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Cook

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[45] **Sept. 16, 1975**

[54] **CLUTCHES**

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[73] Assignee: **Xerox Corporation,** Stamford, Conn.

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[52] **U.S. Cl.** **74/82;** 192/28; 192/33

[51] **Int. Cl.** **F16d 43/26;** F16d 11/02

[58] **Field of Search** 74/82; 192/33, 28, 29

[56] **References Cited**

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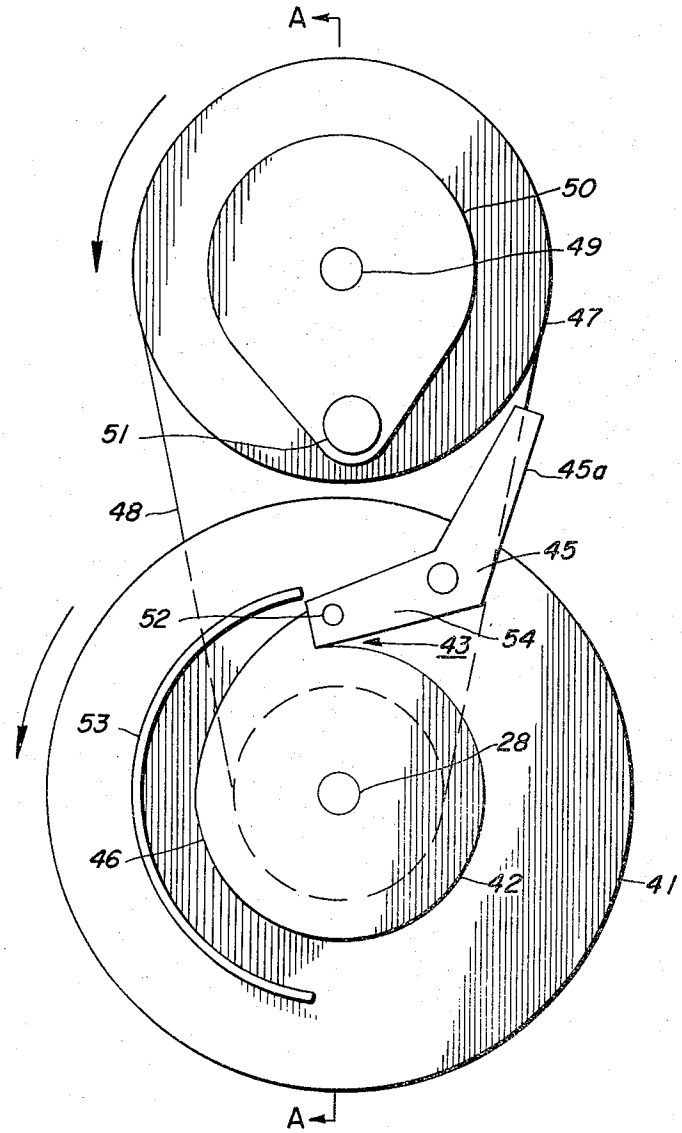
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Primary Examiner—Allan D. Herrmann

[57] **ABSTRACT**

A reproduction machine having a document scanning system has an improved recycling clutch for operating the system. The clutch has a rotatable input plate and a rotatable output plate. A pawl pivotally mounted on the input plate is biased into engagement with a notch on the output plate. A rotatable timing pulley driven by the input plate periodically contacts the pawl to disengage the latter from the output plate to effect release of the clutch at intervals greater than a revolution of the input plate. An arcuate ramp maintains the disengagement of the pawl from the output plate for a sufficient length of time to permit rotation of the latter in the reverse direction greater than one revolution via a biasing spring.

5 Claims, 4 Drawing Figures



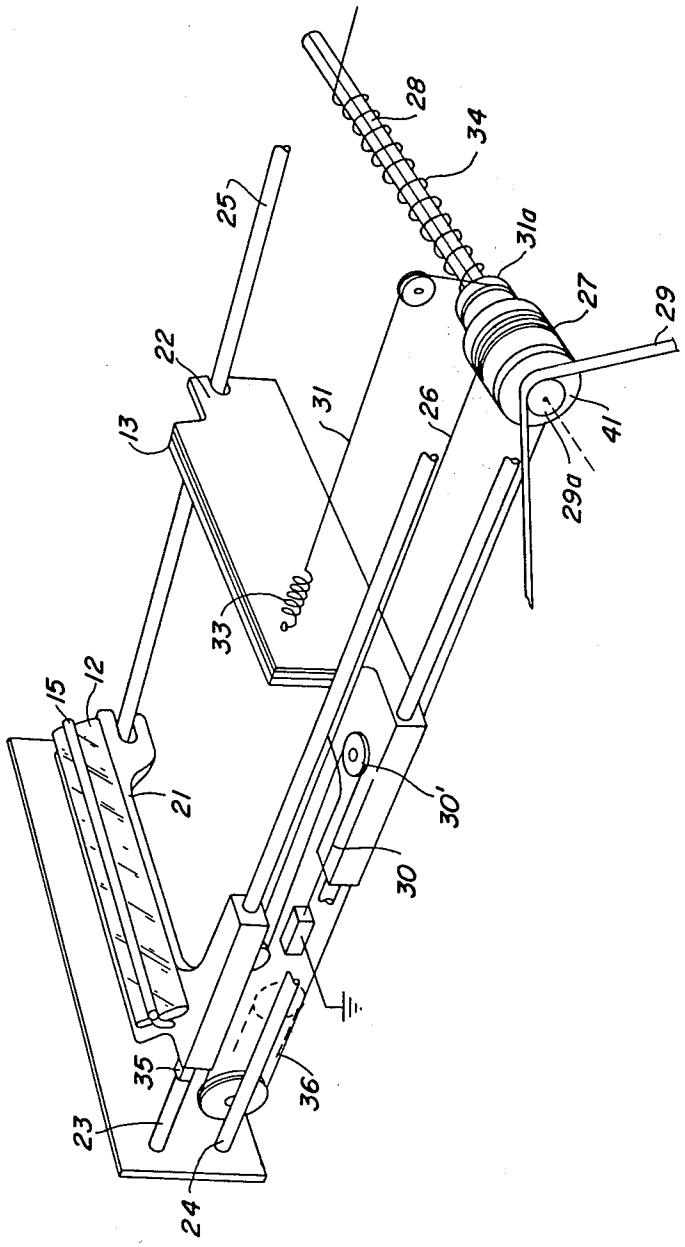
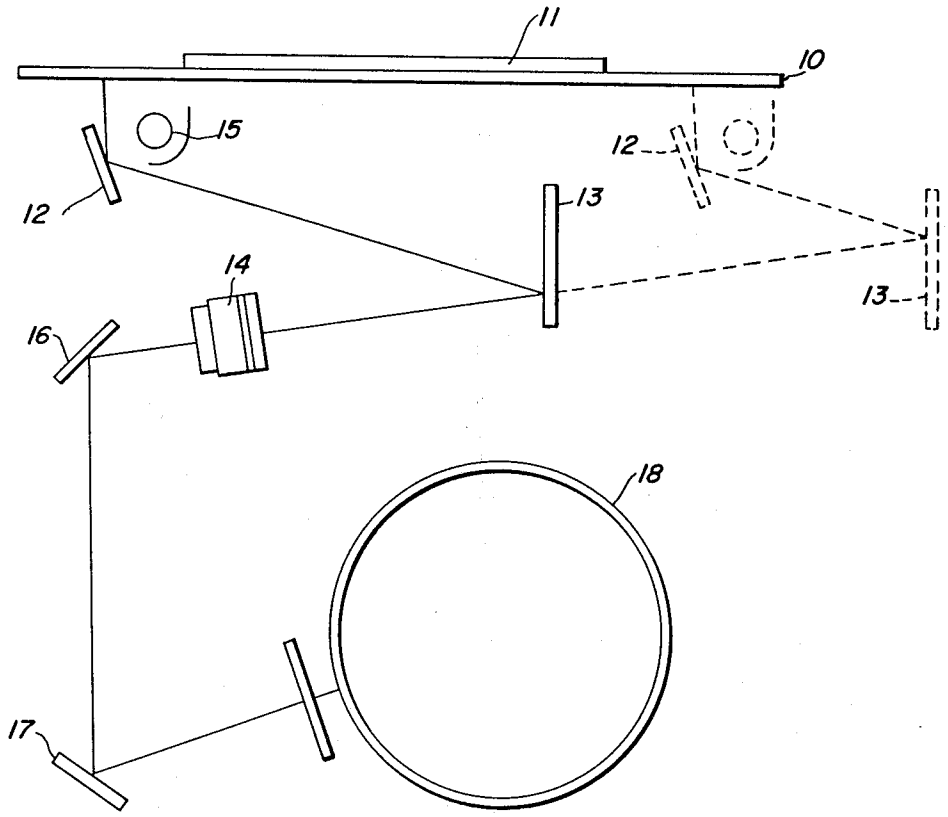


FIG. 1

FIG. 2



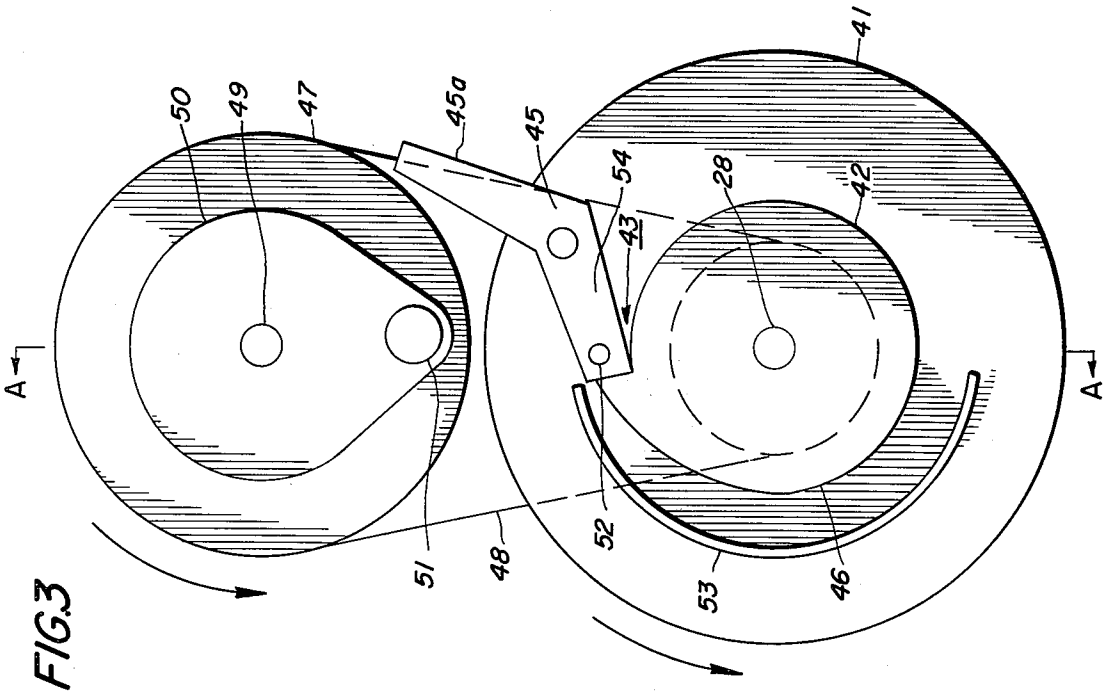

41
50
49
47
45a
45
54
28
42
43
A
A
52
51
48
53
46

FIG.3

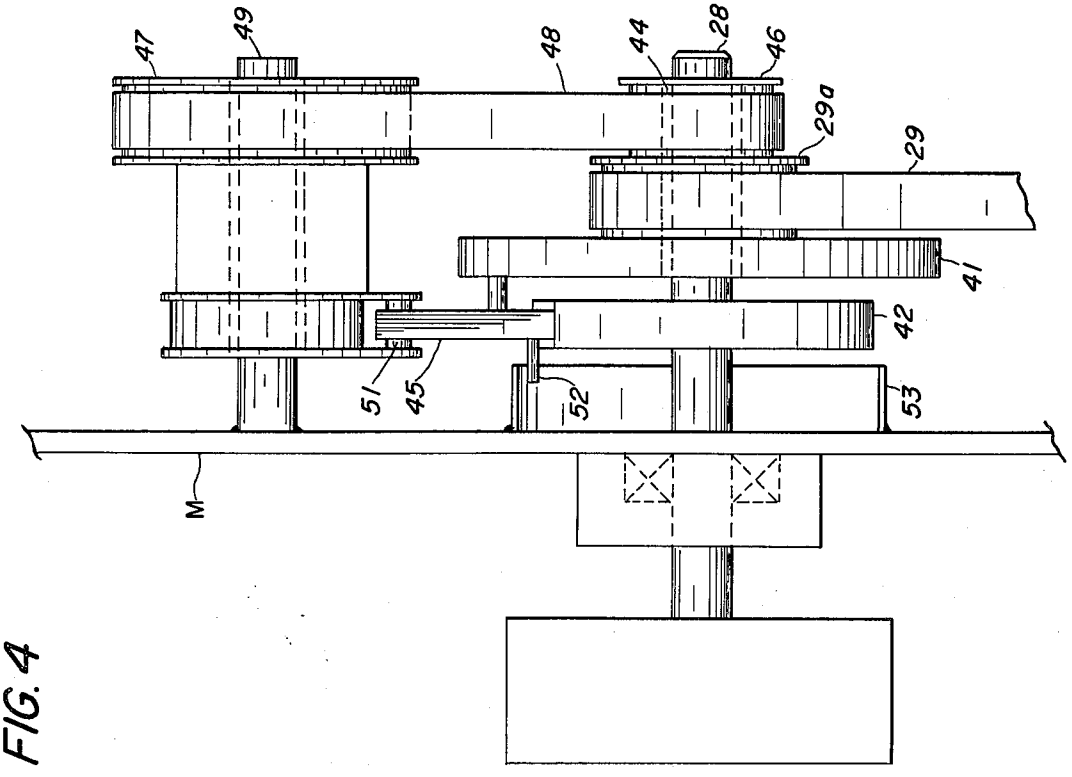

47
49
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29a
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FIG.4

CLUTCHES

BACKGROUND OF THE INVENTION

This invention relates to clutches, particularly for use in controlling the movement of a carriage, and to drive systems incorporating such clutches.

Drive systems are known in which, during operation, a driven element energizes a biasing means as it is driven in one direction from a rest position, and a clutch automatically disengages the drive after a predetermined movement of the driven element whereby the latter is returned to its rest position under the influence of the biasing means. The present invention is particularly concerned with clutches suirable for performing such automatic disengagement of the drive which are hereinafter and in the claims referred to as "recycling clutches".

One application of such a clutch is to be found in a photocopying machine such as an electrostatographic reproduction machine as described in British Patent Specification No. 995,413 which includes lamps for exposing successive portions of the document to be copied to a photosensitive surface. These lamps which are carried on a carriage are scanned slowly across the document and are then quickly returned to their initial (start-of-scan) positions, at the end of the scanning stroke. Normally the carriage is driven in one direction by means of a cable connected to the main drive of the machine through a clutch, and is returned under the influence of a spring when the clutch is disengaged.

Scanning mirror systems for use in electrostatographic copying machines have also been proposed in which a carriage carries one or more mirrors by which images of the successive portions of the document to be copied are directed onto a photosensitive surface. Normally the light is directed onto the photosensitive surface through a fixed aperture and the photosensitive surface is arranged to move past the aperture during exposure of the document. With such an arrangement it is essential that the movement of the carriage be synchronized with the movement of the photosensitive surface which is usually in the form of a drum.

Conveniently such a carriage is driven by means of a cable passing around a capstan mounted on a drive shaft and one suitable clutch comprises rotatable input and output elements of which the output element carries a pawl which is normally engaged by a dog on the input element. The input element is continuously driven, the pawl being released by engaging a fixed stop member once during each revolution of the clutch whereby the carriage may be returned to its start-of-scan position under the influence of a spring, the output element of the clutch rotating in the reverse direction for slightly less than one revolution when it is again picked up by the dog on the still rotating input element. With such an arrangement, in order to ensure that the movement of the carriage is synchronized with that of the photoreceptor, the capstan must be of the same size as the photoreceptor drum, and rotate at the same speed as the drum. This is generally convenient where the capstan can be mounted on the axis of the photoreceptor but particularly where it is desired to arrange the capstan in a different location, space requirements may make a capstan of these proportions inconvenient.

If the capstan is to be of reduced size yet drive the carriage synchronously with the photoreceptor it must rotate faster than the photoreceptor and through more than a single revolution for each scanning movement of the carriage. One way of achieving this is described in our co-pending U.S. Application Ser. No. 367,996, filed June 7, 1973, in which the drive to an optics carriage drive shaft of an electrostatographic reproduction machine is transmitted via a timing pulley rotatably mounted on a driven shaft arranged parallel to the optics drive shaft. (The capstan is fixed on the optics drive shaft.) A cable drive connects this pulley with a pulley on the optics drive shaft. Secured on the driven shaft is a pawl plate and a pawl is pivotally mounted on the timing pulley about an axis disposed radially beyond the periphery of the pawl plate. The pawl normally engages a notch in the pawl plate to complete the drive to the optics drive shaft. A fixed (but adjustable) pawl knock-out plate disengages the pawl from the notch in the pawl plate once in each driving revolution of the pulley so permitting the optics drive shaft to rotate in reverse direction under the influence of a spring connected to the capstan to return the carriage to the start-of-scan position. More than one revolution of the optics drive shaft is achieved by making the diameter of the timing pulley a whole number of multiple of the diameter of the pulley on the optics drive shaft.

In the system described in our aforesaid co-pending U.S. Application Ser. No. 367,996, the timing element carries the pawl and forms part of the clutch assembly. The pawl plate rotates once for each scanning movement of the carriage. This means that it is sufficient merely to knock the pawl out of the notch in the plate and allow it to ride around the periphery of the pawl plate until it drops back into the notch, after slightly less than one revolution of the timing pulley (since the pawl plate is still rotating). Stated another way, the output element of the clutch rotates (in one direction) through slightly less than one revolution during scanning and also in (reverse direction) during rescan. However, removing the timing element from the direct drive to the carriage drive shaft requires that like the capstan the output element of the clutch shall rotate through greater than a revolution during scanning and rescan. It is not sufficient in this circumstance merely to effect release of the clutch since then it would become re-engaged before rescan had been completed.

BRIEF SUMMARY OF THE INVENTION

It is an object of the present invention to provide a recycling clutch which has the above described advantages and at the same time permits the drive to be transmitted directly to the optics drive shaft without the timing element (pulley) being directly loaded. The present invention also provides means for maintaining the clutch disengaged during a sufficient operational interval of time to permit the required rotation.

To this end, the invention consists in a recycling clutch comprising rotatable input and output elements, co-operating drive engagement means on said elements respectively, one of which is pivotally mounted on its associated element and biased for engagement with the engagement means on the other element, a rotatable timing element adapted to be driven by said input element and arranged to come into engagement with said pivotally mounted engagement means to effect release of the clutch at intervals greater than a revolution of said input element, and means for maintaining said engagement means disengaged for a sufficient length of time to permit rotation of the output element in reverse

direction under the influence of a biasing means through greater than one revolution.

In the clutch of the present invention, the pivotally mounted drive engagement means suitably takes the form of a pawl mounted on the input element and biased drivingly to engage a stop or surface on the output element. Preferably the clutch is maintained disengaged for the required operational interval of time by the pawl engaging a ramp or cam surface.

The timing element may include a pulley driven from a pulley fixed against rotation with respect to the input element and including stop means adapted to engage the pawl once in each N revolutions where the ratio of the diameters of the pulleys is N:1. Or the pulleys may be replaced by meshing gears.

From another aspect, the invention consists in a carriage drive assembly incorporating a recycling clutch as described above.

And from a further aspect, the invention consists in a photocopying machine having a document scanning system incorporating such a recycling clutch.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows schematically an embodiment of carriage drive assembly of a document scanning system of an electrostatographic reproduction machine in accordance with the present invention.

FIG. 2 illustrates the optical arrangement of the scanning system shown in FIG. 1.

FIG. 3 is a section through an embodiment of clutch according to this invention.

FIG. 4 is a section along the line AA of FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 there is shown a carriage drive assembly according to the invention applied to the document scanning system of an electrostatographic machine.

In the practice of electrostatography, various procedures may be followed. By way of illustration an electrostatographic image may be formed on a surface comprising a layer of photoconductive insulating material affixed to a conductive backing which is electrically charged uniformly to render it photosensitive, is then exposed to light from a given image so that an electrostatic latent image is formed thereon in accordance with the light image cast thereon, and finally is caused to be approached by a developer material, which may be fine colored particles carrying electric charge (referred to as toner), or it may be in liquid form, so that the developer material is attracted selectively to the electrostatic latent image, converting the latent image into a visible image. The powder or liquid may subsequently be transferred to a sheet of paper and suitably affixed to it so as to form a permanent print.

One method of exposing the photoconductive layer to light from a given image comprises scanning a lamp or lamps across a document to be copied, the image being projected onto the photoconductive surface by means of a suitable optical system. One system for achieving this is described in British Patent Specification 995,413 where lamps which expose successive portions of a document to the photosensitive surface as they are scanned slowly across the document, are mounted on a carriage. At the end of the scanning stroke, the lamps are quickly returned to their start position.

The optical arrangement of the system shown in FIG. 1 is illustrated schematically in FIG. 2 and for clarity will be described first, it being noted that the views in FIGS. 1 and 2 are taken from the same side of the system. A platen 10 is provided to support a document 11 which is to be copied. A scanning mirror system includes two movable mirrors 12 and 13 shown in their extreme left and right hand positions (in FIG. 2) in full and dotted outline respectively. The mirror 13 is arranged to move at half the speed of the mirror 12 during scanning to maintain the optical distance constant between the document 11 and a lens 14. A tubular lamp 15 extending across the palten 10 parallel to the mirror 12 and in fixed relation to the latter moves with the mirror 12. The lamp 15 serves to illuminate the document through the platen 10 during scanning. An optical path extending from the platen 10 to the lens 14 continues beyond the lens to be reflected in sequence by mirrors 16 and 17 towards a photoreceptor drum 18. The photoreceptor may take other forms than a drum, e.g., it may be in the form of a belt or a photoconductive copy sheet.

Referring now to FIG. 1, the mirrors 12 and 13 are mounted respectively on carriages 21 and 22 which run on guide rods, tubes or the like 23 and 24 respectively. A common guide bar 25 is provided at the opposite sides of the carriages to support and stabilize the carriages. The carriage 21 also carries the lamp 15.

In FIG. 1 the carriages 21 and 22 are shown in their "start-of-scan" positions and during scanning they move from left to right.

The carriage 21 is driven by a cable 26 via a capstan 27 fixedly mounted on a shaft 28 which is driven from the main shaft of the machine through a belt 29 via a clutch of this invention schematically illustrated in FIG. 1 by the input element 41 thereof which is mounted on shaft 28 for rotation with respect thereto. The belt 29 which also drives the photoreceptor drum passes over a pulley 29*a* fixed to the clutch input element 41 for rotation therewith. The movement of the carriage 21 is controlled by a single pulley and cable arrangement 30, 30′ wherein the cable 30 extends between the carriage 21 and a fixed point on the machine frame over the pulley 30′ which is mounted on the carriage 22. The cable 30 is held in tension by means of a secondary cable drive 31 from a smaller diameter capstan 31*a* attached to the capstan 27. As shown the cable 31 is connected at its end opposite the capstan, to the carriage 22 and a tension spring 33 is interposed in the cable for tensioning. The drive capstan 27 is operatively connected to the belt drive 29 during scanning by means of a clutch according to this invention which will be described below. During scanning a spring 34 connected between the capstan and a fixed point is loaded and provides the energy for returning the carriages to their start-of-scan positions when the clutch is disengaged. For convenience the return of the carriages to their start-of-scan positions is termed "re-scan".

In its start-of-scan position, the carriage 21 rests against an end stop or buffer 35 and at the end of the re-scan stroke the carriage collides with this stop. In order to soften the collision and avoid damage to the system, particularly the lamps, which are delicate, especially when hot, the velocity of the carriage 21 when

it reaches the end stop is controlled by a suitable dashpot arrangement **36.**

The embodiment of clutch schematically represented in FIG. **1** is also illustrated in FIGS. **3** and **4** and will now be described in detail. The clutch comprises an input element defined by a plate **41** mounted on the shaft **28** for rotation relative thereto and an output element defined by a pawl plate **42** having a single notch **43** and which, like the capstan **27,** is mounted on the shaft **28** against rotation relative to the latter. Secured to or integral with one face of the plate **41** is the pulley **29***a* over which passes the drive belt **29.** The plate **41** and pulley **29***a* are rotatably mounted on shaft **28** on a common bearing **44.** Driving engagement between the input and output elements **41, 42** is provided by a pawl **45** pivotally mounted on the input element **41** and engaging in the notch **43** in the pawl plate (output element) **42.**

With the pawl **45** in the position illustrated in FIG. **3,** the clutch is engaged and, referring to FIG. **1,** the capstan **28** is rotated to drive the carriages **21** and **22** in the scanning direction, the scanning movement of the carriages being synchronized with the rotation of the photoreceptor through the timing belt **29** which drives, via the clutch, the shaft **28.** In the drive arrangement illustrated, the capstan **27** is of lesser diameter than the photoreceptor drum and has to rotate through greater than one revolution in order to effect the required scanning movement of the carriages, before the clutch is disengaged. This is achieved, in accordance with the invention, in the following manner.

A pulley **46** secured to or integral with the plate **41** or as shown the pulley **29***a* and rotatable about the shaft **28** on the same bearing as plate **41** and pulley **29***a* drives a timing pulley **47** through a belt **48;** the pulley **47** is mounted for rotation on a shaft **49** supported from the machine frame M, specifically a side plate thereof being shown. The pulley **47** carries by means of a spacer **47***a* a knock-out member **50,** located in the same plane as pawl **45** and having a pin **51** extending between its pear-shaped side walls adjacent the extremities thereof. The pin **51** is arranged to engage the tail **45***a* of pawl **45,** and effect release of the clutch once in each N revolutions of the shaft **28,** where the diameter of timing pulley **47** is N − times that of pulley **46.** In the embodiment illustrates N = 2. Upon release of the clutch, the capstan **27** is rotated in reverse direction by the spring **34** to effect high speed rescan of the carriages **21** and **22.**

It will be understood that during rescan, the capstan has to rotate in reverse direction through greater than one revolution where N = 2, through greater than two revolutions where N = 3, etc., and in order to permit this means must be provided to maintain the clutch disengaged for a sufficient length of time to avoid re-engagement of pawl **45** and notch **43** before rescan has been completed. This is achieved in the embodiment illustrated by a boss **52** on pawl **45** running on the outside surface of a fixed arcuate ramp **53** secured to the side plate **48** following disengagement so as to maintain the pawl **45** disengaged for a sufficient length of time to permit rescan to be completed.

The operation of the clutch during one copy cycle of the machine will now be described. At the start of the cycle the clutch is engaged and the carriages **21** and **22** are in their start-of-scan positions. The belt drive **28** is started so as to rotate the photoreceptor drum and, through the clutch, the capstan **27** to drive the carriages in the scanning direction. Each scanning cycle (which includes rescan) corresponds to N revolutions of the shaft **28** and accordingly the scan stroke of the carriages must be effected in less than N revolutions. Suitably, the carriages reach the ends of their scanning strokes, during which they move in synchronism with the photoreceptor, after N − ½ revolutions of the capstan **27** (and shaft **28**), whereupon the clutch is disengaged by the pin **51** engaging the pawl **45** and disengaging the latter from the notch **43** in the pawl plate **42** to effect release of the clutch. During scanning the spring **34** is wound up by reason of its connection between capstan **27** and a fixed point. The capstan now rotates in reverse direction under the influence of the spring **34** through N − ½ revolutions to rescan the carriages, the pawl being held disengaged for sufficient time to permit this by ramp **53.** The time interval required is that for the cam to rotate through N − 1 revolutions after which the pawl **45** cannot reengage the notch **43** in pawl plate **42** before rescan is completed. The length of ramp **53** is dependent on the choice of the spring **34** and other factors determining the rescan speed of the carriages (e.g., the effect of the dashpot **36**), and may for example be approximately semicircular. As the boss **52** runs off the end of ramp **53,** the pawl **45** is returned to its drive engaging position, e.g., by a spring **54** connected between the pawl **45** and plate **41,** and picks up pawl plate **42** at the start of the next scanning stroke. Thus, the scanning cycle of N revolutions of shaft **28** comprises a scanning stroke of N − ½ revolutions and rescan during the remaining half revolution.

While a particular embodiment of the invention has been described, it will be appreciated that various modifications may be made to the specific details referred to herein without departing from the scope of the invention as defined in the appended claims. For example, the value of N may be different from the values described, depending on the size of the capstan and the length of the carriage scanning stroke.

Furthermore although a scanning drive for the carriages is described which is effective through a capstan, it will be understood that other drive systems are envisaged within the scope of this invention. Also, while document scanning systems described above include two carriages, a different number of carriages, including a single carriage, may be provided.

Following the making of a desired number of copies an electrostatographic apparatus as described above may enter a shutdown cycle during which the drive to the photoreceptor, and thus the recycling clutch, is maintained so as for example to complete the delivery of the last copy sheet to the output tray and to complete cleaning of residual developer material from the drum. With the construction described above, the clutch will re-engage and drive the carriages **21, 22** in the scanning direction during this shutdown cycle. In order to prevent re-engagement of the clutch during this shutdown cycle, in a modification, the ramp **53** may be movably mounted and suitable means provided for moving the arcuate ramp **53** along the circle of which it forms an arcuate position in the anticlockwise direction in FIG. **3** during rescan following the scan corresponding to the last copy and after the boss **52** has engaged the ramp **53.** By so moving the ramp **53** (while the boss **52** is running thereon) by a suitable amount,

re-engagement of the clutch can be prevented during the shutdown cycle.

What is claimed is:

1. A reproduction machine having a document scanning system, and an improved means for operating the latter, said means comprising:

a recycling clutch comprising rotatable input and output elements, cooperating drive engagement means on said elements respectively, one of which is pivotally mounted on its associated element and biased for engagement with the engagement means on the other element, a rotatable timing element adapted to be driven by said input element and arranged to come into engagement with said pivotally mounted engagement means to effect release of the clutch at intervals greater than a revolution of said input element, and means for maintaining said engagement means disengaged for a sufficient length of time to permit rotation of the output element in reverse direction under the influence of a biasing means through greater than one revolution.

2. A reproduction machine as claimed in claim **1,** in which the input element includes a plate fixedly mounted on a drive shaft, and further including a pawl pivoted to said plate and biased to a position in which said pawl drivingly engages the output element.

3. A reproduction machine as claimed in claim **2,** including a driving element for driving said timing element, said driving element being fixed against rotation with respect to the input element and adapted to engage said pawl once in each N revolutions, and wherein the ratio of the diameters of the timing and driving elements is N:1.

4. A reproduction machine as claimed in claim **2,** and further including a ramp disposed so as to be contacted by said pawl when said clutch is to be held disengaged.

5. A recycling clutch comprising rotatable input and output elements, cooperating drive engagement means on said elements respectively, one of which is pivotally mounted on its associated element and biased for engagement with the engagement means on the other element, a rotatable timing element adapted to be driven by said input element and arranged to come into engagement with said pivotally mounted engagement means to effect release of the clutch at intervals greater than a revolution of said input element, and means for maintaining said engagement means disengaged for a sufficient length of time to permit rotation of the output element in reverse direction under the influence of a biasing means through greater than one revolution.

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