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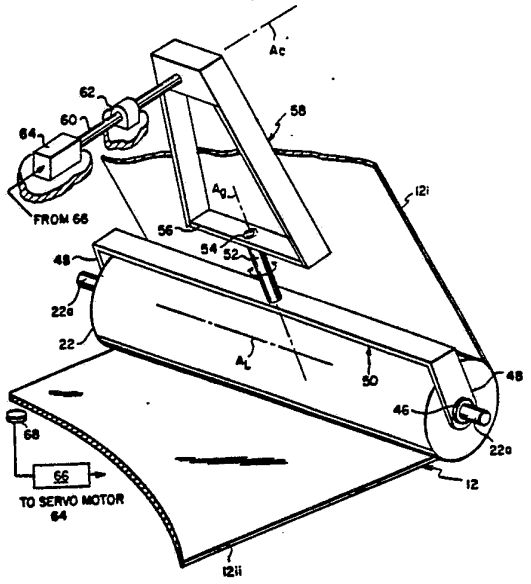
(54) Title: WEB TRACKING APPARATUS

(57) Abstract

Apparatus for controlling lateral alignment of a web (12) moving along a path, said apparatus including at least one steering roller (22) for supporting said web and mounted for turning about an axis (A_c) perpendicular to the plane of the span of said web approaching said steering roller by sensing means (66, 68) for sensing the lateral position of an edge of said web relative to a reference plane as said web moves along such path, characterized by said sensing means producing a first signal when said edge is positioned at a first predetermined location (X_1) relative to such reference plane and producing a second signal when said edge is positioned at a second predetermined location (X_2) relative to such reference plane spaced from said first location and by turning means (64) for turning said steering roller about said axis in either of two opposite directions corresponding to said first and second signals for moving said edge toward said first or second location respectively as said web moves along such path.



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WEB TRACKING APPARATUS

Field of the Invention

This invention relates generally to a web tracking apparatus, and more particularly to apparatus for controlling the alignment, in a lateral (cross-track) direction, of a web moving along a path in an electrographic apparatus.

Description of the Prior Art

In high speed electrographic reproduction apparatus for example, it is a common practice to employ an elongated dielectric belt or web adapted to carry transferable images and moving in a path in operative relation with electrographic process stations. Typically the web is supported by, and driven about, at least one roller. With a roller support, there is a tendency for the moving web to shift laterally with respect to such roller. Various apparatus for correcting for such lateral (cross-track) shifting of roller-supported webs are known, such as crowned rollers, flanged rollers, servo actuated steering rollers, or self-activated steering rollers. Crowned rollers are not suitable for use with a web in an electrographic reproduction apparatus because they force the web toward the apex of such rollers and cause distortion of the web and produce local stresses in the web at the crown which can damage the web. Flanged rollers are also not suitable because they produce a concentrated loading at the edges of the web resulting in edge buckling, seam splitting, or excessive edge wear.

Electrographic reproduction apparatus therefore typically utilize servo actuated or self-activated steering rollers. While such steering rollers generally correct for cross-track shifting of the web, they tend to produce significant back-and-forth lateral movement of the web as it is realigned. In making monochromatic reproductions the

lateral movement, within limits of course, is not critical since only one discrete area of the web is used in generating any one reproduction. However, when either composite monochromatic or multi-color reproductions are made, the degree of lateral movement becomes a significant limiting factor in obtaining quality reproductions from the apparatus.

For example, in making multi-color reproductions with an apparatus utilizing a moving dielectric web, charge patterns corresponding to related color separation images of input information are formed in successive discrete areas of the web. Such patterns are developed with appropriate pigmented marking particles to form transferable images which are transferred sequentially to a receiver member to form the multicolor reproduction. The sequential image transfer must take place in accurate superimposed register in order to obtain quality output (i.e., faithful multi-color reproduction). Therefore, lateral movement of the web must be minimized so that lateral deviation between successive discrete areas is within acceptable limits whereby transferable images formed at such successive discrete areas are alignable in accurate superimposed register at transfer. Known servo actuated or self-activated steering rollers react to the absolute lateral position of the edge of the web and, since such edge may not be true, can cause formation of sequential transferable images on discrete areas outside the acceptable limits which allow accurate superimposed register at transfer.

It is an object of the present invention to overcome the above noted deficiencies by providing an apparatus for controlling alignment, in a lateral direction, of a web moving along a path, which minimizes lateral deviation between successive discrete areas on the web to within acceptable

limits, for example, transfer of marking particle images from such areas in accurate superimposed register for multicolor reproduction.

SUMMARY OF THE INVENTION

This object is accomplished with an apparatus for controlling lateral alignment of a web moving along a path, said apparatus including at least one steering roller for supporting said web and mounted for turning about an axis perpendicular to the plane of the span of said web approaching said steering roller by sensing means for sensing the lateral position of an edge of said web relative to a reference plane as said web moves along such path, characterized by said sensing means producing a first signal when said edge is positioned at a first predetermined location relative to such reference plane and producing a second signal when said edge is positioned at a second predetermined location relative to such reference plane spaced from said first location and by turning means for turning said steering roller about said axis in either of two opposite directions corresponding to said first and second signals for moving said edge toward said first or second location respectively as said web moves along such path.

BRIEF DESCRIPTION OF THE DRAWINGS

In the detailed description of the preferred embodiment of the invention, reference is made to the accompanying drawings, in which:

Fig. 1 is a schematic illustration, in cross-section, of an electrographic reproduction apparatus of the electrophotographic type having a dielectric photoconductive web moving along a path and including a web tracking apparatus according to this invention;

Fig. 2 is a diagramatic illustration representing the movement of the web of Fig. 1, layed

out in planar form, as it travels about a portion of its path;

Fig. 3 is a view, in perspective and on an enlarged scale, of a portion of the web tracking apparatus according to this invention particularly showing the steering roller, its support, and the servo motor associated therewith, with portions removed or broken away to facilitate viewing;

Fig. 4 is a block diagram of the servo motor control circuit for the steering roller of Fig. 3;

Fig. 5 is a graphical representation of the characteristic of operation of the non-linear amplifier of the control circuit of Fig. 4 plotted as the servo motor control signal (V_m) vs. the proportional lateral web edge position signal (V_e); and

Fig. 6 is a graphical representation of the lateral movement of the edge of the web plotted as the lateral web edge position (X) vs. the distance of movement of the web along its path (Y).

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the accompanying drawings, a reproduction apparatus 10 of the electrophotographic type employing a dielectric photoconductive web 12 adapted to carry transferable images, and including a web tracking apparatus according to this invention, is schematically illustrated in Fig. 1. The web 12 is, for example, of the type described in U.S. Patent No. 3,615,414 includes a photoconductive layer. The web 12, shown as being an endless belt, is supported by rollers 14, 16, 18, 20, 22, 24, 26, 28 and 30 for movement along a closed loop path. The path is associated with typical electrographic process stations such as primary charging station 32, exposure station 34, development stations 36a, 36b, 36c, transfer station 38, and cleaning station 40. Of course the web tracking apparatus of this invention is suitable for use with other roller-

supported web configurations (e.g., one roller between web supply and take-up spools) where precise lateral web-position control is needed.

In the operation of apparatus 10 according to a typical monochrome or multicolor electrophotographic process, the web 12 (which is electrically grounded) is moved in the direction of arrow 12a about its closed loop path, and a uniform electrostatic charge is placed on the web as it passes the primary charging station 32. Discrete areas of the charged web are then exposed in exposure station 34 to an image (e.g., reflected light image) of input information to be reproduced to alter the uniform charge and form a charge pattern corresponding to such image. In making multicolor reproductions, by the subtraction color process for example, a reflected light image of the input information is divided into primary color separation images which expose successive discrete areas of the web to form corresponding charge patterns respectively. The charge patterns are respectively developed with pigmented marking particles complementary to the primary colors by developing stations 36a, 36b, and 36c to form transferable images. The images are then transferred seriatim from the discrete areas of the web to a receiver member (not shown) in the transfer station 38, and any residual marking particles remaining on that area of the web are cleaned in cleaning station 40 prior to the reuse of that area.

To obtain a faithful multicolor reproduction, the transferable images must be transferred to the receiver member in accurate superimposed register. Accordingly angular and lateral (cross-track) movement of the web as it travels about the closed loop path between the exposure and transfer stations must be controlled to minimize angular and lateral deviation between successive transferable

images in the discrete areas of the web. Such control is accomplished by the web tracking apparatus, according to the present invention, described hereinbelow.

In such web tracking apparatus, the roller 14, about which the web travels in relation to transfer station 38, has an axis of rotation which is spatially fixed relative to the machine frame of the reproduction apparatus 10. As seen in Fig. 2, the diagramatically represented machine frame is designated by numeral 42 and the rotational axis of roller 14 is designated by numeral 44. The web 12, traveling in direction of arrow 12a, approaches and leaves the roller 14 perpendicular to the axis 44 in the absence of external forces. Upstream of the roller 14, the web is supported by the steering roller 22 and is wrapped around a portion of the circumference of the steering roller to define a span 12i approaching the steering roller and a span 12ii leaving the steering roller. The wrap angle (included angle between plane of span 12i and plane of span 12ii) need only be of a magnitude sufficient to provide frictional drive of the roller 22 by the web 12. The lateral position of the web 12 approaching the roller 14 is controlled by the steering roller 22. Such lateral position is defined in terms of the distance, taken at a preselected location between rollers 14 and 22, of a marginal edge of the web in span 12ii from the plane of the machine frame 42 (designated by letter X in Fig. 2).

The steering roller 22 includes stub shafts 22a extending from the roller coincident with the longitudinal axis A_L of such roller (see Fig. 3). The stub shafts 22a are rotatably supported in bearings 46 mounted in the arms 48 of a generally U-shaped roller carriage 50 so that roller 22 freely rotates about its axis A_L. A shaft 52 is fixed to

and extends from the carriage 50. The longitudinal axis A_g of the shaft 52 is perpendicular to the axis A_L and intercepts such axis at its mid-point, between the ends of roller 22. Further, axis A_g is parallel to the plane of the span 12i of the web 12 approaching the steering roller 22 to define a gimbal axis for the steering roller.

The shaft 52 is rotatably supported in bearing 54 mounted in a caster subframe 56. The caster subframe 56 is supported, in turn, by a yoke 58 mounted on a shaft 60 for rotation therewith. The shaft 60 is rotatably supported in a bearing block 62 fixed to a portion of the frame of apparatus 10. A typical D.C. servo motor 64 (i.e., a motor in which the angular velocity of the motor output shaft is directly proportional to the electrical potential applied to the motor) is coupled to the shaft 60. The output shaft of the servo motor 64 selectively rotates the shaft 60 in either direction about its longitudinal axis A_c. The longitudinal axis A_c of the shaft 60 defines a caster axis about which the steering roller 22 is rotatable, such caster axis being perpendicular to the plane of the span 12i of web 12. Thus, the steering roller 22 of this illustrative embodiment is both gimballed and castered. Of course, other arrangements for gimballing or castering the steering roller 22 are suitable for use with this invention. Moreover, in accordance with this invention, in certain other roller supported web configurations where precise lateral web position control is needed, the steering roller may be mounted for castered movement only.

The steering roller 22, in controlling the lateral position of the web 12 as will be described, corrects for long term lateral movements of a marginal edge of the web in span 12ii relative to the machine frame 42 without attempting to follow short

term lateral movements. That is, the roller 22 steers the web so that it progresses laterally back-and-forth between predetermined allowable marginal edge position limits X_1 and X_2 (see Fig. 2). Within limits X_1 and X_2, transferable images are formable on successive discrete areas of the web in a range acceptable for accurate superimposed transfer of such images to a receiver member to form a faithful multicolor reproduction. On the other hand, the roller 22 does not attempt to follow the short term lateral movements of the web which may, in part, be related to the fact that the marginal edge of the web is not true (straight). Any attempt to follow such short term lateral movements would require a complicated control arrangement for the steering roller. Further, it would result in potentially unacceptable lateral image shifts since the placement of images on the web would be based on the location of the edge of the web at some time relative to when the respective images are placed on the web, rather than on placement of the images on the web at given locations relative to one another.

Correction of the long term lateral web movement is controlled by a negative feed-back control circuit 66 shown in Fig. 4. The circuit 66 is operatively coupled to a sensor 68 located adjacent to a marginal edge of the web 12 in span 12ii (see Fig. 3). The sensor 68 detects the lateral position X of the marginal edge of web 12 and generates a signal V_p indicative thereof. For example, the sensor 68 may be a photoemitter/photodetector pair having a signal value (electrical potential level output) proportional to the area of the sensor covered by the web. The sensor signal V_p is applied to a summing device 70 where it is compared to a reference signal V_r to produce a signal V_e of a value which is proportional to the

lateral position of the edge of the web 12 in span 12ii relative to the plane of the machine frame 42. The reference signal V_r is a preselected input electrical potential level. The value, of signal V_r may be, for example, zero in which case the value of signal V_e is directly proportional to the web edge position relative to the machine frame; or V_r may be of any other desired value in which case the value of the signal V_e is biased to be directly proportional to the web edge position relative to some other reference plane spaced from the machine frame (e.g. ideal location of edge of web from the machine frame). The signal V_e is then applied to a non-linear amplifier 72 where a servo motor control signal V_m may be produced.

The operational characteristic of the non-linear amplifier 72 in producing the servo motor control signal V_m is graphically shown in Fig. 5. Such characteristic includes a deadband range DB between signal values V_{e1} and V_{e2}, low signal gain ranges LG_1 and LG_2 respectively below and above the deadband range, and high signal gain ranges HG_1 and HG_2 respectively below and above the low gain ranges. The signal values V_{e1} and V_{e2} correspond respectively to a lateral position of the edge of the web 12 at the maximum allowable web edge lateral position limits X_1 and X_2. Therefore, any lateral web edge position signal V_e of a value between V_{e1} and V_{e2} corresponds to a lateral web edge position between, but not including, limits X_1 and X_2. When the value of signal V_e is in this deadband range, a signal V_m is produced of a value to which the servo motor is nonresponsive (e.g., electrical potential level is zero).

Similarly, any value of signal V_e in the low signal gain ranges LG_1 and LG_2 corresponds to a lateral position of the edge of the web at (or

slightly beyond) limits X_1 or X_2 respectively. When the value of signal V_e is in these low signal gain ranges, an appropriate control signal V_m of corresponding low value is produced to which the servo motor is responsive. Such signal V_m is amplified and transmitted to the servo motor 64 to actuate the motor and proportionally rotate the shaft 60 in the appropriate direction. Such shaft rotation rotates the steering roller 22 about its caster axis A_c which, in turn, causes the edge of the web to move laterally away from the reached limit position slowly toward the opposite limit position. As the web moves laterally, the value of signal V_e correspondingly returns to the deadband range DB with the signal V_m being correspondingly reduced until such signal reaches zero. As the signal V_m is reduced, the rotation of the servo motor is correspondingly reduced bringing the steering roller to an adjusted position. The steering roller then remains in the adjusted position to steer the web 12 so that the edge of the web progresses from the reached lateral limit position to the opposite lateral limit position without attempting to follow any short term lateral web movement. Thereafter, when such opposite limit lateral position is reached a control signal V_m (of opposite direction) is produced to which the servo motor is responsive to rotate the steering roller in the opposite direction about the caster axis causing the web to move laterally back toward the opposite limit position.

A value of signal V_e in the high signal gain ranges HG_1 and HG_2 correspond to a lateral position of the edge of the web where it substantially exceeds limits X_1 or X_2 respectively, such as might occur when the web 12 is first mounted on its roller supports. When the value of signal V_e is in these ranges, an appropriate control signal

V_m of corresponding high value is produced to which the servo motor is responsive. Such signal is amplified and transmitted to the servo motor 64 to actuate the motor and proportionally rotate the shaft 60 in the appropriate direction to rotate the steering roller 22 significantly about its caster axis A_c. The steering roller is thus adjustably positioned to cause the web edge to rapidly move laterally from the exceeded limit position toward the opposite limit position. As with the instance described above, the steering roller remains in its adjusted position until the opposite limit position is reached by the web edge, at which time the steering roller is rotated to cause the web to laterally move back toward the opposite limit position. In this manner normal tracking is quickly achieved. The selection of values for the signal gains in ranges LG_1, LG_2, HG_1 and HG_2 to produce the appropriate values of signal V_m is dependent upon particular web and web tracking apparatus geometry. This disclosure is written so that one of ordinary skill in control system design will select such values using conventional web transport stability analysis techniques.

As shown in the graph of Fig. 6, the maximum allowable lateral movement of the edge of web 12 for the illustrative apparatus 10 of Fig. 1 is for example a value $\pm M$ (in centimeters) from a pre-selected reference location (or neutral position). Such maximum lateral movement corresponds to maximum allowable deviations between transferable images so that, on transfer, the images are in accurate super-imposed registration to yield faithful multicolor reproductions. The deadband range of the non-linear amplifier 72 of circuit 66 is accordingly set to equate to signal values corresponding to lateral edge movement of 2 x M. Therefore, even though the

position at the edge of the web 12 may shift laterally as much as 1/3 x M for example during any one complete revolution of the web about the closed loop path, such shift is ignored until the maximum allowable limit of lateral edge shift is reached (at completion of cycle 4 in Fig. 6). When the maximum allowable shift is reached, a signal V_m is produced by the circuit 66 in the manner described above to actuate the servo motor 64 to reposition the steering roller and cause the overall direction of the lateral movement of the edge of the web to progress away from such maximum limit position toward the opposite maximum limit position. Such action is repeated when the opposite maximum limit position is reached (not shown in Fig. 6) with the result that the web alternately slowly progresses laterally between the maximum lateral limit positions.

A number of advantages result from the apparatus of the present invention. For example, with the lateral position of the edge of the web 12 controlled by the steering roller 22, the span 12ii of the web between the steering roller and roller 14 is precisely located; i.e. its angular (α) and lateral (X) positions are known. The roller 24 adjacent to the exposure station 34 and the developer station backup rollers 26, 28 and 30 are castered and have only a small wrap angle respectively with the web. Therefore, they apply no lateral disturbance or constraint to the web. Thus, adjacent discrete areas of the web 12 will have a minumum of lateral movement on travel of the web between roller 22 and roller 14. For example, in the illustrated apparatus 10, lateral movement of the web edge measured at a similar time in each cycle of the web is approximately 1/30 x M (see graph of Fig. 6); and if the web has a length to accommodate a given number N discrete image-receiving areas, the lateral shift between

adjacent areas would be at most 1/N x 1/30 x M. Such lateral shift is thus a very small fraction of the maximum allowable lateral movement. Accordingly transfer of the transferable images, formed on adjacent discrete areas of the web, to a receiver sheet in the transfer station 38 occurs in the required accurate superimposed register to form a faithful multicolor reproduction. It should also be noted that the precise location of the web 12 in the span 12ii between rollers 22 and 14 assures that all related transferable images have substantially the same angular relationship (α) to the web and are thus transferred from the web to receiver member with the same angle to prevent any angular misalignment between the images at transfer.

For the remaining portion of the closed loop path of the web downstream of roller 14 to steering roller 22, roller 16 is castered and gimballed and roller 20 is gimballed so that the web is constrained according to the principles discussed in U.S. Patent No. 3,913,813 to approach roller 22 as shown in Fig. 2. The roller 18, assisting the action of the cleaning station 40, is fixed for rotation about its longitudinal axis. However, this roller is formed with a substantially frictionless surface, such as Teflon for example, and has only a small wrap angle with the web so as to minimize any lateral disturbance or constraint on the web.

CLAIMS

1. Apparatus for controlling alignment, in a lateral direction, of a web moving along a path, said apparatus including at least one steering roller (22) for supporting said web (12) and mounted for turning about an axis (A_c) perpendicular to the plane of the span of said web (12) approaching said steering roller (22), by sensing means (66,68) for sensing the lateral position of an edge of said web (12) relative to a reference plane as said web moves along such path, characterized by said sensing means (66,68) producing a first signal when said edge is positioned at a first predetermined location (X_1) relative to such reference plane and producing a second signal when said edge is positioned at a second predetermined location (X_2) relative to such reference plane spaced from said first location (X_1), and by turning means (64) for turning said steering roller (22) about said axis (A_c) in either of two opposite directions corresponding to said first and second signals for moving said edge toward said first (X_1) or second (X_2) location respectively as said web (12) moves along such path.

2. Apparatus according to claim 1, characterized in that said turning means includes a reversible servo motor (64) having an output shaft (60) coupled to said steering roller (22), said output shaft (60) being coincident with said turning axis (A_c) of said steering roller (22), said servo motor (64) being responsive to said first and second signals to turn said output shaft (60) in the respective direction.

3. Apparatus according to claim 1, characterized in that said sensing means (66,68) includes a sensor (68) operatively associated with said web (12) for detecting the lateral position of a marginal edge thereof and producing a signal (V_p)

corresponding to such lateral position, and circuit means (66) responsive to said lateral position signal (V_p) for producing said first or second signal when said lateral position reaches predetermined values corresponding to said predetermined locations respectively.

4. Apparatus according to claim 3, characterized in that said circuit means (66) includes a non-linear amplifier (72) receiving said lateral position signal (V_p) and having an operational characteristic on such signal to produce

(a) a signal in a deadband range to which said turning means (64) is non responsive when said lateral position signal (V_p) corresponds to lateral positions between said predetermined values (X_1, X_2);

(b) said first or second signal in low gain ranges when said lateral position signal (V_p) corresponds to lateral positions substantially at said predetermined values (X_1, X_2) respectively; and

(c) said first or second signal in high gain ranges when said lateral position signal (V_p) corresponds to lateral positions significantly exceeding said predetermined values (X_1, X_2) respectively.

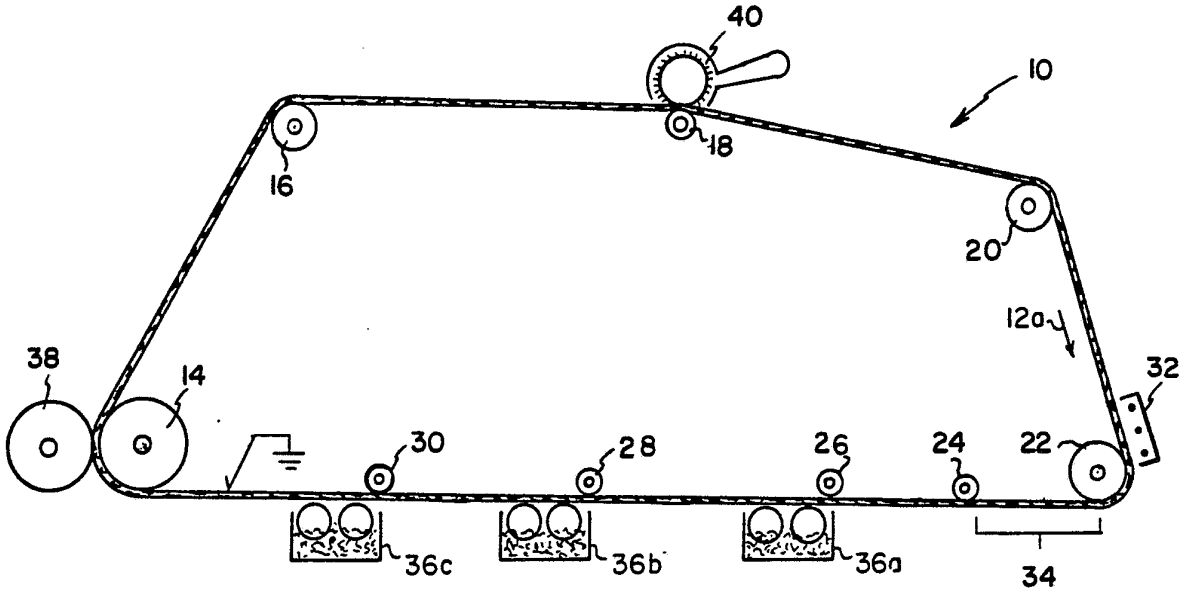

40
10
18
16
20
12a
38
14
32
30
28
26
24
22
36c
36b
36a
34

FIG. 1

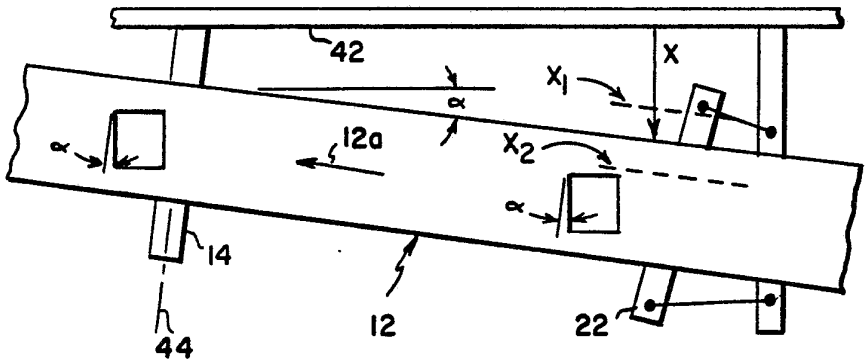

42
X
X1
α
12a
X2
α
α
14
44
12
22

FIG. 2

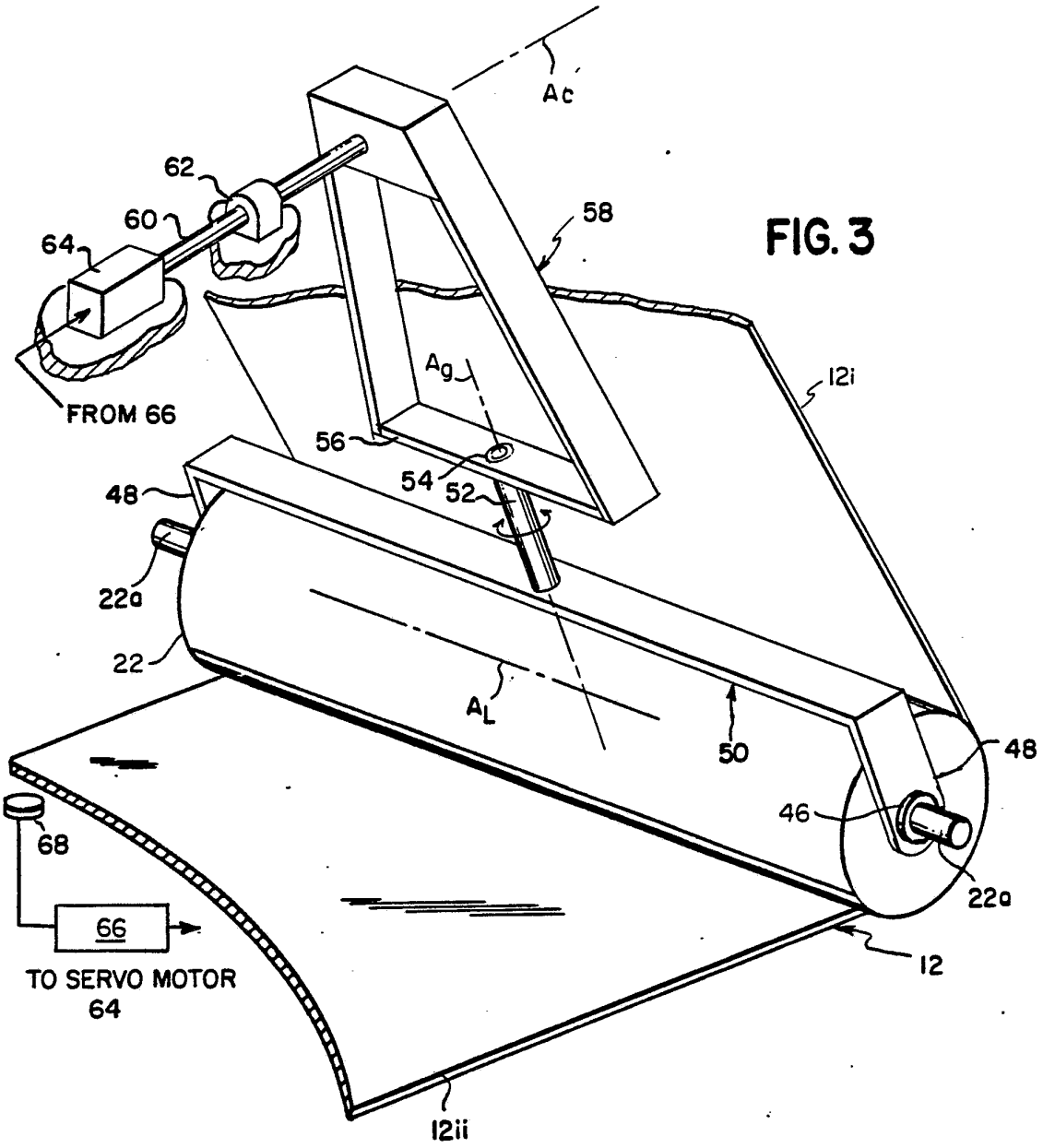

Ac
62
60
64
58
FROM 66
Ag
12i
56
54
52
48
22a
22
AL
50
48
46
22a
68
66
TO SERVO MOTOR
64
12
12ii

FIG. 3

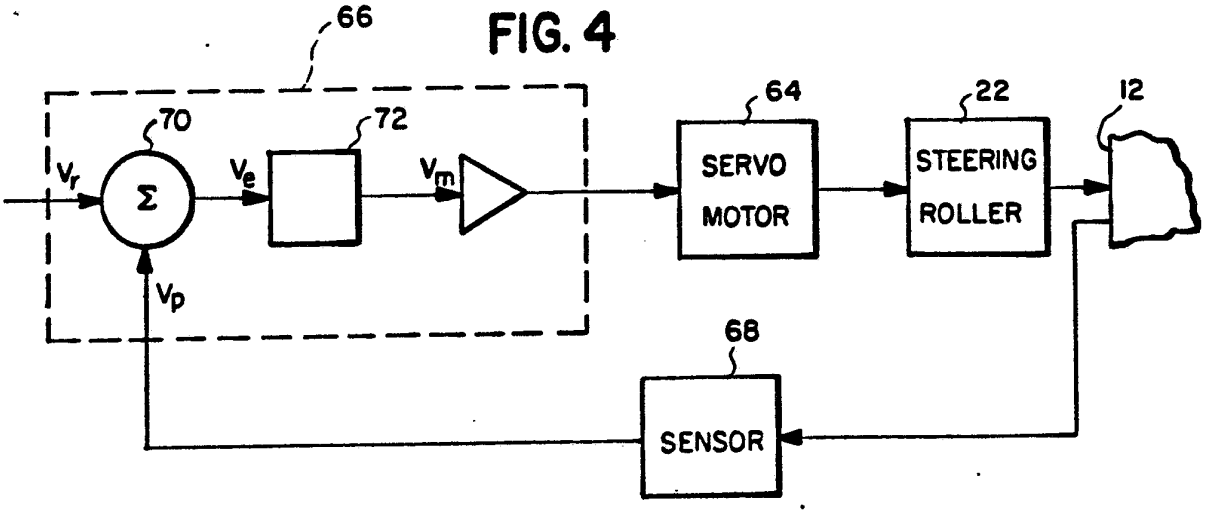
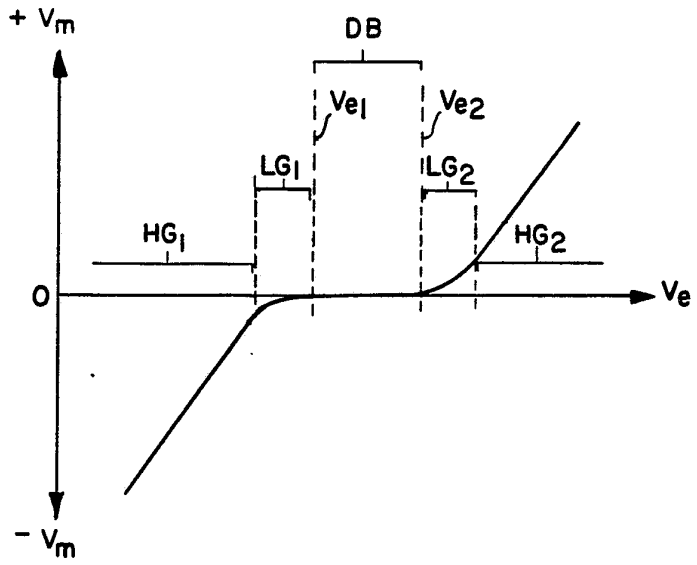

66
70
72
Vr
Σ
Ve
Vm
Vp
64
SERVO MOTOR
22
STEERING ROLLER
12
68
SENSOR

FIG. 4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DB
Ve1
Ve2
LG1
LG2
HG1
HG2
0
Ve
- Vm

FIG. 5

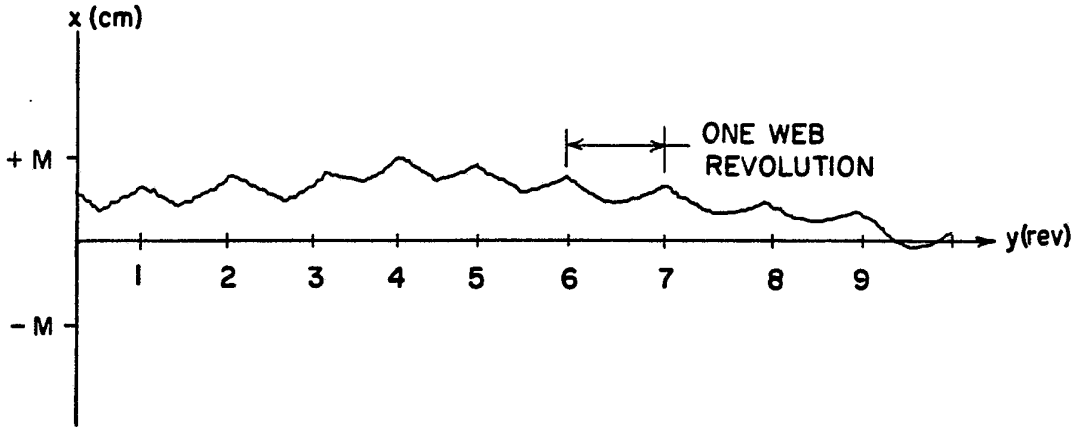
x (cm)
+ M
- M
ONE WEB
REVOLUTION
y(rev)
1
2
3
4
5
6
7
8
9

FIG. 6

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 85/00462

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[4]: B 65 H 23/032

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[4]	B 65 H

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 3606119 (J.G. CALLAN) 20 September 1971 see column 2, lines 17-37, 65-69; column 3, lines 57-60; figures 1,3	1,3
Y	US, A, 3232547 (P.W. THIEDE et al.) 1 February 1966 see column 5, lines 29-43; column 11, lines 34-43; column 3, lines 44-47	1,2,3
Y	US, A, 3913813 (J.E. MORSE) 21 October 1975 see figure 1; column 6, line 62 - column 7, line 3	1,2,3
A	FR, A, 2310949 (VEB POLYGRAPH) 10 December 1976 see page 7, lines 18-34; page 9, line 37 - page 10, line 4	4
A	US, A, 4331274 (HALEWIJN et al.) 25 May 1982 see column 4, lines 32-61; figure 5	1

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
24th June 1985	16 JUIL. 1985
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/US 85/00462 (SA 9156)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/07/85

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
US-A- 3606119	20/09/71	None		
US-A- 3232547		None		
US-A- 3913813	21/10/75	FR-A,B	2284545	09/04/76
		DE-A,B,C	2540357	25/03/76
		GB-A-	1515536	28/06/78
		CA-A-	1037984	05/09/78
FR-A- 2310949	10/12/76	US-A-	4049213	20/09/77
		GB-A-	1536604	20/12/78
		SE-A-	7605421	13/11/76
		SE-B-	434833	20/08/84
US-A- 4331274	25/05/82	None		