US 20210300077A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2021/0300077 A1

(43) Pub. Date: Sep. 30, 2021

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(54) **PRINTER AND TAPE FOR ACCURATELY DETECTING POSITION OF MARK ON THE TAPE**

(71) Applicant: **BROTHER KOGYO KABUSHIKI KAISHA**, Nagoya (JP)

(72) Inventor: **Yoshihiro OTA**, Nagoya (JP)

(21) Appl. No.: **17/196,068**

(22) Filed: **Mar. 9, 2021**

(30) **Foreign Application Priority Data**

Mar. 25, 2020 (JP) 2020-053895

Publication Classification

(51) **Int. Cl.**

B41J 11/46 (2006.01)

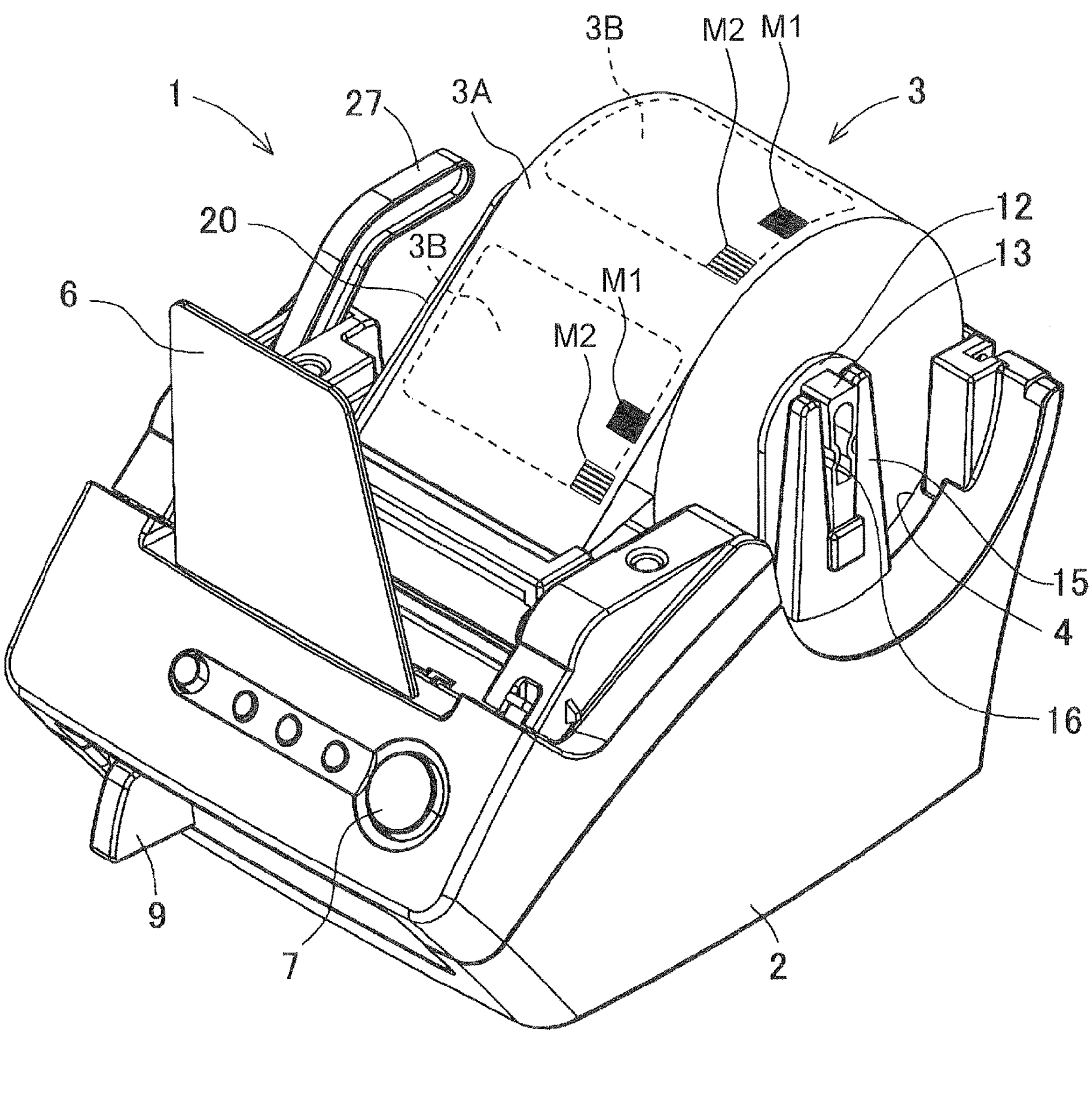
B41J 15/04 (2006.01)

(52) **U.S. Cl.**

CPC *B41J 11/46* (2013.01); *B41J 15/048* (2013.01)

(57) **ABSTRACT**

A printer includes a conveyor to convey a tape having a plurality of marks in a conveyance direction, the marks including a first mark, and a second mark formed downstream of the first mark in the conveyance direction, a print head to print an image on the tape, a reflection sensor to detect the marks on the tape by emitting light toward the tape and receiving reflected light from the tape, and output a detection signal according to the reflected light when detecting the marks, and a controller. The controller is configured to set a threshold to be variable based on a level of the detection signal when the reflection sensor detects the second mark, and identify a position of the first mark based on a result of comparison between the threshold and a level of the detection signal when the reflection sensor detects the first mark.



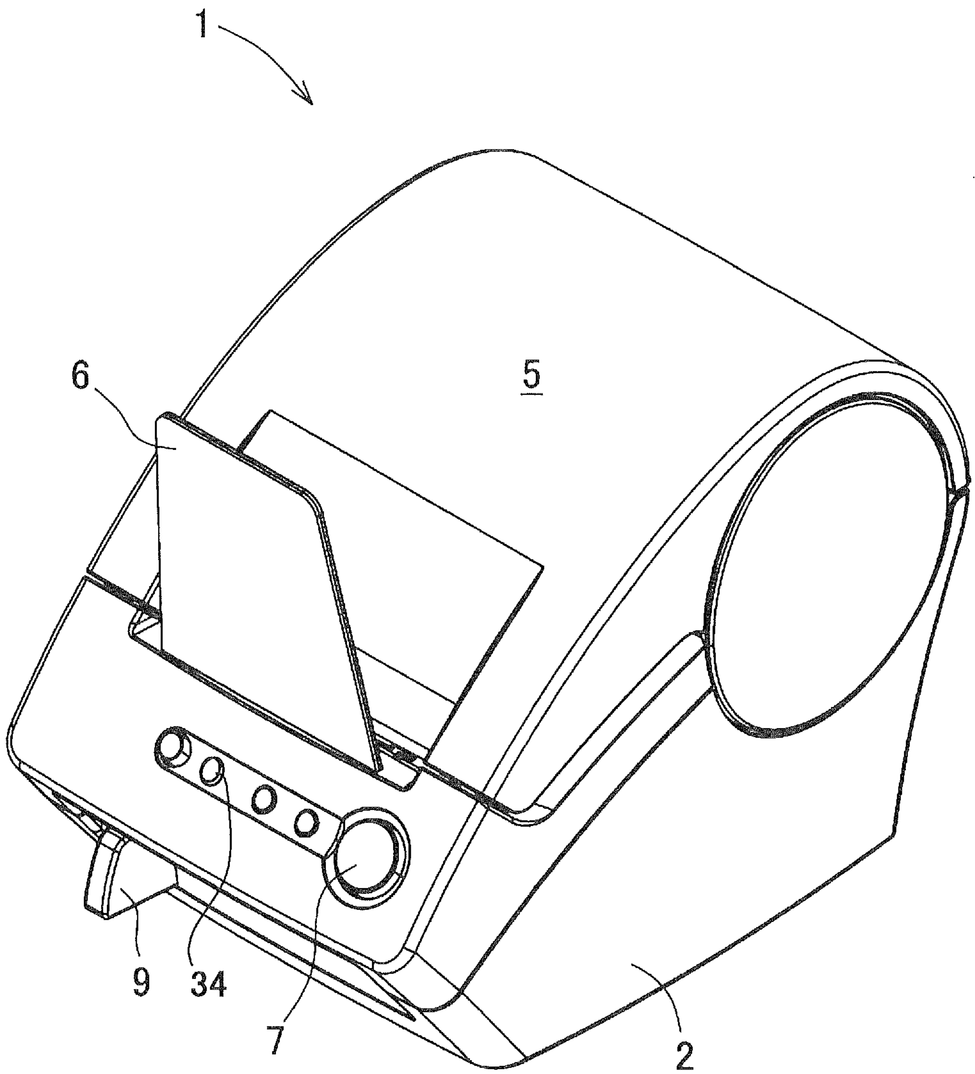


FIG. 1

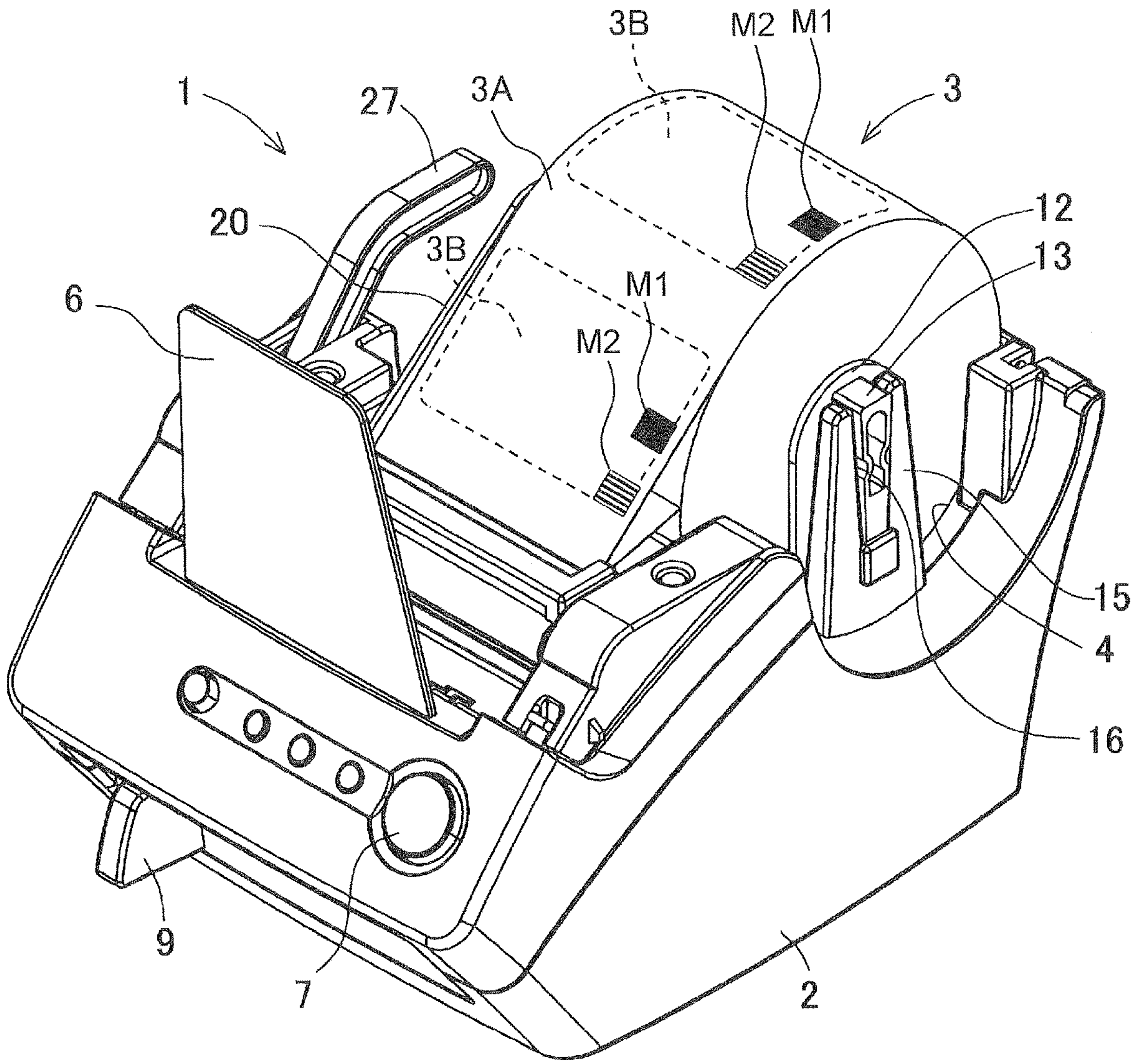


FIG. 2

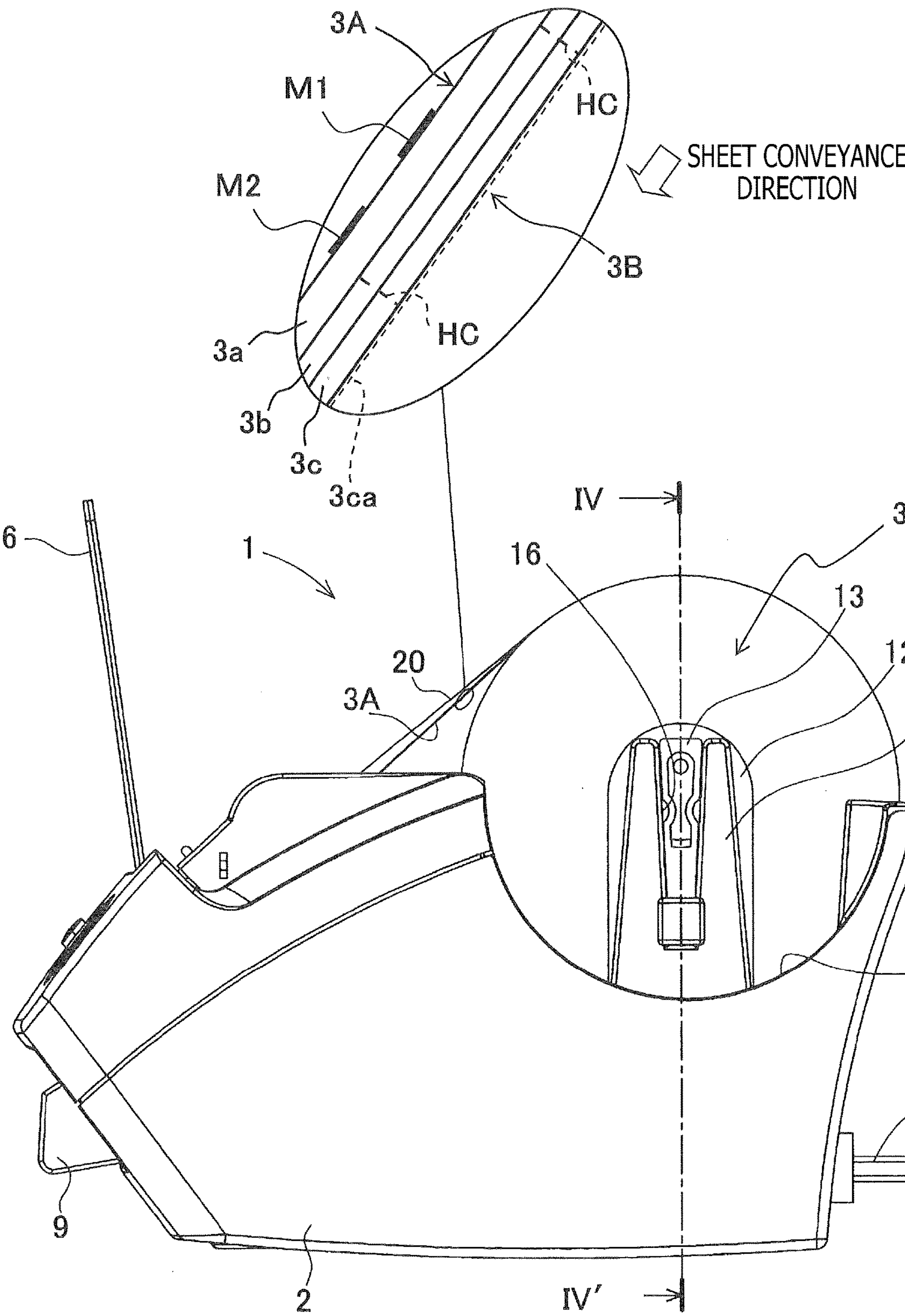

3A
M1
M2
HC
SHEET CONVEYANCE
DIRECTION
3B
HC
3a
3b
3c
3ca
IV
3
6
1
16
13
12
20
3A
15
4
10
9
2
IV′

FIG. 3

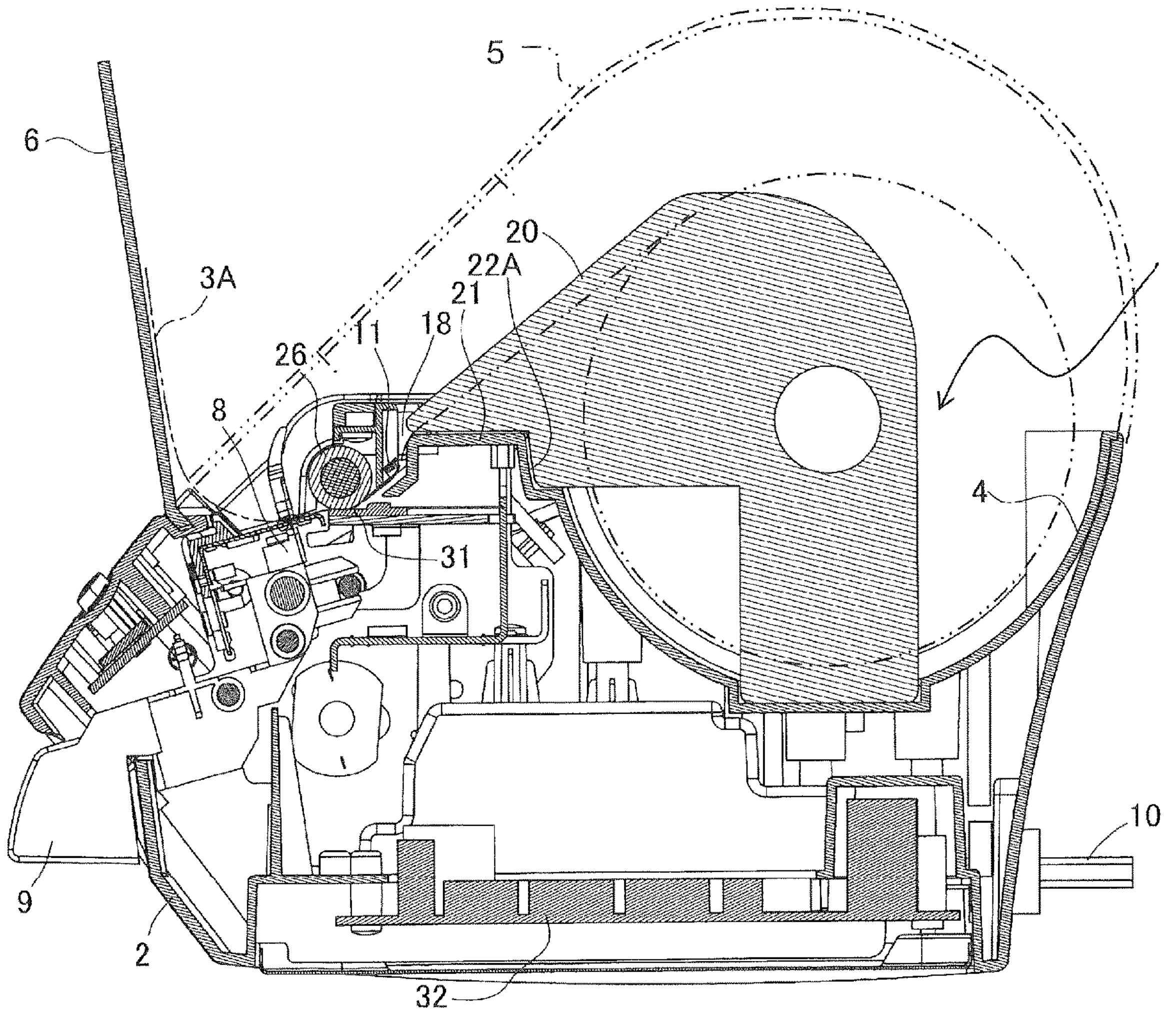


FIG. 4

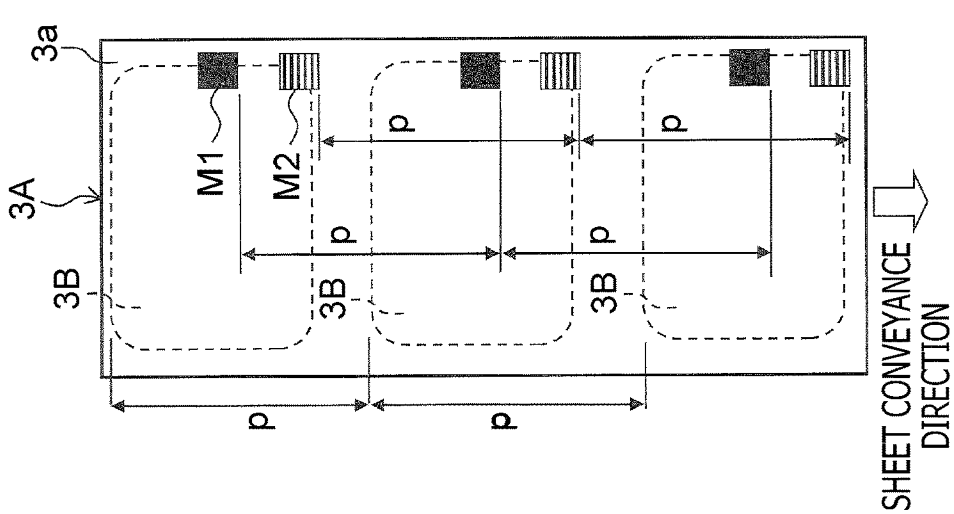


FIG. 5A

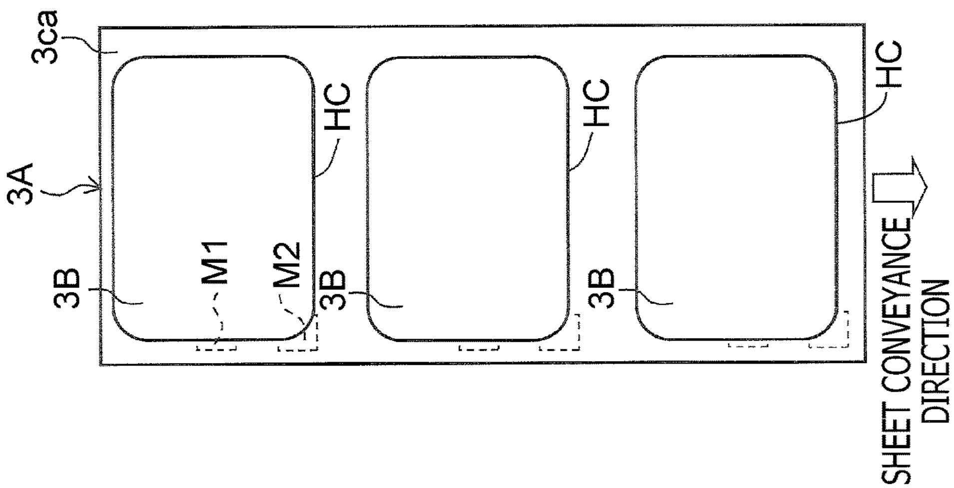


FIG. 5B

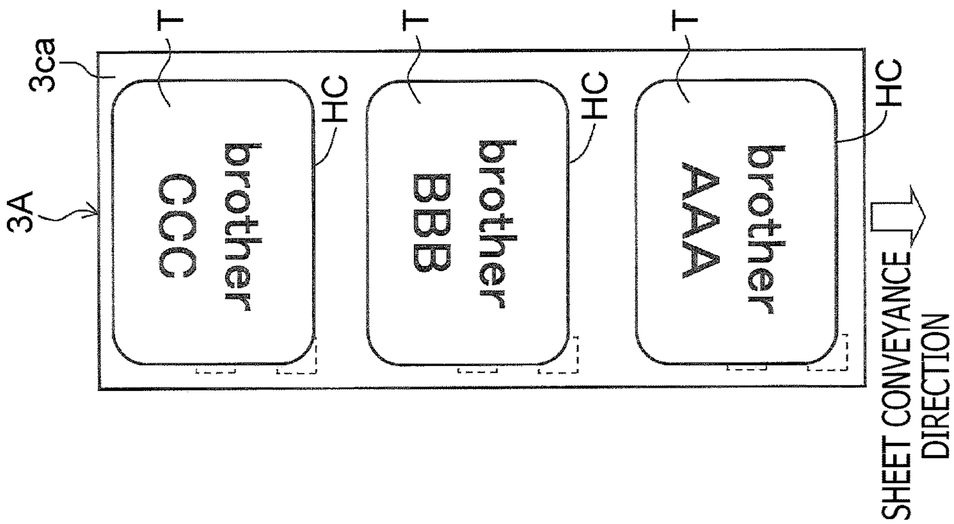


FIG. 5C

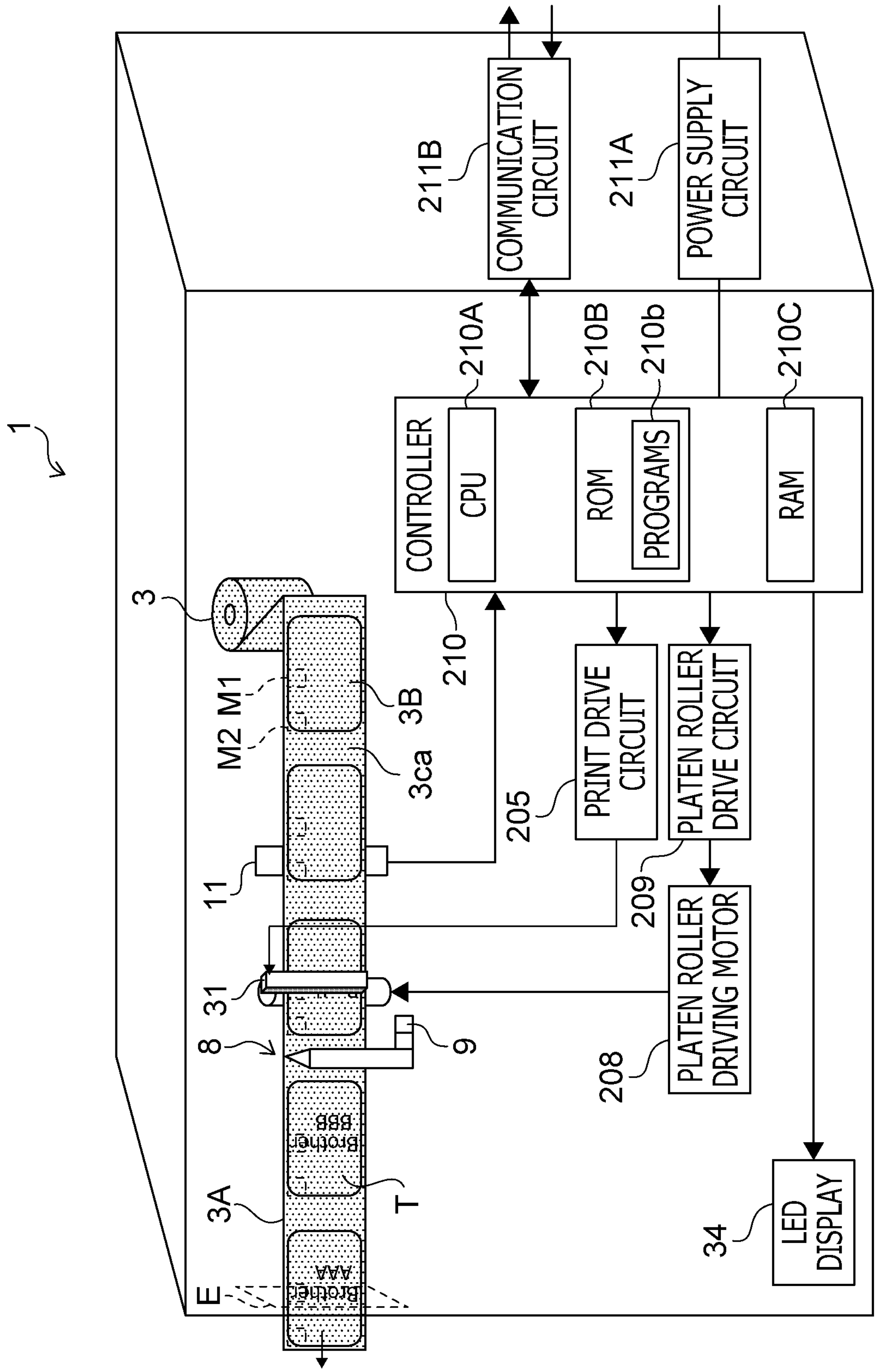

1
211B
COMMUNICATION CIRCUIT
211A
POWER SUPPLY CIRCUIT
210A
210B
210b
210C
CONTROLLER
CPU
ROM
PROGRAMS
RAM
210
3
M2 M1
3B
3ca
205
PRINT DRIVE CIRCUIT
PLATEN ROLLER DRIVE CIRCUIT
209
11
31
8
9
PLATEN ROLLER DRIVING MOTOR
208
3A
T
E
34
LED DISPLAY

FIG. 6

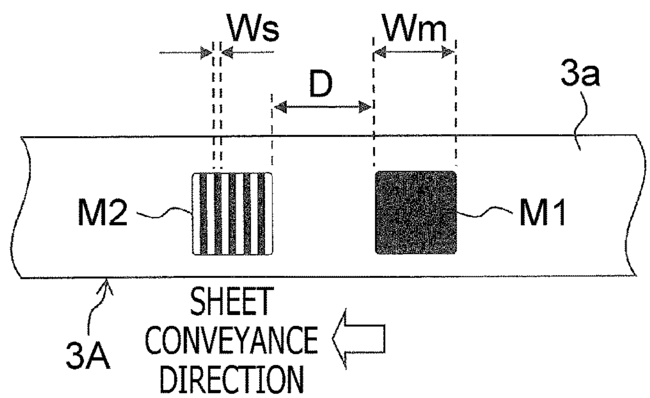

Ws
Wm
D
3a
M2
M1
3A
SHEET
CONVEYANCE
DIRECTION

FIG. 7A

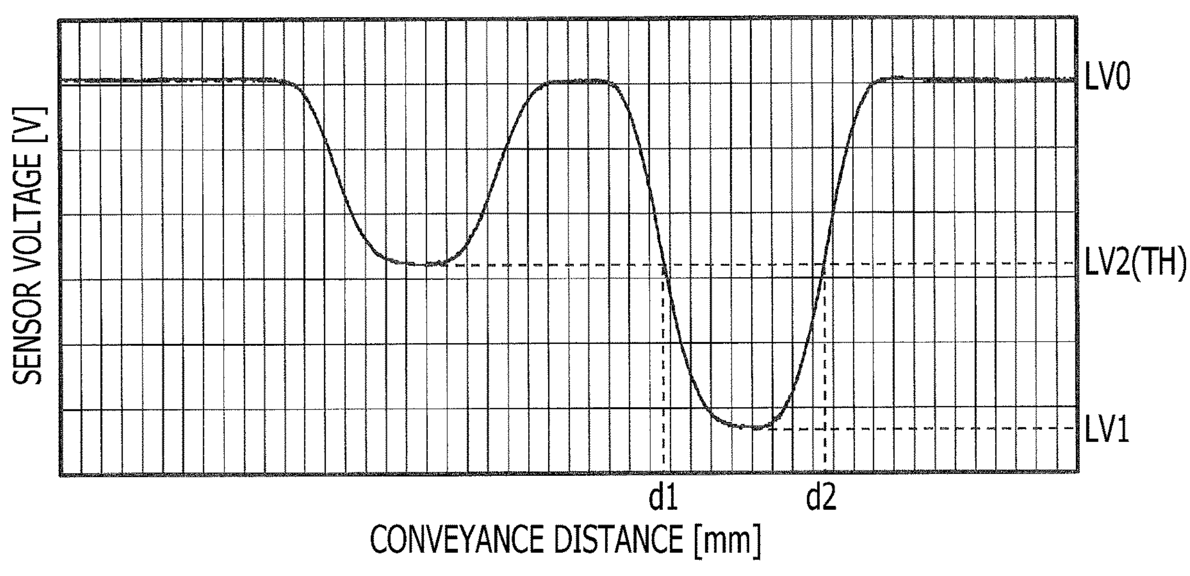

SENSOR VOLTAGE [V]
LV0
LV2(TH)
LV1
d1
d2
CONVEYANCE DISTANCE [mm]

FIG. 7B

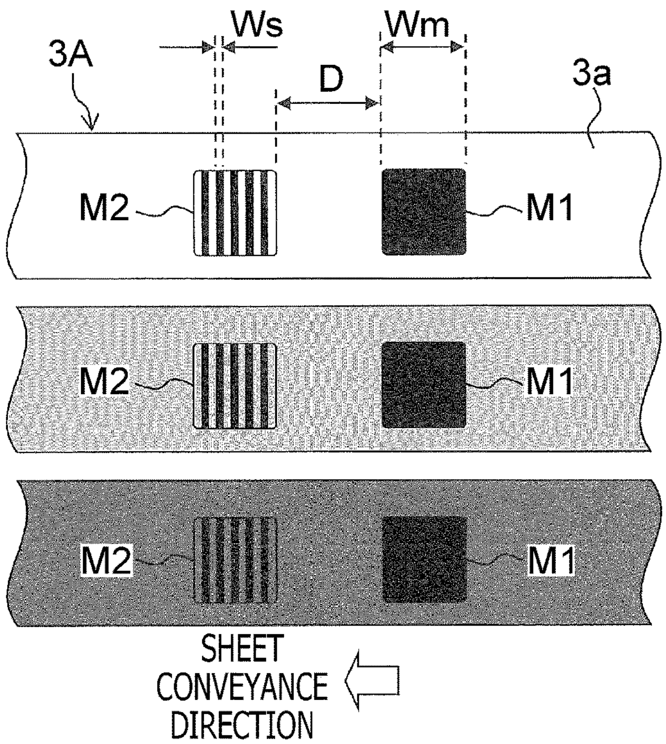


FIG. 8A

FIG. 8B

FIG. 8C

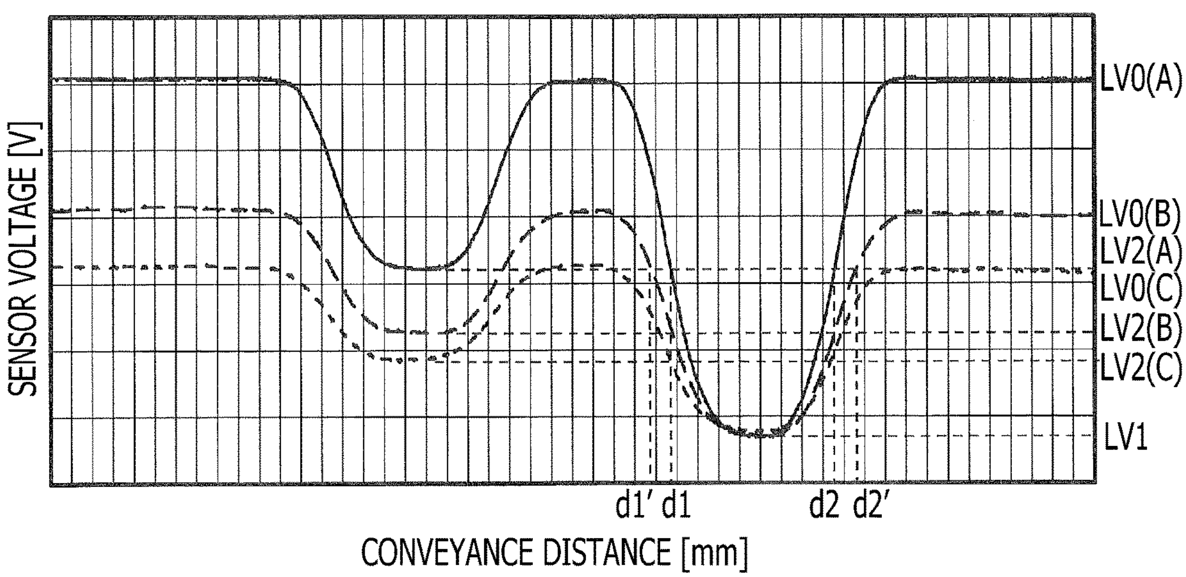


FIG. 8D

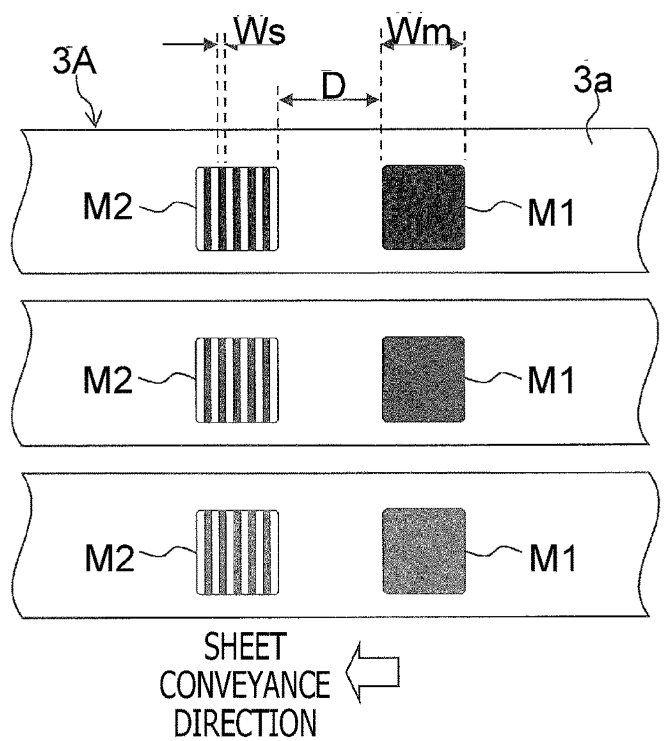


FIG. 9A

FIG. 9B

FIG. 9C

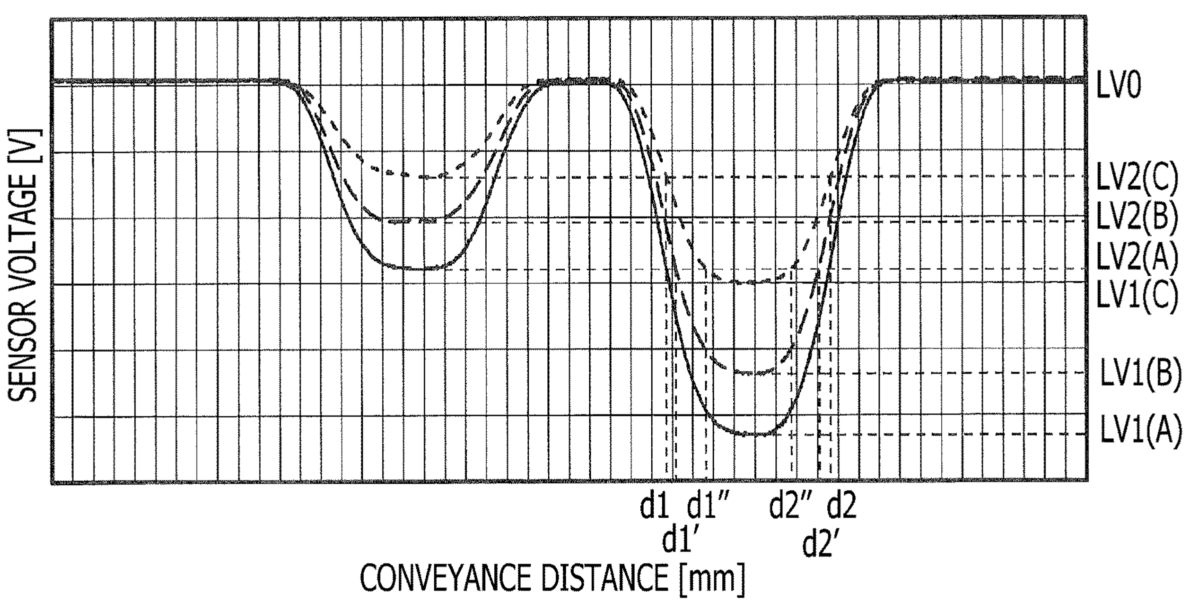


FIG. 9D

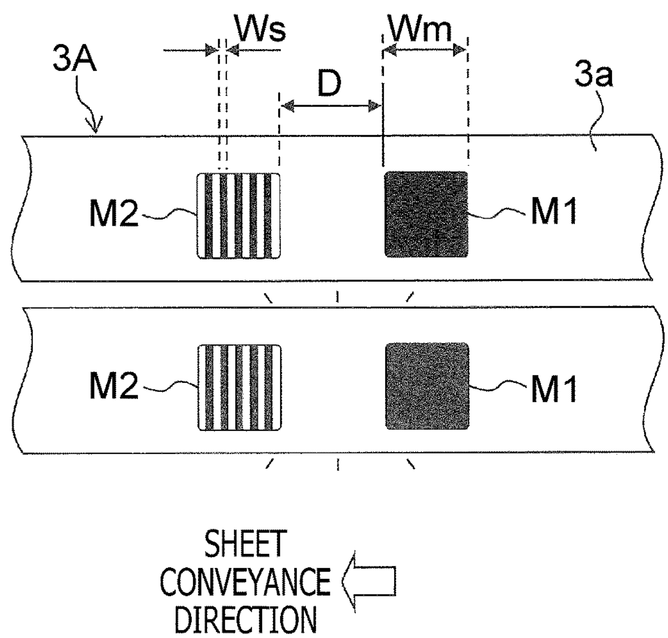


FIG. 10A

FIG. 10B

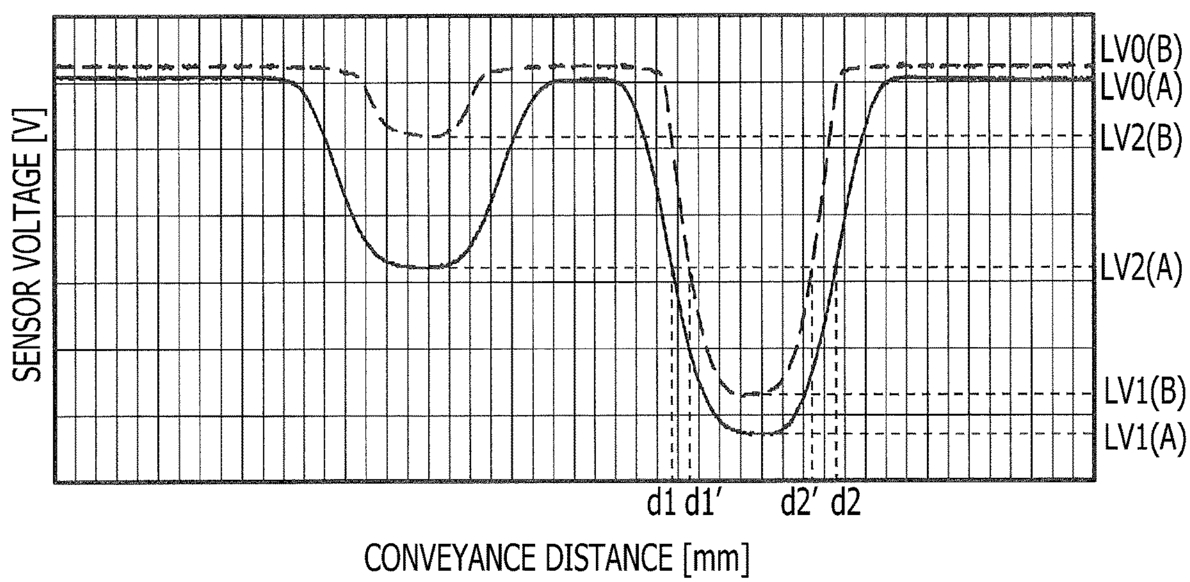


FIG. 10C

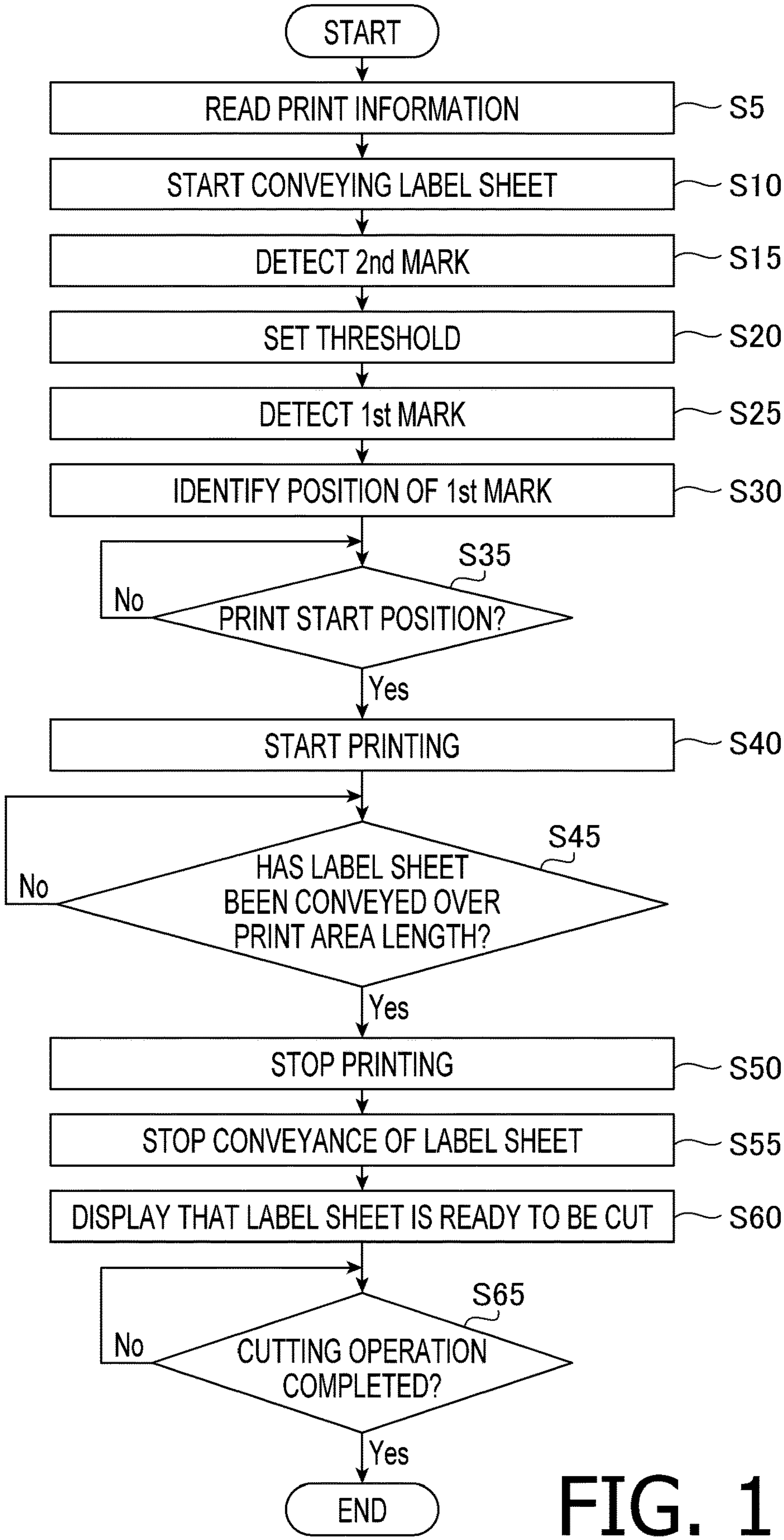

START
READ PRINT INFORMATION
S5
START CONVEYING LABEL SHEET
S10
DETECT 2nd MARK
S15
SET THRESHOLD
S20
DETECT 1st MARK
S25
IDENTIFY POSITION OF 1st MARK
S30
S35
No
PRINT START POSITION?
Yes
START PRINTING
S40
S45
No
HAS LABEL SHEET BEEN CONVEYED OVER PRINT AREA LENGTH?
Yes
STOP PRINTING
S50
STOP CONVEYANCE OF LABEL SHEET
S55
DISPLAY THAT LABEL SHEET IS READY TO BE CUT
S60
S65
No
CUTTING OPERATION COMPLETED?
Yes
END

FIG. 11

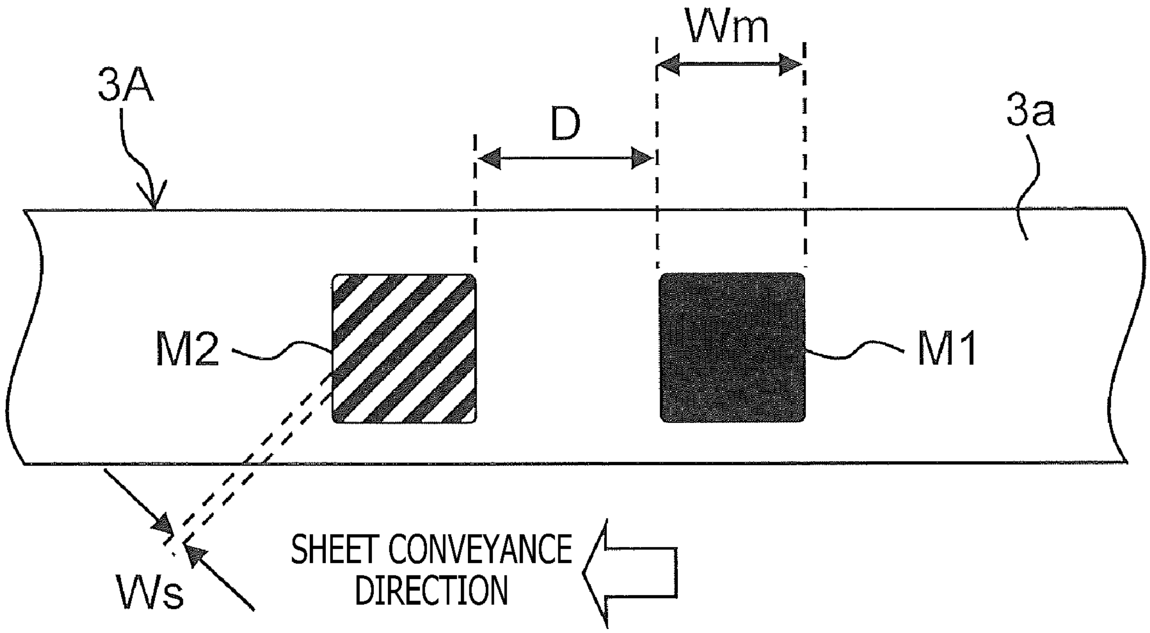

Wm
3A
D
3a
M2
M1
Ws
SHEET CONVEYANCE
DIRECTION

FIG. 12

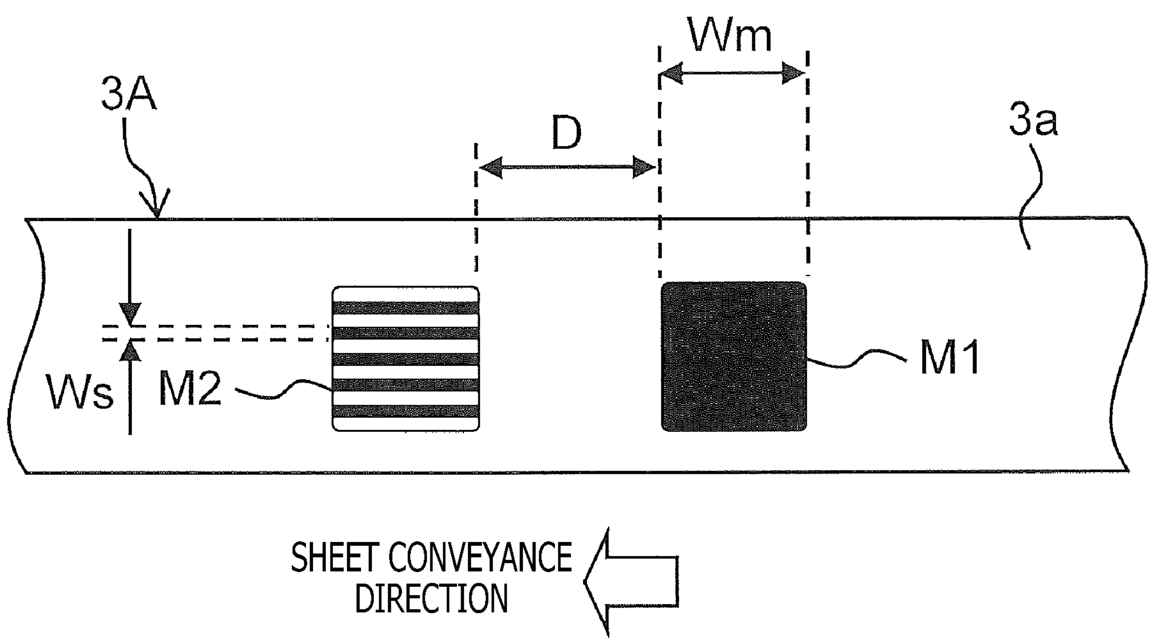

Wm
3A
D
3a
M1
Ws
M2
SHEET CONVEYANCE
DIRECTION

FIG. 13

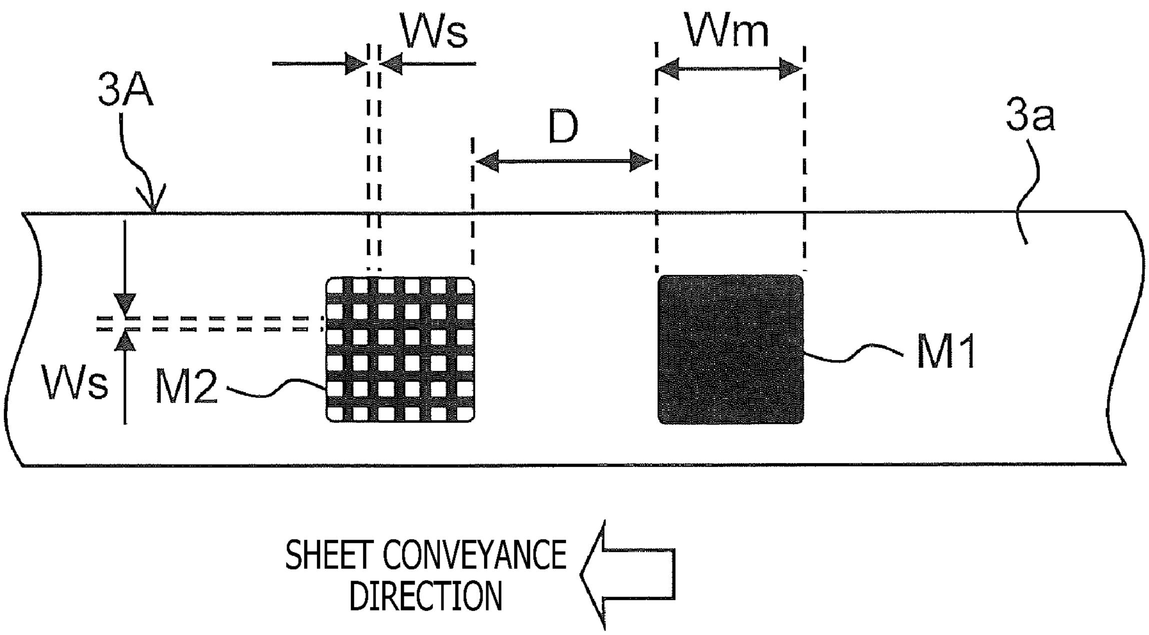

Ws
Wm
3A
D
3a
M1
Ws
M2
SHEET CONVEYANCE DIRECTION

FIG. 14

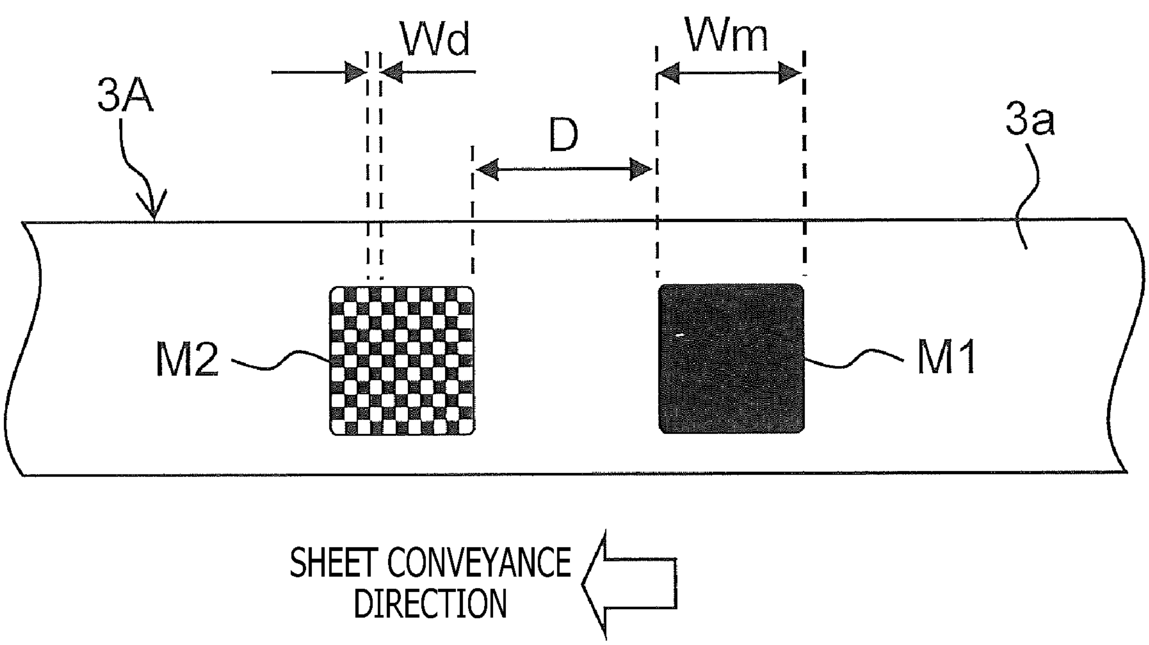

Wd
Wm
3A
D
3a
M2
M1
SHEET CONVEYANCE DIRECTION

FIG. 15

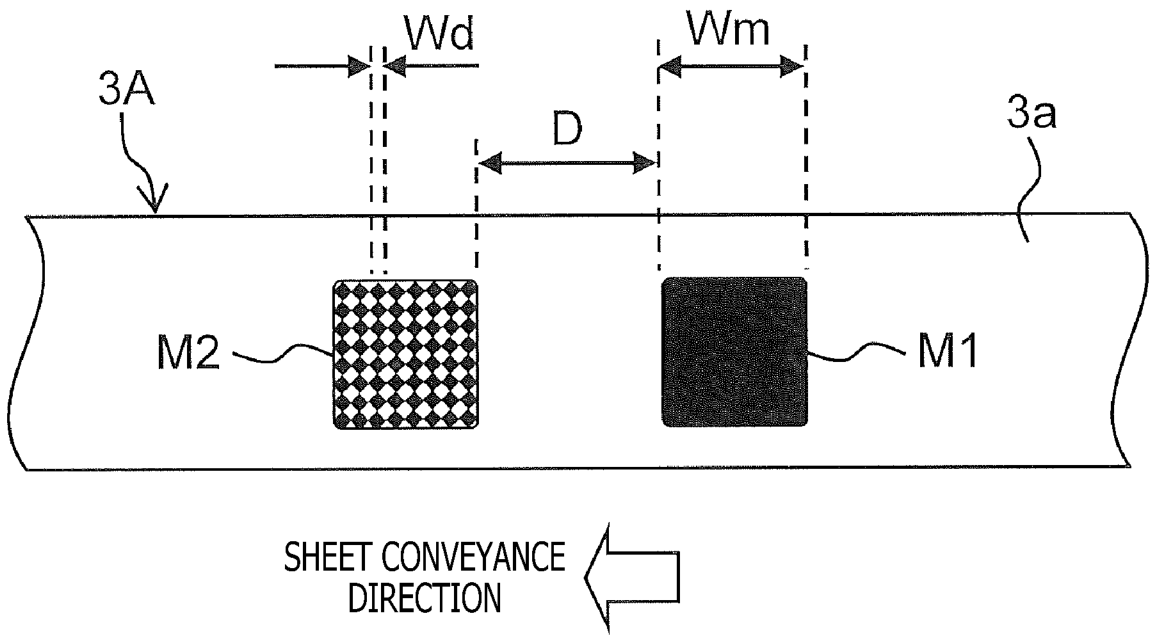

Wd
Wm
3A
D
3a
M2
M1
SHEET CONVEYANCE DIRECTION

FIG. 16

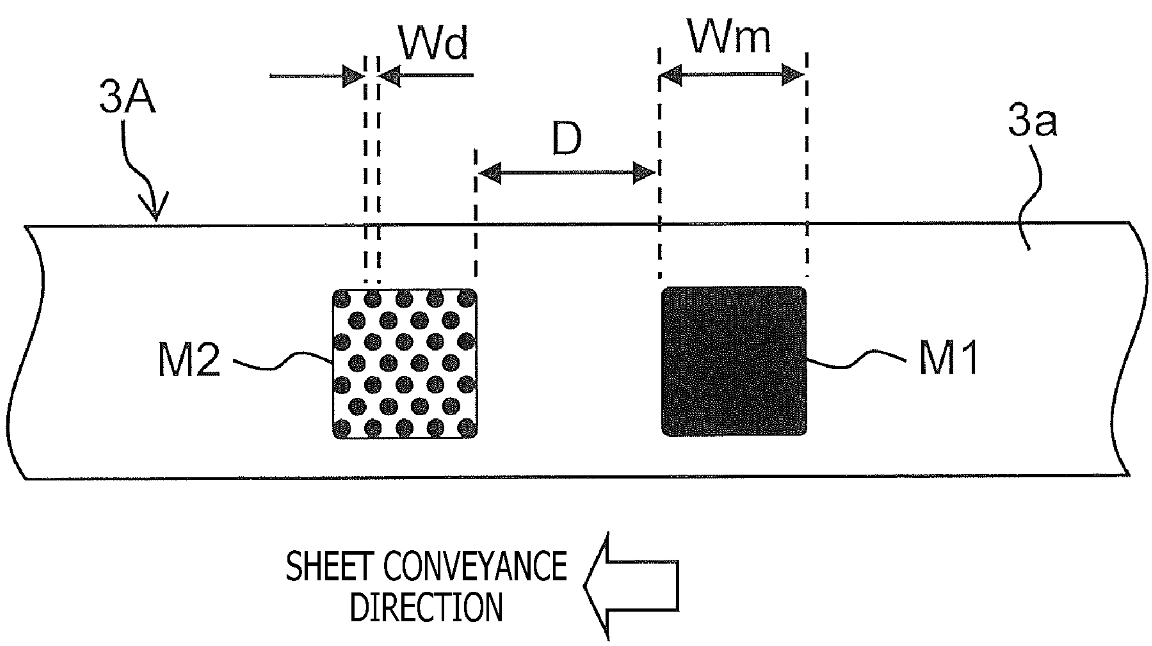

Wd
Wm
3A
D
3a
M2
M1
SHEET CONVEYANCE DIRECTION

FIG. 17

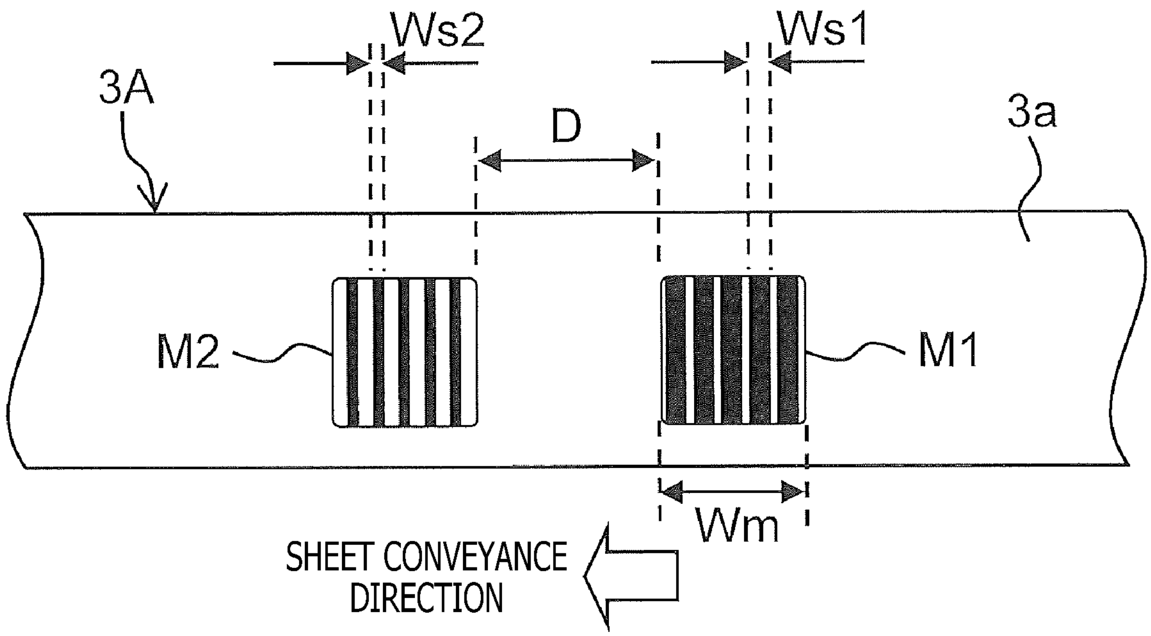

Ws2
Ws1
3A
3a
D
M2
M1
Wm
SHEET CONVEYANCE DIRECTION

FIG. 18

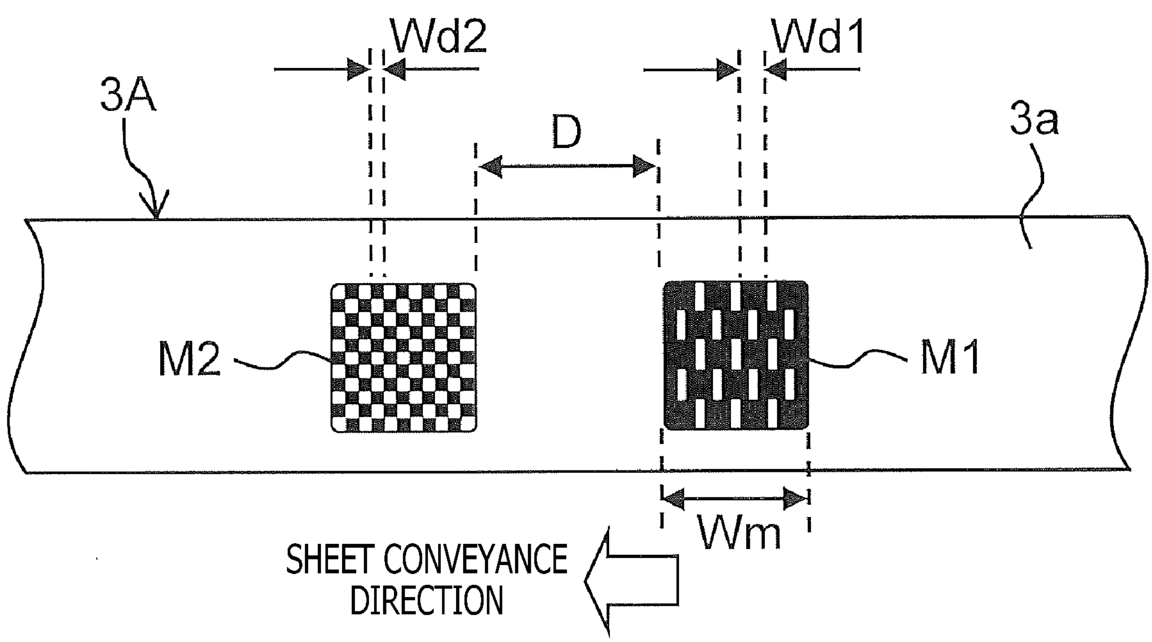

Wd2
Wd1
3A
3a
D
M2
M1
Wm
SHEET CONVEYANCE DIRECTION

FIG. 19

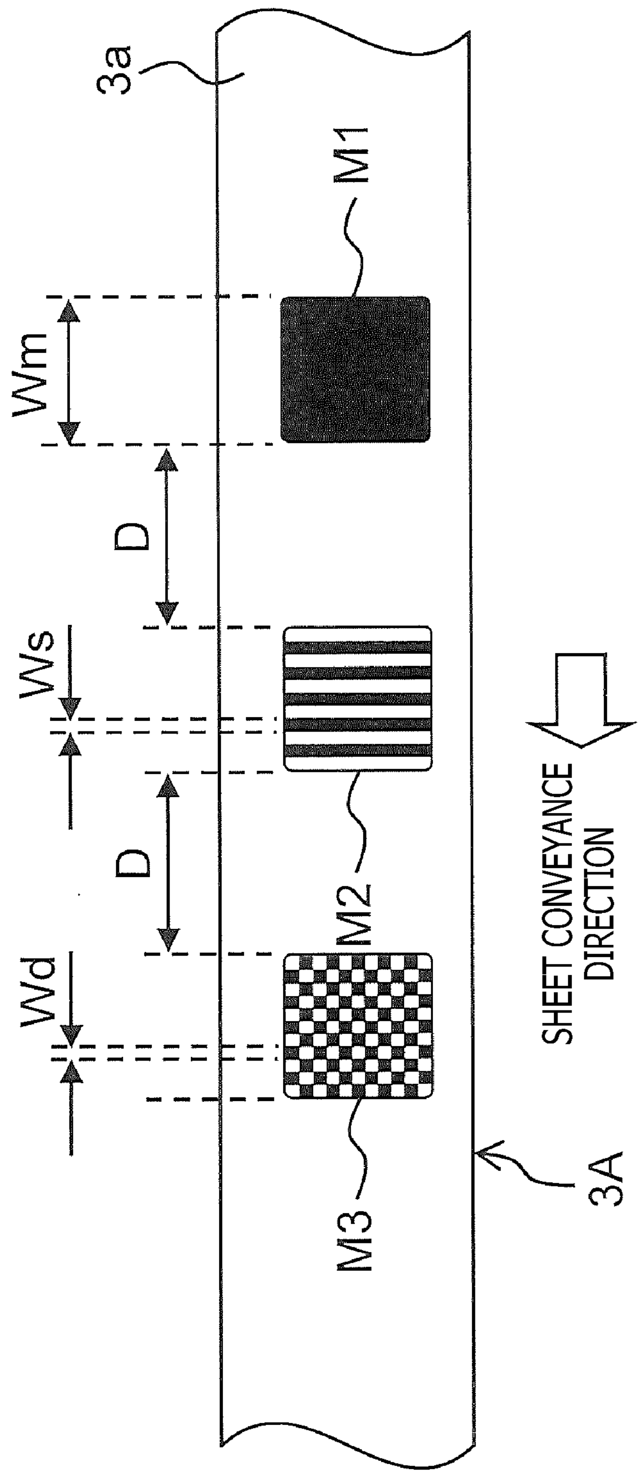


FIG. 20

PRINTER AND TAPE FOR ACCURATELY DETECTING POSITION OF MARK ON THE TAPE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority under 35 U.S.C. § 119 from Japanese Patent Application No. 2020-053895 filed on Mar. 25, 2020. The entire subject matter of the application is incorporated herein by reference.

BACKGROUND

Technical Field

[0002] Aspects of the present disclosure are related to a printer having a reflection sensor for detecting a mark on a tape, and to the tape having the mark thereon.

Related Art

[0003] A printer has been known that is configured to detect a mark on a tape by a reflection sensor and detect a position of the mark based on whether a level of a detection signal output from the reflection sensor has reached a threshold.

SUMMARY

[0004] The known printer might falsely detect the position of the mark due to influences of a print density of the mark and a reflectivity of the tape.

[0005] Aspects of the present disclosure are advantageous to provide one or more improved techniques for a printer that make it possible to accurately detect a position of a mark on a tape without being affected by variations in a print density of the mark and a reflectivity of the tape.

[0006] According to aspects of the present disclosure, a printer is provided, which includes a conveyor configured to convey a tape in a conveyance direction, the tape having a plurality of marks formed thereon, the plurality of marks including a first mark, and a second mark formed downstream of the first mark in the conveyance direction, a print head configured to print an image on the tape being conveyed by the conveyor, a reflection sensor configured to detect the plurality of marks on the tape by emitting light toward the tape and receiving reflected light from the tape, and output a detection signal according to the received reflected light when detecting the plurality of marks, and a controller. The controller is configured to set a threshold to be variable based on a level of the detection signal when the reflection sensor detects the second mark, and identify a position of the first mark based on a result of comparison between the set threshold and a level of the detection signal when the reflection sensor detects the first mark.

[0007] According to aspects of the present disclosure, further provided is a tape that includes a plurality of marks formed thereon. The plurality of marks include a first mark colored uniformly and entirely, and a second mark colored in a striped pattern or a dot pattern. The second mark is spaced apart from the first mark in a longitudinal direction of the tape.

[0008] According to aspects of the present disclosure, further provided is a tape that includes a plurality of marks formed thereon. The plurality of marks include a first mark colored in a first striped pattern or a first dot pattern, and a second mark colored in a second striped pattern or a second dot pattern. The second mark is spaced apart from the first mark in a longitudinal direction of the tape. A coloring ratio of the second mark is lower than a coloring ratio of the first mark. The coloring ratio of each mark is a ratio of a colored area to a whole area of each mark.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0009] FIG. 1 is a perspective view schematically showing a configuration of a label producing apparatus in an illustrative embodiment according to one or more aspects of the present disclosure.

[0010] FIG. 2 is a perspective view of the label producing apparatus from which an upper cover is removed, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0011] FIG. 3 is a side view of the label producing apparatus from which the upper cover is removed, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0012] FIG. 4 is a cross-sectional side view of the label producing apparatus in a state where the upper cover is removed therefrom and a holder is attached thereto, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0013] FIG. 5A is a plan view showing a surface of a release material layer side of a label sheet with first marks and second marks printed thereon, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0014] FIG. 5B is a plan view showing a surface of a heat-sensitive layer side of the label sheet before printing thereon, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0015] FIG. 5C is a plan view showing the surface of the heat-sensitive layer side of the label sheet after printing thereon, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0016] FIG. 6 schematically shows a control system of the label producing apparatus in the illustrative embodiment according to one or more aspects of the present disclosure.

[0017] FIG. 7A is an enlarged view showing a first mark and a second mark printed on the release material layer of the label sheet, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0018] FIG. 7B is a graph showing a change in a level of a detection signal from a reflection sensor detecting the first mark and the second mark, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0019] FIGS. 8A to 8C are enlarged views showing the first mark and the second mark when a white level of a base color of the release material layer decreases, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0020] FIG. 8D is a graph showing changes in the level of the detection signal from the reflection sensor detecting the first mark and the second mark when the white level of the base color of the release material layer decreases, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0021] FIGS. 9A to 9C are enlarged views showing the first mark and the second mark when print densities of the first mark and the second mark change, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0022] FIG. **9**D is a graph showing changes in the level of the detection signal from the reflection sensor detecting the first mark and the second mark when print densities of the first mark and the second mark change, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0023] FIGS. **10**A and **10**B are enlarged views showing the first mark and the second mark when the white level of the base color of the release material layer increases, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0024] FIG. **10**C is a graph showing changes in the level of the detection signal from the reflection sensor detecting the first mark and the second mark when the white level of the base color of the release material layer increases, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0025] FIG. **11** is a flowchart showing a procedure of a control process by a controller of the label producing apparatus to produce a printed label, in the illustrative embodiment according to one or more aspects of the present disclosure.

[0026] FIG. **12** is an enlarged view showing the first mark, and a second mark which has a striped pattern different from a striped pattern shown in FIG. **7**A, in a modification according to one or more aspects of the present disclosure.

[0027] FIG. **13** is an enlarged view showing the first mark, and a second mark which has a striped pattern different from the striped patterns shown in FIGS. **7**A and **12**, in a modification according to one or more aspects of the present disclosure.

[0028] FIG. **14** is an enlarged view showing the first mark, and a second mark which has a striped pattern different from the striped patterns shown in FIGS. **7**A, **12** and **13**, in a modification according to one or more aspects of the present disclosure.

[0029] FIG. **15** is an enlarged view showing the first mark, and a second mark which has a dot pattern, in a modification according to one or more aspects of the present disclosure.

[0030] FIG. **16** is an enlarged view showing the first mark, and a second mark which has a dot pattern different from the dot pattern shown in FIG. **15**, in a modification according to one or more aspects of the present disclosure.

[0031] FIG. **17** is an enlarged view showing the first mark, and a second mark which has a dot pattern different from the dot patterns shown in FIGS. **15** and **16**, in a modification according to one or more aspects of the present disclosure.

[0032] FIG. **18** is an enlarged view showing a first mark and a second mark that have respective different striped patterns, in a modification according to one or more aspects of the present disclosure.

[0033] FIG. **19** is an enlarged view showing a first mark and a second mark that have respective different dot patterns, in a modification according to one or more aspects of the present disclosure.

[0034] FIG. **20** is an enlarged view showing three types of marks, i.e., a first mark, a second mark and a third mark that have respective different patterns, in a modification according to one or more aspects of the present disclosure.

DETAILED DESCRIPTION

[0035] It is noted that various connections are set forth between elements in the following description. It is noted that these connections in general and, unless specified otherwise, may be direct or indirect and that this specification is not intended to be limiting in this respect. Aspects of the present disclosure may be implemented on circuits (such as application specific integrated circuits) or in computer software as programs storable on computer-readable media including but not limited to RAMs, ROMs, flash memories, EEPROMs, CD-media, DVD-media, temporary storage, hard disk drives, floppy drives, permanent storage, and the like.

[0036] Hereinafter, an illustrative embodiment according to aspects of the present disclosure will be described with reference to the accompanying drawings. In the illustrative embodiment, aspects of the present disclosure are applied to a label producing apparatus as a printer.

[0037] As shown in FIG. **1**, a label producing apparatus **1** includes a main body housing **2**, an upper cover **5**, a tray **6**, a power button **7**, a cutter lever **9**, and an LED display **34**. The tray **6** is erected to face a front middle portion of the upper cover **5**. The power button **7** is disposed in front of the tray **6**. It is noted that a lower left side of FIG. **1** is defined as a front side of the label producing apparatus **1**, and an upper right side of FIG. **1** is defined as a rear side of the label producing apparatus **1**.

[0038] FIG. **2** shows the label producing apparatus **1** from which the top cover **5** is removed. As shown in FIG. **2**, a holder **3** is stored in a holder storage **4**. The holder **3** includes a positioning holding member **12** and a guide member **20**. A label sheet **3**A with a particular width is rotatably wound in a roll, as a "tape" held by the holder **3**. On a front side (i.e., an inner circumferential side of the roll) of the label sheet **3**A, a plurality of labels **3**B, on which printing is performed, are arranged at intervals of a particular pitch p along a longitudinal direction of the label sheet **3**A. It is noted, hereinafter, the longitudinal direction of the label sheet **3**A may be referred to as the "sheet longitudinal direction." In the illustrative embodiment, each of the labels **3**B is formed in a substantially rectangular shape with rounded corners. However, each of the labels **3**B may be formed in another shape. On a back side (i.e., an outer circumferential side of the roll) of the label sheet **3**A, a first mark M**1** and a second mark M**2** are printed in respective positions corresponding to each label **3**B. On both sides of the label sheet **3**A in an axial direction of the roll, the aforementioned guide member **20** and the aforementioned positioning holding member **12** are disposed, respectively. The aforementioned top cover **5** is attached to a rear-side upper end portion in an openable and closable manner, so as to cover an upper side of the holder storage.

[0039] A holder support member **15** is disposed at one side end section of the holder storage **4** in a direction substantially perpendicular to a conveyance direction (hereinafter, which may be referred to as a "sheet conveyance direction") in which the label sheet **3**A is conveyed. The holder support member **15** has a first positioning groove **16** that is open upward. An attachment member **13**, protruding outward of the positioning holding member **12**, is in close contact with the first positioning groove **16**, thereby being fitted into the holder support member **15**. A lever **27** is disposed at a front end portion, in the sheet conveyance direction, of the other side end section of the holder storage **4**.

[0040] As shown in FIG. **3**, the label sheet **3**A has a four-layered structure in the illustrative embodiment. Specifically, the label sheet **3**A has a release material layer **3***a*, an adhesive material layer **3***b*, a base material layer **3***c*, and a heat-sensitive layer **3***ca*, which are stacked in this order from the outer circumferential side to the inner circumferential side of the roll. The heat-sensitive layer **3***ca* has a self-coloring property to cause the heat-sensitive layer **3***ca* itself to color with heat. A substantially rectangular half-cut line HC, for forming a corresponding label **3**B, is formed from a surface of the heat-sensitive layer **3***ca* side to the adhesive material layer **3***b*, of the label sheet **3**A. Each label **3**B, after printing, is peeled off from the release material layer **3***a* and attached to a particular product by the adhesive material layer **3***b* as a printed label T.

[0041] On an opposite side (i.e., an upper left side in FIG. **3**) of the release material layer **3***a*, the first mark M**1** and the second mark M**2** are printed in the respective positions corresponding to each label **3**B. The first mark M**1** and the second mark M**2** are detected by a reflection sensor **11** (see FIG. **6**). Using results of the detection by the reflection sensor **11**, printing positions are determined relative to the label **3**B. The second mark M**2** is disposed downstream of the first mark M**1** in the sheet conveyance direction in which the label sheet **3**A is conveyed. In the illustrative embodiment, for instance, the first mark M**1** is printed substantially in a middle position of each label **3**B in the sheet conveyance direction. Further, the second mark M**2** is printed substantially in a downstream end position of each label **3**B in the sheet conveyance direction. However, the second mark M**2** may be printed in a position other than the above position, as long as the second mark M**2** is located downstream of the first mark M**1** in the sheet conveyance direction.

[0042] As shown in FIG. **4**, when the lever **27** is rotated downward, the label sheet **3**A inserted from an insertion port **18** is pressed toward a platen roller **26** by a thermal head **31**. The platen roller **26** may be included in a "conveyor" according to aspects of the present disclosure. The thermal head **31** may be an example of a "print head" according to aspects of the present disclosure. When the thermal head **31** performs printing while the platen roller **26** is driven to rotate, intended printed images are sequentially formed on the printing surface of the heat-sensitive layer **3***ca* of each label **3**B while the label sheet **3**A is being conveyed. The label sheet **3**A discharged on the tray **6** is cut by a cutter unit **8** when the cutter lever **9** is operated to move.

[0043] The reflection sensor **11** is disposed between the insertion port **18** and the platen roller **26** in the sheet conveyance direction. The reflection sensor **11** is a reflection-type optical sensor including a light emitting element (not shown) and a light receiving element (not shown). The reflection sensor **11** is configured to detect the first mark M**1** and the second mark M**2** formed on the release material layer **3***a* of the label sheet **3**A based on light received by the light receiving element, and output a corresponding detection signal.

[0044] The aforementioned guide member **20** is stored in the holder storage **4**, with a front portion thereof in contact with a placement section **21** and a positioning groove **22**A. Below the holder storage **4**, a control board **32** is disposed on which a controller **210** is formed. The controller **210** is configured to drive and control each mechanism included in the label producing apparatus **1** according to instructions from an external device such as a personal computer. A power cord **10** is connected with one side end portion of a rear section of the main body housing **2**.

[0045] As shown in FIG. **5**A, the first mark M**1** and the second mark M**2** are printed in respective positions corresponding to each label **3**B, on the surface of the release material layer **3***a* side of the label sheet **3**A, as described above. Each of the first and second marks M**1** and M**2** is printed at intervals of substantially the same pitch as the pitch p for the labels **3**B. The second mark M**2** is disposed downstream of the first mark M**1** in the sheet conveyance direction in which the label sheet **3**A is conveyed. As described above, for instance, the first mark M**1** is printed substantially in the middle position of each label **3**B in the sheet conveyance direction. The second mark M**2** is printed substantially in the downstream end position of each label **3**B in the sheet conveyance direction.

[0046] As shown in FIGS. **5**B and **5**C, on the surface of the heat-sensitive layer **3***ca* side of the label sheet **3**A, the substantially rectangular half-cut line HC is formed by cutting the other portion than the release material layer **3***a* of the label sheet **3**A, as described above. The half-cut line HC is for peeling a printed label T, which is a label **3**B with an intended image (e.g., characters) printed thereon, off from the release material layer **3***a*. In a print area of the label **3**B surrounded by the half-cut line HC, the intended image based on print data is printed from the downstream side of the label sheet **3**A in the sheet conveyance direction. After completion of the printing, only the printed label T is peeled off from the release material layer **3**A along the half-cut line HC. Then, the printed label T is attached to a product by the adhesive material layer **3***b*. In the example shown in FIG. **5**C, a printed label T with characters "brother AAA" printed thereon, a printed label T with characters "brother BBB" printed thereon, and a printed label T with characters "brother CCC" printed thereon are conveyed side by side in this order in the sheet conveyance direction.

[0047] In FIG. **6**, on each label **3**B of the label sheet **3**A fed out of the holder **3**, printing is performed by the thermal head **31**, and the printed labels T are produced. The label sheet **3**A, on which the printed labels T are arranged, is cut by the cutter unit **8** when the cutter lever **9** is operated, as described above.

[0048] The label producing apparatus **1** includes the aforementioned platen roller **26**, a platen roller driving motor **208**, a platen roller drive circuit **209**, and a print drive circuit **205**. The platen roller **26** is configured to convey the label sheet **3**A toward a discharge port E. The platen roller driving motor **208** is configured to drive the platen roller **26**. The platen roller drive circuit **209** is configured to control the platen roller driving motor **208**. The print drive circuit **205** is configured to perform energization control for the thermal head **31**. Further, the label producing apparatus **1** includes the aforementioned controller **210** and the aforementioned LED display **34**. The controller **210** is configured to control overall operations of the label producing apparatus **1** via the print drive circuit **205** and the platen roller drive circuit **209**. The LED display **34** is configured to be turned on by a control signal from the controller **210**. The disposition, as shown in FIG. **6**, of the reflection sensor **11**, the platen roller **26**, the thermal head **31**, and the cutter unit **8** is conceptual, and does not indicate actual locations of these elements.

[0049] The controller **210** is a so-called microcomputer, which includes a CPU **210**A, a ROM **210**B, and a RAM **210**C. The controller **210** performs signal processing according to programs **210***b* stored in the ROM **210**B, using a temporary storage function of the RAM **210**C. The controller **210** is supplied with electricity from a power supply circuit **211**A. The controller **210** is connected, for instance, with a communication network via a communication circuit **211**B. The control unit **210** is further configured to perform data communication to exchange information with a root server (not shown), other terminals (not shown), a general-purpose computer (not shown), and an information server (not shown) via the communication network.

[0050] The controller **210** receives detection signals from the reflection sensor **11** and performs a position identification process and a threshold setting process based on the detection signals. The position identification process is a process to identify the position of the first mark M**1** based on a result of comparison between a level of the detection signal when the reflection sensor **11** detects the first mark M**1** and a threshold set in the threshold setting process. The threshold setting process is a process to set a threshold to be variable based on a level of the detection signal when the reflection sensor **11** detects the second mark M**2**. The specific details of these processes will be described below with reference to FIGS. **7** to **10**.

[0051] FIG. **7** shows an enlarged view of the first mark M**1** and the second mark M**2** printed on the release material layer **3***a* of the label sheet **3**A, and also shows changes in the level (i.e., a sensor voltage [V]) of the detection signal from the reflection sensor **11** when the first mark M**1** and the second mark M**2** are detected.

[0052] As shown in FIG. **7**, the first mark M**1** is a substantially rectangular mark uniformly and entirely colored black. The second mark M**2** is a substantially rectangular mark with a black striped pattern. The first mark M**1** and the second mark M**2** are formed to have the same shape and the same area. However, the first mark M**1** and the second mark M**2** may be formed to have respective different shapes and respective different areas. Further, each of the first mark M**1** and the second mark M**2** may be formed in a shape other than the rectangular shape. Moreover, each of the first mark M**1** and the second mark M**2** may be formed with a color (e.g., dark blue) other than black as long as the color is low in reflectivity.

[0053] A length Wm of the first mark M**1** in the sheet longitudinal direction (i.e., a left-right direction in FIG. **7**) is set to be equal to or more than a spot diameter of the reflection sensor **11**. Likewise, a length of the second mark M**2** in the sheet longitudinal direction is also set to be equal to or more than the spot diameter of the reflection sensor **11**. Further, a distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0054] The second mark M**2** has a striped pattern. In general, the "striped pattern" is a pattern formed with a plurality of lines colored with two or more different colors or different densities of the same color being arranged parallel to or crossing each other. Examples of the "striped pattern" may include, but are not limited to, a pattern of vertical stripes, a pattern of horizontal stripes, and a pattern of crossing stripes (e.g., a checkered pattern). In the illustrative embodiment, the striped pattern of the second mark M**2** is formed with a plurality of black straight lines substantially perpendicular to the sheet conveyance direction being arranged parallel to each other at intervals of a particular pitch. Further, the striped pattern of the second mark M**2** is formed with the black color of the said plurality of lines and the white color that is a base color of the release material layer **3***a*. Thereby, a coloring ratio (i.e., a black-white ratio) of the second mark M**2** is lower than the coloring ratio of the first mark M**1**, It is noted that the coloring ratio is a ratio of an area of portion(s) colored black to the whole area. As a result, an amount of light received by the light receiving element when the second mark M**2** is detected by the reflection sensor **11** is larger than an amount of light received by the light receiving element when the first mark M**1** is detected by the reflection sensor **11**. In the illustrative embodiment, a line width Ws and the pitch of the striped pattern are set in such a manner that the coloring ratio of the second mark M**2** is approximately 50%, while the coloring ratio of the first mark M**1** is 100%.

[0055] The coloring ratio of the second mark M**2** is not limited to 50% but may be any other ratio. However, as will be described below, a threshold for detecting the first mark M**1** is set based on the detection signal level when the reflection sensor **11** detects the second mark M**2**. Therefore, the coloring ratio of the second mark M**2** is preferred to be a value (e.g., 40% to 60%) around half of the coloring ratio of the first mark M**1**, in such a manner that the threshold is set to a value around half of the detection signal level for the first mark M**1** so as to more securely prevent false detection of the first mark M**1**.

[0056] The line width Ws of the striped pattern of the second mark M**2** is not limited to a particular value, as long as the coloring ratio of the second mark M**2** is settable to about 50%, However, the line width Ws is preferred to be equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction, in such a manner that the reflection sensor **11**, when detecting the second mark M**2**, outputs a detection signal with a gentle waveform.

[0057] As shown in FIG. **7**B, the level of the detection signal from the reflection sensor **11** changes when the reflection sensor **11** detects the first mark M**1** and the second mark M**2**. In FIG. **7**B, a level LV**0** is a detection signal level when the reflection sensor **11** detects the base color (i.e., white) of the release material layer **3***a*, A level LV**1** is a minimum level of the detection signal when the reflection sensor **11** detects the first mark M**1**. A level LV**2** is a minimum level of the detection signal when the reflection sensor **11** detects the second mark M**2**. As described above, the coloring ratio of the second mark M**2** is approximately 50% while the coloring ratio of the first mark M**1** is 100%. Therefore, an amount of change in the level LV**2** relative to the level LV**0** is approximately 50% of an amount of change in the level LV**1** relative to the level LV**0**.

[0058] In the aforementioned threshold setting process, the controller **210** sets, to the level LV**2**, a threshold TH of the detection signal level to be used for detecting the first mark M**1**. Further, in the aforementioned position identification process, the controller **210** identifies the position of the first mark M**1** based on a result of comparison between the detection signal level when the reflection sensor **11** detects the first mark M**1** and the set threshold TH (i.e., the level LV**2**). In the example shown in FIG. **7**, the first mark M**1** is identified as being formed between respective corresponding positions of a conveyance distance d**1** and a conveyance distance d**2** of the label sheet **3**A. The conveyance distance of the label sheet **3**A is detected by an encoder (not shown) provided to the platen roller driving motor **208**.

[0059] Subsequently, an explanation will be provided of a case in which a white level (i.e., reflectivity) of the base color of the release material layer **3***a* of the label sheet **3**A decreases. The white level of the release material layer **3***a* may decrease due to, for instance, a change in material, a manufacturing process, or a manufacturer of the release material layer **3***a*, or a decrease in the reflectivity of the release material layer **3***a* due to the release material layer **3***a* being thinner. FIGS. **8**A to **8**C show enlarged views of the first mark M**1** and the second mark M**2** in a situation where print densities of the first mark M**1** and the second mark M**2** do not change, and the white level of the release material layer **3***a* decreases. Further, FIG. **8**D shows changes in the level of the detection signal from the reflection sensor **11** detecting the first mark M**1** and the second mark M**2** in the same situation as above. More specifically, FIG. **8**A shows a normal state in which the white level of the release material layer **3***a* is not reduced. FIG. **8**B shows a state in which the white level of the release material layer **3***a* has become lower than in the state shown in FIG. **8**A. FIG. **8**C shows a state in which the white level of the release material layer **3***a* has become even lower than in the state shown in FIG. **8**B.

[0060] In FIG. **8**D, a level LV**0**(A) is a detection signal level when the reflection sensor **11** detects the base color in the state (see FIG. **8**A) in which the white level of the release material layer **3***a* is not reduced. A level LV**0**(B) is a detection signal level when the reflection sensor **11** detects the base color in the state (see FIG. **8**B) in which the white level of the release material layer **3***a* has become lower. A level LV**0**(C) is a detection signal level when the reflection sensor **11** detects the base color in the state (see FIG. **8**C) in which the white level of the release material layer **3***a* has become even lower. Likewise, a level LV**2**(A) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark M**2** in the state (see FIG. **8**A) in which the white level of the release material layer **3***a* is not reduced. A level LV**2**(B) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark M**2** in the state (see FIG. **8**B) in which the white level of the release material layer **3***a* has become lower. A level LV**2**(C) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark M**2** in the state (see FIG. **8**C) in which the white level of the release material layer **3***a* has become even lower.

[0061] As shown in FIG. **8**D, when the white level of the release material layer **3***a* decreases, the detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* decreases. Thus, if the threshold TH (which is equal to the level LV**2**(A)) set in the state shown in FIG. **8**A is used as is when the white level of the release material layer **3***a* has decreased, false detection will occur. For instance, in the state shown in FIG. **8**A, the first mark M**1** is detected as being located between the respective corresponding positions of the conveyance distances d**1** and d**2** of the label sheet **3**A. Meanwhile, in the state shown in FIG. **8**B, the detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* becomes lower. Therefore, the first mark M**1** is detected as being located between respective corresponding positions of conveyance distances d**1**' and d**2**', to be displaced from an actual position of the first mark M**1**. Furthermore, in the state shown in FIG. **8**C, the detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* is substantially equal to or less than the threshold TH (which is equal to the level LV**2**(A)). In this case, it might be impossible to identify the position of the first mark M**1**.

[0062] In the illustrative embodiment, the controller **210** sets the threshold TH to the level LV**2**(A) in the state shown in FIG. **8**A, The controller **210** sets the threshold TH to the level LV**2**(B) in the state shown in FIG. **8**B. The controller **210** sets the threshold TH to the level LV**2**(C) in the state shown in FIG. **8**C. As described above, the first mark M**1** is uniformly and entirely colored black. Hence, the detection signal level LV**1** when the reflection sensor **11** detects the first mark M**1** does not change even though the white level of the release material layer **3***a* decreases. On the other hand, the second mark M**2** includes the colored portions (i.e., the black portions) and the uncolored portions (i.e., the portions with the base color of the release material layer **3***a*). Hence, the detection signal level when the reflection sensor **11** detects the second mark M**2** varies according to a change in the white level of the release material layer **3***a*. Thus, since the threshold TH is set as described above, the threshold TH is rendered variable in such a manner that the threshold TH is maintained to be approximately 50% of the amount of change in the level LV**1** relative to the varying level LV**0**. Accordingly, even though the white level of the release material layer **3***a* has decreased as described above, it is possible to detect the position of the first mark M**1** with substantially the same degree of accuracy as in the normal state (see FIG. **8**A) where the white level of the release material layer **3***a* is not reduced. In the example shown in FIGS. **8**A to **8**D, even in the states shown in FIGS. **8**B and **8**C, the first mark M**1** is detected as being located between the respective corresponding positions of the conveyance distances d**1** and d**2** of the label sheet **3**A, in substantially the same manner as in the state shown in FIG. **8**A.

[0063] Next, an explanation will be provided of a case where the print densities of the first mark M**1** and the second mark M**2** change. The first marks M**1** and the second marks M**2** on the label sheet **3**A are printed in a unit of roll in a printing process. The print density is controlled in each printing process. Therefore, variations in the print density may occur among individual printing processes. FIGS. **9**A to **9**C show enlarged views of the first mark M**1** and the second mark M**2** in a situation where the white level of the release material layer **3***a* does not change, and the print densities of the first mark M**1** and the second mark M**2** decrease. Further, FIG. **9**D shows changes in the level of the detection signal from the reflection sensor **11** detecting the first mark M**1** and the second mark M**2** in the same situation as above. More specifically, FIG. **9**A shows a state in which the print densities of the first mark M**1** and the second mark M**2** are normal. FIG. **9**B shows a state in which the print densities of the first mark M**1** and the second mark M**2** have become lower than in the state shown in FIG. **9**A. FIG. **9**C shows a state in which the print densities of the first mark M**1** and the second mark M**2** have become even lower than in the state shown in FIG. **9**B.

[0064] In FIG. **9**D, a level LV**1**(A) is a minimum level of the detection signal when the reflection sensor **11** detects the first mark M**1** in the state (see FIG. **9**A) in which the print densities of the first mark M**1** and the second mark M**2** are normal. A level LV**1**(B) is a minimum level of the detection signal when the reflection sensor **11** detects the first mark M**1** in the state (see FIG. **9**B) in which the print densities of the first mark **M1** and the second mark **M2** have become lower. A level LV**1**(C) is a minimum level of the detection signal when the reflection sensor **11** detects the first mark **M1** in the state (see FIG. **9**C) in which the print densities of the first mark **M1** and the second mark **M2** have become even lower than in the state shown in FIG. **9**B. Likewise, a level LV**2**(A) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark **M2** in the state (see FIG. **9**A) in which the print densities of the first mark **M1** and the second mark **M2** are normal. A level LV**2**(B) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark **M2** in the state (see FIG. **9**B) in which the print densities of the first mark **M1** and the second mark **M2** have become lower. A level LV**2**(C) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark **M2** in the state (see FIG. **9**C) in which the print densities of the first mark **M1** and the second mark **M2** have become even lower than in the state shown in FIG. **9**B,

[0065] As shown in FIGS. **9**A to **9**D, as the print densities of the first mark **M1** and the second mark **M2** decrease, the detection signal level when the reflection sensor **11** detects each of the first and second marks **M1** and **M2** becomes higher. As a result, if the threshold TH (which is equal to the level LV**2**(A)) set in the state shown in FIG. **9**A is used as is when the print densities of the first mark **M1** and the second mark **M2** have decreased, false detection will occur. For instance, in the state shown in FIG. **9**A, the first mark **M1** is detected as being located between the respective corresponding positions of the conveyance distances **d1** and **d2**. Meanwhile, in the state shown in FIG. **9**B, the detection signal level when the reflection sensor **11** detects each of the first and second marks **M1** and **M2** becomes higher. Therefore, the first mark **M1** is detected as being located between respective corresponding positions of conveyance distances **d1'** and **d2'**, to be displaced from the actual position. Furthermore, in the state shown in FIG. **9**C, the detection signal level when the reflection sensor **11** detects each of the first and second marks **M1** and **M2** is even higher than in the state shown in FIG. **9**B. Therefore, the first mark **M1** is detected as being located between respective corresponding positions of conveyance distances **d1"** and **d2"**, to be displaced from the actual position of the first mark **M1**, Additionally, in the state shown in FIG. **9**C, a level difference between the threshold TH (which is equal to the level LV**2**(A)) and the level LV**1**(C) is small, Therefore, it might be impossible to detect the position of the first mark **M1**.

[0066] In the illustrative embodiment, the controller **210** sets the threshold TH to the level LV**2**(A) in the state shown in FIG. **9**A. The controller **210** sets the threshold TH to the level LV**2**(B) in the state shown in FIG. **9**B. The controller **210** sets the threshold TH to the level LV**2**(C) in the state shown in FIG. **9**C. As described above, the print density is controlled in each printing process. Therefore, even if there are variations in the print density among individual printing processes, the first marks **M1** and the second marks **M2** printed on the label sheet **3**A in the same printing process will be darker or lighter together to substantially the same degree. In other words, the first marks **M1** and the second marks **M2** printed on the label sheet **3**A of the same roll may be considered to be formed with substantially the same density. On the other hand, in the example shown in FIGS. **9**A to **9**D, the detection signal level LV**0** when the reflection sensor **11** detects the base color of the release material layer **3**A does not change. Thus, since the threshold TH is set as described above, the threshold TH is rendered variable in such a manner that the threshold TH is maintained to be approximately **50**% of the amount of change in the varying level LV**1** relative to the level LV**0**. Therefore, even when the print densities of the first mark **M1** and the second mark **M2** become lower as described above, it is possible to detect the position of the first mark **M1** with substantially the same level of accuracy as in the state (see FIG. **9**A) where the print densities of the first mark **M1** and the second mark **M2** are normal. In the example shown in FIGS. **9**A to **9**D, even in the states shown in FIGS. **9**B and **9**C, the first mark **M1** is detected as being located between the respective corresponding positions of the conveyance distances **d1** and **d2** of the label sheet **3**A, in substantially the same manner as in the state shown in FIG. **9**A.

[0067] Next, an explanation will be provided of a case where the white level of the base color of the release material layer **3***a* of the label sheet **3**A increases. For instance, the white level of the release material layer **3***a* may be unexpectedly higher due to the use of glossy paper as the release material layer **3***a*, changes in the material, the manufacturing process, or the manufacturer of the release layer **3***a*, or an increase in the reflectivity of the release material layer **3***a* due to the release material layer **3***a* being thicker. FIGS. **10**A and **10**B show enlarged views of the first mark **M1** and the second mark **M2** in a situation where the print densities of the first mark **M1** and the second mark **M2** do not change, and the white level of the release material layer **3***a* increases. Further, FIG. **10**C shows changes in the level of the detection signal from the reflection sensor **11** detecting the first mark **M1** and the second mark **M2** in the same situation as above. More specifically, FIG. **10**A shows a normal state in which the white level of the release material layer **3***a* is not raised. FIG. **10**B shows a state in which the white level of the release material layer **3***a* has become higher than in the state shown in FIG. **10**A.

[0068] In FIG. **10**C, the level LV**0**(A) is a detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* in the state (see FIG. **10**A) in which the white level of the release material layer **3***a* is not raised. The level LV**0**(B) is a detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* in the state (see FIG. **10**B) in which the white level of the release material layer **3***a* has become higher. It is noted that when a maximum output of the detection signal from the reflection sensor **11** is set to the level LV**0**(A), the level LV**0**(B) is a saturated level of the detection signal output from the reflection sensor **11**. The level LV**1**(A) is a minimum level of the detection signal when the reflection sensor **11** detects the first mark **M1** in the state (see FIG. **10**A) in which the white level of the release material layer **3***a* is not raised. The level LV**1**(B) is a minimum level of the detection signal when the reflection sensor **11** detects the first mark **M1** in the state (see FIG. **10**B) in which the white level of the release material layer **3***a* has become higher. Likewise, the level LV**0**(A) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark **M2** in the state (see FIG. **10**A) in which the white level of the release material layer **3***a* is not raised. The level LV**2**(B) is a minimum level of the detection signal when the reflection sensor **11** detects the second mark M**2** in the state (see FIG. **10**B) in which the white level of the release material layer **3***a* has become higher.

[0069] As shown in FIGS. **10**A to **10**C, as the white level of the release material layer **3***a* increases, the detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* becomes higher. As a result, if the threshold TH (which is equal to the level LV**2**(A)) in the state shown in Fig, **10**A is used as is when the white level of the release material layer **3***a* has become higher, false detection will occur. For instance, in the state shown in FIG. **10**A, the first mark M**1** is detected as being located between the respective corresponding positions of the conveyance distances d**1** and d**2**. Meanwhile, in the state shown in FIG. **10**B, the detection signal level when the reflection sensor **11** detects the base color of the release material layer **3***a* becomes higher. Therefore, the first mark M**1** is detected as being located between respective corresponding positions of conveyance distances d**1**' and d**2**', to be displaced from the actual position of the first mark M**1**.

[0070] In the illustrative embodiment, the controller **210** sets the threshold TH to the level LV**2**(A) in the state shown in FIG. **10**A, and sets the threshold TH to the level LV**2**(B) in the state shown in FIG. **10**B. As described above, the first mark M**1** is uniformly and entirely colored black. Hence, the detection signal level LV**1** when the reflection sensor **11** detects the first mark M**1** changes little even though the white level of the release material layer **3***a* increases. On the other hand, the second mark M**2** includes the colored portions (i.e., the black portions) and the uncolored portions (i.e., the portions with the base color of the release material layer **3***a*). Hence, the detection signal level LV**2** when the reflection sensor **11** detects the second mark M**2** increases significantly as the white level of the release material layer **3***a* increases. Therefore, by setting the threshold TH as described above, as long as the level LV**2** (B) is not even saturated, it is possible to detect the position of the first mark M**1** with substantially the same accuracy as in the normal state (see FIG. **10**A) in which the white level of the release material layer **3***a* is not raised, even when the white level of the release material layer **3***a* is raised and saturated as mentioned above. In the example shown in FIGS. **10**A to **10**C, even in the state shown in FIG. **10**B, the first mark M**1** is detected as being located between the respective corresponding positions of the conveyance distances d**1** and d**2**, in substantially the same manner as in the state shown in FIG. **10**A.

[0071] FIG. **11** shows a procedure of a control process to be performed by the controller **210** to produce a printed label T. The control process shown in FIG. **11** may be performed by the CPU **210**A of the controller **210** executing one or more programs **210***b* stored in the ROM **210**B.

[0072] As shown in FIG. **11**, in S**5**, the controller **210** reads print information, for instance, from an operation terminal via the communication circuit **211**B. The print information represents an image (e.g., characters) to be printed on a label **3**B of the label sheet **3**A by the thermal head **31**.

[0073] In S**10**, the controller **210** drives the platen roller driving motor **208** via the platen roller drive circuit **209**, thereby driving the platen roller **26** to start conveying the label sheet **3**A.

[0074] In S**15**, the controller **210** receives a detection signal from the reflection sensor **11** that has detected the second mark M**2**.

[0075] In S**20**, the controller **210** performs the threshold setting process to set a threshold for identifying the position of the first mark M**1** to be variable based on a level of the detection signal received in S**15** from the reflection sensor **11** having detected the second mark M**2**.

[0076] In S**25**, the controller **210** receives a detection signal from the reflection sensor **11** that has detected the first mark M**1**.

[0077] In S**30**, the controller **210** performs the position identification process to identify a position of the first mark M**1** based on a result of comparison between the level of the detection signal received in S**25** from the reflection sensor **11** having detected the first mark M**1** and the threshold set in S**20**.

[0078] In S**35**, the controller **210** determines whether the label sheet **3**A has been conveyed to a particular print start position. Specifically, the controller **210** determines whether a conveyance distance from the detection position of the first mark M**1** as identified in S**30** has reached a particular conveyance distance. The controller **210** repeatedly makes the determination in S**35** while waiting until the label sheet **3**A is conveyed to the print start position (S**35**: No). The controller **210** goes to S**40** when determining that the label sheet **3**A has been conveyed to the print start position (S**35**: Yes).

[0079] In S**40**, the controller **210** sends a control signal to the thermal head **31** via the print drive circuit **205**. Thereby, the controller **210** performs printing to form, on the heat-sensitive layer **3***ca*, the image (e.g., characters) corresponding to the print information read in S**5**.

[0080] In S**45**, the controller **210** determines whether the label sheet **3**A has been conveyed over a particular print area length. Specifically, the controller **20** determines whether the conveyance of the label sheet **3**A over the print area length has been completed, based on the conveyance distance from the detection position of the first mark M**1** as identified in S**30**. The controller **210** repeatedly makes the determination in S**45** while waiting until the conveyance of the label sheet **3**A over the print area length is completed (S**45**: No). The controller **210** goes to S**50** when determining that the conveyance of the label sheet **3**A over the print area length has been completed (S**45**: Yes).

[0081] In S**50**, the controller **210** stops supplying electricity to the thermal head **31** via the print drive circuit **205**, thereby stopping the printing on the label sheet **3**A.

[0082] In S**55**, the controller **210** stops driving the platen roller driving motor **208** via the platen roller drive circuit **209**, thereby stopping the rotation of the platen roller **26**. As a result, the conveyance of the label sheet **3**A is stopped.

[0083] In S**60**, the controller **210** sends a lighting control signal to the LED display **34**. Thereby, the LED display **34** shows thereon that the label sheet **3**A is ready to be cut by manually operating the cutter lever **9**.

[0084] In S**65**, the controller **210** determines whether a cutting operation of cutting the label sheet **3**A by operating the cutter lever **9** has been completed. The controller **210** repeatedly makes the determination in S**65** while waiting until the cutting operation is completed (S**65**: No). The controller **210** terminates the process shown in FIG. **11** when determining that the cutting operation has been completed (S**65**: Yes).

[0085] As described above, in the illustrative embodiment, the first marks M**1** and the second marks M**2** are printed on the surface of the release material layer **3***a* side of the label sheet **3**A. As mentioned above, when the first marks M**1** and the second marks M**2** are printed on the label sheet **3**A held by the same holder **3**, the first marks M**1** and the second marks M**2** are printed in the same printing process. Thus, for instance, even if them are variations in the print density among individual printing processes, the first marks M**1** and the second marks M**2** printed on the label sheet **3**A in the same printing process will be darker or lighter together to substantially the same degree. In other words, the first marks M**1** and the second marks M**2** printed on the same label sheet **3**A may be considered to be printed with substantially the same density. In the threshold setting process of the illustrative embodiment, using the above properties, the threshold TH of the detection signal level for detecting the first mark M**1** is determined based on the detection signal level when the second mark M**2** is detected.

[0086] For instance, if the first mark M**1** is printed lighter in color (i.e., with a density lower than a normal density), the detection signal level when the reflection sensor **11** detects the first mark M**1** will be a level when the first mark M**1** has a reflectivity higher than when printed as usual (i.e., with the normal density). Namely, in this case, the sensor voltage when the reflection sensor **11** detects the first mark M**1** is higher than when the first mark M**1** is printed with the normal density. As a result, if the threshold TH set when the printing is performed with the normal density is used as is when the printing is performed with a lower density, false detection may occur such as the first mark M**1** being detected to be located in a position displaced from the actual position or being unable to be detected. At this time, the second mark M**2** is also printed with such a lower density. Therefore, the detection signal level when the reflection sensor **11** detects the second mark M**2** is a level when the second mark M**2** has a reflectivity higher than when printed with the normal density. Thereby, it is possible to set the threshold TH to be shifted toward a level for the first mark M**1** having a reflectivity higher than when the printing is performed with the normal density, based on the detection signal level for the second mark M**2**. Accordingly, even though the printing is performed with a lower density as described above, it is possible to identify the position of the first mark M**1** with substantially the same degree of accuracy as when the printing is performed with the normal density, in the position identification process to identify the position of the first mark M**1** based on a result of comparison between the detection signal level and the threshold TH.

[0087] Conversely, if the first mark M**1** is printed darker in color (i.e., with a density higher than the normal density), the detection signal level when the reflection sensor **11** detects the first mark M**1** will be a level when the first mark M**1** has a reflectivity lower than when printed as usual (i.e., with the normal density). Namely, in this case, the sensor voltage when the reflection sensor **11** detects the first mark M**1** is lower than when the first mark M**1** is printed with the normal density. As a result, if the threshold TH set when the printing is performed with the normal density is used as is when the printing is performed with a higher density, the first mark M**1** may be detected to be located in a position displaced from the actual position. At this time, the second mark M**2** is also printed with such a higher density. Therefore, the detection signal level when the reflection sensor **11** detects the second mark M**2** is a level when the second mark M**2** has a reflectivity lower than when printed with the normal density. Thereby, it is possible to set the threshold TH to be shifted toward a level for the first mark M**1** having a reflectivity lower than when the printing is performed with the normal density, based on the detection signal level for the second mark M**2**. Accordingly, even though the printing is performed with a higher density as described above, it is possible to identify the position of the first mark M**1** with substantially the same degree of accuracy as when the printing is performed with the normal density.

[0088] On the other hand, if the print densities of the first mark M**1** and the second mark M**2** do not change, and the reflectivity of the base color of the label sheet **3**A becomes lower, the detection signal level when the reflection sensor **11** detects the base color will be a level when the base color of the label sheet **3**A has a reflectivity lower than its normal reflectivity. Namely, in this case, the sensor voltage when the reflection sensor **11** detects the first mark M**1** is lower than when the reflectivity of the base color of the label sheet **3**A is normal. As a result, if the threshold TH set when the reflectivity of the base color of the label sheet **3**A is normal is used as is when the reflectivity of the base color of the label sheet **3**A is lower, false detection may occur such as the first mark M**1** being detected to be located in a position displaced from the actual position or being unable to be detected. At this time, the detection signal level when the reflection sensor **11** detects the second mark M**2** is also a level when the base color of the label sheet **3**A has a reflectivity lower than its normal reflectivity. Thereby, it is possible to set the threshold TH to be shifted toward a level for the base color of the label sheet **3**A having a reflectivity lower than its normal reflectivity, based on the detection signal level for the second mark M**2**. Accordingly, even though the reflectivity of the base color of the label sheet **3**A has become lower as described above, it is possible to identify the position of the first mark M**1** with substantially the same degree of accuracy as when the reflectivity of the base color of the label sheet **3**A is normal.

[0089] Conversely, if the print densities of the first mark M**1** and the second mark M**2** do not change, and the reflectivity of the base color of the label sheet **3**A becomes higher, the detection signal level when the reflection sensor **11** detects the base color will be a level when the base color of the label sheet **3**A has a reflectivity higher than its normal reflectivity. As a result, if the threshold TH set when the reflectivity of the base color of the label sheet **3**A is normal is used as is when the reflectivity of the base color of the label sheet **3**A is higher, the first mark M**1** may be detected to be located in a position displaced from the actual position. At this time, the detection signal level when the reflection sensor **11** detects the second mark M**2** is also a level when the base color of the label sheet **3**A has a reflectivity higher than its normal reflectivity. Thereby, it is possible to set the threshold TH to be shifted toward a level for the base color of the label sheet **3**A having a reflectivity higher than its normal reflectivity, based on the detection signal level for the second mark M**2**. Accordingly, even though the reflectivity of the base color of the label sheet **3**A has become higher as described above, it is possible to identify the position of the first mark M**1** with substantially the same degree of accuracy as when the reflectivity of the base color of the label sheet **3**A is normal.

[0090] As a result, in the illustrative embodiment, even though there are variations in the print densities of the first mark M**1** and the second mark M**2** on the label sheet **3**A and in the reflectivity of the label sheet **3**A, it is possible to detect the position of the first mark M**1** with high accuracy without being affected by those variations.

[0091] Further, in the illustrative embodiment, particularly, an amount of light received by the light receiving element when the reflection sensor **11** detects the second mark M**2** is larger than when the reflection sensor **11** detects the first mark M**1**.

[0092] Thereby, the detection signal level when the reflection sensor **11** detects the second mark M**2** may be considered as such a level that the second mark M**2** has a reflectivity higher than the reflectivity of the first mark M**1**. As a result, it is possible to set the detection signal level for the second mark M**2** as the threshold TH of the detection signal level for detecting the first mark M**1**, and thus, to easily set the threshold TH.

[0093] Further, in the illustrative embodiment, particularly, the coloring ratio (i.e., the ratio of the area of the portion(s) colored black to the whole area) of the second mark M**2** is smaller than the coloring ratio of the first mark M**1**.

[0094] Thereby, it is possible to adjust the threshold TH of the detection signal level for detection of the first mark M**1** to be an appropriate value according to the coloring ratio of the second mark M**2**. Further, the second mark M**2** may include a colored portion (e.g., a portion colored black) and a portion with the base color of the label sheet **3**A. As a result, when the reflectivity of the base color portion of the label sheet **3**A becomes higher or lower, the detection signal level for the second mark M**2** varies according to the variation in the reflectivity of the base color portion. Thus, it is possible to set the threshold TH to be variable according to the variation in the reflectivity of the base color portion. Accordingly, it is possible to detect the position of the first mark M**1** with high accuracy without being affected by the variation in the reflectivity of the label sheet **3**A.

[0095] Further, in the illustrative embodiment, particularly, the first mark M**1** is a mark colored uniformly and entirely. The second mark M**2** is a mark colored in the striped pattern.

[0096] Thereby, it is possible to set the coloring ratio of the second mark M**2** with high accuracy in accordance with the line width Ws and the pitch of the striped pattern, with respect to the coloring ratio (i.e., 100%) of the first mark M**1** that is colored uniformly and entirely.

[0097] Further, in the illustrative embodiment, particularly, the line width Ws of the striped pattern of the second mark M**2** is equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0098] In general, the length Wm of the first mark M**1** in the sheet longitudinal direction is set to be equal to or more than the spot diameter of the reflection sensor **11**. Therefore, when the line width Ws of the striped pattern of the second mark M**2** is set to be equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction, the reflection sensor **11**, when detecting the second mark M**2**, outputs a detection signal with a gentle waveform. Thereby, it is possible to improve the accuracy for setting the threshold TH.

[0099] Further, the label sheet **3**A of the illustrative embodiment provides the following advantageous effects. In general, when marks for position detection are printed on the label sheet **3**A as a printing medium, it is necessary to control the print densities of the marks. This is because, for instance, if the densities of the marks become lower, the level of the detection signal output from the reflection sensor **11** detecting the marks may be equal to or more than the threshold TH, thereby causing false detection. However, the accurate densities of the marks need to be measured by a densitometer, for instance, in a process separate from the printing process. Therefore, in this case, there are problems as follows. It takes time to measure the densities by the densitometer since the measurement has to be performed offline after stopping the printing process. Further, it is not possible to measure the densities of all the printed marks. Further, more ink than necessary is used because, in most cases, the densities are controlled using results of the density measurement at the beginning and the end of the printing process, and a target print density is set with a margin in consideration of density variations (which may include a variation due to measurement errors). Moreover, since the density of each printed mark varies depending on how dried the ink of each printed mark is, it takes time to check whether each examined mark satisfies the required density.

[0100] Therefore, in the illustrative embodiment, the first mark M**1** colored uniformly and entirely and the second mark M**2** colored in the striped pattern are formed to be spaced apart from each other in the sheet longitudinal direction. Thereby, the label producing apparatus **1** is enabled to determine the threshold TH of the detection signal level to be used for detection of the first mark M**1**, based on the detection signal level when the reflection sensor **11** detects the second mark M**2**. In this case, the first mark M**1** and the second mark M**2** are printed with substantially the same density, since the first mark M**1** and the second mark M**2** are formed in positions close to each other in the same printing process. Therefore, the threshold TH may be adjusted to an appropriate value according to the coloring ratios of the first mark M**1** and the second mark M**2**, regardless of the print density. Further, since the first mark M**1** is formed as a mark colored uniformly and entirely, and the second mark M**2** is formed as a mark colored in the striped pattern, it is possible to accurately set the coloring ratios of the first and second marks M**1** and M**2** according to the line width Ws and the pitch of the striped pattern of the second mark M**2**. As a result, even though there are variations in the print densities of the first marks M**1** and the second marks on the label sheet **3**A, it is possible to detect the position of each first mark M**1** with high accuracy without being affected by the density variations, and to prevent false detection.

[0101] Thus, since strict control of the print densities is unnecessary, it is possible to omit the offline measurement of the print densities or reduce the frequency of the density measurement. Further, the coloring ratios of the first mark M**1** and the second mark M**2** have only to be within respective specified ranges. Hence, a pass/fail judgment may be made, for instance, using an imaging device such as a camera. Therefore, the pass/fail judgment may be made in-line in the printing process, thereby enabling inspection of all the printed marks. As a result, it is possible to avoid undesirable situations such as the printing process being stopped halfway to perform the offline measurement of the densities and occurrence of a lot defect due to a mark out of standards being found at the end of the printing process.

[0102] Further, in the illustrative embodiment, the distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0103] In general, the length Wm of the first mark M**1** in the sheet longitudinal direction is set equal to or more than the spot diameter of the reflection sensor **11** of the label producing apparatus **1**. Therefore, when the distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction, the said distance D is set equal to or more than the spot diameter of the reflection sensor **11**. Thereby, the level of the detection signal from the reflection sensor **11** is restored to the detection signal level when the reflection sensor **11** detects the base color of the label sheet **3**A, during a period of time from when the reflection sensor **11** detects the second mark M**2** until when the reflection sensor **11** detects the first mark M**1**. Consequently, it is possible to render neat the waveform of the detection signal from the reflection sensor **11** detecting the first mark M**1** and improve the accuracy for detecting the position of the first mark M**1**.

[0104] Hereinabove, the illustrative embodiment according to aspects of the present disclosure has been described. Aspects of the present disclosure may be practiced by employing conventional materials, methodology and equipment. Accordingly, the details of such materials, equipment and methodology are not set forth herein in detail. In the previous descriptions, numerous specific details are set forth, such as specific materials, structures, chemicals, processes, etc., in order to provide a thorough understanding of the present disclosure. However, it should be recognized that aspects of the present disclosure may be practiced without reapportioning to the details specifically set forth. In other instances, well known processing structures have not been described in detail, in order not to unnecessarily obscure the present disclosure.

[0105] Only an exemplary illustrative embodiment of the present disclosure and but a few examples of their versatility are shown and described in the present disclosure. It is to be understood that aspects of the present disclosure are capable of use in various other combinations and environments and are capable of changes or modifications within the scope of the inventive concept as expressed herein. For instance, the following modifications may be feasible.

[0106] (1) Different Striped Patterns for the Second Mark

[0107] In the aforementioned illustrative embodiment, the striped pattern of the second mark M**2** is formed with a plurality of black straight lines substantially perpendicular to the sheet conveyance direction being arranged parallel to each other at intervals of a particular pitch. However, the striped pattern may be other patterns than the pattern as exemplified in the illustrative embodiment. For instance, as shown in FIG. **12**, the striped patter may be formed with a plurality of black straight lines inclined at a particular angle (e.g., 45 degrees) relative to the sheet conveyance direction being arranged parallel to each other at intervals of a particular pitch. In another instance, as shown in FIG. **13**, the striped patter may be formed with a plurality of black straight lines substantially parallel to the sheet conveyance direction being arranged parallel to each other at intervals of a particular pitch. In yet another instance, as shown in FIG. **14**, the striped pattern may be formed with a plurality of black straight lines substantially perpendicular to the sheet conveyance direction and a plurality of black straight lines substantially parallel to the sheet conveyance direction being arranged crossing each other (i.e., arranged in a grid pattern).

[0108] In any of the above modifications of the second mark M**2**, a line width Ws and the pitch of the striped pattern are set such that the coloring ratio of the second mark M**2** is approximately 50%, in substantially the same manner as in the aforementioned illustrative embodiment. Further, the line width Ws of the striped pattern of the second mark M**2** is equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0109] Further, a distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0110] Each of the lines included in the striped pattern is not limited to a straight line, but may be a bent line or a curved line, and the lines may be arranged not to be parallel to each other. Each of the lines included in the striped pattern may not necessarily be uniform in thickness. For instance, each of the lines included in the striped pattern may be an elongated area.

[0111] The above modifications also produce substantially the same effects as in the aforementioned illustrative embodiment.

[0112] (2) When the Second Mark is Colored in a Dot Pattern

[0113] In the aforementioned illustrative embodiment, the second mark M**2** is colored in the striped pattern. However, for instance, the second mark M**2** may be colored black in a dot pattern. The "dot pattern" may be formed with a plurality of dots being arranged regularly or irregularly. Each of the dots included in the "dot pattern" may be formed in any shape, for instance, a rectangle, a parallelogram, a circle, or other shapes. For instance, as shown in FIG. **15**, the dot pattern may be formed with a plurality of dots formed substantially in a rectangular shape being arranged in a staggered manner at intervals of a particular pitch. In another instance, as shown in FIG. **16**, the dot pattern may be formed with a plurality of dots formed substantially in a parallelogram shape being arranged in parallel at intervals of a particular pitch. In yet another instance, as shown in FIG. **17**, the dot pattern may be formed with a plurality of dots formed substantially in a round shape being arranged in a staggered manner at intervals of a particular pitch.

[0114] In any of the above modifications of the second mark M**2**, a dot width Wd and the pitch of the dot pattern are set such that the coloring ratio of the second mark M**2** is approximately 50%, in substantially the same manner as in the aforementioned illustrative embodiment. In addition, the dot width Wd of the dot pattern of the second mark M**2** is equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction. Further, a distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0115] Each of the dots included in the dot pattern is not limited to the dots shaped as above, but may be formed in any other shape. Further, the dots may be arranged in contact with each other, or may be spaced apart from each other. The arrangement of the dots is not limited to the parallel arrangement or the staggered arrangement, but the dots may be arranged, for instance, irregularly.

[0116] The above modifications also produce substantially the same effects as in the aforementioned illustrative embodiment.

[0117] (3) When Both the First Mark and the Second Mark have a Striped Pattern or a Dot Pattern

[0118] In the aforementioned illustrative embodiment, the first mark **1** is uniformly and entirely colored black, and the second mark M**2** is colored in the striped pattern. However, for instance, both the first mark M**1** and the second mark M**2** may be colored in a striped pattern or a dot pattern.

[0119] For instance, as shown in FIG. **18**, each of the first and second marks M**1** and M**2** may be formed with a plurality of black straight lines substantially perpendicular to the sheet conveyance direction being arranged parallel to each other at intervals of a particular pitch. In this case, the coloring ratio of the second mark M**2** is lower than the coloring ratio of the first mark M**1**. In this modification, a line width Ws**1** and the pitch of the first mark M**1** and a line width Ws**2** and the pitch of the second mark M**2** are set in such a manner that the coloring ratio (e.g., 40%) of the second mark M**2** is approximately half of the coloring ratio (e.g., 80%) of the first mark M**1**. In addition, the line width Ws**1** of the first mark M**1** is larger than the line width Ws**2** of the second mark M**2**. Further, both of the line widths Ws**1** and Ws**2** are equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction. Furthermore, a distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0120] Further, for instance, as shown in FIG. **19**, each of the first and second marks M**1** and M**2** may be formed with a plurality of dots formed substantially in a rectangular shape being arranged in a staggered manner at intervals of a particular pitch. In this case, the coloring ratio of the second mark M**2** is lower than the coloring ratio of the first mark M**1**. In this modification, a dot width Wd**1** and the pitch of the first mark M**1** and a dot width Wd**2** and the pitch of the second mark M**2** are set in such a manner that the coloring ratio (e.g., 40%) of the second mark M**2** is approximately half of the coloring ratio (e.g., 80%) of the first mark M**1**. In addition, the dot width Wd**1** of the first mark M**1** is larger than the dot width Wd**2** of the second mark M**2**. Further, both of the dot widths Wd**1** and Wd**2** are equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction. Furthermore, a distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction.

[0121] The coloring ratio of the second mark M**2** is not limited to approximately half of the coloring ratio of the first mark M**1**, but may be another ratio. However, as described above, the threshold TH for detecting the first mark M**1** is set based on the detection signal level when the reflection sensor **11** detects the second mark M**2**. Therefore, the coloring ratio of the second mark M**2** is preferred to be around half (e.g., 40% to 60%) of the coloring ratio of the first mark M**1**, in such a manner as to set the threshold TH to be around half of the detection signal level when the reflection sensor **11** detects the first mark M**1** and to more certainly prevent false detection of the first mark M**1**.

[0122] Although the following features are not shown in any drawing, for instance, a mark (e.g., the first mark MO colored in a striped pattern and a mark (e.g., the second mark M**2**) colored in a dot pattern may be mixed.

[0123] The above modifications may also produce substantially the same effects as in the aforementioned illustrative embodiment. In the present modifications, each of the first mark M**1** and the second mark M**2** is colored in a striped pattern or a dot pattern. Thereby, it is possible to accurately set the respective coloring ratios of the first mark M**1** and the second mark M**2** in accordance with the line widths Ws**1** and Ws**2** and the pitches of the respective striped patterns of the first mark M**1** and the second mark M**2** or the dot widths Wd**1** and Wd**2** and the pitches of the respective dot patterns of the first mark M**1** and the second mark M**2**,

[0124] In the present modifications, particularly, the coloring ratio of the second mark M**2** is preferred to be approximately 50% of the coloring ratio of the first mark M**1** or within a range of 40% to 60% of the coloring ratio of the first mark M**1**. Thereby, it is possible to set the threshold TH for detecting the first mark M**1** to be around half of the detection signal level LV**1** when the reflection sensor **11** detects the first mark M**1**, based on the detection signal level LV**2** when the reflection sensor **11** detects the second mark M**2**. Therefore, it is possible to more certainly prevent false detection of the first mark M**1**.

[0125] (4) When Three or More Types of Marks are Formed

[0126] In the aforementioned illustrative embodiment, the two types of marks, i.e., the first mark(s) M**1** and the second mark(s) M**2** are formed on the label sheet **3**A. However, the number of the types of the marks is not limited to two, but may be three or more.

[0127] For instance, in FIG. **20**, three types of marks including a first mark M**1**, a second mark M**2**, and a third mark M**3** are printed on the surface of the release material layer **3***a* side of the label sheet **3**A. The second mark M**2** is formed downstream of the first mark M**1** in the sheet conveyance direction. The third mark M**3** is formed further downstream of the second mark M**2** in the sheet conveyance direction. The first mark M**1** is colored black uniformly and entirely. The second mark M**2** is colored black in a striped pattern. The third mark M**3** is colored black in a dot pattern. In this modification, the coloring ratio of the first mark M**1** is 100%. Meanwhile, with respect to the second mark M**2**, a line width Ws and a pitch of the striped pattern thereof are set in such a manner that the coloring ratio of the second mark M**2** is approximately 50%. Similarly, with respect to the third mark M**3**, a dot width Wd and a pitch of the dot pattern thereof are set in such a manner that the coloring ratio of the third mark M**3** is approximately 50%.

[0128] The line width Ws of the striped pattern of the second mark M**2** is equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction. In addition, a distance D between the first mark M**1** and the second mark M**2** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark M**1** in the sheet longitudinal direction. Likewise, the dot width Wd of the dot pattern of the third mark M**3** is equal to or less than half of the length Wm of the first mark M**1** in the sheet longitudinal direction. Further, a distance D between the second mark M**2** and the third mark M**3** in the sheet longitudinal direction is set to be equal to or more than the length Wm of the first mark **M1** in the sheet longitudinal direction.

[0129] In this modification, in a threshold setting process, the controller **210** sets the threshold TH to be variable based on a detection signal level when the reflection sensor **11** detects the third mark M**3** and a detection signal level when the reflection sensor **11** detects the second mark M**2**. Specifically, the level of the detection signal from the reflection sensor **11** detecting the third mark M**3** is substantially equal to the level of the detection signal from the reflection sensor **11** detecting the second mark M**2**. Hence, for instance, the controller **210** may calculate an average value of these detection signal levels and set the average value as the threshold TH. Then, in a position identification process, the controller **210** identifies a position of the first mark M**1** based on a result of comparison between a detection signal level when the reflection sensor **11** detects the first mark M**1** and the threshold TH.

[0130] In this modification, as described above, the threshold TH is set using the two types of marks. Therefore, it is possible to set the threshold TH with a higher degree of accuracy than when the threshold TH is set using only one type of mark.

[0131] In the above example, both the coloring ratio of the second mark M**2** and the coloring ratio of the third mark M**3** are set to 50%. However, each of the coloring ratios of the second and third marks M**2** and M**3** may be a ratio other than 50%. For instance, the coloring ratio of the second mark M**2** may be set to 60%, and the coloring ratio of the third mark M**3** may be set to 40%. In this case, the controller **210** may calculate an average value of a detection signal level when the reflection sensor **11** detects the second mark M**2** and a detection signal level when the reflection sensor **11** detects the third mark M**3**, and may set the average value as the threshold TH.

[0132] In the above descriptions, when there are expressions such as "perpendicular," "parallel," and "flat," these expressions may not necessarily give their rigorous meanings. Namely, the expressions of "perpendicular," "parallel," and "flat" may give meanings of "substantially perpendicular," "substantially parallel," and "substantially flat," respectively, in consideration of tolerances and errors in design and manufacturing.

[0133] In the above descriptions, when there are expressions such as "same," "equal," or "different" in terms of dimensions or size in appearances, these expressions may not necessarily give their rigorous meanings. Namely, the expressions of "same," "equal," and "different" may give meanings of "substantially the same," "substantially equal," and "substantially different," respectively, in consideration of tolerances and errors in design and manufacturing.

[0134] However, unlike the above, for instance, when there are criteria such as a threshold (see FIG. **11**) and a reference value, the expressions of "same," "equal," and "different" in comparison to the criteria give their respective rigorous meanings.

[0135] In the above descriptions, each arrow, showing an example of a signal flow in drawings such as FIG. **6**, does not limit a direction of the signal flow.

[0136] The control process (see FIG. **11**) according to aspects of the present disclosure is not limited to the procedure of the flowchart as shown in FIG. **11**. The control process according to aspects of the present disclosure is capable of changes or modifications (e.g., addition of one or more steps, deletion of one or more steps, and changes in the order of the steps) within the scope of the inventive concept as expressed herein.

[0137] The following shows examples of associations between elements exemplified in the aforementioned illustrative embodiments and modifications and elements according to aspects of the present disclosure. The label producing apparatus **1** may be an example of a "printer" according to aspects of the present disclosure. The label sheet **3**A may be an example of a "tape" according to aspects of the present disclosure. The first mark M**1** may be an example of a "first mark" according to aspects of the present disclosure. The second mark M**2** may be an example of a "second mark" according to aspects of the present disclosure. The platen roller **26** may be included in a "conveyor" according to aspects of the present disclosure. The thermal head **31** may be an example of a "print head" according to aspects of the present disclosure. The reflection sensor **11** may be an example of a "reflection sensor" according to aspects of the present disclosure. The controller **210** may be an example of a "controller" according to aspects of the present disclosure. The CPU **210**A may be an example of a "processor" according to aspects of the present disclosure. The ROM **210**B storing the programs **210***b* may be an example of a "memory storing computer-readable instructions" according to aspects of the present disclosure. The CPU **210**A and the ROM **210**B may be included in the "controller" according to aspects of the present disclosure.

What is claimed is:

1. A printer comprising:

a conveyor configured to convey a tape in a conveyance direction, the tape having a plurality of marks formed thereon, the plurality of marks including a first mark, and a second mark formed downstream of the first mark in the conveyance direction;

a print head configured to print an image on the tape being conveyed by the conveyor;

a reflection sensor configured to detect the plurality of marks on the tape by emitting light toward the tape and receiving reflected light from the tape, and output a detection signal according to the received reflected light when detecting the plurality of marks; and

a controller configured to:

set a threshold to be variable based on a level of the detection signal when the reflection sensor detects the second mark; and

identify a position of the first mark based on a result of comparison between the set threshold and a level of the detection signal when the reflection sensor detects the first mark.

2. The printer according to claim **1**,

wherein an amount of the reflected light received when the reflection sensor detects the second mark is larger than an amount of the reflected light received when the reflection sensor detects the first mark.

3. The printer according to claim **2**,

wherein a coloring ratio of the second mark is lower than a coloring ratio of the first mark, the coloring ratio of each mark being a ratio of a colored area to a whole area of each mark.

4. The printer according to claim **3**,

wherein the first mark is colored uniformly and entirely, and wherein the second mark is colored in a striped pattern or a dot pattern.

5. The printer according to claim **3**,

wherein each of the first mark and the second mark is colored in a striped pattern or a dot pattern.

6. The printer according to claim **4**,

wherein, when the second mark is colored in the striped pattern, a width of each line included in the striped pattern in a longitudinal direction of the tape is equal to or less than half of a length of the first mark in the longitudinal direction of the tape, and

wherein, when the second mark is colored in the dot pattern, a width of each dot included in the dot pattern in the longitudinal direction of the tape is equal to or less than half of the length of the first mark in the longitudinal direction of the tape.

7. The printer according to claim **5**,

wherein, when the second mark is colored in the striped pattern, a width of each line included in the striped pattern in a longitudinal direction of the tape is equal to or less than half of a length of the first mark in the longitudinal direction of the tape, and

wherein, when the second mark is colored in the dot pattern, a width of each dot included in the dot pattern in the longitudinal direction of the tape is equal to or less than half of the length of the first mark in the longitudinal direction of the tape.

8. The printer according to claim **1**,

wherein the controller comprises:

a processor; and

a memory storing computer-readable instructions configured to, when executed by the processor, cause the processor to:

set the threshold to be variable based on the level of the detection signal when the reflection sensor detects the second mark; and

identify the position of the first mark based on the result of comparison between the set threshold and the level of the detection signal when the reflection sensor detects the first mark.

9. A tape comprising a plurality of marks formed thereon, the plurality of marks including:

a first mark colored uniformly and entirely; and

a second mark colored in a striped pattern or a dot pattern, the second mark being spaced a particular distance apart from the first mark in a longitudinal direction of the tape.

10. The tape according to claim **8**,

wherein, when the second mark is colored in the striped pattern, a width of each line included in the striped pattern in a longitudinal direction of the tape is equal to or less than half of a length of the first mark in the longitudinal direction of the tape, and

wherein, when the second mark is colored in the dot pattern, a width of each dot included in the dot pattern in the longitudinal direction of the tape is equal to or less than half of the length of the first mark in the longitudinal direction of the tape.

11. The tape according to claim **8**,

wherein the particular distance between the first mark and the second mark in the longitudinal direction of the tape is equal to or more than a length of the first mark in the longitudinal direction of the tape.

12. A tape comprising a plurality of marks formed thereon, the plurality of marks including:

a first mark colored in a first striped pattern or a first dot pattern; and

a second mark colored in a second striped pattern or a second dot pattern, the second mark being spaced a particular distance apart from the first mark in a longitudinal direction of the tape, a coloring ratio of the second mark being lower than a coloring ratio of the first mark, the coloring ratio of each mark being a ratio of a colored area to a whole area of each mark.

13. The tape according to claim **11**,

wherein the coloring ratio of the second mark is 40% to 60% of the coloring ratio of the first mark.

14. The tape according to claim **11**,

wherein, when the second mark is colored in the second striped pattern, a width of each line included in the second striped pattern in a longitudinal direction of the tape is equal to or less than half of a length of the first mark in the longitudinal direction of the tape, and

wherein, when the second mark is colored in the second dot pattern, a width of each dot included in the second dot pattern in the longitudinal direction of the tape is equal to or less than half of the length of the first mark in the longitudinal direction of the tape.

15. The tape according to claim **11**,

wherein the particular distance between the first mark and the second mark in the longitudinal direction of the tape is equal to or more than a length of the first mark in the longitudinal direction of the tape.

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