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U1S S1879 S2243

(56) Documents cited
GB 2188618 A GB 1430047 A

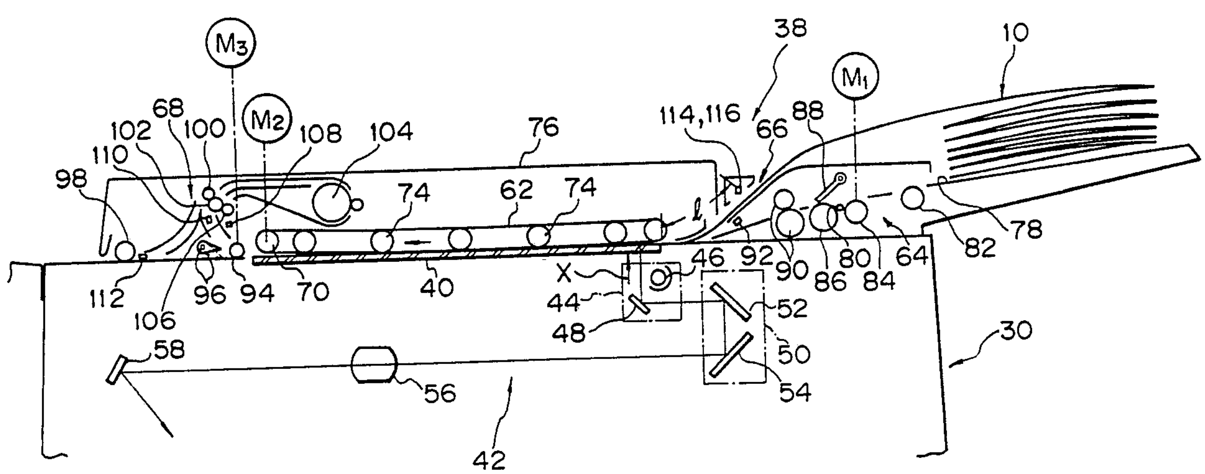
(58) Field of search
UK CL (Edition K) B8R RRW10, G3N NGCA3 NGCA3A NGCA3B NGCA4A
INT CL⁵ B65H

(54) Automatic document feeder capable of feeding a document in the form of a computer form

(57) An automatic document feeder (ADF) for use with an electrophotographic copier, digital copier or similar image recorder feeds ordinary documents in the form of separate sheets and a continuous document in the form of computer form (CF) paper 10. Sprocket holes formed through the CF paper are sensed 114, 116 to controllably transport and stop the CF paper on the basis of the number of sensed holes.

A timer operates between successive detections of sprocket holes so that intervening cuts for fastening a carbon to the CF paper are ignored. Also if no sprocket hole detection is made after a predetermined time then the paper is considered jammed. The sensor 114, 116 is upstream of the image forming platen 40 so hole detection stops before the final page of CF paper has been positioned. A pulse generator or timer then operates to bring the final page into position.

Fig. 3



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

GB 2 237 413 A

Fig. 1A

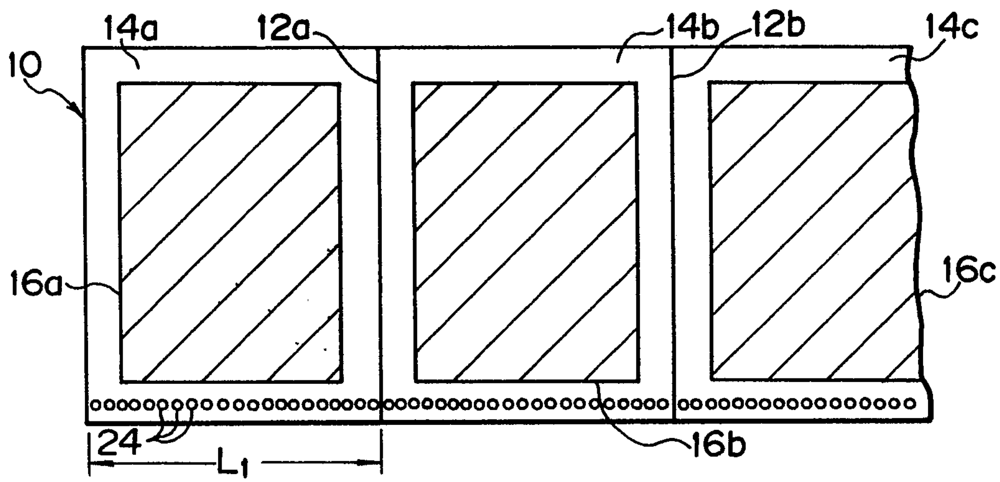


Fig. 1B

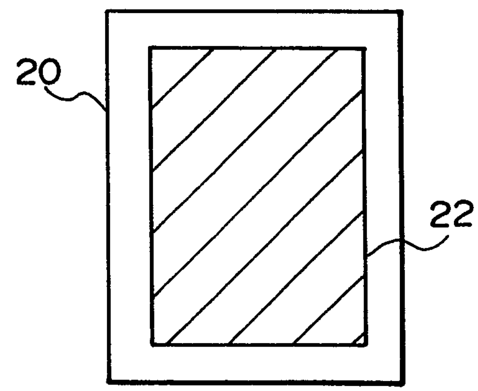


Fig. 1C

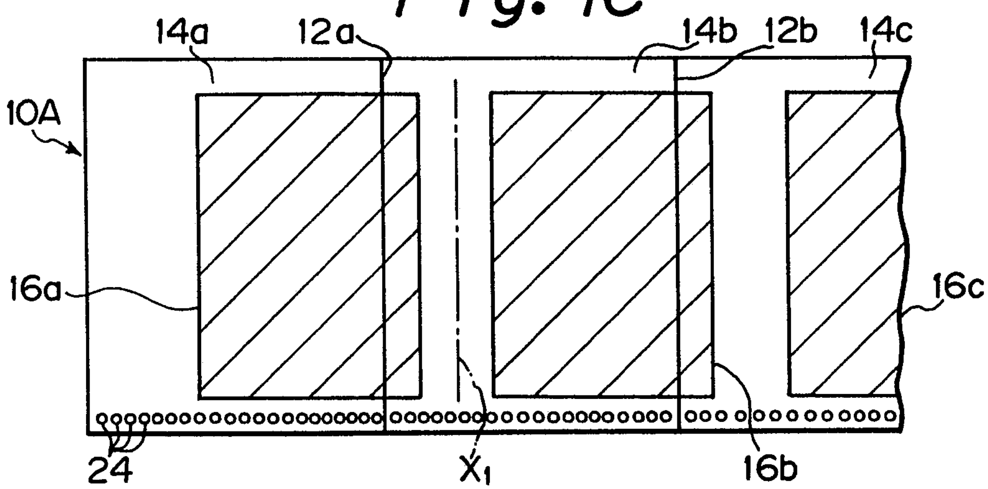


Fig. 1D

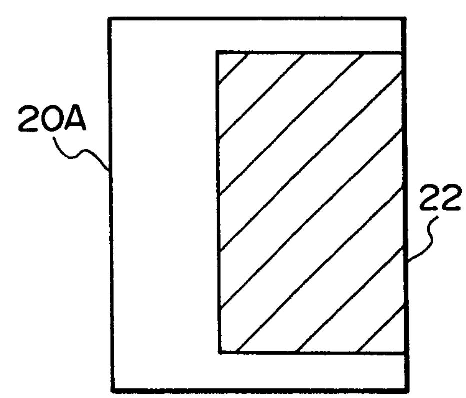


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Fig. 2

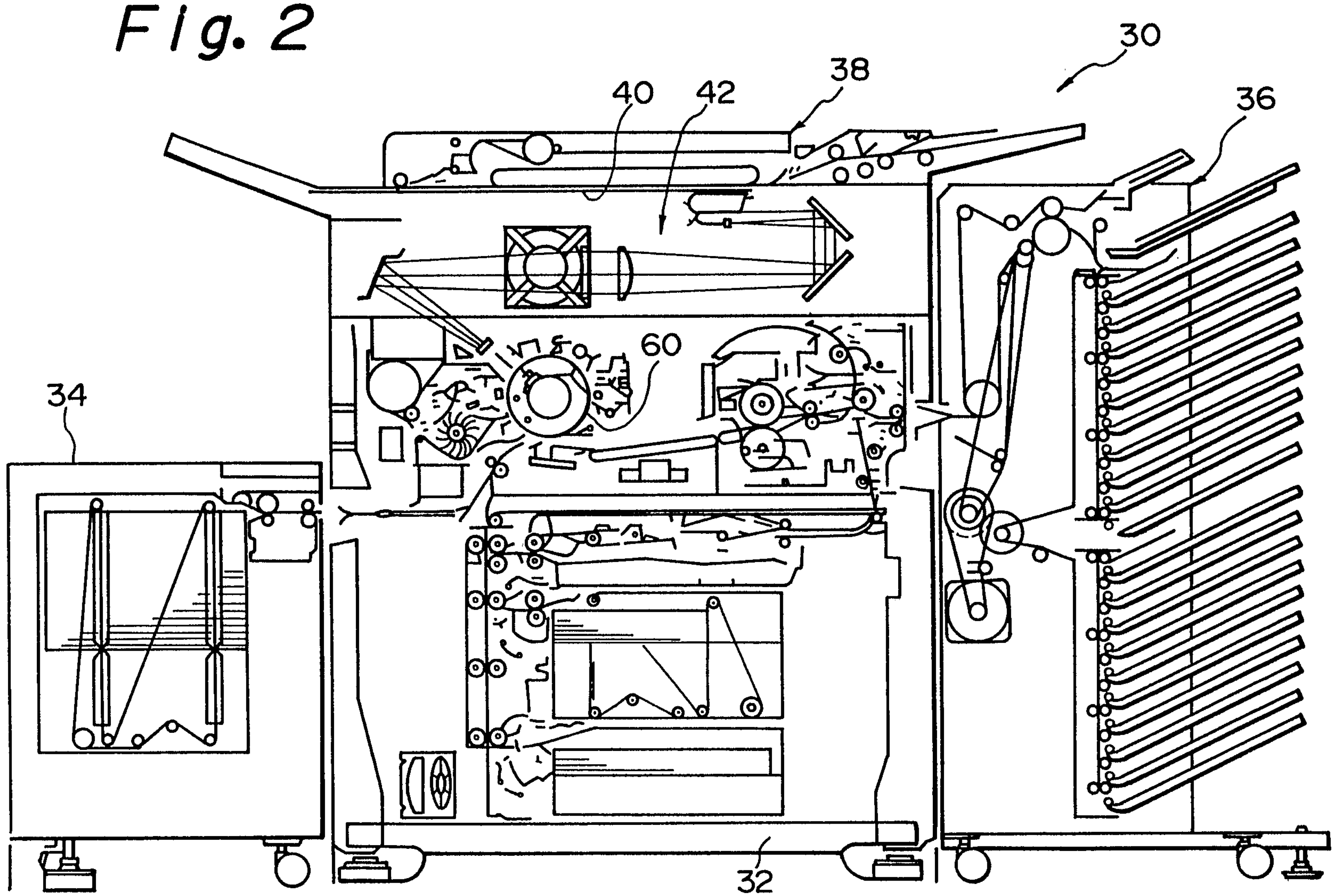

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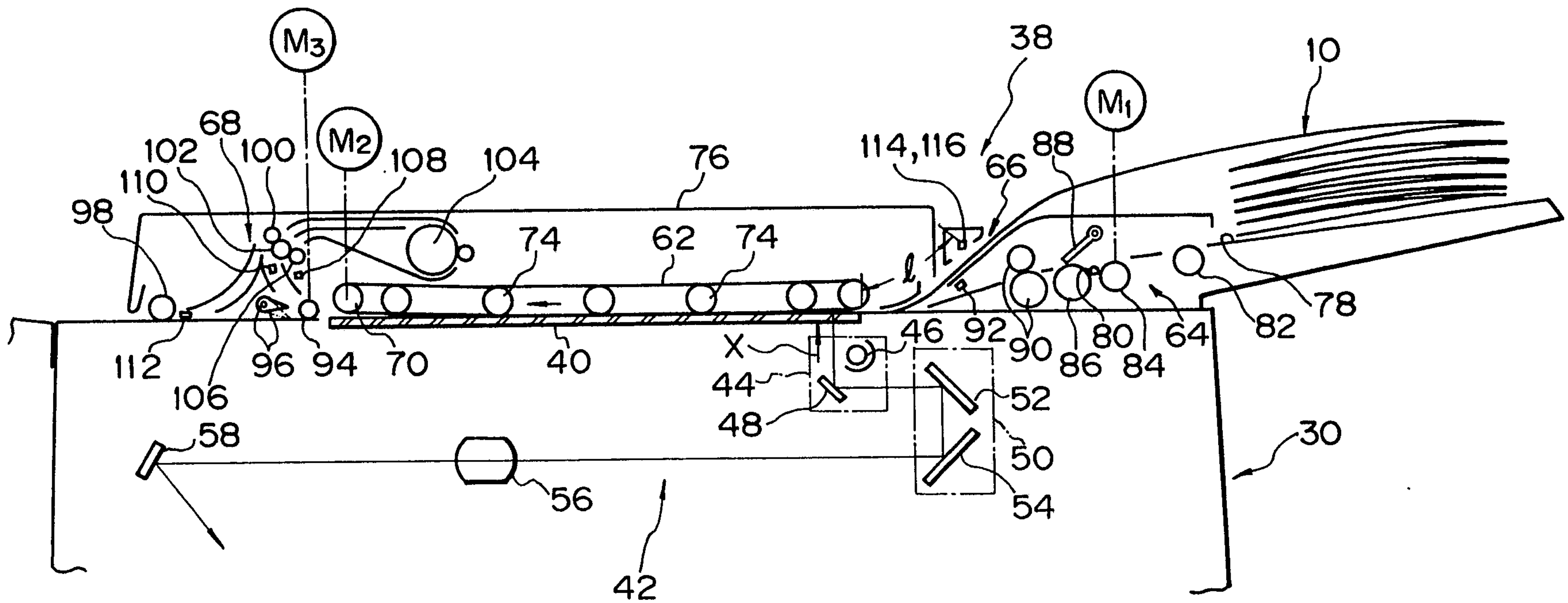
Fig. 3


M3
M2
M1
10
30
38
40
42
44
46
48
50
52
54
56
58
62
64
66
68
70
74
74
76
78
80
82
84
86
88
90
92
94
96
98
100
102
104
106
108
110
112
114,116
X
ℓ

420

Fig. 4A

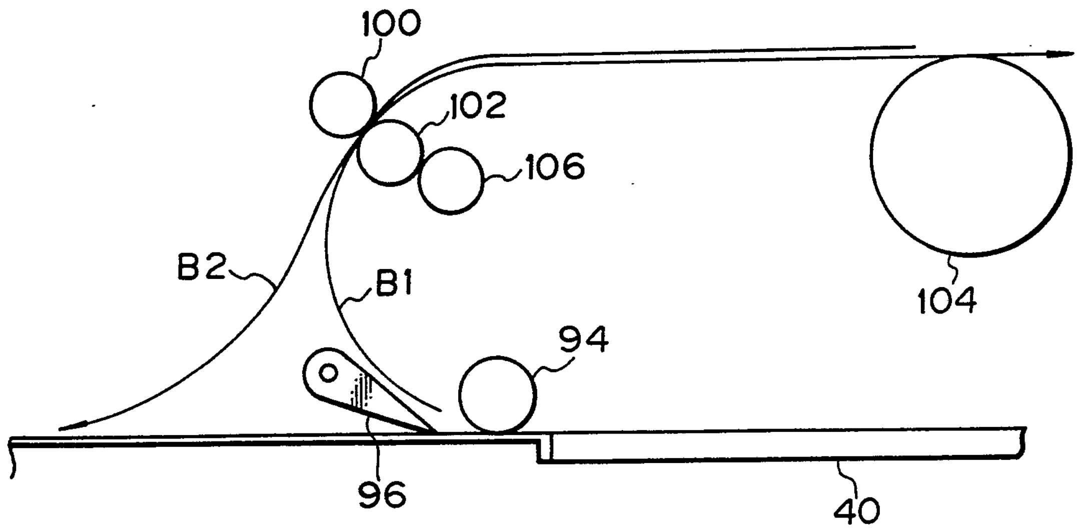
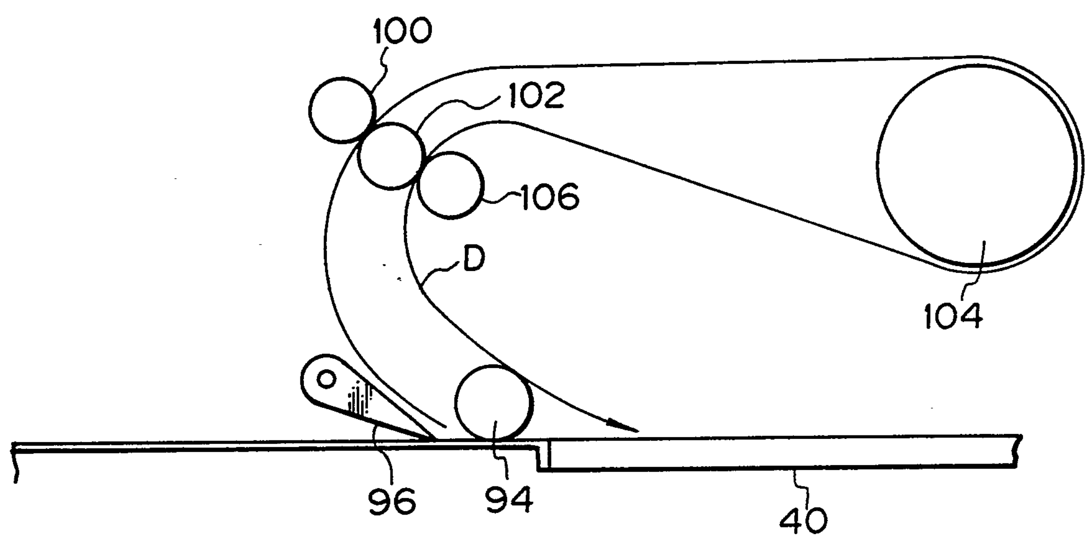
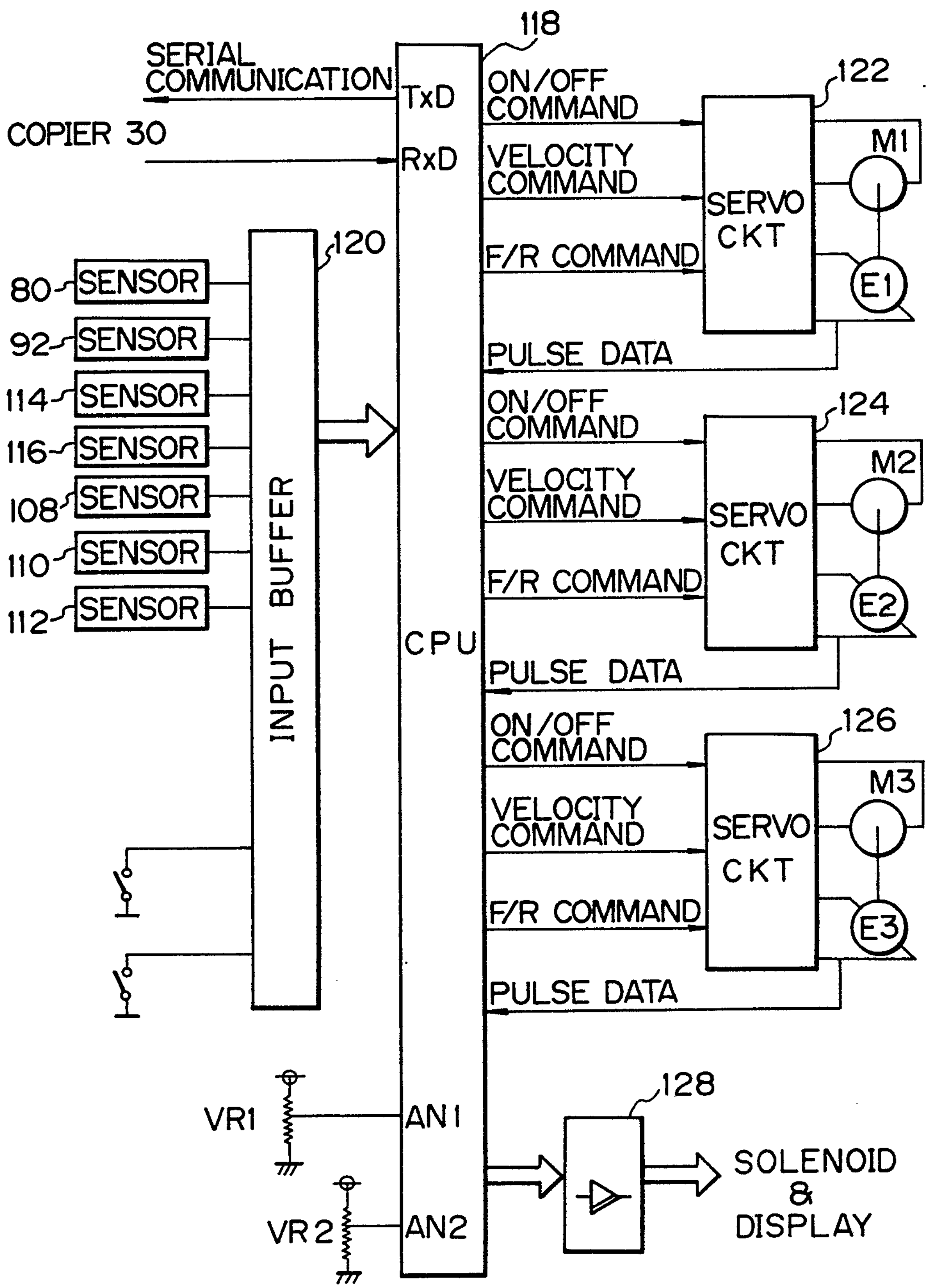


Fig. 4B



5120

Fig. 5



118
SERIAL COMMUNICATION
COPIER 30
TxD
RxD
ON/OFF COMMAND
VELOCITY COMMAND
F/R COMMAND
PULSE DATA
122
124
126
SERVO CKT
M1
E1
M2
E2
M3
E3
120
INPUT BUFFER
80
92
114
116
108
110
112
SENSOR
CPU
VR1
VR2
AN1
AN2
128
SOLENOID & DISPLAY

6120

Fig. 6

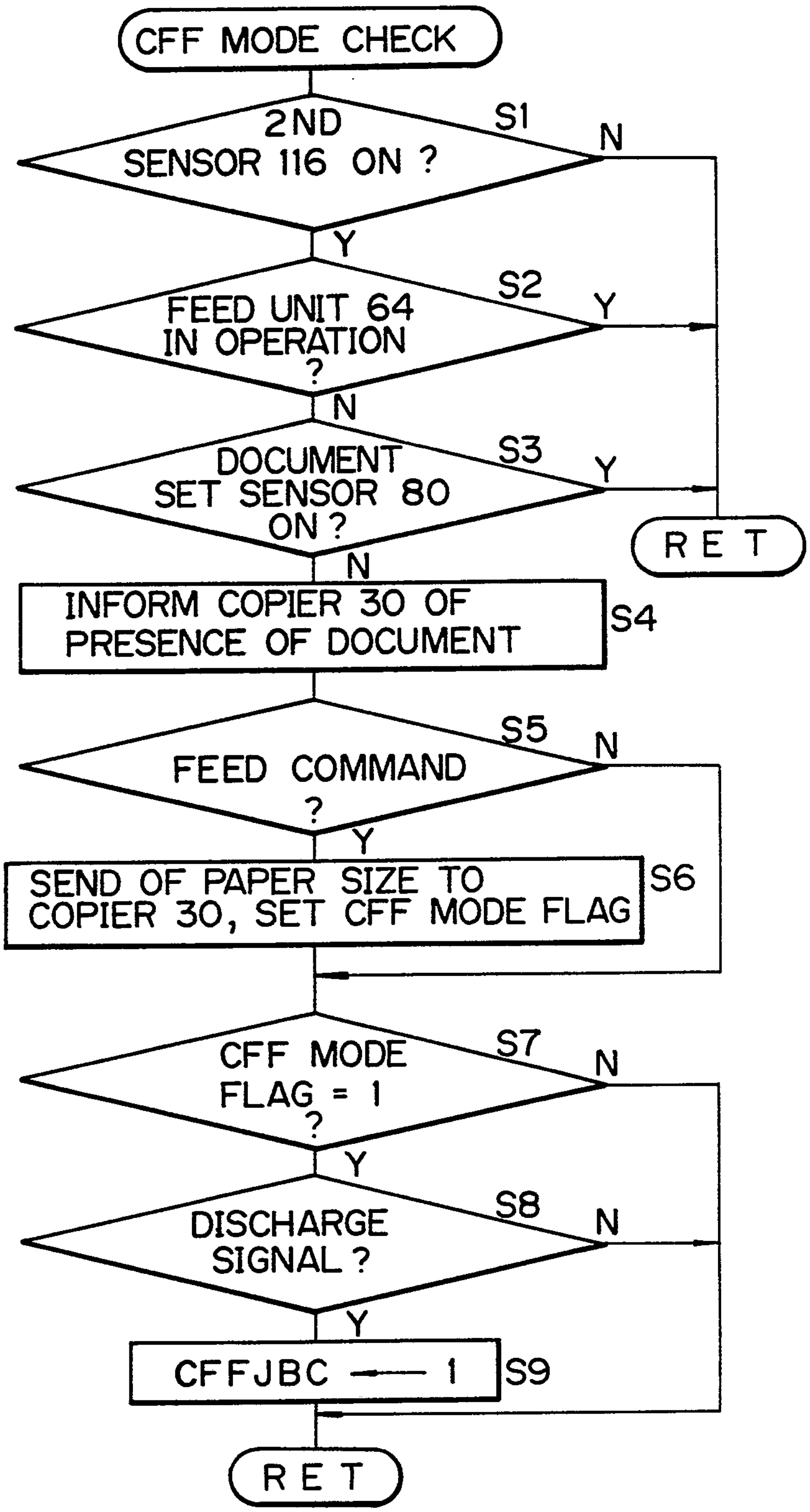

CFF MODE CHECK
2ND SENSOR 116 ON ?
S1
N
Y
FEED UNIT 64 IN OPERATION ?
S2
Y
N
DOCUMENT SET SENSOR 80 ON ?
S3
Y
N
RET
INFORM COPIER 30 OF PRESENCE OF DOCUMENT
S4
FEED COMMAND ?
S5
N
Y
SEND OF PAPER SIZE TO COPIER 30, SET CFF MODE FLAG
S6
CFF MODE FLAG = 1 ?
S7
N
Y
DISCHARGE SIGNAL ?
S8
N
Y
CFFJBC ← 1
S9
RET

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Fig. 7

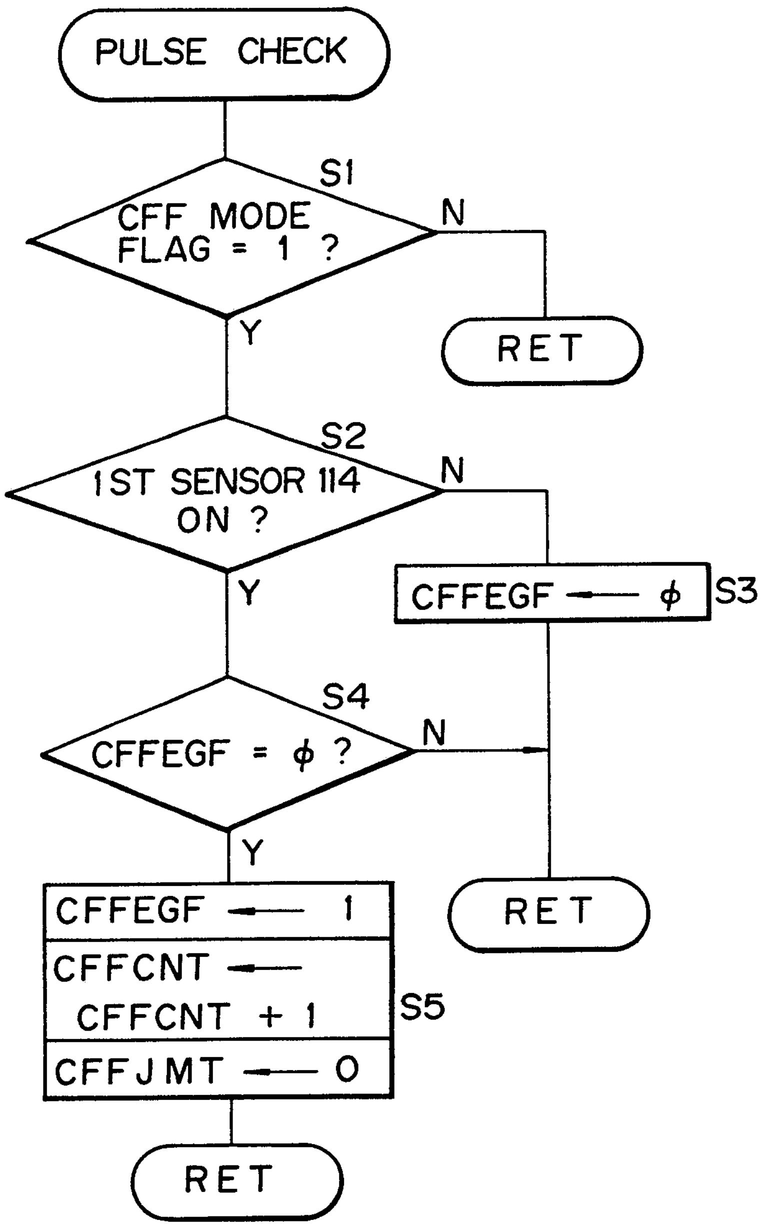
PULSE CHECK
S1
CFF MODE FLAG = 1 ?
N
Y
RET
S2
1ST SENSOR 114 ON ?
N
Y
CFFEGF ← ϕ
S3
S4
CFFEGF = ϕ ?
N
Y
CFFEGF ← 1
CFFCNT ← CFFCNT + 1
CFFJMT ← 0
S5
RET
RET

Fig. 8

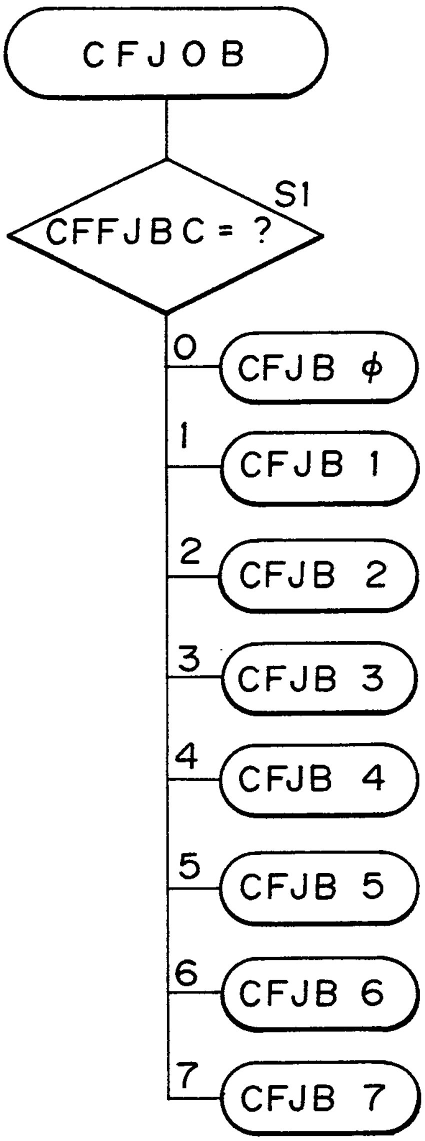

Fig. 9

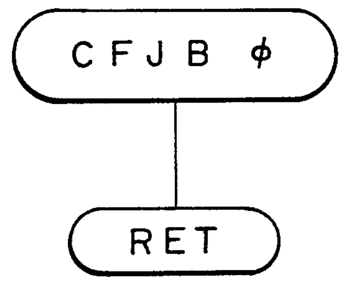

Fig. 10

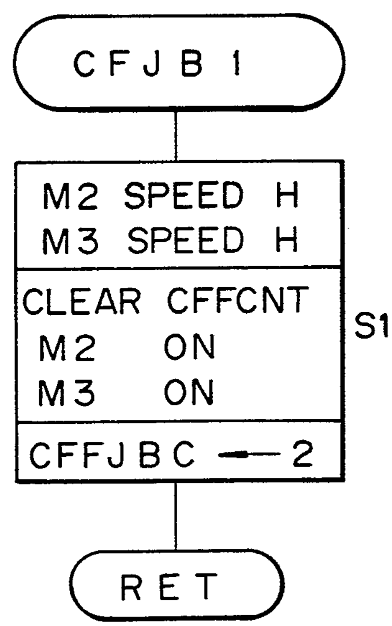

Fig. 11

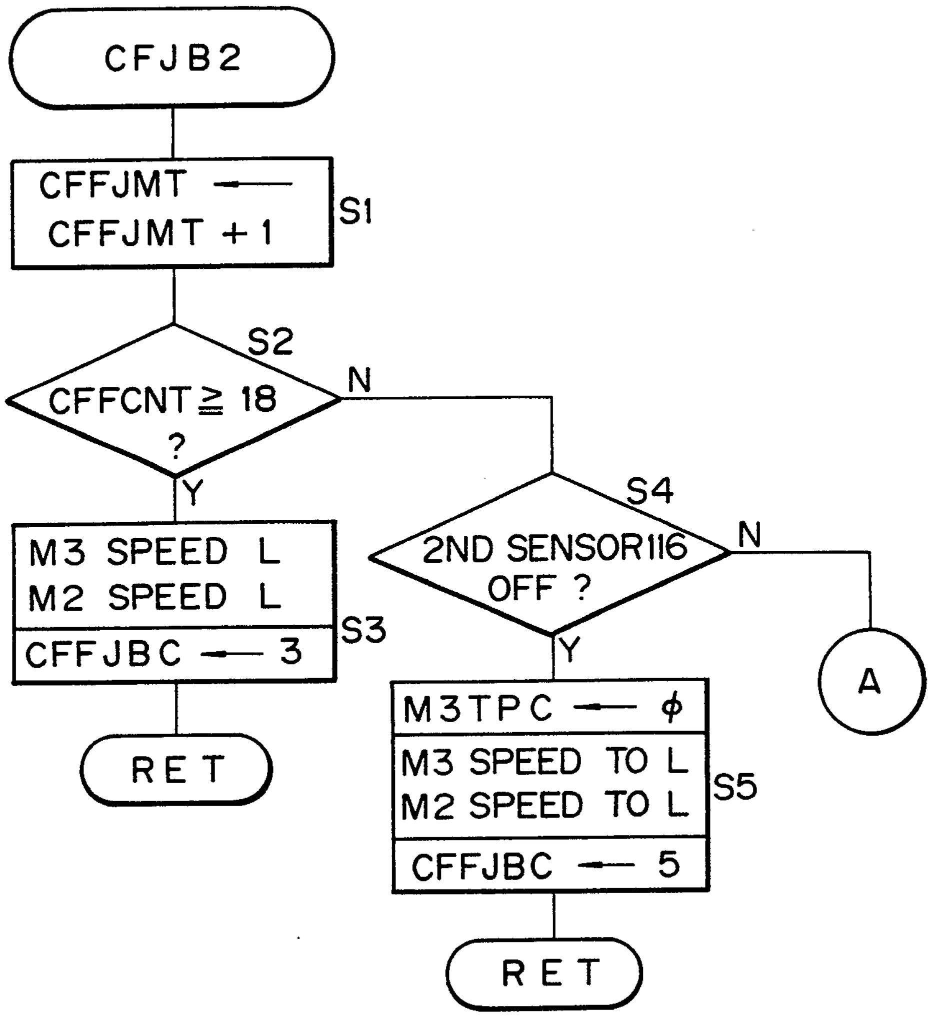
CFJB2
CFFJMT ← CFFJMT + 1
S1
S2
CFFCNT ≧ 18 ?
N
Y
M3 SPEED L
M2 SPEED L
CFFJBC ← 3
S3
RET
S4
2ND SENSOR116 OFF ?
N
Y
A
M3TPC ← φ
M3 SPEED TO L
M2 SPEED TO L
CFFJBC ← 5
S5
RET

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Fig. 12

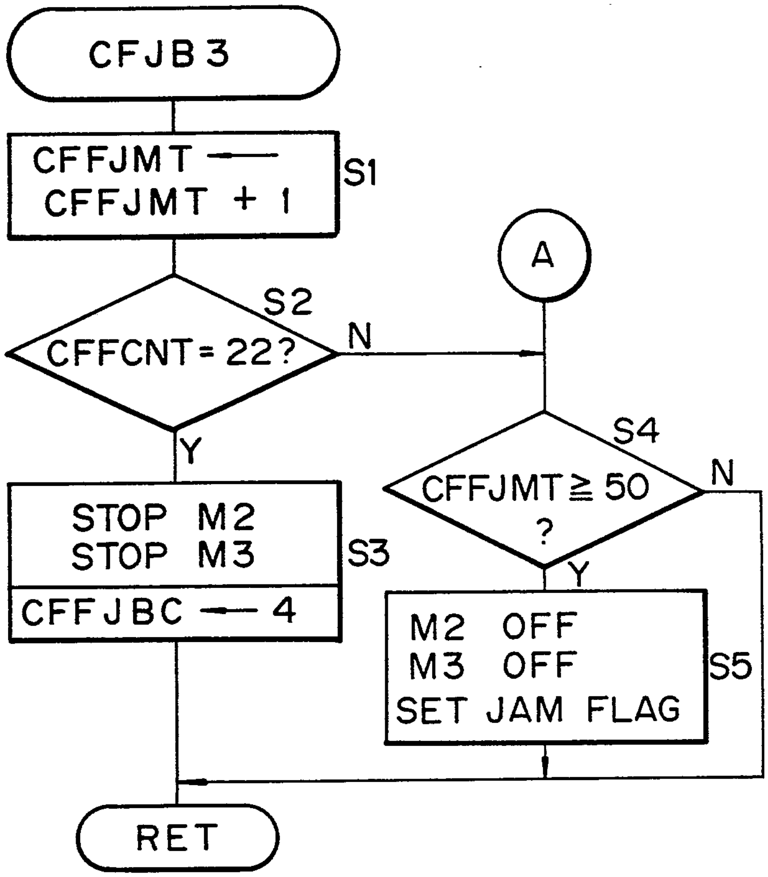
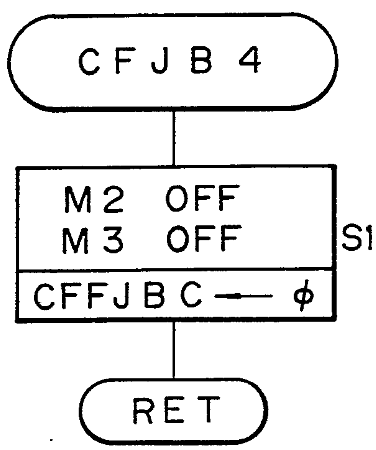


Fig. 13



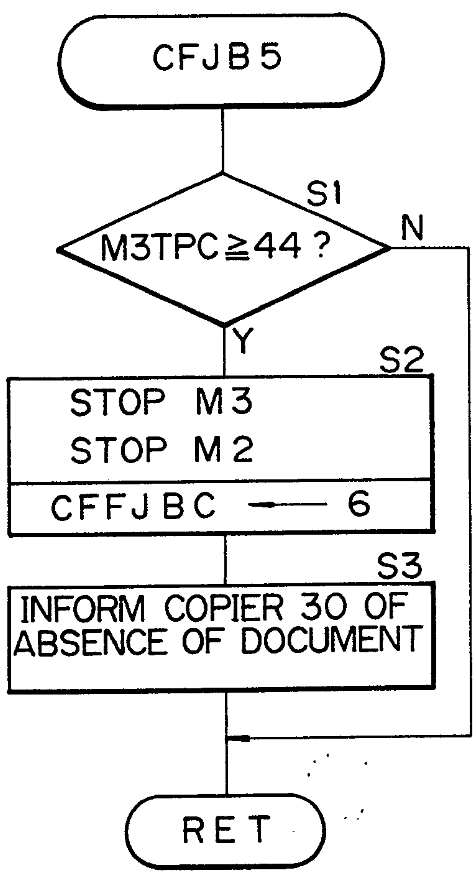

CFJB5
S1
M3TPC≧44 ?
N
Y
S2
STOP M3
STOP M2
CFFJBC ← 6
S3
INFORM COPIER 30 OF ABSENCE OF DOCUMENT
RET

Fig. 14

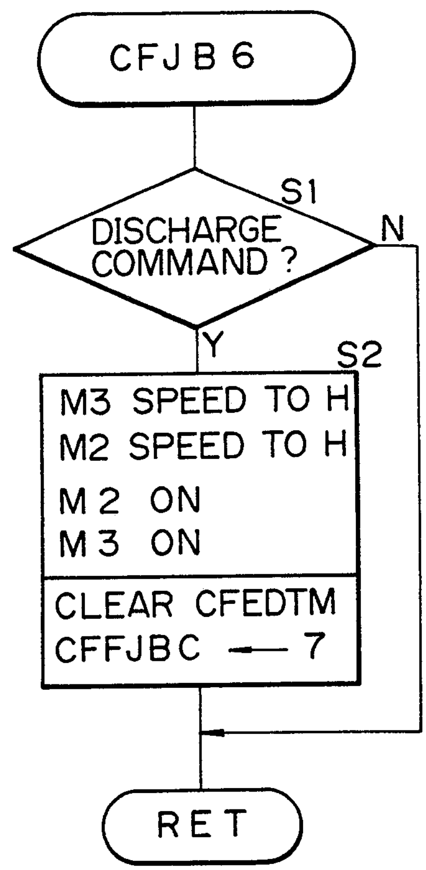

CFJB6
S1
DISCHARGE COMMAND ?
N
Y
S2
M3 SPEED TO H
M2 SPEED TO H
M2 ON
M3 ON
CLEAR CFEDTM
CFFJBC ← 7
RET

Fig. 15

Fig. 16

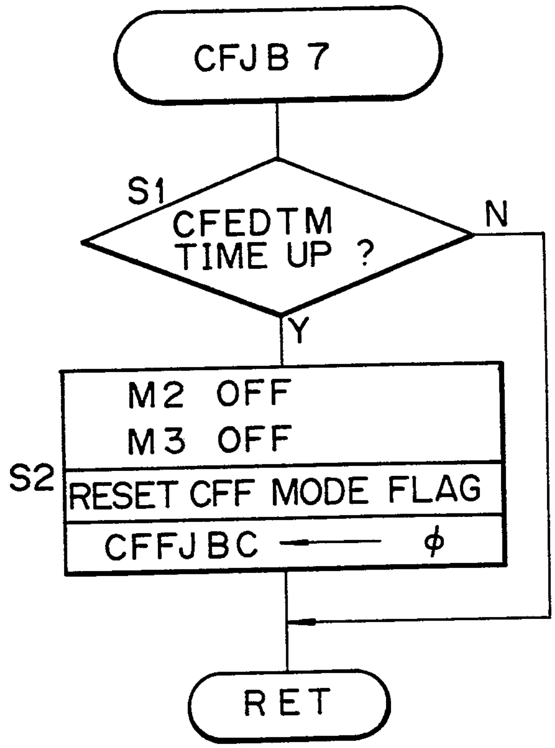

CFJB 7
S1
CFEDTM
TIME UP ?
N
Y
M2 OFF
M3 OFF
S2
RESET CFF MODE FLAG
CFFJBC ← φ
RET

Fig. 17

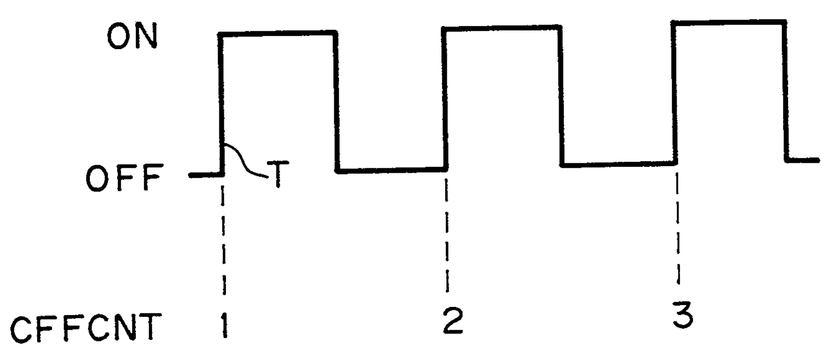

ON
OFF
T
CFFCNT
1
2
3

Fig. 18

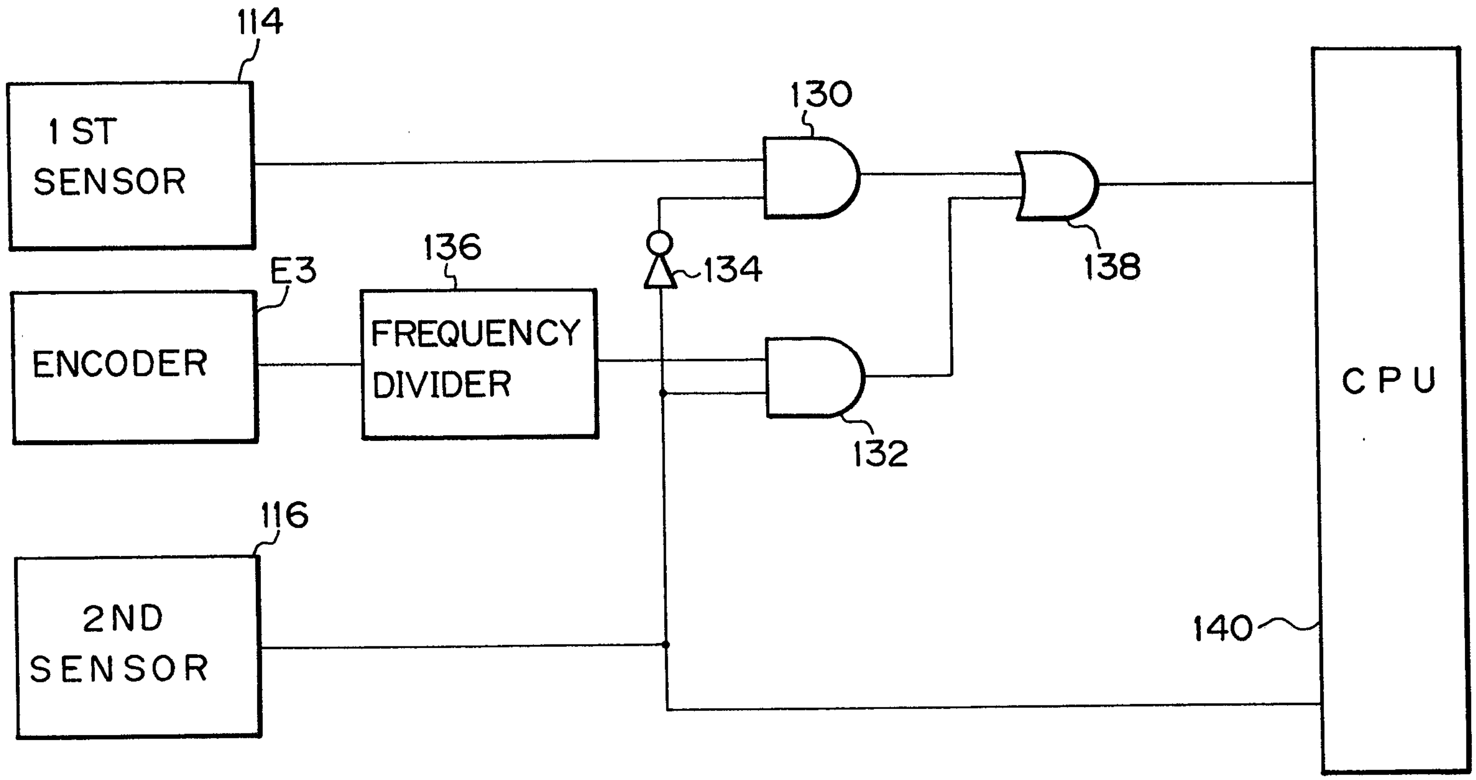

114
1 ST SENSOR
E3
ENCODER
136
FREQUENCY DIVIDER
116
2ND SENSOR
134
130
132
138
140
CPU

Fig. 19

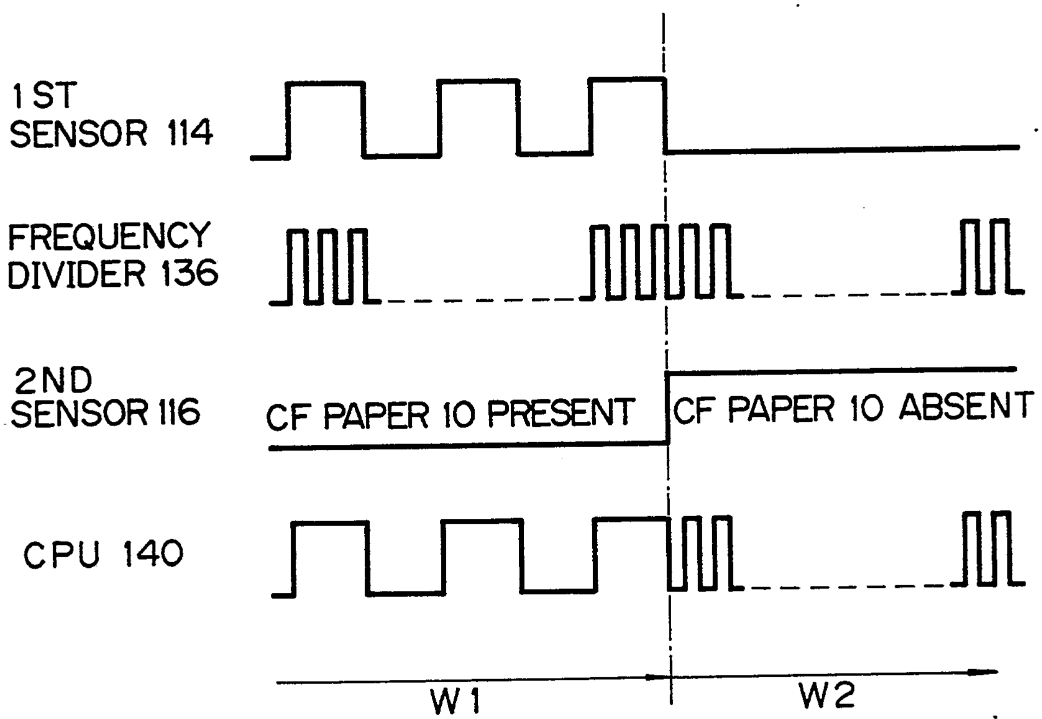
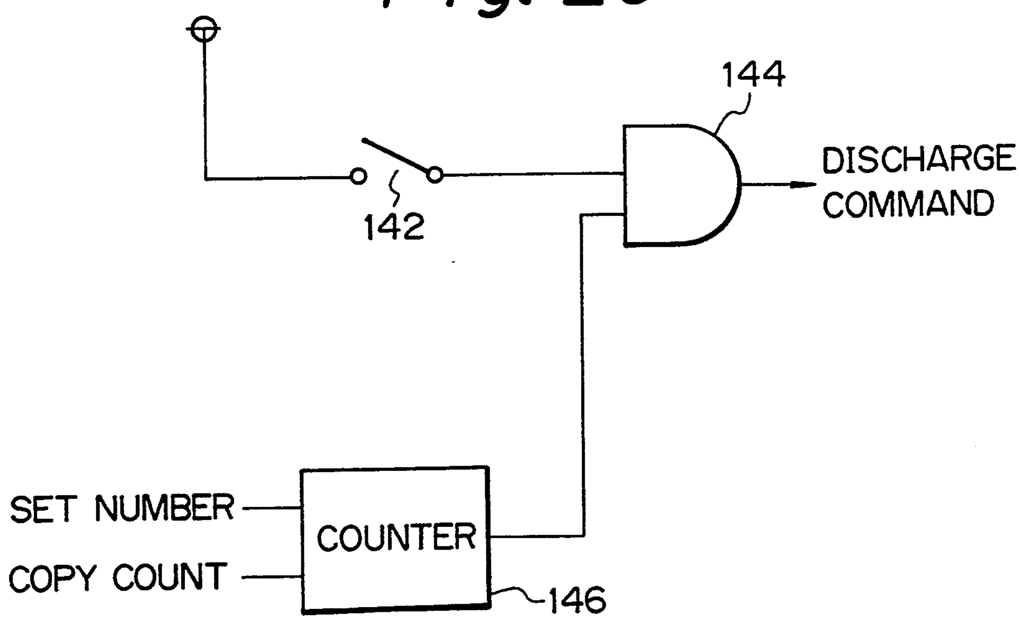
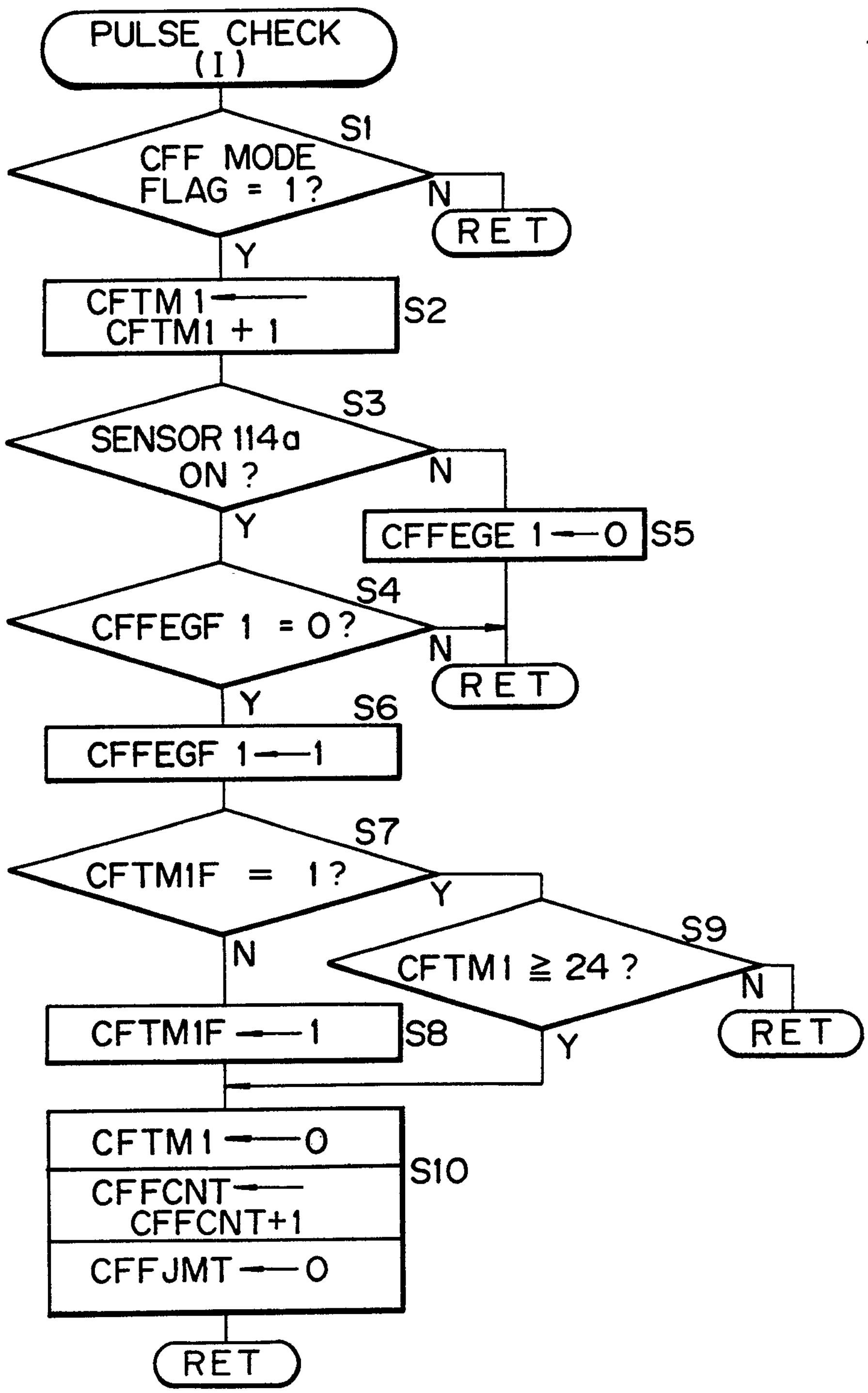

1 ST
SENSOR 114
FREQUENCY
DIVIDER 136
2ND
SENSOR 116
CF PAPER 10 PRESENT
CF PAPER 10 ABSENT
CPU 140
W1
W2

Fig. 20


144
142
DISCHARGE
COMMAND
SET NUMBER
COPY COUNT
COUNTER
146

520

Fig. 21A



PULSE CHECK (I)
S1
CFF MODE FLAG = 1?
N
RET
Y
CFTM 1 ← CFTM1 + 1
S2
S3
SENSOR 114a ON ?
N
Y
CFFEGE 1 ← 0
S5
S4
CFFEGF 1 = 0?
N
RET
Y
S6
CFFEGF 1 ← 1
S7
CFTM1F = 1?
Y
S9
CFTM1 ≧ 24 ?
N
RET
N
CFTM1F ← 1
S8
Y
CFTM1 ← 0
S10
CFFCNT ← CFFCNT+1
CFFJMT ← 0
RET

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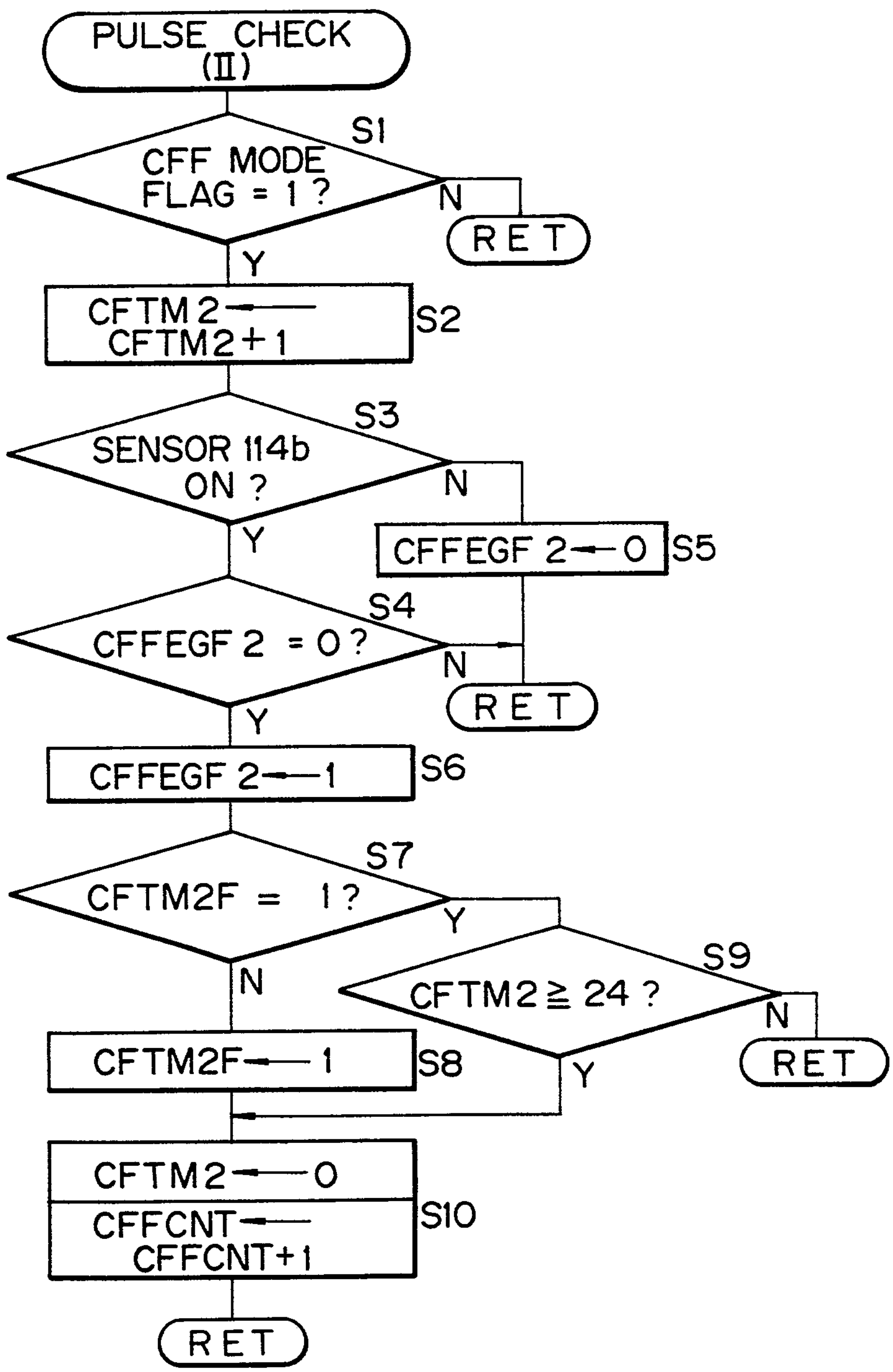
Fig. 21B



PULSE CHECK (II)
S1
CFF MODE FLAG = 1 ?
N
RET
Y
CFTM2 ← CFTM2+1
S2
S3
SENSOR 114b ON ?
N
CFFEGF 2 ← 0
S5
Y
S4
CFFEGF 2 = 0 ?
N
RET
Y
CFFEGF 2 ← 1
S6
S7
CFTM2F = 1 ?
Y
S9
CFTM2 ≧ 24 ?
N
RET
N
CFTM2F ← 1
S8
Y
CFTM2 ← 0
CFFCNT ← CFFCNT+1
S10
RET

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Fig. 21C

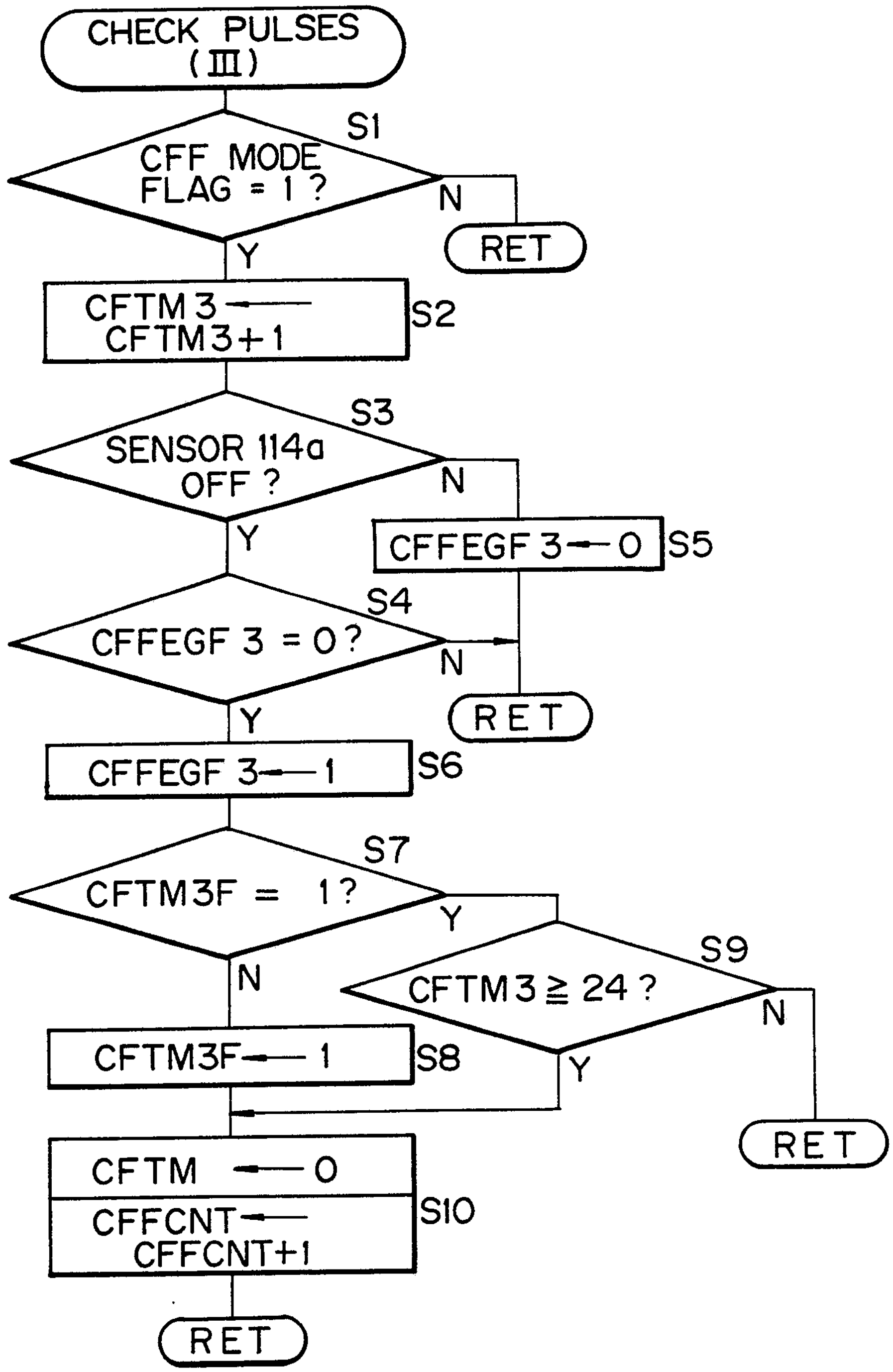
CHECK PULSES (III)
S1
CFF MODE FLAG = 1 ?
N
RET
Y
CFTM 3 ← CFTM3+1
S2
S3
SENSOR 114a OFF ?
N
CFFEGF 3 ← 0
S5
Y
S4
CFFEGF 3 = 0 ?
N
RET
Y
CFFEGF 3 ← 1
S6
S7
CFTM3F = 1 ?
Y
S9
CFTM 3 ≧ 24 ?
N
N
CFTM3F ← 1
S8
Y
RET
CFTM ← 0
CFFCNT ← CFFCNT+1
S10
RET

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Fig. 22

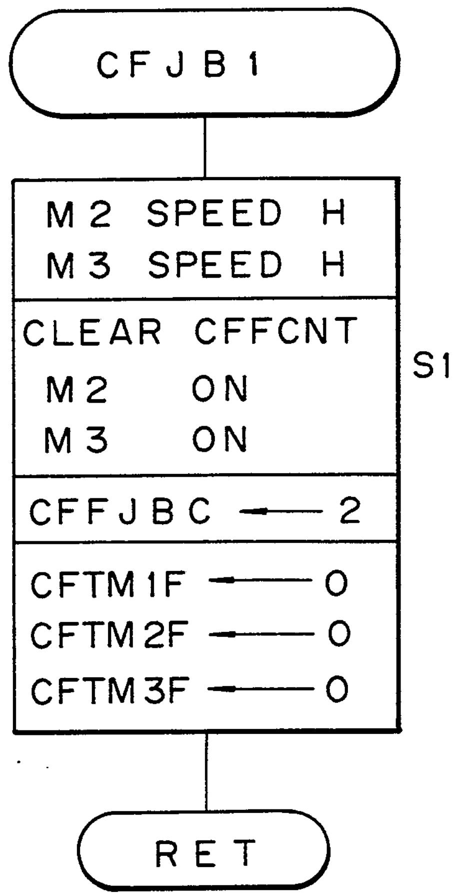

CFJB1
M2 SPEED H
M3 SPEED H
CLEAR CFFCNT
M2 ON
M3 ON
CFFJBC ← 2
CFTM1F ← 0
CFTM2F ← 0
CFTM3F ← 0
S1
RET

Fig. 23

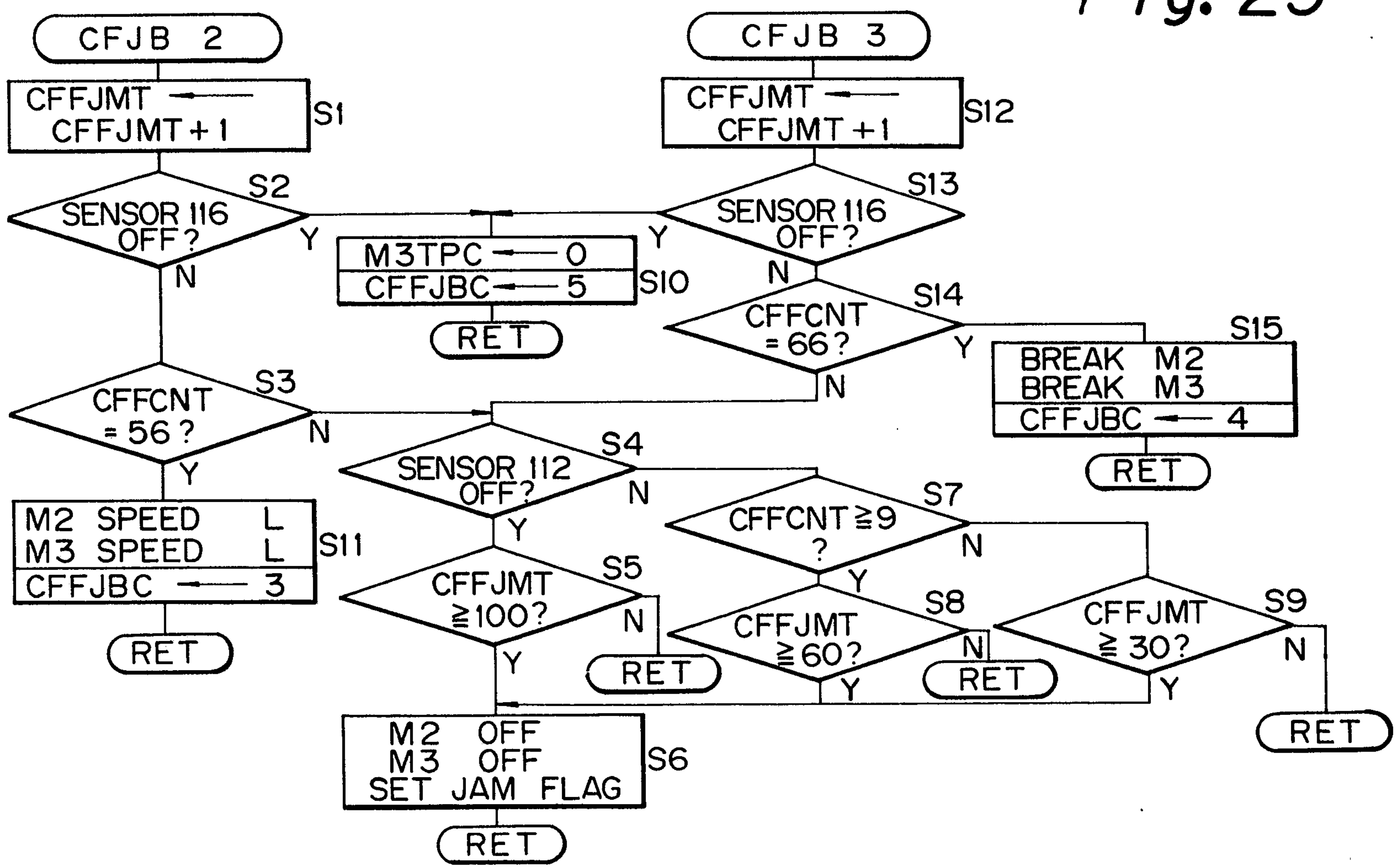
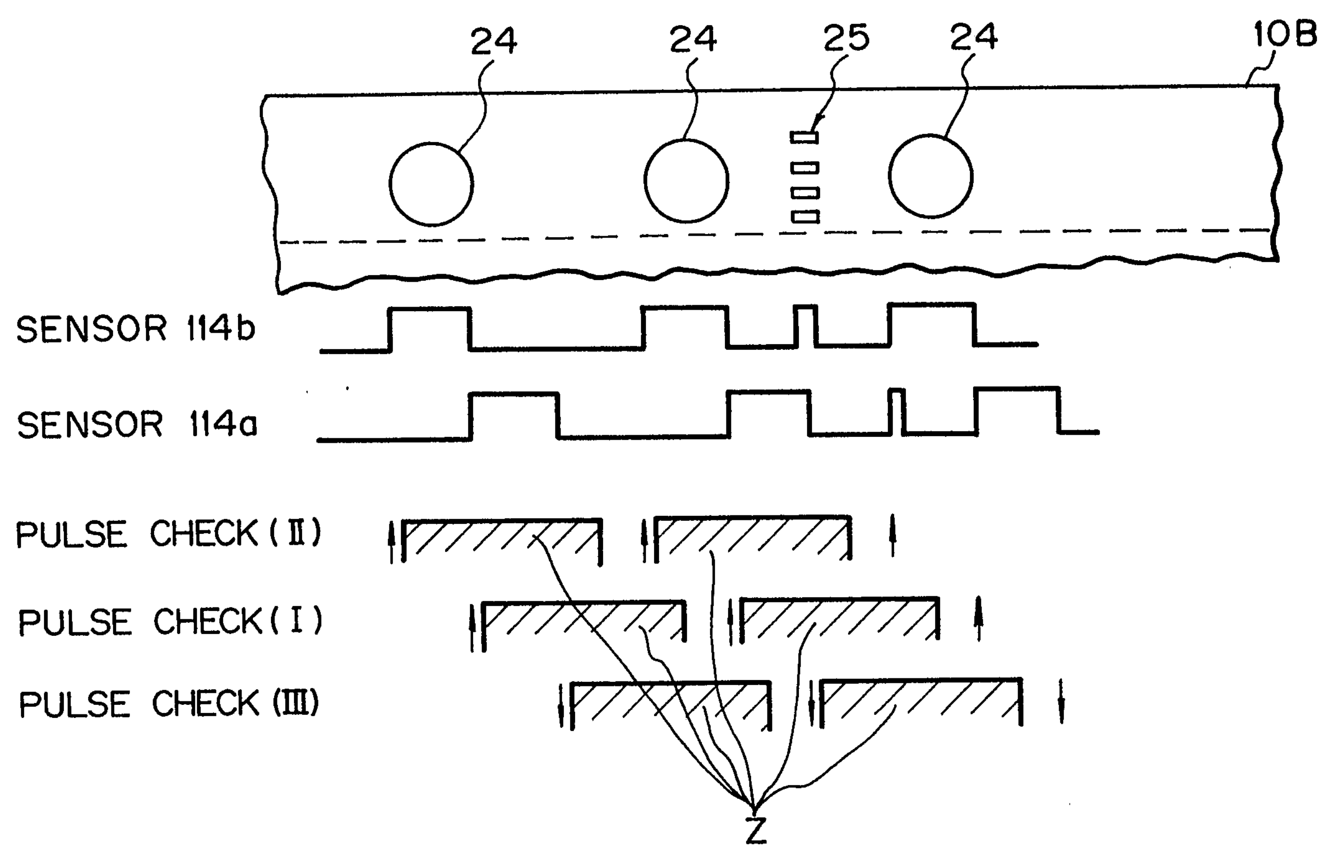

CFJB 2
CFFJMT ← CFFJMT + 1
S1
SENSOR 116 OFF?
S2
Y
N
CFFCNT = 56?
S3
N
Y
M2 SPEED L
M3 SPEED L
CFFJBC ← 3
S11
RET
CFJB 3
CFFJMT ← CFFJMT + 1
S12
SENSOR 116 OFF?
S13
Y
N
M3TPC ← 0
CFFJBC ← 5
S10
RET
CFFCNT = 66?
S14
Y
N
BREAK M2
BREAK M3
CFFJBC ← 4
S15
RET
SENSOR 112 OFF?
S4
N
Y
CFFJMT ≧100?
S5
N
Y
RET
CFFCNT ≧9 ?
S7
N
Y
CFFJMT ≧60?
S8
N
Y
RET
CFFJMT ≧30?
S9
N
Y
RET
M2 OFF
M3 OFF
SET JAM FLAG
S6
RET

Fig. 24


24
24
25
24
10B
SENSOR 114b
SENSOR 114a
PULSE CHECK (II)
PULSE CHECK (I)
PULSE CHECK (III)
Z

2020

2237413

AUTOMATIC DOCUMENT FEEDER CAPABLE OF FEEDING A DOCUMENT IN THE FORM OF A COMPUTER FORM

BACKGROUND OF THE INVENTION

The present invention relates to an automatic document feeder (ADF) for use with an electrophotographic copier, digital copier or similar image recorder for selectively feeding ordinary documents in the form of separate sheets and a continuous document in the form of computer form (CF) paper.

An ADF is extensively used with the above-described kind of image recorder for automatically feeding a document to a glass platen of the image recorder while preventing it from jamming the path or from being damaged, then stopping it on the glass plate, and then discharging it after an image printed thereon has been scanned. Documents usable with the ADF include ordinary documents in the form of separate sheets and elongate documents such as CF paper. Generally, CF paper has a number of sprocket holes formed through a marginal area thereof. Specifically, the sprocket holes are positoned one after another in an intended direction of paper feed to mesh with the teeth of a sprocket which drives the CF paper. A sensor is located on the transport path of the CF paper to sense the sprocket holes, so that the transport of the paper may be controlled in response to the output of the sensor. An ADF having a capability for transporting such CF paper to the glass platen is disclosed in Japanese Patent Laid-open Publication No. 72455/1984. A drawback with a prior art ADF having such a capability is that the document transport control cannot be readily implemented for each of different kinds of documents. Moreover, it is difficult to accurately position a document in a predetermined position of a glass platen for imagewise exposure. Especially, sequentially locating consecutive pages provided on CF paper in the particular position on the platen is extremely difficult.

CF paper with a carbon is a special kind of CF paper and has, in addition to ordinary sprocket holes, some cuts intervening between nearby sprocket holes. Such cuts are adapted to fasten the CF paper and carbon temporarily to each other. An ADF capable of transporting CF paper with a carbon to the glass platen is taught in Japanese Patent Laid-Open Publication No. 72456/1984 by way of example. The ADF disclosed in this Laid-Open Publication adopts an extremely complicated system for discriminating the above-mentioned cuts from the sprocket holes. Specifically, the system is such that the number of sprocket holes are divided into consecutive zones and sensed by a sensor zone by zone. Nevertheless, this prior art ADF is not entirely free from the fear that the cuts intervening between nearby sprocket holes are mistaken for sprocket holes.

It is therefore an object of the present invention to reduce the drawbacks particular to above-mentioned ADFs.

It is another object of the present invention to provide a generally improved ADF for an image recorder.

According to the present invention, there is provided an automatic document feeder (ADF) for an image recorder comprising:

an inlet for feeding therethrough to a platen a continuous document constituted by a sequence of continuous pages and having a plurality of equally spaced feed holes;

document transporting means located to face the platen for transporting any of the documents placed on and along the platen;

means located upstream of the platen with respect to an intended direction of transport of the continuous document for generating feed pulses by sensing the feed holes of the continuous document;

counter means for counting said generated feed pulses; and determining means for determining a state of said continuous document by comparing the number of generated feed pulses counted by the counter means with a predetermined number.

With the present invention the incidence of jamming or damage to the paper may be reduced and images on CF paper with or without a carbon may be reproduced with improved accuracy.

A further advantage of the present invention is that with such an ADF, the first page of CF paper with or without a carbon may be positioned on a glass platen by hand and be transported and stopped page by page to the last page more reliably.

Yet another advantage of the present invention is that CF paper with a carbon can be fed to a glass platen and the fastening cuts not be mistaken for sprocket holes.

The present invention will be further understood from the following description when taken with the accompanying drawings which are given by way of example only and in which:-

Figs. 1A and 1C show CF paper having multiple print areas thereon;

Fig. 1B shows a copy sheet on which an image is reproduced in an accurate position;

Fig. 1D shows a copy sheet on which an image is deviated from the accurate position;

Fig. 2 is a section showing the overall construction of an electrophotographic copier which belongs to a family of image recorders to which an ADF in accordance with the present invention is applicable;

Fig. 3 is a section showing a part of the copier shown in Fig. 2 and a first embodiment of the ADF in accordance with the present invention;

Figs. 4A and 4B are schematic diagrams each showing a specific manner of discharging an ordinary sheet document;

Fig. 5 is a schematic block diagram showing a control circuit associated with the ADF of Fig. 3;

Figs. 6 through 16 are flowcharts demonstrating specific operations which are performed in a CFF mode;

Fig. 17 plots a waveform of an output of a first sensor shown in Fig. 3;

Fig. 18 is a schematic block diagram showing another specific construction of a switching device;

Fig. 19 is a timing chart associated with the circuitry of Fig. 18;

Fig. 20 is a block diagram schematically showing a specific construction of a feed command generating unit;

Figs. 21A through 21C and Figs. 22 and 23 are flowcharts demonstrating various CFF mode check and CFF pulse check routines and representative of a second embodiment of the present invention; and

Fig. 24 is a chart showing how a third embodiment of the present invention senses the sprocket holes of CF paper with a carbon.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

To better understand the present invention, a prior art ADF will be outlined.

Assume an electrophotographic copier or similar image recorder on which is mounted an ADF of the type capable of feeding a document in the form of CF paper. When a document in the form of CF paper is to be copied, the ADF automatically feeds the document, the first page being the first, toward a glass platen of the image recoder via an inlet which is formed in the ADF, in exactly the same manner as with ordinary documents. After the first page has been illuminated for imagewise exposure, the CF paper is transported until the second page reaches the platen. After the second page has been stopped on the platen, it is illuminated in the same manner as the first page. In this construction, images printed on predetermined areas of individual pages of CF paper are sequentially fed page by page onto the platen to produce desired copies. Specifically, as shown in Fig. 1A, assume that CF paper 10 has image areas or print areas 16a, 16b, 16c, ... which are individually accurately located in predetermined positions on consecutive pages 14a, 14b, 14c, ... which in turn are delimited by folds 12a, 12b ... Then, the print areas can be successfully copied to obtain complete reproductions, as represented by a copy 20 having an image 22 in Fig. 1B. However, it often occurs that images are not printed in predetermined positions on the consecutive pages 14a, 14b, 14c ... of the CF paper 10A, e.g., each of the print areas 16a, 16b, 16c, ... extends over two nearby pages, as shown in Fig. 1C. When the prior art ADF is operated to automatically feed such CF paper 10A from the first page 14a, stop it in a predetermined position on the platen, and copy it, the image 22 will be partly lost on the resulting copy as represented by a copy 22A in Fig. 1D.

The above occurrence will be eliminated if the operator sets the first print area 16a of the first page 12A of the CF paper 10A in a predetermined position on the platen by hand, copies the first page 12A, and then activates the ADF for automatically feeding the ADF paper 10A page by page. Then, all the print areas 16a, 16b, 16c ... will be accurately reproduced on copies, as shown in Fig. 1B.

The prior art ADF has a sensor located downstream of the platen and responsive to sprocket holes 24 (Figs. 1A and 1C) which are formed through CF paper, so that the CF paper may be automatically fed page by page. Specifically the sensor senses a particular number of sprocket holes which are representative of one page of CF paper. The sensor, therefore, allows CF paper to be transported one page at a time, then stopped on the platen, and then copied. The location of the sensor downstream of the platen allows even the last page of CF paper to be accurately controlled with respect to transport and stop.

However, a problem with the above-stated manual setting scheme is that the position of the first page on the platen slightly changes depending upon the position of the print area 16a provided on the first page. That is, the first page of CF paper cannot always be set as precisely in a predetermined position on the platen as the CF paper 10 which is automatically fed from the first page. Hence, it is impossible to transport CF paper accurately by one page and then stop it on the platen, on the basis of an output of the sensor which is located downstream of the platen. While the sensor may be located upstream of the platen in order to eliminate this problem, then the sensor would fail to control the transport and provide for the stopping of the last page of CF paper, as discussed previously, due to the distance between the platen and the sensor.

Preferred embodiments of the ADF in accordance with the present invention will be described hereinafter.

First Embodiment

Referring to Fig. 2, an electrophotographic copier which belongs to a family of image recorders and is implemented by a first embodiment of the present invention is shown. The copier, generally 30, is generally made up of a copier body 32, a mass paper feed unit 34, a sorter 36, and an ADF 38 representative of the illustrative embodiment. The copier body 32 has a glass platen 40 on which the ADF 38 is mounted for feeding a document to the glass platen 40. Optics 42 illuminates a document support surface of the glass platen 40 to reproduce a document on a paper sheet which is fed from the mass paper feed unit 34. The resulting copies are sorted by the sorter 36.

Fig. 3 shows the ADF 38 in detail. In the figure, a document fed in a specific manner as will described is laid on the glass platen 40. The optics 42 located below the platen 40 has a first scanner 44 loaded with a light source 46 and a first mirror 48, a second scanner 50 loaded with a second mirror 52 and a third mirror 54, a lens 56, and a fourth mirror 58. The scanners 44 and 50 are individually moved to the left away from their home positions shown in the figure, so that the document laid on the platen 40 is illuminate by light issuing from the light source 46. A reflection from the document is sequentially reflected by the first to third mirrors 38, 52 and 54, then propagated through the lens 56, and then reflected by the fourth mirror 58, which is fixed in place, to reach a photoconductive element 60 (Fig. 2). As a result, a latent image representative of the document is electrostatically formed on the photoconductive element 60. The latent image is developed by a conventional procedure which uses toner. The resulting toner image on the photoconductive element 60 is transferred to a paper sheet to produce a copy 20 as shown in Fig. 1B.

Referring to Fig. 3, a specific construction of the ADF 38 is shown. In the illustrative embodiment, the ADF 38 has a transport member in the form of a belt 62 which is located to face the glass platen 40. An ordinary document feed unit 64 feeds ordinary sheet documents (hereinafter referred to as ordinary documents) one by one to the platen 40. A CF paper inlet 66 is provided so that CF paper 10 may be fed toward the platen 40 via the inlet 66. A document discharge unit 68 drives a document coming out of the platen 40 after illumination to the outside of the ADF 38. The belt 62 is passed over a drive roller 70, a driven roller 72, and a number of presser rollers 74. The drive roller 70 is driven in a clockwise rotational motion by a motor M2 which is schematically shown in Fig. 3. The belt 62 is rotatable as indicated by an arrow A in the figure, transporting a document on and along the platen 40.

A cover 76 accommodates the belt 62, rollers 70, 72 and 74 and document discharge unit 68 and is supported by the copier body 32 to be rotatable integrally with those rollers and unit. The cover 76 may be raised away from the platen 40 to access the platen 40, so that a document may be laid on the platen 40 by hand as needed.

A specific operation of the ADF 38 for causing the ordinary document feed unit 64 to feed an ordinary document automatically and an arrangement associated with such an operation will be described.

First, a main switch (not shown) of the copier 30 is turned on, and a stack of sheet documents (not shown) are loaded on a document table 78. The paper feed unit 54 has a document set sensor 80 which is turned on by the leading edges of the documents. When a print switch (not shown) of the copier 30 is pressed, the copier 30 feeds a document feed command to the

ADF 38. This causes the ADF 38 begin to operate, i. e., pick-up rollers 82 and 84 of the document feed unit 64 are rotated counterclockwise to move a sheet document forward. At the same time, a separator roller 86 is rotated counterclockwise and, in cooperation with a separator blade 88 which is pressed against the roller 86 feeds only the lowermost sheet document out of the stack toward a pull-out roller pair 90. This roller pair 90 drives the sheet document toward the platen 40. The rollers 82, 86 and 90 are driven by a motor M1 which is schematically shown in Fig. 3.

As soon as the leading edge of the document fed out of the stack reaches the platen 40, the document is transported on and along the platen 40 by the belt 62 which is rotating in the direction A. When the trailing edge of the document moves away from a register sensor 92, the sensor 92 senses it. Thereafter, as the sheet document is moved by a predetermined distance, the belt 62 is brought to a halt so that the sheet document becomes stationary on the platen 40. At this instant, the trailing edge of the sheet document is located at a reference position X on the platen 40. This control is effected by an encoder E2 which is associated with the drive motor M2, as described later in detail.

Then, the scanners 40 and 50 are operated so that the document on the platen 46 is illuminated by the light source 46. This is followed by the previously mentioned sequence of copying steps. When a predetermined number of copies are produced with the above document, the copier 30 delivers a feed command to the ADF 38 for feeding the next sheet document, while feeding a discharge command to the ADF 38 for discharging the preceding sheet document. In response, the feed unit 64 feeds the next sheet document while, at the same time, the belt 62 is driven again in the direction A. As a result, the illuminated sheet document is driven out of the platen 40 and then out of the ADF 38 by the discharge unit 68. The procedure described above is repeated to feed the stack of documents one by one automatically.

The document discharge unit 68 has an intermediate transport roller 94 which transports a document coming out of the platen 40. When the sheet document is to be directly discharged to the outside of the ADF 38, a selector pawl 96 located downstream of the roller 94 is held in a position indicated by a solid line in the figure. In this condition, the sheet document is continuously transported to the left by the roller 94 and a discharge roller 98 which is located downstream of the roller 94. When the sheet document is to be discharged face down, the selector pawl 96 is switched to a position indicated by a phantom line in the figure. Then, the sheet document coming out of the platen 40 is steered by the selector pawl 96 toward a first and a second reversal rollers 100 and 102, and then further transported by the reversal rollers 100 and 102, as indicated by an arrow B in Fig. 4A. Thereupon, the rotating directions of the coactive rollers 100 and 102 are reversed to discharge the sheet document to the outside of the ADF 38, as indicated by an arrow B2 in Fig. 4A. When an image is printed on the back of the sheet document and is to be copied also, the next sheet is not fed from the feed unit 64 and, instead, the sheet document coming out of the reversal rollers 100 and 102 is transported wrapping around a turn roller 104. The sheet document is then caught by the second reversal roller 102 and a third reversal roller 106 to be thereby returned to the platen 40. This allows the image printed on the back of the sheet document to be copied. A motor M3 schematically shown in Fig. 3 is adapted to drive the above-mentioned rollers of the document discharge unit 68. A reversal registration sensor 108, a reversal inlet sensor 110 and a paper discharge sensor 112 are disposed in the illustrated positions of the discharge unit 68.

To enhance efficient copying operations, an arrangement may be so made as to begin feeding the sheet document subsequent to the document lying on the platen and, thereafter, discharge the preceding document from the platen 40. Although this causes a part of the preceding document to remain on the platen 40 when the subsequent document is brought to a halt on the platen 40, the former document is surely discharged by the intermediate transport roller 94.

The operation of the ADF 38 with a document in the form of CF paper will be described together with an arrangement associated therewith.

In this case, the CF paper 10, 10A shown in Figs. 1A and 1C is inserted by hand in the CF paper inlet 66 which is provided independently of the document feed unit 64. So long as the print areas 16a, 16b, 16c, ... are formed in predetermined positions on the CF document 10 (Fig. 1A), the first page 14a of the CF paper 10 is set on the platen 40 with the first fold 12a being held in register with the reference position X of the platen 40. As shown in Fig. 1C, when the print areas are deviated from the predetermined positions, the CF document is set on the platen 40 with the fold 12a being deviated from the reference position X. Specifically, the intermediate X1 between the nearby print areas 16a and 16b is held in register with the reference position X. As shown in Fig. 3, the remaining part of the CF paper 10 may be folded and laid on the table 78 or any other suitable place.

The manipulation stated above is easy to perform because the cover 76 can be raised to expose the platen 40.

After the CF paper 10 has been set on the platen 40 by hand, the cover 76 is closed and, then, the main switch and print switch of the copier 30 are pressed. Then, the copier 30 delivers a feed command to the ADF 38. However, none of the belt 62 and discharge unit 68 operate in response to the feed command and, therefore, the CF paper 10 remains stationary on the platen 40, as described in detail later. While the CF paper 10 is held in a halt on the platen 40, the first print area 16a is reproduced by the previously described procedure to produce a desired number of copies 20 shown in Fig. 1B. As the illumination of the first print area 16a is completed, the copier 30 delivers a discharge command to the ADF 38. In response, the motors M2 and M3 (Fig. 3) are energized to move the belt 62 in the direction A while starting driving the rollers of the discharge unit 68. In this instance, the selector pawl 94 is continuously held in the solid-line position of Fig. 3 so that the CF paper 10 is transported horizontally by the intermediate roller 94 and discharge roller 98. Consequently, the print area 16b on the second page of the CF paper 10 is transported toward the platen 40.

A first sensor 114 and a second sensor 116 are located upstream of the platen 40 with respect to the direction of CF paper transport, i. e., between the document inlet 66 and the platen 40 in the illustrative embodiment. The first sensor 114 is responsive to the sprocket holes 24 of the CF paper 10; the transport and stop of the CF paper 10 are controlled on the basis of output pulses of the sensor 114. The second sensor 116 is adapted to determine whether or not the CF paper 10 is in a position where it can be sensed by the first sensor, or sprocket hole sensor, 114. In the illustrative embodiment, the two sensors 114 and 116 are arranged side by side in a direction perpendicular to the sheet surface of Fig. 3. The distance l between the position where the sensors 114 and 116 sense the CF paper 10 and the platen 40 is selected to be equal to or smaller than the length L1 (Fig. 1A) of one page of the CF paper 10. Guide members (not shown) are disposed along the transport path between the document inlet 66 and the platen 40 for the purpose of guiding the opposite edges of the CF paper 10 which is apt to be fed askew, but members for driving the CF paper 10 are not provided there.

As the CF paper 10 begins to be transported after the reproduction of the first page 16a, the sprocket sensor 114 senses the sprocket holes 24 of the CF paper 10. At the instant when the number of output pulses of the sensor 24 reaches a predetermined number associated with one page of the CF paper 10, e. g. , twenty-two, the motors M2 and M3 are deenergized to stop the movement of the CF paper 10. At this time, the second print area 16b of the CF paper 10 has been located in the predetermined position on the platen 40. In this condition, the print area 16b is illuminated to produce a copy. When a desired number of copies are produced with the print area 16b, the CF paper 10 is driven again by the previously discussed manner until the third print area 16c reaches the predetermined position on the platen 40. While the print areas 16a, 16b, 16c, ... are sequentially copied with the CF paper 10 being controlled on the basis of the outputs of the sprocket hole sensor 114 with respect to transport and stop, the second sensor or CF paper sensor 116 continuously senses the presence of the CF paper 10. As soon as the trailing edge of the last page of the CF paper 10 moves away from the sensors 114 and 116, the sensor 114 cannot sense sprocket holes 24 any longer and therefore would prevent the transport and stop of the CF paper 10 from being controlled.

In the light of the above, from the time when the sprocket sensor 114 stops producing an output pulse, the control over the transport and stop of the CF paper 10 is automatically handed over from the CF paper sensor 116 to a control device which may include timer or a pulse generator. Then, despite that the sprocket sensor 114 does not sense any sprocket hole 24, the CF paper 10 can be brought to a stop when a predetermined period of time expires or when a predetermined number of pulses appear after the trailing edge of the last page has moved away from the CF paper sensor 116. This allows the print area on the last page of the CF paper 10 to be accurately positioned on the platen and copied. After the the print area of the last page has been fully copied, the CF paper 10 is bodily driven out of the ADF 38.

Referring to Fig. 5, a control circuit associated with the ADF 38 for implementing the above-stated operations is shown in a schematic block diagram. In the figure, the ADF 38 has a CPU 118 which interchanges data with the copier 30 by serial communication. The outputs of ths sensors 80, 92, 114 and 116 as well as the outputs of other various sensors disposed in the discharge unit 68 are fed to the CPU 118 via an input buffer 120. Each sensor may advantageously be implemented by a light emitting diode and a phototransistor. The motors M1, M2 and M3 are respectively driven via servo circuits 122, 124 and 126 to which the CPU 118 delivers motor ON/OFF commands, motor velocity commands (6-bit data), and forward/reverse direction commands. A solenoid for actuating the selector pawl 96, a display and so forth are driven by a driver 128 in response to commands which are also fed from the CPU 118. The servo circuits 122, 124 and 126 use output pulses of encoders E1, E2 and E3 of their associated motors M1, M2 and M3 for the velocity controlling pulse, while feeding pulse data to the CPU 118. The CPU 118 controls the position of the document on the basis of the incoming pulse data. A part of the pulse data is used to sense errors which may occur in the motors M1, M2 and M3.

The CPU 118 has analog ports (e. g. μPD 7810 available from NEC). Variable resistors VR1 and VR2 are connected to analog ports AN1 and AN2, respectively. The resistance values of the variable resistors VR1 and VR2 are fed to the CPU 118 at a resolution of "256" to implement the control over the document stopping position. Such a configuration is successful in compensating for some scattering among ADFs. Specifically, assuming that in a certain ADF the number of pulses appearing from the instant when a sheet document moves past the register sensor 92 to the instant when it reaches the reference position X (Fig. 3) is 640, the variable resistor VR1 may be so adjusted as to produce such a number of pulses. In the software aspect, the adjustment may be made by using 600 pulses as a fixed value and adding the analog value of the variable resistor VR1 to 600.

Hereinafter will be described specific procedures associated with the control over the transport and stop of the CF paper 10. The mode for feeding the CF paper 10 will be referred to as "CFF mode" for convenience.

Fig. 6 shows a "CFF mode check" routine for determining whether or not the operation enters into the CFF mode. When the CF paper 10 is inserted in the inlet 66, the CF paper sensor 116 is turned on (step S1). In this condition, if the feed unit 64 for feeding an ordinary sheet document is not operative (S2) and if a sheet document is not laid on the table 78, i. e., the document set sensor 80 is not turned on (S3), the operation enters into the CFF mode. This indicates that the operation for feeding an ordinary sheet for copying it has priority over the operation which handles the CF paper 10. When all the above conditions are satisfied, the ADF 38 sends a command representative of the presence of a document to the copier 30 (S4). The copier 30 then knows that the ADF 38 is loaded with a document. When the print switch of the copier 30 is pressed, the copier 30 sends a feed command to the ADF 38 (S5). If the document is an ordinary document, the ADF 38 will start feeding it immediately in response to the feed command. In the CFF mode, however, the feeding operation does not begin, as stated earlier; the ADF 38 sends the size of CF paper to the copier 30 in response to the feed command from the copier 30 (S6). The copier 30 uses this information for the automatic selection of paper sheets and the automatic selection of a magnification.

In response to the feed command, the ADF 38 sets a CFF mode flag (S6). This flag is adapted to determine that the CFF mode has been established. In this manner, despite the arrival of a feed command from the copier 30, the ADF 38 seemingly does not operate in the CFF mode. The copier 30, therefore, does not have to discriminate an ordinary sheet document and the CF paper 10, achieving a simplified control arrangement. Of course, the ADF 38 may inform the copier 30 of the fact that the CF paper 10 has been set to allow the latter to perform a particular control associated with the CF paper 10.

After the set state of the CFF mode flag has been confirmed (S7), the first print area 16a of the CF paper 10 is illuminated for the purpose of producing a copy. After the illumination, the copier 30 sends a discharge command to the ADF 38 for instructing the latter to discharge a copied document (S8). In response, the ADF 38 loads CFFJBC (CFF job counter) with 1 (one) in order to perform an operation for transporting and stopping the CF paper 10 (CFF job) (S9). A sequence of operations which follows the step S9 will be described with reference to Figs. 8 to 16 later.

Fig. 7 shows a "CFF pulse check" routine which begins with a step S1 for determining whether or not the CFF mode flag is set. If it is set, whether or not the sprocket hole sensor 114 is turned on is determined (S2). Specifically, assuming that the sensor 114 produces pulses shown in Fig. 17 when it senses the sprocket holes 24, whether the sensor 114 is in an ON state representative of a sprocket hole 24 or in an OFF state is determined. If the sensor 114 is in an OFF state, CFFEGF (CFF edge flag) is reset (S3). If the ensor 114 is in an ON state, whether or not CFFEGF is set is determined (S4) and, if it not set, it is set (S5). At the same time, CFFCNT (CFF counter) counts the sprocket holes 24 which are sensed by the sprocket hole sensor 114 (S5). Further, a counter (or timer) CFFJMT responsive to jams of the CF paper 10 is cleared, as described in detail later.

As shown in Fig. 7, the counter CFFCNT counts a sprocket hole 24 and the counter or timer CFFJMT is cleared, each at the leading edge of a sprocket hole 24. More specifically, they occur at the positive-going edge T of a pulse shown in Fig. 17, i. e., when the leading edge of a sprocket hole 24 is sensed. Hence, even if the sprocket sensor 114 is in an ON state, the operations represented by the step S5 in Fig. 7 are not executed when CFFEGF is set, i. e., such operations are performed at the positive-going edge of a pulse without exception. By such a procedure, the sprocket holes 24 are counted while being sensed by the sensor 114.

Figs. 8 to 16 show what kind of operations occur in association with the count of the CFF job counter CFFJBC.

As stated with reference to Fig. 6, when the ADF 38 receives a discharge signal (S8, Fig. 6), CFFJBC is set to "1" so that multi-jump occurs on the basis of a "CFJOB" routine shown in Fig. 8 and the count of CFFJBC. If CFFJBC is "1", the program jumps to a "CFJB1" routine shown in Fig. 10. In this routine, the velocity commands associated with the belt drive motor 62 and the dischrage unit drive motor M3 are so selected as to set up a high speed state H, and the motors M2 and M3 are energized. At the same time, the counter CFFCNT responsive to the sprocket holes 24 being sensed by the sprocket hole sensor 114 is cleared, and CFFJBC is loaded with "2" (S1, Fig. 10). By such a procedure, the CF paper 10 is transported so that its first page begins to be discharged from the platen 40.

As CFFJBC is incremented to "2" (see Fig. 8 also), "CFJB2" shown in Fig. 11 is executed on the basis of the multi-jump of "CFJOB". Every time the program enters into this routine, the jam counter CFFJAMT is incremented (S1, Fig. 11), as will be described also. When a predetermined number of sprocket holes 24 are counted up, the velocity of each motor M2 and M3 is switched from high H to low L and, at the same time, CFFJBC is incremented to "3" (S2 and S3). In the illustrative embodiment, it is assumed that one page of of CF paper 10 is 22.11 inches long, and twenty-two sprocket holes 24 are formed per page. The above operation is executed when eighteen sprocket holes 24 are counted. Switching the rotation speed of the motors M2 and M3 from high to low before one page of the CF paper 10 is fully transported as mentioned above is successful in causing the paper 20 to stop at the predetermined position accurately. What occurs when the count of CFFCNT is less than eighteen as determined in the step S2 of Fig. 11 will be described later.

As the CFJB becomes "3" (see Fig. 8 also), CFFJMT is incremented, as shown in Fig. 12 and as will be described (S1). When the counter CFFCNT counts up twenty-two sprocket holes representative of one page (S2), the motors M2 and M3 are braked to stop them rapidly. After this processing, CFFJBC is loaded with "4" (S3).

As shown in Fig. 13, in a "CFJB4" routine, the CF paper 10 is stopped, the ON/OFF commands for the motors M2 and M3 are turned from ON to OFF, and CFFJBC is reset to "0" (S1).

By the above sequence of steps, the second print area 16b of th CF paper 10 is set in the predetermined position on the platen 40 and then copied. Then, the operations described above are repeated.

Assume that the count of the counter CFFCNT is less than eighteen as determined in the step S2 of Fig. 11, and that the second sensor or CF paper sensor 10 is turned off (step S, Fig. 11). This suggests that the trailing edge of the last page of the CF paper 10 has moved away from the CF paper sensor 116. In this condition, the CF paper transport and stop control implemented by the first sensor or sprocket hole sensor 114 and counter CFFCNT is disabled. Such a control, therefore, is handed over to the encoder E3 (Fig. 5) which is associated with the motor M3, i. e., the control is automatically handed from the sprocket hole sensor 114 and counter CFFCNT over to the encoder E3 which is a specific controller. This switchover is effected by a command from the CPU. Specifically, when the CF paper sensor 116 is in an OFF state as determined in the step S4 of Fig. 11, a counter M3TPC responsive to output pulses of the encoder E3 is cleared, the speed of the motors M2 and M3 are switched to low L, and CFFJBC is loaded with "5". This is followed by a "CFJB5" routine which is shown in Fig. 14. Again, reducing the rotation speed of the motors M2 and M3 as mentioned above is effective to stop the CF paper 10 at the predetermined position accurately.

In the "CFJB5" routine, whether or not the counter M3TPC has reached a predetermined number, which is "44" in the illustrative embodiment is determined (S1, Fig. 14). This count is associated with the interval between the time when the counter M3TPC begins to count pulses and the time when the print area of the last page of the CF paper 10 reaches the predetermined position on the platen 40. At this time, therefore, the motors M2 and M3 are rapidly braked to a stop, whereby the CF paper 10 is stopped (S2). CFFJBC is loaded with "6" (S2), and a command representative of the absence of the document is sent to the copier 30 to show the latter that the page is the last page of the CF paper 10.

As shown in Fig. 15, in the "CFJB6" routine, in response to a discharge command sent from the copier 30 after the illumination of the last page (S1), the motors M2 and M3 are operated at a high speed H to discharge the CF paper 10 (S2). CFFJBC is loaded with "7", and a timer CFEDTM (computer form end timer) is cleared (S2).

In a "CFJB7" routine shown in Fig. 16, after the time-up of the timer CFEDTM (S1), the motors M2 and M3 are denergized, the CFF mode flag is reset, and CFFJBC is cleared to "0". This is the end of a sequence of CFF mode operations.

Concerning the overall flow, CFFJB0 to CFFJB$ are repeated so long as the CF paper 10 is continuously copied and, for the last page only, CFFJB0, CFFJB2, CFFJB2, CFFJB5, CFFJB6 and

CFFJB7 are executed.

The counter CFFJMT cleared in the step S5 of Fig. 7 is incremented every time each of "CFJB2" and "CFJB3" is executed. Specifically, this counter is cleared every time the sprocket hole sensor 114 senses a sprocket hole 24. When the counter counts a longer period of time than the period of time which the portion intervening between the leading edges of two nearby sprocket holes 24 of the CF paper 10 being transported without a jam would need to move past the sensor 114 , 50 in the illustrative embodiment, the program determines that the CF paper 10 has jammmed the ADF 38. More specifically, in the "CFJB3" routine shown in Fig. 12, before the counter CFFCNT reaches 22 representative of one page of the CF paper 10, the counter CFFJMT is checked (S4, Fig. 12). When the counter CFFJMT counts 50, the program determines that the CF paper 10 has jammed the ADF 38, deenergizes the motors M2 and M3, and sets a jam flag which is used for various kinds of jam processing (S5, Fig. 12). So long as the CF paper 10 is transported without a jam, the counter CFFJMT is necessarily cleared before counting fifty pulses. For example, assume that the pitch of the sprocket holes 24 is 1/2 inch, that the sprocket hole sensor 114 senses sprocket holes 24 at the intervals of about 20 milliseconds to 30 milliseconds, that the counter CFFCNT counts the outputs of the sensor 114, and that the counter CFFJMT is incremented every 2 milliseconds to 3 milliseconds. Then, CFFJMT is cleared every time it counts ten to fifteen pulses and does not reach 50 pulses. Stated another way, when a sprocket hole 24 of the CF paper 10 is not sensed more than 100 milliseconds to 150 milliseconds, a jam is detected and, as stated previously, the motors M2 and M3 are deenergized.

The ADF 38 of the illustrative embodiment is capable of turning over an ordinary sheet document which carries images on both sides threrof for sequentially copying the images, as stated earlier. In addition, the copier 30 has a two-sided copying function available for forming images on both sides of a paper sheet. On the other hand, data are printed out only on one side of a CF paper without exception. In such a situation, when the operator desires to produce a two-sided copy by using the CF paper 10, the operator is expected to select a copy mode by manipulating keys which allow a two-sided copy to be produced from a one-sided document. However, it may occur that the operator inadvertently selects a mode which produces a two-sided copy from a two-sided document. Therefore, in order that a two-sided copy may be attained even under such a condition, an arrangement is preferably be made such that even when a document reversal command or a face-down discharge command is fed from the copier 30, the same processing as would be executed in response to a discharge signal as indicated in the step S8 of Fig. 6 is effected.

In summary, in the ADF 38, the sprocket hole sensor 114 is located upstream of the platen 40. Hence, even if the first page of the CF paper 10 is set on the platen 40 by hand and the second and successive pages are automatically fed so as to produce predetermined copies 20 as shown in Fig. 1B, all the pages inclusive of the first page can be transported and stopped page by page accurately. Moreover, the control device is constructed such that when the output of the CF paper sensor 10 representative of the presence of the CF paper 10 disappears, the page of the CF paper 10 is brought to the predetermined position on the platen 40. This allows even the last page of the CF paper 10 to be copied while being positioned on the platen 40 with accuracy.

In the illustrative embodiment, the pulse generator constituted by the encoder E3 which is associated with the motor M3 and the counter M3TPC for counting the output pulses of the pulse generator are the major components of the control device. Of course, the encoder E3 or similar pulse generator may be replaced with timer means, stated earlier. The encoder E3 may even be replaced with an encoder which is associated with the drive system for driving the belt 62 or the rollers 70, 72 and 74, for example.

As soon as the CF paper 10 on the platen 40 is fully illuminated, the copier 30 sends a discharge command to the ADF 38, as described previously. The motors M2 and M3 start operating in response to the discharge command only and thereby individually drive the belt 62 and discharge unit 69 to transport the CF paper 10. Stated another way, in the CFF mode the CF paper 10 is not transported despite the arrival of a feed command from the copier 30. This allows the first page of the CF paper 10 to be set on the platen 40 without any trouble. Should the CF paper 10 be transported in response to a feed command as an ordinary document, it would be driven out of the platen 40 before the start of reproduction of the first page resulting in a predetermined copy being not produced.

In the CFF mode, the CF paper 10 may be transported by the feed unit 64 which is adapted to feed an ordinary document. This is undesirable, however, because the feed unit 64 has a separator roller 86 and a separator blade 88 which is held in pressing contact with the roller 86. Specifically, when the CF paper 10 is driven by the separator roller 86 and blade 88, a substantial degree of friction is apt to act on the CF paper 10 to cause to latter skew. While an ordinary document rarely skews despite the friction exerted by the roller 86 and blade 88 because it is relatively short, the CF paper 10 which has a substantial length is apt to undergo a noticeable skew as a result of accumulation of unnoticeable skews.

In the light of the above, the ADF 38 has the CF paper inlet 66 which is independent of the feed unit 64 that serves to feed an ordinary document to the platen 40. Although a transport roller pair or similar transport members for driving the CF paper 10 may be provided between the paper inlet 66 and the platen 40, so long as the first page of the CF paper 10 is set on the platen 40 by hand, the CF paper 10 can be sequentially transported by the belt 62, i. e., without resorting to such extra transport members because the first page will of course be located below the belt 62. For this reason, in the illustrative embodiment, no transport members are provided on the transport path extending between the paper inlet 66 and the platen 40. This positively cuts down the cost of the ADF 38.

In this particular embodiment, use is made of a CPU for switching the control over the transport and stop of the CP paper 10 from the first sensor 114 to the encoder E3. Fig. 18 shows a specific arrangement for facilitating an understanding of such a switching device. In Fig. 18, before the trailing edge of the last page of the CF paper 10 moves away from the first and second sensors 114 and 116, the output pulses of the sensor 114 responsive to the sprocket holes 24 of the CF paper 10 are fed to a first AND gate 130. On the other hand, while the sensor 116 senses the CF paper 10, its output has a low level and is applied to a second AND gate 132 while being routed through an inverter 134 to the first AND gate 130. Output pulses of the encoder E3 associated with the motor M3 are fed to the second AND gate 132 via a frequency divider 136. The outputs of the AND gates 130 and 132 are coupled to an OR gate 138 the output of which in turn is connected to the CPU 140.

In the above configuration, pulses associated with the output pulses of the first sensor 114 appear on the output of the first AND gate 130 and are fed to the OR gate 138. However, since the inverted low level output of the second sensor 116 is fed to the second AND gate 132, the AND gate 132 does not produce AND. Hence, a pulse signal associated with the outputs of the sensor 114 are fed from the OR gate 138 to the CPU 140 and counted by the latter. This operation is continued over a period of time W1 shown in Fig. 19, whereby the transport and stop of the CF paper 10 is controlled.

As soon as the trailing edge of the last page of the CF paper 10 moves away from the sensors 114 and 116, the sensor 116 does not sense the CF paper 10 any longer and, therefore, its output level becomes high. It follows that the output of the sensor 116 is fed to the AND gate 130 as a low level while being fed to the AND gate 130 as a high level. On the other hand, the output of the sensor 114 is maintained at a low level, and the output of the encoder E3 appearing through the frequency divider 136 is applied to the AND gate 132 as in the previously stated condition. As a result, the AND output of the AND gate 130 disappears, and the outputs of the AND gate 132 associated with the output pulses of the encoder E3 are fed to the OR gate 138. The OR gate 138 produces the same pulses as the output pulses of the frequency divider 136 and delivers them to the CPU 140. Counting the incoming pulses, the CPU 140 controls the transport and stop of the CF paper 10. This operation is performed during a period of time W2 shown in Fig. 19.

As stated above, when the trailing edge of the CF paper 10 moves away from the sensors 114 and 116, the control by the first sensor 114 is automatically handed over to the control by the encoder E3 by the switching device shown in Fig. 18.

After the CF paper 10 on the platen 40 has been illuminated, a discharge command is generated to operate the motors M2 and M3 for driving the CF paper 10, as stated earlier. Fig. 20 shows a specific construction of a device for so generating a discharge command. When the first scanner shown in Fig. 3 returns to its home position after fully illuminating a document laid on the platen 40, a home scanner sensor 142 shown in Fig. 20 is turned on and the resulting output is fed to an AND gate 144. While the operator enters a desired number of copies to be produced with a single document, the entered number is set on a counter 146 which is also shown in Fig. 20. As the copying operation is repeated with a certain page of the CF paper 10, the number of times that the operation is repeated is counted by a copy counter so that the counter 146 is sequentially decremented. When the counter 146 is decremented to zero, it feeds an end-of-copy signal to the AND gate 144. At this time, the home sensor 142 delivers its output to the AND gate 144 resulting in a discharge signal being produced from the AND gate 144. In response, the motors M2 and M3 begin to operate and feed the CF page 10 by one page.

While the illustrative embodiment have been shown and described in relation to an electrophotographic copier, it will be apparent that it is similarly applicable to a digital copier, facsimile apparatus or similar image recorder.

The embodiment shown and described achieves various unprecedented advantages as enumerated below.

(1) CF paper can be surely transported and stopped page by page from the first page to the last page thereof only if the first page is positioned on a platen by hand.

(2) When the first page of CF paper is positioned on a platen by hand, the paper is surely prevented from being transported before the first page is copied.

(3) CF paper is free from skews while an ADF is implemented at low cost.

Second Embodiment

A second embodiment of the present invention is generally constructed in the same manner as the ADF 38 shown in Fig. 3, except for the use of two sensors 114a and 114b in place of the single first sensor 114. The sensors 114a and 114b are arranged along the row of sprocket holes 24 in the intended direction of paper transport. The ADF is controlled by substantially the same control circuitry as the circuitry shown in Fig. 5.

The illustrative embodiment transports and discharges an ordinary document in the same manner as the first embodiment, and redundant description will be avoided for simplicity. The following description will concentrate on the transport and discharge of CF paper only.

As shown in Fig. 6, whether or not the CFF mode operation should be performed is determined by exactly the same sequence of steps as in the first embodiment. This is followed by CFF pulse check routines (I), (II) and (III) shown in Figs. 21A, 21B and 21C, respectively.

Briefly, the CFF pulse check routine (I) shown in Fig. 21A detects the sprocket holes 24 of the CF paper 10, causes the counter CFFCNT to count the holes 24, clears the timer CFFJMT adapted to check the jam of the CF paper 10, clears the routine timer CFTM1 which is incremented every millisecond, and performs other various operations. These operations each occurs at the edge of a sprocket hole 24 where the state changes from a "no hole" state to a "hole" state. Specifically, in a step S1, whether or not the CFF mode flag has been set to ONE is determined. If the answer of the step S1 is positive (Y), the routine timer CFTM1 is incremented by 1 (one) (S2). Subsequently, whether or not the sensor 114a is ON is determined (S3). If the answer of the step S3 is positive (Y), whether or not the flag CFFEGF1 has been reset to ZERO is determined (S4). If the answer of the step S4 is negative (N), CFFEGF1 is reset to ZERO (step S5). If the answer of the step S4 is positive (Y), the flag CFFGF1 is set to ONE (S6) and whether or not the timer CFTM1F is "1" is determined (S7). If the answer of the step S7 is negative (N), the operation advances to a step S8 for incrementing the timer CFTM1F to "1" and then to a step S10. If the answer of the step S7 is positive (Y), that the timer CFTM1 has reached "24" is confirmed (S9), and this is followed by a step S10. Since the timer CFTM1 is incremented every millisecond, the sprocket holes 24 of the CF paper 10 are counted up at the intervals of more than 24 milliseconds, i. e., holes other than the sprocket holes 24 whih are spaced apart by the predetermined distance are not sensed. In the step S10, the timer CFTM1 is cleared, the counter CFFCNT is incremented, and the timer CFFJMT is cleared.

In the CFF pulse check routine (II) shown in Fig. 21B, operations similar to those constituting the CFF pulse check routine (I) are executed with use of the other sensor 114b. Specifically, whether or not the CFF mode flag is set to ONE is determined (S1). If the answer of the step S1 is positive (Y), the routine timer CFTM2 is incremented by 1 (S2). Then, the program advances to a step S3 to see if the sensor 114b is ON. If the answer of the step S3 is positive (Y), whether or not the flag CFFEGF2 has been reset to ZERO is determined (S4). If the answer of the step S4 is negative (N), CFFEGF2 is reset (step S5). If the answer of the step S4 is positive (Y), the flag CFFEGF2 is set to ONE (step S6) and then whether or not the timer CFTM2F is "1" is determined (S7). If the answer of the step S7 is negative (N), the timer CFTM2F is incremented to "1" (step S8), followed by a step S10. If the answer of the step S7 is positive (Y), whether or not the timer CFTM2 has reached "24" is determined (S9). If the answer of the S9 is positive (Y), the program advances to the step S10. Again, holes other than the holes spaced apart by the predetermined distance are not sensed. In the step S10, the timer CFTM2 is cleared, and the counter CFFCNT is incremented.

In the CFF pulse check routine (III) shown in Fig. 21C, a procedure similar to the CFF pulse check routine (I) is executed by use of the sensor 114a. As shown, whether or not the CFF mode flag has been set to ONE is determined (S1). If the answer of the step S1 is positive (Y), the routine timer CFTM3 is incremented by 1 (S2). Then, whether or not the sensor 114 is

OFF is determined (S3). If the answer of the step S3 is positive (Y), whether or not the flag CFFEGF3 has been reset to ZERO is determined (S4). If the answer of the step S3 is negative (N), the flag CFFEGF3 is reset (S5). If the answer of the step S4 is positive (Y), the flag CFFEGF3 is set to ONE (S6) and then whether or not the timer CFTM3F is "1" is determined (S7). If the answer of the step S7 is negative (N), the timer CFTM3F is incremented to "1" (S8), followed by a step S10. If the answer of the step S8 is positive (Y), whether or not the timer CFTM3 has reached "24" is determined (S9). If the answer of the step S9 is positive, the program advances to the step S10. In this manner, the hole sensing operation occurs at the intervals of more than 24 milliseconds, i. e., holes other than regular holes are not sensed. In the step S10, the timer CFTM3 is cleared, and the counter CFFCNT is incremented.

As stated above, in all the CFF pulse check routines (I), (II) and (III), one pulse is counted per sprocket hole 24. It follows that the counter CFFCNT responsive to the pulses is incremented by 3 per hole 24.

As stated previously, the illustrative embodiment uses the timer CFFJMT for jam detection, and this timer is cleared every time a sprocket hole 24 is sensed. When the timer CFFJMT is not cleared even after it has reached a predetermined count, it is determined that a jam has occurred. Generally, the CF paper 10 is transported only by the force of the belt 62 until the first page thereof has been effected by the intermediate transport roller 94 and discharge roller 98, Fig. 3, so that it is apt to slip. Also, slippage of the CF paper 10 is apt to occur more when the CF paper 10 begins to be transported than when it is in transport.

In the light of the above, this embodiment assigns a greater count for jam decision to the condition wherein the CF paper 10 is transported only by the belt 62 than to the condition wherein it is transported by the rollers 94 and 98. Also, a greater count for jam decision is assigned to the condition wherein the CF paper 10 begins to be fed than to the condition wherein it is in transport.

Even when slippage occurs, control is so effected as to bring the CF paper 10 into a halt at a predetermined position. Hence, the slippage is not critical so long as the CF paper 10 comes in time for the imagewise exposure. Rather, selecting a relatively small count for the jam decision would cause simple slippage to be determined to be a jam.

In the illustrative embodiment, therefore, a particular count for jam decision is selected for each of the different conditions on the basis of actually measured data. This is successful in detecting a jam accurately and rapidly while clearly discriminating it from slippage, thereby protecting the CF paper 10 from damage.

In response to a discharge command, the counter CFFJBC is incremented to "1", as stated earlier with reference to Fig. 6.

While the CF paper 10 is transported, the set count of the counter DFFJBC is changed to execute a particular operation. In this embodiment, the set count of the counter CFFJBC is also determined in the step S1 of the CFJOB routine, Fig. 8, causing multi-jump to occur on the basis of the determined count.

Fig. 22 shows a CFJB1 routine particular to this embodiment. As shown, when the set count of the counter DFFJBC is determined to be "1", a high speed command is fed to motor M2 associated with the belt 62 and the motor M3 associated with the discharge unit, and these motors M2 and M3 are turned to an ON state. At the same time, the counter CFFCNT is cleared. Thereafter, the counter CFFJBC is set to "2" while the flags CFTM1F to CFTM3F are reset to ZERO. These steps are collectively represented by a step S1 in the figure. The flags DVTM1F to CFTM3F are used in the CFF pulse check routines (I) to (III), and each is set on the detection of the first hole 24 to start associated one of the timers CFTM1 to CFTM3.

Fig. 23 shows a CFJB2 and a CFJB3 routine particular to the illustrative embodiment. The program enters into the flowchart of Fig. 23 when the set count of the counter CFFJBC is determined to be "2". Specifically, before this routine begins, the counter CFFJMT is incremented (S1). The counter CFFJMT is cleared every time a hole 24 is sensed in the CFF pulse check routine (I) and indicates that a jam has occurred when not cleared even after reaching the predetermined count, as stated earlier. Subsequently, whether or not the second sensor 116 responsive to the CF paper 10 is OFF is determined (S2). If the answer of the sep S2 is negative (N), meaning that the CF paper 10 is present, whether or not the counter CFFCNT has reached "56" is determined (S3). If the answer of the step S3 is negative (N), whether or not the discharge sensor 112 is OFF is determined (S4). If the answer of the step S4 is positive (Y), meaning that the CF paper 10 has not yet been discharged, whether or not the timer CFFJMT has reached "100" is determined (S5). If the answer of the step S5 is positive (Y), the program determines that a jam has occurred and advances to a step S6. In the step S6, the motors M2 and M3 are turned to an OFF state, the JAM flag is set to ONE, and the transport of the CF paper 10 is interrupted. If the answer of the step S4 is negative (N), whether or not the counter CFFCNT is "9" or less is determined (S7). If the answer of the step S7 is positive (Y), whether or not the counter CFFJMT has reached "60" is determined (S8). If the answer of the step S8 is positive (Y), the program determines that a jam has occurred and advances to the step S6. If the answer of the step S7 is negative (N), whether or not the counter CFFJMT has reached "30" is determined (S9). If the answer of the step S9 is positive (Y), the step S6 is executed.

As described above, in this embodiment, a different count for jam decision is assigned to the counter CFFJMT for each of the condition wherein the discharge sensor 112 is OFF with the CF paper 10 being transported only by the belt 62 and the condition wherein the discharge sensor 112 is ON with the CF paper 10 being transported by the rollers 94 and 98. Such different counts prevent simple slippage from being determined to be a jam. Further, a different count for jam decision is assigned to the counter CFFJMT for each of the condition wherein the CF paper 10 begins to be transported and the condition wherein it is transported by the rollers 94 and 98. This prevents slippage apt to occur at the beginning of transport from being determined to be a jam.

Referring again to Fig. 23, if the answer of the step S2 is positive (Y), M3TPC is cleared while CFFJBC is set to "5" (S10). If the answer of the step S3 is positive (Y), meaning that CFFCNT has reached "56" without a jam having occurred, the motors M2 and M3 are individually set to a low speed to enhance accurate stop of the CF paper 10 while CFFJBC is set to "3" (S11).

When the CFFJBC is set to "3", the operation is transferred to a step S12 so that CFFJMT is incremented before the beginning of the routine. In the next step S13, whether or not the sensor 116 responsive to the CF paper is OFF is determined. If the answer of the step S13 is positive (Y), the step S10 is executed. If the answer of the step S13 is negative (N), whether or not CCFCNT has reached "66" is determined (S14). If the answer of the step

14 is positive (Y), the motors M2 and M3 are braked and CFFJBC is loaded with "4" (S15). If the answer of the step S14 is negative (N), the operation is transferred to the step S4. This is followed by the sequence of steps previously described in relation to the CFJB2 routine.

It is to be noted that the routines CFJB4 to CFJB7 of this embodiment are identical with those previously stated with reference to Figs. 13 through 16.

As described above, this embodiment assigns a greater count for jam decision to the condition wherein the CF paper 10 is transported only by the belt 62 than to the condition wherein it is transported by the rollers 94 and 98, and a greater count to the condition wherein the CF paper 10 begins to be fed than to the condition wherein it is in stable transport. This successfully prevents slippage from being determined to be a jam. Hence, this embodiment detects a jam of the CF paper 10 accurately without any malfunction and then brings it to a halt, whereby the CF paper 10 is freed from damage and efficiently transported. Furthermore, by selecting an optimum count for jam decision in matching relation to the characteristics of the CF paper 10, it is possible to detect a jam within the shortest period of time available with the CF paper.

Third Embodiment

A third embodiment which will be described is capable of transporting and discharging CF paper with a carbon. In this embodiment, the sensors 114a and 114b each is inhibited from sensing a hole in CF paper with a carbon over a predetermined period of time after it has sensed a sprocket hole. This embodiment is essentially the same in general construction and control circuitry as those shown in Figs. 3 and 5, and redundant description will be avoided for simplicity.

Fig. 24 shows CF paper with a carbon 10B which is transported and discharged by this particular embodiment. As shown, the CF paper 10B has a number of sprocket holes 24 and some cuts 25 intervening between nearby sprocket holes 24. The cuts 25 are adapted to fasten the CF paper 10B and the carbon temporarily to each other. When this embodiment transports the CF paper with a carbon 10B, in CFF pulse check routines (I), (II) and (III) shown in Figs. 21A through 21C, the sensors 114a and 114b each is inhibited from sensing a hole over a predetermined period of time after having sensed a single sprocket hole 24, as represented by inhibition ranges Z in Fig. 24. Hence, the sensors 114a and 114b do not sense the fastening cuts 25 at all.

As stated above, this embodiment prevents the fastening cuts 25 formed through the CF paper 10B with a carbon 10B from being determined to be the sprocket holes 24 which are also formed through the CF paper 10B. This insures error-free transport of the CF paper 10B.

CLAIMS

1. An automatic document feeder (ADF) for an image recorder comprising:

an inlet for feeding therethrough to a platen a continuous document constituted by a sequence of continuous pages and having a plurality of equally spaced feed holes;

document transporting means located to face the platen for transporting any of the documents placed on and along the platen;

means located upstream of the platen with respect to an intended direction of transport of the continuous document for generating feed pulses by sensing the feed holes of the continuous document;

counter means for counting said generated feed pulses; and determining means for determining a state of said continuous document by comparing the number of generated feed pulses counted by the counter means with a predetermined number.

2. An ADF according to claim 1, wherein said predetermined number is varied according to whether the continuous document is to be accelerated or is to be forwarded at constant speed.

3. An ADF according to claim 2, wherein said predetermined number is greater when the continuous document is to be accelerated from rest than when it is to be forwarded at constant speed.

4. An ADF according to claim 2 or 3 wherein said predetermined number is varied according to whether the continuous document is transported by said document transporting means or by a document discharging means.

5. An ADF according to claim 4, wherein said predetermined number is greater when the continuous document is transported by said document transporting means than when the continuous document is transported by said document discharging means.

6. An ADF according to any preceding claim wherein when said holes sensor means sense a single hole, it is inhibited from sensing a subsequent hole until a predetermined period of time expires.

7. An ADF according to claim 6, wherein a carbon is provided on and temporarily fastened to the continuous document by cuts interspersed between feed holes, said holes sensor means not sensing said cuts.

8. An ADF according to any preceding claim, further comprising:

document sensor means located upstream of the platen with respect to the intended direction of transport of the continuous document for sensing the presence of a continuous document; and

pulse generator means for generating pulses when the document sensor no longer senses the presence of the continuous document.

9. An ADF according to claim 8, wherein control means are provided, the control means controlling said document transporting means, said counter means and said pulse generator means such that the first page of a continuous document to be positioned in a predetermined position on the platen, the second and successive pages except for the last page of the continuous document are positioned in said predetermined position of the platen by counting the number of said feed pulses generated, and the last page of the continuous document is positioned in the predetermined position on the platen by counting a number of said document pulses, and controlling the transport means.

10. An ADF according to claim 9, wherein the first page of the continuous document is manually positioned in said predetermined position of the platen by inserting the leading edge of the continuous document into an inlet leading to the platen.

11. An ADF according to any one of the preceding claims wherein the determining means are adapted to determine that a continuous sheet being fed by the transport means is jammed when the number of feed pulses generated equals the predetermined number.

12. An ADF constructed and arranged to operate substantially as hereinbefore described with reference to the accompanying drawings.

13. An image recorder including an ADF according to any preceding claim.

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