United States Patent

Fujimoto

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[54] INFORMATION RECORDING DEVICE

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[52] **U.S. Cl.**.....**355/3**
[51] **Int. Cl.**.....**G03g 15/00**
[58] **Field of Search**.....355/3, 10, 11, 13

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Attorney—Burgess, Ryan and Hicks

[57] **ABSTRACT**

An electrostatic-photographic information recording device wherein a recording sheet is fed through an electrostatically charging section, an exposure section (photographing and recording section), a developing section and a drying section. The pressure rollers disposed in said sections and feed rollers are displaced by operation of one lever from the exterior of the device to the positions so as to open the path of feed of said recording sheet for loading the same in the device.

3 Claims, 8 Drawing Figures

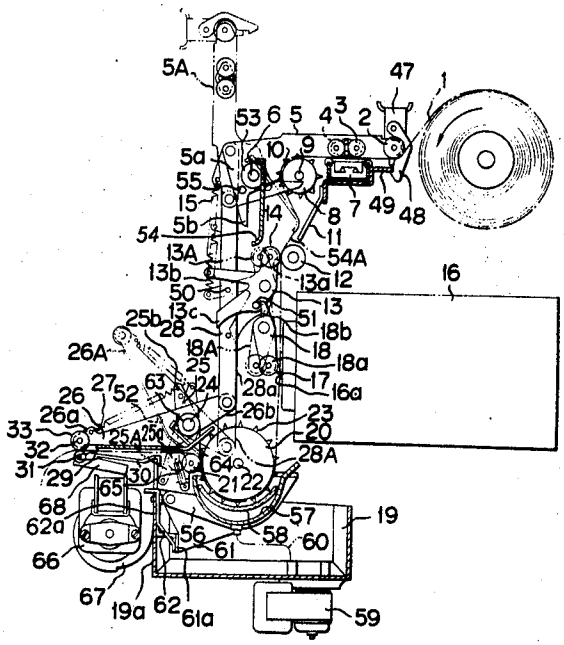
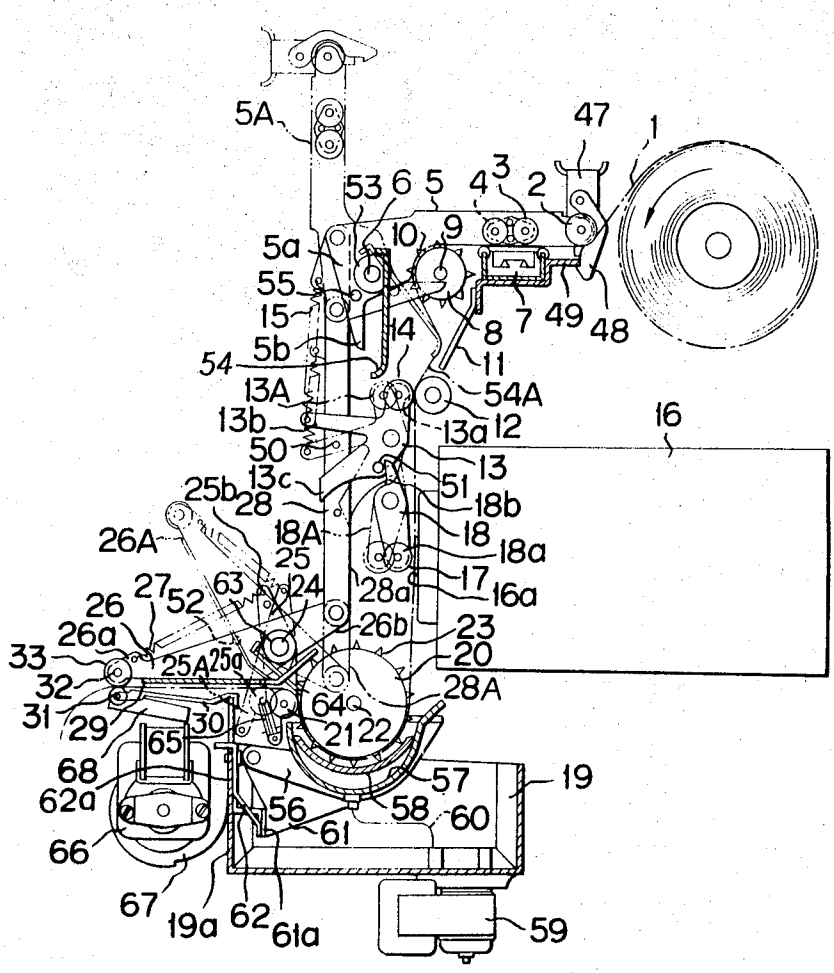


FIG. 1



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FIG. 2

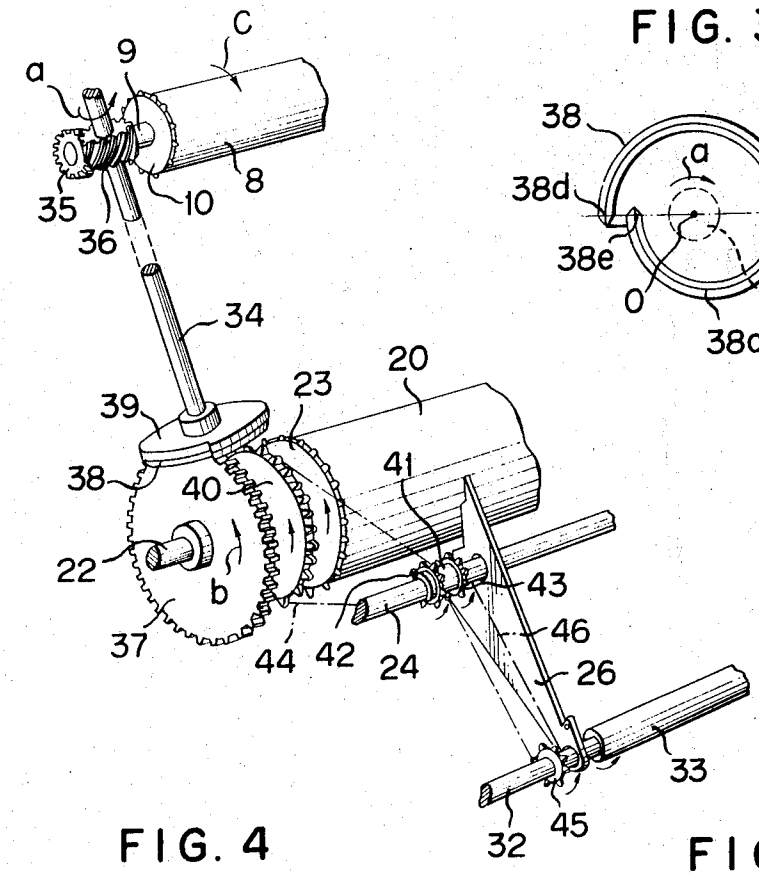


FIG. 3

FIG. 4

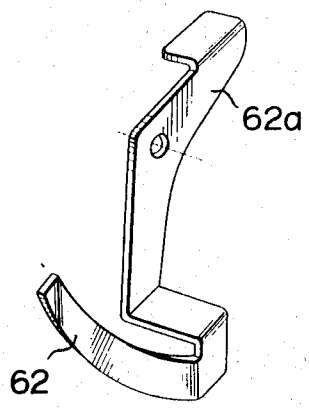
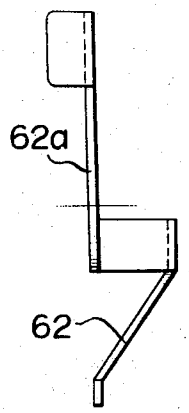


FIG. 5



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FIG. 6

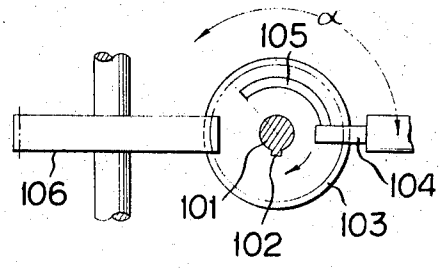


FIG. 7

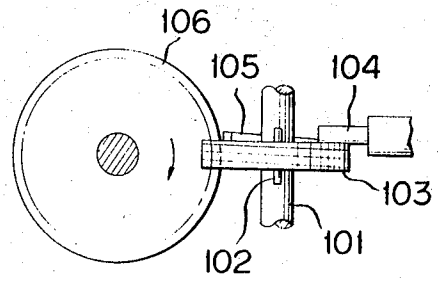
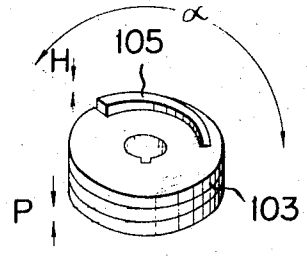


FIG. 8



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INFORMATION RECORDING DEVICE

BACKGROUND OF THE INVENTION

The present invention generally relates to an information recording device and more particularly to an information recording device utilizing electrostatic photography.

The conventional photographic device has been widely used for recording information, but since silver halides are used as the sensitive agent, the processing is tedious and both of the apparatus and the materials are very expensive.

One of the objects of the present invention is to eliminate the above described defects encountered in the conventional photographic device.

Another object of the present invention is to provide an information recording device utilizing the electrostatic process.

A further object of the present invention is to provide an information recording device incorporating therein an electrostatically charging section, an exposure section, a developing section and a drying section all of which are arranged to cooperate with one another for recording the information upon a recording sheet.

A still another object of the present invention is to provide an information recording device in which the recording sheet is advanced intermittently in the exposure section.

A yet another object of the present invention is to provide an information recording device in which all of the pressure rollers disposed in the sections described above are simultaneously displaced to the positions away from the recording sheet upon operation of one lever thereby opening the path of feed of the recording sheet and facilitating the loading of the recording sheet into the device.

A further object of the present invention is to provide an information recording device in which the developing time can be arbitrarily adjustable.

SUMMARY OF THE INVENTION

In brief, the present invention provides an information recording device of the type in which the images of information continuously transmitted electrically or optically can be successively projected and recorded upon a recording sheet at high speed by the electrostatic photographic process.

According to one aspect of the present invention, a cathode ray tube (CRT) is used as an information displaying device, and a recording sheet having a light sensitized coating layer such as special zinc oxide or the like formed upon one side surface thereof is made to pass upon the face plate of the cathode ray tube with the sensitized layer being in contact with the face plate. Prior to this, the recording sheet is electrostatically charged in the charging section and then exposed in the exposure section by the light image formed upon the face plate of the cathode ray tube, thereby forming an electrostatic latent image corresponding to the information light image. When the recording sheet is being exposed, it remains stationary. The exposed recording sheet is transported to the developing section where it is developed and then directed further toward the drying section where it is dried and from where it is discharged out of the device. In this case, to intermittently transport the recording sheet in order to hold stationary the recording sheet against the face plate of the cathode ray tube when it is being exposed, an intermittent drive mechanism which will be described in more detail hereinafter is utilized.

All of the pressure rollers for the recording sheet are simultaneously retracted from the path of feed of the recording sheet by operating only one lever so that the path of feed is opened or becomes accessible for loading the recording sheet into the device.

In order to adjust the developing time, one cam is used so as to incline a developing solution tray, thereby varying the level of the solution in the tray.

The above and other objects, features and advantages of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a side view illustrating only the essential parts of an information recording device of the present invention;

FIG. 2 is a perspective view illustrating one embodiment of an intermittent drive mechanism of the present invention;

FIG. 3 is an end view illustrating one example of a cam used in said mechanism;

FIG. 4 is a perspective view of one example of a cam used in a developing time adjustment mechanism;

FIG. 5 is a top view thereof;

FIG. 6 is a plan view of another embodiment of an intermittent drive mechanism of the present invention;

FIG. 7 is a front view thereof; and

FIG. 8 is a perspective view of a worm having said cam formed thereupon.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a roll of recording sheet 1 comprising light sensitized sheet having a photoconductive layer of zinc oxide or the like coated upon one surface thereof is loosely fitted over a stationary shaft. The rolled sheet 1 has perforations formed along either or both side edges thereof. A rocking arm 5 pivotably carried by a shaft 6 extends toward the rolled recording sheet 1 and has a guide roller 2 rotatably carried at the free end thereof and a pair of rollers 3 and 4 which serve as one electrode of a pair of electrodes, the other of which is shown by a wire electrode 7, for imparting the charge to the recording sheet 1. A feed roller 8 having a sprocket 10 formed integral therewith is carried by the drive shaft 9 at the side opposite to the guide roller 2 relative to the wire electrode 7. Upon rotation of the drive shaft 9, since the perforations of the recording sheet 1 engage with the sprocket teeth of the sprocket 10, the recording sheet is pulled from the roll. That is, the recording sheet 1 is guided by the guide roller 2, passes through the space between the rollers 3 and 4 and the wire electrode 7 and is further advanced downwardly by the feed roller 9.

The electrostatically charging section constructed by the above described rollers 3 and 4 and the wire electrode 7 is energized at the instant when the drive shaft 9 is driven so that the recording sheet 1 with its sensitized surface directed downwardly is continuously electrically charged as the sheet is advanced by the sprocket 10 and the feed roller 8.

Below the feed roller 8 is disposed a recording sheet guide plate 11 which in turn is fixedly secured to a stationary member of the machine. Below the leading edge of the guide plate 11 are disposed a pair of guide rollers 12 and 14. The roller 12 is rotatably carried by a stationary member of the machine while the roller 14 is rotatably carried by one end 13*a* of a rocking member 13 which in turn is pivotably mounted upon the stationary member of the machine. Furthermore, the guide roller 14 is imparted with a tendency of normally pressing against the guide roller 12 by a spring 15 interconnected between the leading end of an arm 13*b* integrally attached to the rocking member 13 and the upper end of a connecting lever 28 pivotably carried at the rear end 5*a* of the rocking arm 5.

Below the pair of guide rollers 12 and 14 is arranged and disposed a recording sheet exposure section comprising an information image projection device 16 such as a CRT or the like and a roller 17 which is normally pressed against the face plate 16*a* of the device 16. The roller 17 is rotatably carried at one end 18*a* of a rocking member 18 pivotably mounted upon the stationary member of the machine and is normally pressed against the face plate 16*a* by a spring (not shown).

Below the exposure section is disposed a developing or processing section comprising a developing solution vessel 19 and a pair of developing rollers 20 and 21. The roller 20 is carried by a drive shaft 22 which rotates intermittently having a sprocket 23 formed integrally therewith while the roller 21 is rotatably carried at the one end 25*a* of a rocking member 25 loosely fitted over a shaft 24 extending from the stationary member of the machine. A spring 27 is interconnected

between the other end 25*b* of the rocking member 25 and one end 26*a* of a rocking member 26 pivotably carried by a shaft 24. The other end 26*b* of the rocking member 26 is pivotably carried at the lower end 28*a* of the connecting rod 28 which in turn is pivotably carried at the upper portion of the rear end 5*a* of the rocking arm 5. As far as the rocking arm 5 is stationary, the rocking member 26 will not move back and forth so that the roller 21 is normally pressed against the roller 20 by the spring 27.

The recording sheet 1 advanced by the roller 8 and the sprocket 10 passes through the guide plate 11, the pair of guide rollers 12 and 14, the exposure section, the developing rollers 20 and 21 and further advances by means of the sprocket 23 which engages with the perforations of the recording sheet 1.

The information light image to be recorded is projected upon the recording sheet 1 at the projection device 16 in the exposure section so that electrostatic latent images are formed upon the sensitized surface of the recording sheet 1 successively as it passes through this section. The exposed recording sheet 1 is immersed by the roller 20 into a developing solution consisting of a carrier having resin coated carbon black suspended therein and a high electrical resistance, so that the electrostatic latent image is developed into a visible image. Thereafter, the recording sheet 1 is advanced out of the developing section through the rollers 20 and 21.

Beyond the rollers 20 and 21 are arranged a guide plate 29 which is securely fixed to the undersurface of the rocking member 26 and a roller supporting plate 30 which is securely fixed to the stationery member and made of a resilient material. At the leading end of the roller supporting plate 30 is rotatably carried a roller 31. A roller 33 is rotatably carried by a drive shaft 32 carried at the one end 26*a* of the rocking member 26 and is normally pressed by the roller 31. It will be seen that the developed recording sheet 1 is discharged out of the machine through the pair of rollers 31 and 32.

In the exposure section, the recording sheet 1 must stop stationarily for the time when the recording sheet 1 is exposed so that the shaft 22 carrying the developing roller 20 must be driven intermittently by an intermittent drive mechanism as shown in FIG. 2.

Referring to FIG. 2, a shaft 34 has at one end thereof a toothed wheel 36 which meshes with a toothed wheel 35 carried by the shaft 9 of the roller 8 and at the other end a cam 39 having a ridge 38 which is adapted to engage with a toothed wheel 37 carried by the shaft 22 of the roller 20. The toothed wheel 37 engages with the ridge 38 at the right side portion of the cam 39 when the toothed wheel 37 and the cam 39 are viewed from the side of the roller 20.

The cam 39 has a semicircular ridge 38*a* whose center coincides with center O of the cam 39 and a ridge 38*c* which is smoothly connected to one end 38*b* of the ridge 38*a* and approaches gradually inwardly toward the center O. The starting end 38*d* of the semicircular ridge 38*a* is spaced apart from its opposing point 38*e* of the ridge 38*c* by a distance corresponding to an exposure time of the recording sheet 1. Therefore, when the shaft 34 is rotated in the direction indicated by the arrow *a* continuously by a drive device (not shown), the toothed wheel 37 remains stationary when engaged with the semicircular ridge 38*a*, but is caused to rotate in the direction indicated by the arrow *b* through an angle corresponding to the above distance between the starting end 38*d* and the point 38*e* when engaged with the ridge 38*c*. Thus, it will be seen that the recording sheet is intermittently advanced or transported by the roller 20 and the sprocket 23 which rotate in unison with the toothed wheel which intermittently rotates as described hereinabove. In this case, during this intermittent advance the recording sheet 1 is stopped stationarily for the time during which it is exposed and this exposure time, that is the time when the advance of the recording sheet is stopped may be determined by a length of the ridge 38*a*. The ridge 38*c* may be arranged so as to be spaced away from the center O gradually outwardly.

The shaft 22 carries a sprocket 40 wheel while a tubular shaft 41 fitted loosely over the shaft 24 carries sprocket wheels 42 and 43. Chain 44 is lapped over the sprockets 40 and 42 so that the intermittent rotation of the toothed wheel 37 is transmitted to the sprocket wheel 43. A sprocket wheel 45 is carried by a shaft 32 and a chain 46 is lapped over this sprocket 45 and the sprocket 43 so that the rotation of the sprocket 43 is transmitted to the roller 33. Therefore, the recording sheet 1 which is advanced intermittently by the roller 20 and the sprocket 23 is intermittently discharged out of the machine without causing any slack because of the provision of the rollers 31 and 33.

When the recording sheet 1 has a long length as shown in this embodiment, it must be loaded in the machine along the passage thereof for charging, exposure and developing from the roller 2 to the pair of rollers 31 and 33.

Next, the description will be directed to the recording sheet path opening device for loading the recording sheet 1 in the machine along its path of feed. Referring back to FIG. 1, at the top end of the rocking arm 5 is rotatably carried a handle 47 which in turn has an engaging lever 48 and is adapted to engage with an engaging plate 49 fixedly secured to the stationary member. The engaging lever 48 has a tendency of normally pressing against the engaging plate 49 by means of a spring (not shown), but when the handle 47 is pulled toward the left in FIG. 1, the engaging lever 48 is released from the engagement with the engaging plate 49. When the handle 47 is raised after disengaging the engaging lever from the engaging plate 49, then the rocking arm 5 is caused to rotate in the counterclockwise direction in FIG. 1 about the shaft 6 so that the projection 5*b* formed at the lower portion of the rear end 5*a* abuts against the shaft 9 and stops at a position indicated by the chain line 5A. In this case, the connecting rod 28 is lowered down to the position indicated also by the chain line 28A so that the rocking member 26 is displaced toward the position indicated by the chain line 26A. Concurrently, a pin 50 extending from an intermediate area of the ends of the connecting rod 28 presses against the one end 13*c* of the rocking member 13 so that the rocking member 13 is displaced to the position indicated by the chain line 13A.

A pin 51 is attached to the one end 13*c* of the rocking member 13 at a position opposing the one end 18*b* of the rocking member 18 so that the rocking member 13 pushes the one end 18*b* of the rocking member 18 through the pin 51, whereby the rocking member 18 is displaced to the position indicated by the chain line 18A. A pin 52 fixedly attached to the rocking member 26 pushes the one end 25*b* of the rocking member 25 when the rocking member 26 is being displaced so that the rocking member 25 is displaced to the position indicated by the chain line 25A. Thus, when the rocking arm 5 and the rocking members 13, 18, 26 and 25 are displaced to their positions as described hereinabove, the rollers 2, 3, 4, 14, 17, 21 and 33 carried by the above rocking arm and members respectively are also displaced so that the path of feed of the recording sheet is opened, whereby a long recording sheet 1 may be loaded into the machine along its feed path from the roller 2 to the pair of rollers 31 and 32.

The recording sheet 1 is advanced continuously down to the pair of rollers 12 and 14 through the roller 8 and the sprocket 10 both of which are rotated continuously in the direction indicated by the arrow *c* in FIG. 2 from the drive device through the toothed wheel 38 in mesh with the toothed wheel 36 carried by the shaft 34. After having passed through the pair of rollers 12 and 14, the recording sheet 1 is advanced intermittently through the roller 20 and the sprocket 23 which rotate intermittently.

In order that the recording sheet 1 may not be advanced in an irregular manner and may not be subjected to excess tension, a recording sheet slack forming mechanism comprised of a slack forming member 54 fixedly carried by a boss 53 loosely fitted over the shaft 6 in opposed relation with the guide plate 11 is disposed below the roller 8 and the sprocket 10. The slack forming member 54 is adapted to move back and forth in

response to the operation of the recording sheet path opening mechanism constructed with the rocking arm **5** and other members as described hereinabove. That is, a pin **55** is fixed to a position adjacent to the shaft **6** of the rocking arm **5** so that the pin **55** pushes forward the slack forming member **54** when the rocking arm **5** is displaced to the position **5A** indicated by the chain line so as to load the recording sheet **1** into the machine. Therefore, the slack forming member **54** is displaced to the position **54A** indicated by the chain line so that between the slanting guide plate **11** and the slacking forming member **54** slack is easily formed in the recording sheet. After the slacked portion is formed, the rocking arm **5** is returned to the position indicated by the solid line so that the slack forming member **54** is also returned to its initial position indicated by the solid line at which the member **54** depends. After the recording sheet **1** has been loaded in the machine, the continuous feed of the recording sheet **1** by the roller **8** and the sprocket **10** is suitably adjusted relative to the intermittent feed by the roller **20** and the sprocket **23** so that the slack of the recording sheet **1** formed as described hereinabove may be maintained. The pair of rollers **12** and **14** also serve to maintain this slack.

The developing solution vessel **19** has a developing solution tray or saucer **57** fixed to a supporting body **56** which in turn is rotatably carried by one side wall of the machine and within this tray **57** is disposed a recording sheet guide plate **58** having perforations formed therein along the path of the sheet. At the bottom of the developing solution vessel **19** is mounted a developing solution circulation pump **59** so that the developing solution contained in the vessel **19** is pumped by the pump **59** through a pipe **60** communicating the pump with the bottom of the developing solution tray **57** and ejected through the perforations of the guide plate **58** so that the exposed recording sheet **1** advanced by the developing roller **20** is immersed into the developing solution. After having developed the recording sheet **1**, the solution overflows from the side edge of the developing solution tray **57** and is returned into the developing solution vessel **19**.

In order to cause the movement of the developing solution tray **57** so that the level of the developing solution within the tray **57** may be moved up and down in response to a required developing time, a developing time adjustment mechanism is mounted upon the side wall of the developing solution vessel **19**. That is, a rocking lever **62***a* having cam **62** formed integral therewith and adapted to contact with a depending fin **61***a* integrally formed with the supporting body **56** of the developing solution tray **57** is mounted upon the side wall **19***a* of the developing solution vessel **19**. The configuration of this cam **62** is best shown in FIGS. **4** and **5** and when the rocking lever **62***a* is moved from the exterior of the machine, the cam **62** is also rocked so that the depending fin **61** in contact with the cam **62** is moved right and left in the figure. Since the leading edge of the cam **62** is curved or bent and is always in contact with the inner wall of the vessel **19**, the cam **62** can securely support the depending fin **61**, and the developing solution tray **57** may be held in a suitably inclined position. This cam **62** can have any other suitable configuration such as a disk. In this arrangement, the developing solution overflows from one side edge of the tray **57** so as to return it to the vessel **19** so that the level of the developing solution may be raised or lowered by the developing solution tray **57** which can be inclined so that the time during which the recording sheet **1** is immersed in the developing solution may be varied as needs demand.

At the discharge side of the roller **20**, the sprocket **23** and the roller **21** is disposed a recording sheet guide plate **64** fixedly secured to a boss **63** fixedly carried by the shaft **24** in such a manner that the leading edge thereof is closely spaced apart from the roller **20**. This guide plate **64** serves to prevent the recording sheet **1** from being wound around the roller **20** when the sheet **1** is loaded into the machine. A cleaner **65** which is pressed against the roller **21** is disposed at the one end **25***a* of the rocking member **25** so that the toner, dust and the like attached to the roller **21** may be removed. A blower **66** is mounted below the rollers **31** and **32** so that dried air is supplied through ducts **67** and **68** upon the developed recording sheet **1**, thereby drying the same.

As mentioned above, the present invention is to provide an information recording device in which the successively electrically or optically transmitted information images can be projected and recorded upon the recording sheet of the electrostatic photography so that the high-speed information recording can be effected continuously and automatically without the necessity of any complicated process, thereby remarkably improving the information processing efficiency.

Next another embodiment of the intermittent drive device according to the present invention will be described with reference to FIGS. **6**, **7** and **8**.

A drive shaft **101** has a key **102** and above the drive shaft **101** is disposed a worm **103** adapted to engage with the key **102**. The worm **103** has a pull-down cam **105** which contacts with a stationary member **104** and is in mesh with a worm wheel **106**. Let it be that the pitch of the worm **103** is P, the pull-down angle of the pull-down cam **105** an angle of α and the height thereof H given by the relation of $H = P \times (360 - \alpha)/360$. When the drive shaft **101** is rotated in the direction indicated by the arrow through α the worm **103** is lowered by a distance corresponding to the height H because of the interrelation of the worm **103** with the stationary member **104** and the pull-down cam **105**. In this case, the worm **103** causes the worm wheel **106** to rotate in the direction indicated by the arrow through an angle equal to $P \times \alpha\beta 60$. That is upon rotation of the worm **103** through an angle of α, the worm wheel **106** is rotated in the direction indicated by the arrow through an angle equal to

$$H + P \times \frac{\alpha}{360} = P \times \frac{360 - \alpha}{360} + P \times \frac{\alpha}{360} = P$$

Then, the worm **103** rotates through an angle of $(360 - \alpha)^{\circ}$, but since the resistance between the drive shaft **101** and the worm **103** is extremely small, the worm **103** can not rotate the worm wheel **106** but rises by a distance equal to $P \times (360 - \alpha)/360 = H$, thereby returning its initial position. That is, when the drive shaft **101** makes contact on rotation the worm **103** rotates through an angle of α so that the worm **106** is rotated through an angle corresponding to the pitch P, but when the worm **103** rotates through the remaining angle of $360 - \alpha$ the worm wheel **106** is not rotated. Thus, the worm wheel **106** is intermittently rotated.

From the foregoing, it is obvious that in the intermittent drive device of the present invention, the worm and the worm wheel are utilized so that the pull-down cam formed upon the worm imparts the intermittent rotation of the worm wheel, whereby positive and reliable intermittent rotation or drive can be ensured. Furthermore, the pull-down angle α may be freely selected as needs demand so that various intermittent rotation or drive may be arbitarily selected very advantageously.

The present invention has been so far described in detail with particular reference to the preferred embodiments thereof, but it will be understood that variations and modifications can be effected without departing from the true spirit thereof as described hereinabove and as defined in the appended claims.

I claim:

1. An information recording device comprising:
means for optically displaying the information transmitted;
a recording sheet;
means for imparting said recording sheet with an electrostatic charge;
means for providing a slack portion in said recording sheet;
means for exposing said recording sheet by light rays from said optically displayed information to form a latent image thereon;
means for developing the latent image formed on said recording sheet;
means for drying said developed recording sheet;

means for advancing said recording sheet including guide rollers, feed rollers, pressure rollers and discharge rollers disposed at spaced positions in said device for advancing said recording sheet along a feed path in said device in a predetermined state, said rollers adapted to be displaced at said positions to open said feed path upon actuation of means operable from the exterior of said device; and

said means for advancing said recording sheet includes an intermittent drive mechanism comprising

a cam having an arcuate ridge whose center coincides with the center of rotation of said cam and another ridge which is smoothly interconnected to one end of said first mentioned arcuate ridge and gradually approaches toward or moves away from said center of rotation, and

a toothed wheel in mesh with said ridges and carried by a drive shaft.

2. An information recording device comprising

means for optically displaying the information transmitted;

a recording sheet;

means for imparting said recording sheet with an electrostatic charge;

means for providing a slack portion in said recording sheet;

means for exposing said recording sheet by light rays from said optically displayed information to form a latent image thereon;

means for developing the latent image formed on said recording sheet;

means for drying said developed recording sheet;

means for advancing said recording sheet including guide rollers, feed rollers, pressure rollers and discharge rollers disposed at spaced positions in said device for advancing said recording sheet along a feed path in said device in a predetermined state, said rollers adapted to be displaced at said positions to open said feed path upon actuation of means operable from the exterior of said device; and

said providing means for advancing said recording sheet includes an intermittent drive mechanism comprising

a worm carried by a drive shaft slidably of the axis of said shaft, and

a worm wheel in mesh with said worm,

said worm having a pull-down cam which contacts a stationary member so that said worm is caused to slide axially of said shaft upon rotation of said worm.

3. An information recording device comprising

means for optically displaying the information transmitted;

a recording sheet;

means for imparting said recording sheet with an electrostatic charge;

means for providing a slack portion in said recording sheet;

means for exposing said recording sheet by light rays from said optically displayed information to form a latent image thereon;

means for developing the latent image formed on said recording sheet;

mean for drying said developed recording sheet;

means for advancing said recording sheet including guide rollers, feed rollers, pressure rollers and discharge rollers disposed at spaced positions in said device for advancing said recording sheet along a feed path in said device in a predetermined state, said rollers adapted to be displaced at said positions to open said feed path upon actuation of means operable from the exterior of said device; and

said recording sheet slack providing means comprises

a member which is adapted to advance into the path of said recording sheet between said recording sheet feed roller disposed upwardly of said exposure means and said exposure means in response to said opening of said feed path of said recording sheet by said recording sheet path opening mechanism and to retract from said first mentioned path upon closing of said feed path of said recording sheet.

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