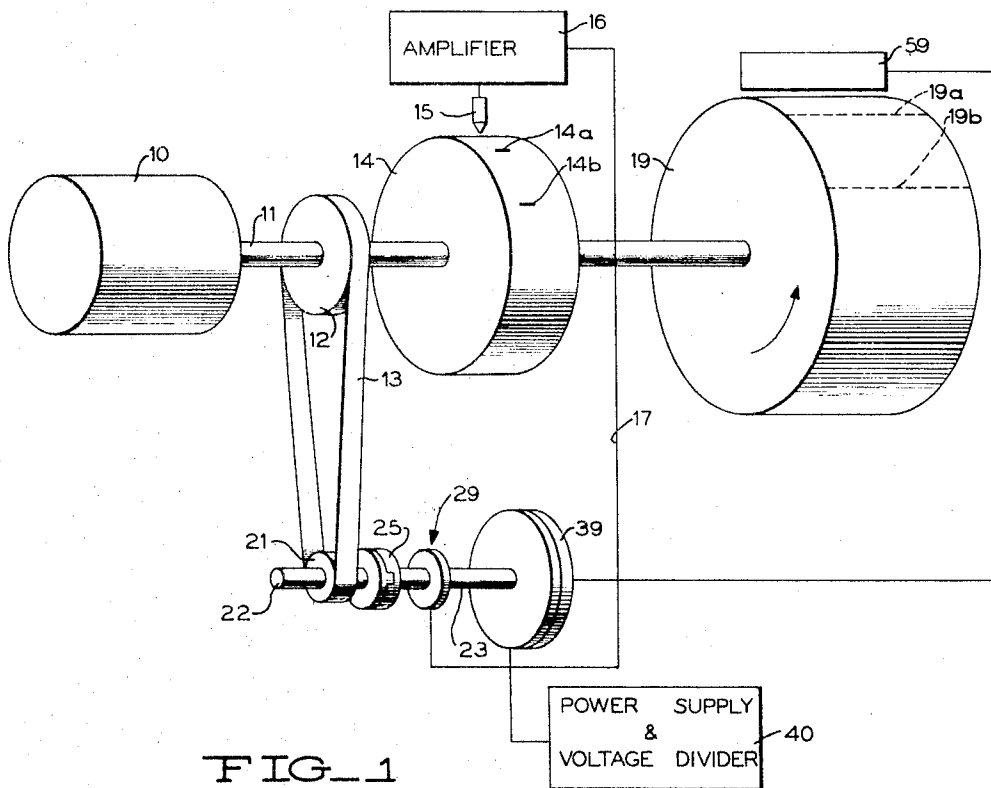


FIG. 1

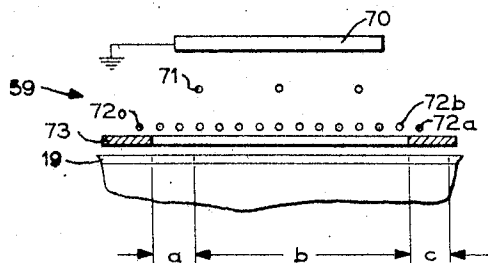


FIG. 2

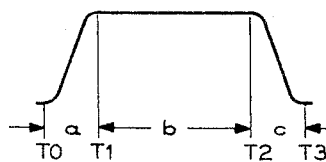


FIG. 3a

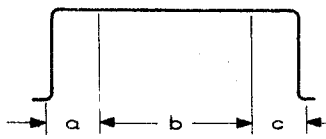


FIG. 3b

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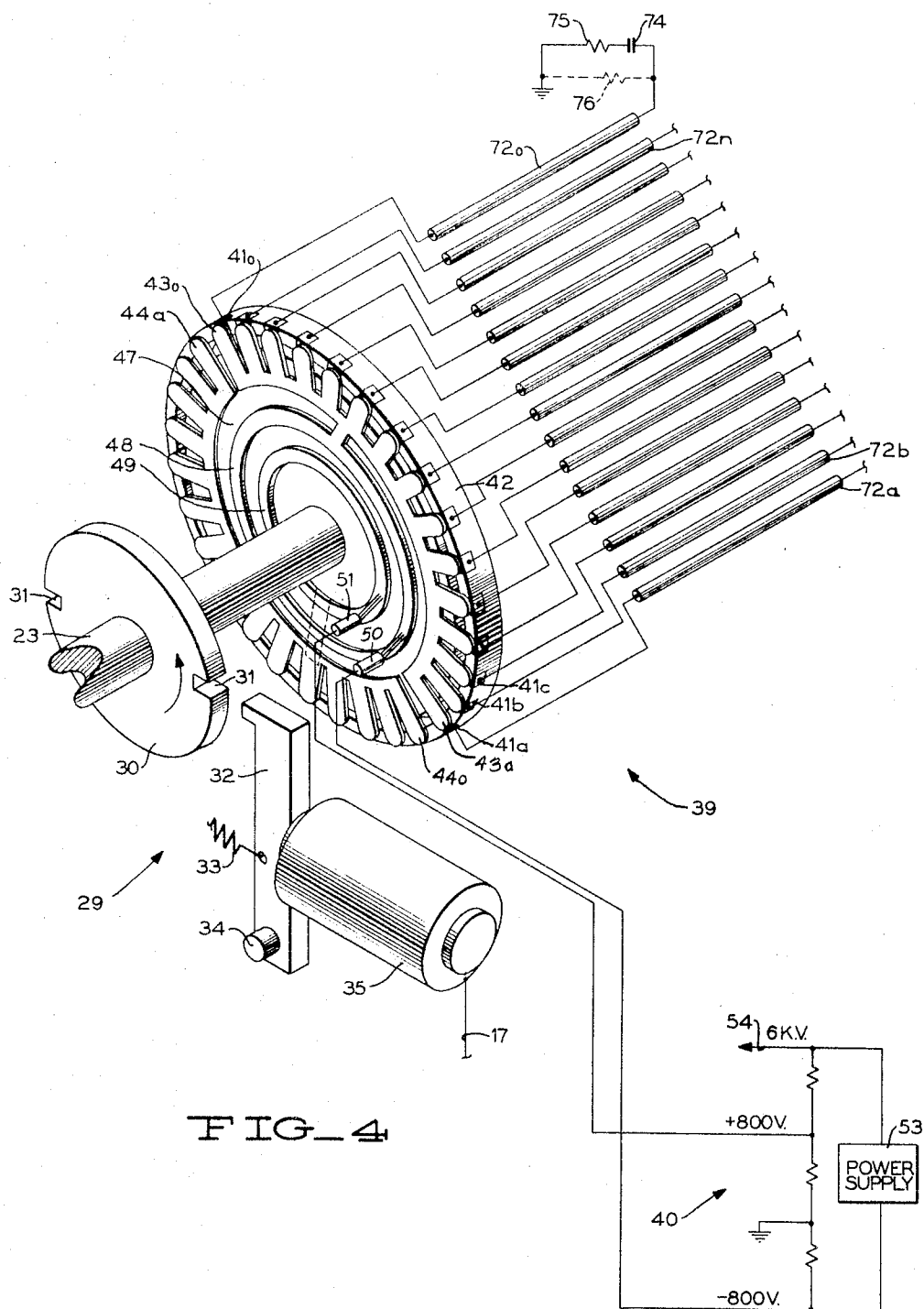
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2 Sheets-Sheet 2



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XEROGRAPHIC DRUM CHARGING APPARATUS

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Application December 27, 1957, Serial No. 705,560

8 Claims. (Cl. 250—49.5)

This invention relates to a select area sensitizing device and in particular to a device for selectively charging a predetermined area on a rotating xerographic drum.

In a xerographic drum printer such as shown in the application to Derk J. Oldenboom, application No. 607,491, filed August 31, 1956, a conductive drum surface has bonded thereto a photoconductive layer of selenium. This drum is rotated and, as it rotates, the selenium layer is first charged by exposure to a corona charging unit and then selectively discharged by exposing the drum surface to an image of light. Later in the process, a developing powder is dusted on the rotating drum and the electrostatic image carried thereon to form a developed image which is then transferred to a print receiving member.

In a process such as described above, the xerographic drum is charged along its width and continuously about its periphery so long as the drum is rotated and the charging unit is turned on. For certain applications, however, a conventional corona charging unit is not suitable, for while a corona charging unit can be turned On and Off in accordance with a predetermined program to selectively charge areas of a xerographic drum, this process gives rise to the undesirable result that the initial and terminal portions of the sensitized area hereinafter referred to as the leading and trailing edges, respectively, of the voltage profile of the sensitized area are not sharply defined. It is convenient to define the width of a leading or trailing edge as that portion of the voltage profile of the sensitized area which represents the transition from the uncharged portion to the fully charged portion. Ordinarily the width of the leading and trailing edges corresponds to the cross-sectional width of the charging unit. The conditions leading to these transitions are as follows: At the instant of turn-on, the portion of the xerographic drum just leaving the region of the charging unit will not be charged at all, while the portions just entering will receive a full charge. All portions in between these two points will be charged to a point somewhere between zero and full charge. When the charging unit is turned off, a similar result occurs in the reverse order.

In this invention, the charging unit is operated to provide a selected charged area with a uniform charge and sharpened leading and trailing edges of the voltage profile of the area. A sensitizing device for producing a precisely selected area finds application in three distinct areas. One of these areas is where there are a number of documents to be reproduced whose physical area is much less than the area of the drum surface. These documents appear successively and if continuous drum sensitizing has been used, it is necessary that the portions of drum area between successive documents be

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discharged so that edges of documents will not print as black marks. A second application is where it is desired to copy only a portion of the master document, suppressing the printing from the remainder of the document. A third application is where it is desirable to resensitize areas which are discharged in the normal course of a previous exposure to permit the composition of the final document which will contain information from one or more optical stations. Examples of these applications of this principle are as follows:

(1) Transcription of name and address information from source documents;

(2) Placement of microfilm images adjacent information transcribed from conventional printed documents;

(3) Addition of repetitive information, such as check signatures; and

(4) Addition of other data, such as serial numbers which might be generated by an electronic display, or reflective character generator device.

It is therefore an object of this invention to provide an area sensitizing unit for precisely sensitizing a given area on a movable member.

It is another object of this invention to provide an area sensitizing device which is programmable according to the desired area to be sensitized.

It is a further object of this invention to provide an area sensitizing unit for a xerographic drum wherein a charging unit for charging the xerographic drum is selectively turned On and Off to provide for a sensitized area, with sharp leading and trailing edges of the voltage profile of the area.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of examples, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings:

Fig. 1 shows a schematic diagram of the xerographic drum apparatus.

Fig. 2 is a schematic illustration of a charging unit.

Figs. 3a and 3b are graphs of different charge patterns.

Fig. 4 is a detailed showing of the charging unit control means.

The schematic illustration of a xerographic printer of Fig. 1 has only those portions of the printer represented which are directly concerned with the present invention. For a more complete description of a xerographic printer, reference may be made to the Derk J. Oldenboom application, mentioned above. In Fig. 1, a motor 10 having a shaft 11 is energized for rotation by means not shown. Mounted on the shaft 11 is a drive pulley 12, a magnetic drum 14 utilized as a referencing apparatus and a xerographic drum 19 which could have a photoconductive insulating surface. When energized, the motor 10 rotates the drive pulley 12, magnetic drum 14 and xerographic drum 19.

The drive pulley 12 rotates a driven pulley 21 by means of a drive belt 13 to rotate a driven shaft 22 on which the driven pulley 21 is secured. The ratio of the pulley diameters is such that the driven shaft 22 will make a plurality of revolutions for each revolution of the drive shaft 11.

A conventional slip clutch 25 is interposed between the shaft 22 and a shaft 23 so that the shafts may rotate in unison or the shaft 23 may be selectively locked while

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still allowing rotation of shaft 22. A detent mechanism 29, shown more particularly in Fig. 4, cooperates with shaft 23 for selectively locking or preventing motion thereof. A switching mechanism 39 is operated in response to movement of shaft 23 to control the charging unit 59 positioned adjacent the xerographic drum 19. A power supply and voltage divider 40 furnishes voltage to the switching mechanism 39 for application to the corona discharge device 59.

The magnetic drum 14 is formed of a magnetizable material which will store a magnetic mark upon a suitable exposure to magnetic flux. A reading head 15 is positioned adjacent a peripheral track on which magnetic marks 14a and 14b, for the control of the instant apparatus, are stored. As the drum 14 rotates past the reading head, an electrical pulse will be generated which will be amplified by amplifier 16 and applied over a suitable line 17 to the detent mechanism 29. The magnetic drum, reading head and amplifier are conventional and form no part of the instant invention insofar as the specific details are concerned so that further description is not deemed necessary.

As a general description of the apparatus shown in Fig. 1, it will be assumed that motor 10 is energized and the shaft 11 is rotating along with drive pulley 12, magnetic drum 14 and xerographic drum 19 mounted thereon; the pulley 12, by means of belt 13, is driving pulley 21 so that shaft 22 is rotating with shaft 11; and the detent mechanism 29 is effective to lock shaft 23 against rotation and consequently operation of the switching apparatus 39. As a further condition, it will be assumed that the corona discharge device 59 is now turned off. When a magnetic mark 14a, associated with a predetermined position 19a on xerographic drum 19 is sensed by the reading head 15, the detent mechanism 29 is energized to allow operation of the switching unit 39 and consequently the energization of corona discharge device 59.

After a predetermined rotation of shaft 23, the detent mechanism 29 again becomes effective to prevent rotation of shaft 23 and consequently operation of mechanism 39. At this time, however, the charging unit is On and the xerographic drum is being charged continuously as it rotates. Another magnetic mark 14b on the drum 14 associated with a predetermined position 19b of the xerographic drum 19 actuates the detent mechanism 29 to turn the corona discharge device 59 Off in a similar manner to that described in relation to the On cycle.

It should be pointed out that the magnetic drum and associated circuitry is illustrative of a selective type of storage apparatus and could be replaced by any conventional mechanical or electrical apparatus wherein a particular position on a rotating member may be selected without departing from the scope of this invention.

The corona discharge device 59 shown in Fig. 2 is similar to the apparatus shown in the patent to Walkup, Patent No. 2,777,957, issued January 15, 1957. The unit comprises a grounded shield 70, a plurality of corona wires 71 energized by a voltage of approximately 6,000 volts and a plurality of grid wires 72 for controlling the corona discharge. An apertured shielding member 73 is placed directly under the corona charging unit to define the effective area of corona discharge. The xerographic drum 19 is shown directly beneath the apertured shielding member 73. By impressing a suitable positive voltage on the grid wires 72, a corona discharge is maintained between the corona wires 71 and the drum 19. The discharge is terminated by removing the positive potential from the grid wires 72 and substituting a negative potential.

The problem inherent in using a device such as shown in the Walkup patent for a continuously rotating drum is the fact that as the corona unit is turned On and Off, the areas a and c (Fig. 2) will suffer from less exposure than the intermediate area b. This occurs because the

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area a, while exposed for a period of time, is also continuously moving under the shielding member 73 so that the area a will have a charged area starting with a zero charge near the beginning edge to a maximum charge at the adjacent boundary of area b. The area b will be charged to a maximum charge throughout its length because this area has been exposed for a sufficient time period. In Fig. 3a, T0 represents the time at which the corona discharge device 59 was turned On; T1 represents the time at which the boundary of area a and area b moved under the shield 73; T2 represents a time at which the boundary of area b and area c was just emerging from under the shield 73 into the effective area of charging; and T3 represents a time at which the boundary of area b and area c was in the effective discharge area and spaced from the right side of shield 73 by the width of area c as the charging unit is turned Off. From this figure, it can be readily seen that only the area b will receive a full charge and that areas a and c will only receive a partial charge since both areas are beneath the charging area of the corona wires 71 for a time period which varies from zero time to a time adequate to receive a full charge.

It is necessary in selective charging of various areas on a xerographic drum that a reasonably sharp line of demarcation be maintained between charged and not charged areas. If the drum is charged, as shown in Fig. 3a, and it is desired to only use the area b of the drum, then an undesirable result is produced because partial printing will take place in areas a and c. If it is desired to use the entire area a, b and c, there will not be an adequate charge on the extremities a and c to adequately reproduce the image to be placed thereon and consequently poor printing will result.

To obviate this result, the grid wires 72 have been selectively energized at the same rate as the movement of the xerographic drum and in sequence. Therefore, to energize an area a, b, and c, it would be necessary that the first grid wire 72a be energized at the same time that the initial part of area a passes beneath grid wire 72a and each subsequent grid wire be energized as the same part of area a passed under each wire until all grid wires 72a-72o are energized and the area a is in the position as now shown in Fig. 2. Area a therefore will have received a charging time equal to the time that it took for this area to proceed across the shielded opening. When it is desired to terminate the sensitized area, the grid wires are selectively turned Off in the same manner starting with the end portion of area c. In this manner, the end portion of area c will selectively receive the charge controlled by the grid wires 72 at each point but the area directly behind area c will receive very little, if anything, since the grid wires directly above said area will be turned off as this area progresses across the shielded opening.

Fig. 3b illustrates the resulting charged area achieved in utilizing the selective energization of grid wires in sequence with the movement of areas a, b and c beneath the effective area of the corona charging unit.

Referring to Fig. 4, the detent mechanism 29 consists of a detent disc 30 having diametrically opposed slots 31 cooperating with a detent 32. The detent 32 is biased by a spring 33 about a pivot 34 and moved away from said disc 31 by an electromagnet 35 energized in response to the operation of the amplifier 16. The detent disc 30 is mounted on the shaft 23 and prevents or locks movement thereof when the detent falls in the slot 31. The electromagnet 35 being energized in response to a magnetic mark 14a, 14b on the drum 14 releases the disc 30 and allows the shaft 23 to rotate. The release is momentary so that the detent normally rides on the periphery of the disc and is engaged by the next successive slot 31.

The selective switching device 39 is designed to perform the selective energization of the grid wires as a

selected portion of the xerographic drum progresses under the charging unit. The device 39 comprises a plurality of stationary contacts 41a-41o which are connected respectively to the grid wires 72a-72o. Two sets of movable contacts 43 and 44 each contain a plurality of radially outwardly projecting contacts a through o adapted to cooperate with the stationary contacts 41. The peripheral velocity of the movable contacts is adjusted by means of the pulley diameters to correspond to the peripheral velocity of the xerographic drum. The stationary contacts are molded into an insulator 42 which isolates the contacts one from the other and supports the same in the circular arrangement as shown. The movable contacts are carried on an insulating disc 47 mounted for rotation on the shaft 23. Each set of movable contacts 43 and 44 is connected by means of slip rings 48 and 49 and brushes 50 and 51, respectively, to the source of potential 40 which furnishes +800 v. and -800 v. to each set respectively. The voltage divider network has a 6 kv. potential applied thereto for the corona unit, line 54, and two taps for the +800 and -800.

The detent disc notches 31 are aligned with the detent 32 when either the dividing line between plus contacts 43 and minus contacts 44 on the movable contact assembly is on either side of the stationary contacts 41. In operation, the detent disc 30 is normally engaged by the detent 32 and held from movement by the slip clutch 25 which is attached to the drive shaft 22 connected to the shaft 11 of the motor 10. At a point where it is desired to initiate an area of charge, a magnetic mark 14a is placed at this location on the track assigned to such purpose on the magnetic drum 14. When the magnetic mark 14a is read and amplified, the electromagnet 35 is energized, as shown in Fig. 4, to remove the detent 32 from the detent disc 30 and allow the movable contacts 43 and 44 to rotate in unison with the rotation of the shaft 22.

As shown in Fig. 4, the movable contacts 43 are connected individually a through o to the stationary contacts 41a through 41o so that a potential of -800 volts is being applied to the grid wires 72a through 72o, and no corona discharge is being effected to the moving xerographic drum 19.

As movable contact 44o reaches each stationary contact the potential of -800 volts maintained by contact 43a is changed to +800 volts and that portion 19a of the xerographic drum then passing beneath the grid wire 72a is exposed to the corona discharge. It is seen therefore that each grid wire 72 is energized successively as the shaft 23 rotates, while the grid wires ahead of the energized grid wires are maintained at -800 volts by the plurality of movable contacts 43 which precede plus contact 44o. The last minus contact 43a is therefore associated with the first portion of the area on the xerographic drum which is to be charged and when this last contact reaches last grid wires 72o, the entire charging unit will have been turned On and the area passing beneath the charging unit at that time will be exposed for a uniform time duration.

At the same time that the first plus potential movable contact 44o has reached the last contact 41o, the notch 31 of detent disc 30 will be opposite the detent 32 which is spring biased to fall into the notch 31 and hold the movable contacts 43 and 44 from further movement. Fig. 3b illustrates an example of area charging corresponding to the area shown in Fig. 2. In this example, the charging unit would stay On for a period equal to the time it takes area c to pass from beneath the apertured plate 73. The end of area c would correspond to the position of magnetic mark 14b on drum 14. When mark 14b is sensed, the detent 32 will be removed, the movable contacts will rotate and successive grid wires will have minus potential placed thereon in synchronism with the movement of the xerographic drum. The last

contact 44a of positive potential will correspond to the end of the desired charging area c and since this contact moves in synchronism with this last incremental area there will be a uniform charge over the entire area a, b and c.

The stator contact points are separated sufficiently to prevent breakdown when a maximum of 1600 volts difference is applied across any two contiguous points. The rotor points are of such size that the rotor points are disconnected from the stator points for a short interval each time a rotor point advances from one stator point to the next.

The condenser 74 and resistor 75 are illustrated as attached to grid wire 72o and it is to be understood that each grid wire has a similarly attached arrangement. The condenser 74 is utilized to maintain the charge on the grid wire while the movable contacts 43 and 44 are spaced between stationary contacts 41 and to provide a discharge path through resistor 75 to ground when the voltage applied to grid wires 72 is abruptly charged. The resistor 75 is proportioned to limit the peak charging current to a safe value. The resistor 76 shown dotted represents the leakage resistance between the grid wires 72 and ground.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a machine including a moving charge receiving element, a discharge device fixed in proximity to said element and overlying a predetermined area thereof, a plurality of discharge control means for said device with each said control means effective to control individual incremental segments of said predetermined area, and switching means for said control means synchronized with the movement of said element to operate said control means and allow charge to flow from said discharge device to successive incremental segments of said predetermined area.

2. The apparatus of claim 1 further including a referencing apparatus synchronized with the movement of said charge receiving element and containing control data, and a sensing device situated adjacent said referencing apparatus for detecting said reference data and actuating said switching means in response thereto.

3. The apparatus of claim 2 wherein said discharge device comprises a corona charging apparatus and said control means is a grid wire extending across said predetermined area and is responsive to plus or minus potentials for alternatively allowing or preventing charge flow from said device to said receiving element.

4. The apparatus of claim 3 wherein said switching means comprises a set of stationary contacts each connected to one of said grid wires and two sets of movable contacts, a detent mechanism operable to prevent movement of said movable contacts when one set is contacting all stationary contacts.

5. The apparatus of claim 4 wherein said sensing mechanism is operable to release said detent upon the occurrence of a control datum to allow successive contacts in a series to contact successive stationary contacts.

6. In a xerographic printer including a rotating photoconductive insulating drum operable to accept and store optical images on selected charged areas of said drum, a discharge device fixed in proximity to said drum for charging said drum, a plurality of discharge control means for said device operable to control the flow of charge from said device to said drum, and switching means synchronized with the movement of said drum for sequentially

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operating each said control means as the borders of said selected area move beneath each said control means.

7. The apparatus of claim 6 wherein said switching means includes a commutator normally restrained from movement but operable when the borders of said selected area move beneath the first reached control means to rotate, said commutator comprising means for connected selected potentials to said control means.

8. The apparatus of claim 7 wherein said discharge

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device comprises a corona charging unit and said control means is a grid wire.

References Cited in the file of this patent

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2,802,085	Rothacker	Aug. 6, 1957