(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 500 336 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
26.01.2005 Bulletin 2005/04

(21) Application number: **03712686.9**

(22) Date of filing: **13.03.2003**

(51) Int Cl.[7]: **A24C 5/38**

(86) International application number:
PCT/JP2003/003018

(87) International publication number:
WO 2003/077686 (25.09.2003 Gazette 2003/39)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LI LU MC NL PT RO SE SI SK TR
Designated Extension States:
AL LT LV MK

(30) Priority: **20.03.2002 JP 2002078293**

(71) Applicant: **Japan Tobacco Inc.**
Tokyo 105-8422 (JP)

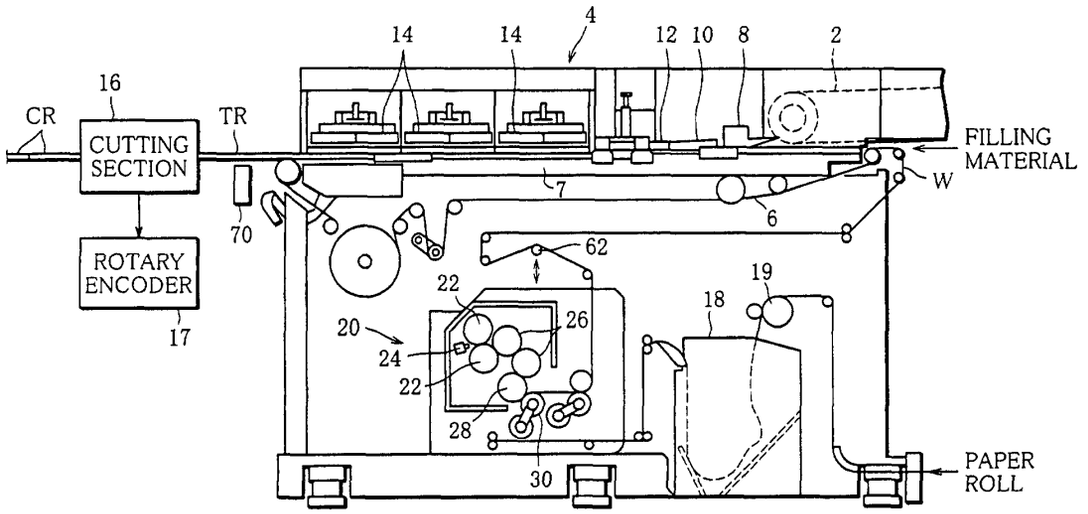
(72) Inventors:
- **KUBO, Fumio, c/o JAPAN TOBACCO INC.**
Tokyo 114-0004 (JP)
- **SUZUKI, Takehiro, c/o JAPAN TOBACCO INC.**
Tokyo 114-0004 (JP)
- **SAITOU, Masayoshi, c/o JAPAN TOBACCO INC.**
Tokyo 114-0004 (JP)
- **OKAMOTO, Hiroshi, c/o JAPAN TOBACCO INC.**
Tokyo 114-0004 (JP)

(74) Representative: **Weise, Reinhard, Dipl.-Ing.**
Reinhard-Skuhra-Weise & Partner
Patentanwälte
Postfach 44 01 51
80750 München (DE)

(54) PRINTER OF CIGARETTE MANUFACTURING MACHINE

(57) A printer for a cigarette-manufacturing machine has a density sensor (70) disposed between a wrapping section (4) and a cutting section (16) of the machine, and the density sensor (70) detects the print density of printed information (PI) of a tobacco rod (TR). The information (PI) is printed on a paper web W by a printing unit (20) located upstream from the wrapping section (4). Disposed between the printing unit (20) and the wrapping section (4) is an adjusting device (62) for varying the length of a feeding path of the paper web W. A density signal from the density sensor (70) is used to control the operation of the printing unit (20) and adjusting device (62). Thus, based on the density signal, the print density of the printed information (PI) and the arrival timing thereof at the density sensor (70) are each controlled.

FIG. 1



EP 1 500 336 A1

Description

Technical Field

[0001] The present invention relates to a printer for printing the desired information on a paper web used for the manufacture of tobacco rod, or of cigarette rods, in a cigarette-manufacturing machine.

Background Art

[0002] A printer for a cigarette-manufacturing machine is disclosed in, for example, Unexamined Japanese Patent Publication No. 5-327938. The printer described in this publication includes a printing unit that is interposed in a paper web-feeding path. The paper web is fed along the feeding path to a wrapping section of the cigarette-manufacturing machine. In this process, the printing unit intermittently prints the desired information onto the surface of the paper web.

[0003] There is ensured a predetermined distance between two adjacent pieces of the printed information on the paper web, that is, a length equal to two cigarette portions of filter cigarettes. Moreover, each piece of the printed information includes a pair of marks, and these marks are located separately with a given space therebetween in the longitudinal direction of the paper web. In addition, each mark includes a number indicative of the cigarette-manufacturing machine, a symbol denoting the factory equipped with the cigarette-manufacturing machine, and so on.

[0004] In the process of the printed paper web's passing through the wrapping section, filling material containing shred tobacco is wrapped in the paper web, thereby forming a tobacco rod. Thereafter, the tobacco rod is delivered from the wrapping section to a cutting section of the cigarette-manufacturing machine and cut into discrete cigarette rods at the cutting section. Each of the cigarette rods has the aforementioned length and includes one piece of the printed information. The printed information is located at the center of the cigarette rod with respect to the longitudinal direction of the rod.

[0005] Subsequently, the cigarette rods produced by the cigarette-manufacturing machine are fed to a filter-attaching machine, namely filter attachment. In the filter attachment, the cigarette rod is first cut at between the pair of marks to be formed into two cigarette portions, so that each cigarette portion has one mark.

[0006] Next, a filter plug is disposed in between the two cigarette portions. The cigarettes and the filter plug are formed into one double filter cigarette together by wrapping tip paper therearound. More specifically, the tip paper is wrapped around the filter plug and the ends of the cigarette portions which sandwich the filter plug from both sides, thereby attaching the filter plug to both the cigarette portions and hiding the mark on each cigarette portion at the same time.

[0007] Furthermore, the double filter cigarette is cut at the center of the filter plug through the tip paper, which produces separate filter cigarettes.

[0008] Since the mark on the cigarette portion is hidden by the tip paper as mentioned, the smoker does not smoke the filter cigarette down to the mark, thereby preventing the mark from being burnt.

[0009] In order to hide the mark on the cigarette portion by using the tip paper without fail, the printed information must be accurately located on the paper web. However, if a slip occurs in the travel of the paper web at the wrapping section of the cigarette-manufacturing machine, the printed information of the cigarette rod is located out of the center of the cigarette rod.

[0010] If such a cigarette rod is cut in the filter attachment, it is impossible to cut exactly between a pair of marks of the printed information. This results in production of a filter cigarette whose mark shows from under the tip paper and one having no mark at all, and such filter cigarettes are considered to be defective.

[0011] When the information is printed on the paper web, the print density of the printed information, that is, of a pair of marks, has to be adequate. Either high or low print density of the marks also produces inferior filter cigarettes.

Disclosure of the Invention

[0012] An object of the present invention is to provide a printer capable of detecting displacement and print density of information printed on a paper web by using a common detector and properly controlling the displacement and print density of the printed information.

[0013] In order to achieve the above object, the printer of the present invention comprises a printing section having a print roller interposed in a paper web-feeding path and an ink supply source for supplying ink to the print roller, the printing section for printing given information on the paper web by using the print roller to provide the information to each cigarette rod, a density sensor disposed between a wrapping section and a cutting section, for detecting density of each piece of the printed information on the paper web to output a density signal, a density-controlling device for controlling print density of the printed information on the basis of the density signal from the density sensor, a calculating device for calculating time deviation between an arrival time point at which the printed information provided to a tobacco rod is supposed to arrive at the density sensor and an actual detection time point at which the density sensor actually detects the printed information, and outputting the calculated deviation, and a timing-controlling device for controlling the timing of arrival of the printed information at the density sensor to correct the deviation from the calculating device.

[0014] According to the aforementioned printer, the density signal from the density sensor is used for controlling the print density of the printed information, and at the same time used for calculating the time deviation

between the arrival time point at which the printed information is supposed to arrive at the density sensor and the actual detection time point at which the printed information is actually detected, or an output time point of the density signal. Based on the calculated deviation, correction is made to the arrival timing of the printed information at the density sensor, that is, the displacement of the printed information. Consequently, the printer of the present invention does not require a sensor dedicated to the calculation of the deviation.

[0015] The arrival time point can be determined from cut timing of the tobacco rod, distance between a cutting position of the tobacco rod and the density sensor, and a delivery speed of the tobacco rod (feeding speed of the paper web).

[0016] Specifically, the cigarette rod has a to-be-cut position so as to be cut at the center with respect to a longitudinal direction thereof. After being fed to the filter cigarette-manufacturing machine, the cigarette rod is cut at the to-be-cut position to be formed into two cigarettes. In this case, the printed information includes a pair of marks located at both sides of the to-be-cut position of the cigarette rod, respectively.

[0017] The density-controlling device may have abnormality-determining means for determining whether the density signal of each cigarette rod falls in a correct range, and outputs a removal signal if the density signal is out of the correct range, and density-adjusting means for calculating average density of the printed information on the basis of density signals for a given number of cigarette rods and adjusting an ink supply amount from ink supply means on the basis of the average density calculated.

[0018] With such a density-controlling device, the cigarette rods that are defective in print density are removed one by one in response to the removal signals, thereby preventing defective cigarette rods from getting mixed in non-defective ones.

[0019] The density-controlling device can output an operation stop signal for stopping the operation of the cigarette-manufacturing machine when the average density is at an abnormal level. The output of the operation stop signal prevents defective cigarette rods from being manufactured in large quantity.

[0020] Specifically, the ink supply means includes an ink spray for spraying ink. In this case, the density-controlling device can vary at least either ink-spray time period or ink-spray interval.

[0021] In this case, according to a manufacturing speed of cigarette rods, a discharge amount of the ink sprayed from the ink spray is minutely controlled, which makes it possible to maintain the print density of the printed information adequate, regardless of an operation speed of the cigarette-manufacturing machine.

[0022] The timing-controlling device may have abnormality-determining means for determining whether displacement of each cigarette rod falls in a correct range, and outputting a removal signal if the displacement is out of the correct range, and path length-adjusting means for calculating an average displacement of the printed information on the basis of the displacement of a given number of cigarette rods and adjusting the length of the feeding path between the printing section and the wrapping section on the basis of the average displacement calculated.

[0023] With such a timing-controlling device, cigarette rods, in which positions of the printed information are incorrect, are removed one by one, so that defective cigarette rods do not get mixed in non-defective ones.

[0024] The timing-controlling device also outputs an operation stop signal for the cigarette-manufacturing machine when the average displacement is at the abnormal level. This inhibits the manufacturing of a large number of defective cigarette rods.

[0025] For instance, the path length-adjusting means includes a guide roller interposed in the feeding path between the printing section and the wrapping section and guiding travel of the paper web, a roller carrier rotatably supporting the guide roller and displaceable in a direction intersecting the feeding path, and a drive source for displacing the roller carrier. Specifically, the roller carrier is a rotatable arm having the guide roller at a tip end thereof, and a base end of the rotatable arm is rotatably supported.

[0026] The path length-adjusting means either advances or delays the arrival timing of the printed information at the density sensor when the guide roller is moved, thereby correcting the displacement amount.

Brief Description of the Drawings

[0027]

Fig. 1 is a schematic view showing a part of a cigarette-manufacturing machine;

Fig. 2 is a side view of a cigarette rod produced by the cigarette-manufacturing machine of Fig. 1;

Fig. 3 is a view showing a printing unit and the periphery thereof;

Fig. 4 is a view showing an adjusting device for adjusting the length of a paper web-feeding path between the printing unit and a wrapping section;

Fig. 5 is a plan view of a density sensor;

Fig. 6 shows a controlling device for controlling operation of an ink spray and that of the adjusting device in response to signals from the density sensor and from a rotary encoder, respectively;

Fig. 7 is a control block diagram showing control of print density of printed information in the controlling device of Fig. 6;

Fig. 8 is a flowchart showing a control routine of the print density;

Fig. 9 is a control block diagram showing control of displacement, or arrival timing, of the printed information in the controlling device of Fig. 6; and

Fig. 10 is a flowchart showing a control routine of

the arrival timing.

Best Mode of Carrying out the Invention

[0028] Fig. 1 schematically shows a part of a cigarette-manufacturing machine.

[0029] The cigarette-manufacturing machine is provided with an endless tobacco band 2, which is disposed at the far right with respect to Fig. 1. The tobacco band 2 sucks filling material in layers on a lower surface thereof. The filling material includes shred tobacco. The filling material sucked onto the tobacco band 2 is fed to a wrapping section 4 along with the running of the tobacco band 2. The wrapping section 4 is supplied with a paper web W, and the filling material delivered from the tobacco band 2 is placed on the paper web W.

[0030] The filling material passes through the wrapping section 4 with the paper web W. At this moment, the filling material is wrapped in the paper web W, thereby continuously forming a tobacco rod TR.

[0031] More specifically, the wrapping section 4 has an endless garniture tape 6. A horizontal portion of the garniture tape 6 extends through the wrapping section 4 to cause the paper web W to run in one direction with the filling material.

[0032] The wrapping section 4 includes a forming bed 7 for guiding the horizontal portion of the garniture tape 6. Over the forming bed 7, there are disposed a tongue 8, a short holder 10 and a long holder 12 in the order named from the tobacco band 2 side. The tongue 8 is provided with a shoe, which serves as a scraper for detaching the filling material from the tobacco band 2. Accordingly, the filling material is fed from the tobacco band 2 onto the paper web W. Subsequently, the tongue 8 compress-forms the filling material into a cylindrical shape in cooperation with the forming bed 7 and the garniture tape 6. In so doing, the paper web W is formed into a U shape. The short holder 10 curves one side edge portion of the paper web W along the cylindrical filling material, and the long holder 12 curves the other side edge of the paper web W along the cylindrical filling material. The other side edge is then superposed upon the one side edge portion, whereby the cylindrical filling material is wrapped in the paper web W.

[0033] Before being curved, the other side edge portion of the paper web W is applied with glue. Therefore, when both the side edges of the paper web W are overlapped each other, both the side edges are adhered, which forms a seam line of the tobacco rod TR.

[0034] Thereafter, the tobacco rod TR passes through a plurality of heaters 14 sequentially, the heaters 14 being located downstream of the long holder 12. The heaters 14 dry the seam line of the tobacco rod TR.

[0035] The tobacco rod TR having been subjected to dry treatment is delivered from the wrapping section 4 and then passes through a cutting section 16. The cutting section 16 cuts the tobacco rod TR into pieces of a given length to produce cigarette rods CR. The cigarette rod CR is twice the length of cigarette portion of a filter cigarette.

[0036] More specifically, the cutting section 16 includes a rotary knife (not shown). The rotary knife has a rotating disk and a plurality of cutter blades fixed onto an outer circumference of the rotating disk at regular intervals. The rotary knife rotates at a peripheral velocity corresponding to travel speed of the paper web W and cuts the tobacco rod TR into discrete cigarette rods CR.

[0037] Furthermore, the cutting section 16 includes a rotary encoder 17, which detects a rotation angle of the rotary knife and outputs a detection signal.

[0038] The paper web P is guided from a web roll (not shown) to the garniture tape 6 of the wrapping section 4 along a given feeding path. The feeding path is provided with a web reservoir 18, a feed roller 19 and a printing unit 20 in the order named from the web roll side. The feed roller 19 pulls the paper web W out from the web roll at a speed corresponding to travel speed of the garniture tape 6. In addition, the web roll is provided with given braking force.

[0039] The printing unit 20 comprises an ink spray 24 and a pair of inlet rollers 22. The inlet rollers 22 rotate while contacting each other and receive the ink sprayed from the ink spray 24. A print roller 28 is in rolling contact with one of the inlet rollers 22 with a pair of transfer rollers 26 therebetween. The paper web W passes through between the print roller 28 and a press roller 30.

[0040] The ink received by the pair of inlet rollers 22 is supplied to the print roller 28 through the pair of transfer rollers 26, and the print roller 28 intermittently prints desired information on the paper web W. Specifically, the information is printed on the paper web W at intervals each corresponding to the length of the cigarette rod CR. As a result, each cigarette rod CR has one piece of the printed information. The printed information is located at the center of the cigarette rod CR with respect to a longitudinal direction thereof so that the printed information is positioned at an opposite side to the seam line with respect to a diametrical direction of the cigarette rod CR.

[0041] As illustrated in Fig. 2, printed information PI includes a pair of marks M. Between the marks M, there is assured a given space in the longitudinal direction of the paper web W, or of cigarette rod CR. The length between one of the pair of marks M and a corresponding end face of the cigarette rod CR is equal to that between the other mark M and a corresponding end face. Each mark M includes a number indicating the cigarette-manufacturing machine and a symbol representative of a number assigned to a factory equipped with the manufacturing machine.

[0042] Fig. 3 specifically shows the ink spray 24 and a supply system for supplying ink and compressed air to the ink spray 24.

[0043] The ink spray 24 has a nozzle 34 at a tip end thereof, the nozzle 34 having a spray opening 32. The spray opening 32 opens toward between the pair of inlet

rollers 22. The ink spray 24 further includes a valve needle (not shown), the valve needle being driven by a solenoid to open/close the spray opening 32 of the nozzle 34.

[0044] The ink spray 24 further has two ports 36 and 38 on an outer surface thereof. Extending from the ports 36 and 38 are an ink supply pipe 40 and an air supply pipe 42, respectively. The ink supply pipe 40 is connected to an ink tank 46, and the ink tank 46 stores blue ink. A variable throttle 44 is interposed in the ink supply pipe 40.

[0045] A pressure pipe 48 extends from a top of the ink tank 46 and is connected to a compression air source 50. A regulator 52 and an open/close valve 54 are interposed in the pressure pipe 48 in the order named from the compression air source 50 side. When the open/close valve 54 is opened, the compression air source 50 supplies compression air through the pressure pipe 48 into the ink tank 46, and pressure of the compression air is adjusted by the regulator 52. Consequently, the ink stored in the ink tank 46 is under pressure due to the compression air.

[0046] The air supply pipe 42 is also connected to a compression air source 56. A regulator 58 and a solenoid valve 60 are interposed in the air supply pipe 42 in the order named from the compression air source 56 side. The solenoid valve 60 is a direction control valve of three-port-connection and two-position, and is switched between a supply position for supplying the compression air to the ink spray 24 and a discharge position for discharging the compression air from the ink spray 24. When the solenoid valve 60 is switched to the supply position, the compression air is supplied from the compression air source 56 through the air supply pipe 42 to the ink spray 24, and the pressure of the compression air is adjusted by the regulator 58.

[0047] when the spray opening 32 of the nozzle 34 is opened on condition that both the pressurized ink and the compression air are allowed to be supplied to the ink spray 24, the ink is sprayed from the spray opening 32 with the compression air and then supplied to between the pair of inlet rollers 22.

[0048] More specifically, the spray opening 32 of the nozzle 34 is opened/closed by the valve needle as mentioned, and the valve needle is driven by the solenoid. Accordingly, when the solenoid of the valve needle receives a pulsed supply of drive signals in a pulse mode, the ink is intermittently sprayed from the spray opening 32. Thus, a splay amount of the ink is determined by an output time of the drive signals (ink-spray time) and an output interval of the drive signals (ink-spray interval).

[0049] A basic spray time and a basic spray interval are each determined according to an ink consumption, namely a manufacturing speed of the cigarette rods CR. The manufacturing speed of the cigarette rods CR is calculated from a delivery speed of the tobacco rod TR, that is, a rotating speed of the rotary knife of the cutting section 16.

[0050] Referring to Fig. 1 again, an adjusting device 62 is interposed in the feeding path of the paper web W. The adjusting device 62 is arranged between the printing unit 20 and the wrapping section 4 and varies the length of the travel path of the paper web W between the printing unit 20 and the wrapping section 4.

[0051] As illustrated in Fig. 4, the adjusting device 62 includes a guide roller 64, which guides the travel of the paper web W. The guide roller 64 is rotatably supported at a tip end of a control arm 66, and the control arm 66 has a base end mounted on an output shaft of a step motor 68. The step motor 68 causes the control arm 66 to rotate in a forward direction (clockwise) or backward direction (counterclockwise) with respect to Fig. 4. The rotation of the control arm 66 displaces the guide roller 64 in a direction intersecting a travelling direction of the paper web W, and the length of the travel path of the paper web W is changed by the displacement. Specifically, when the control arm 66 is rotated in the forward direction as shown in Fig. 4, the length of the travel path is increased. On the contrary, when the control arm 66 is rotated in the backward direction, the length of the travel path is decreased.

[0052] As illustrated in Fig. 1, there is disposed a photographic density sensor 70 in between the wrapping section 4 and the cutting section 16, the density sensor 70 being disposed right under the delivery path of the tobacco rod TR. The density sensor 70 detects the printed information PI of the tobacco rod TR, or of the wrapping paper (paper web W), and outputs a detection signal. The detection signal from the density sensor 70 indicates print density of the printed information PI, or of the pair of marks M.

[0053] As illustrated in Fig. 5, the density sensor 70 has a detection window 72 facing the tobacco rod TR side and radiates a infrared ray toward the tobacco rod TR through the detection window 72. The infrared ray reflected on the tobacco rod TR is received by the density sensor 70 through the detection window 72. The density sensor 70 outputs a density signal indicative of a strength level of the received infrared ray, that is, the print density of the printed information PI.

[0054] The printed information PI is printed in blue ink as mentioned above, and the infrared ray is in a complementary color relation to the blue color of the printed information PI. This enables the density sensor 70 to effectively receive the infrared ray reflected from the mark M, so that the density signal indicates the print density of the printed information PI with accuracy.

[0055] As illustrated in Fig. 6, the rotary encoder 17 and the density sensor 70 are electrically connected to an input side of a controlling device 74 with an input instrument 76, such as a keyboard etc. Electrically connected to an output side of the controlling device 74 are a solenoid driver 78, a motor driver 80 and a display unit 82. The solenoid driver 78 is connected to the ink spray 24, namely the solenoid of the valve needle, and the motor driver 80 is connected to the step motor 68.

[0056] The controlling device 74 determines, in accordance with the density signal from the density sensor 70, whether the print density of the printed information PI and the arrival timing of the printed information PI at the density sensor 70 are correct. Based on determination results, the controlling device 74 adjusts the print density of the printed information PI and the arrival timing.

[0057] A controlling function of the controlling device 74 is embodied by control block diagrams and control routines shown in Figs. 7 through 10. The control block and the control routines will be described below in detail.

[0058] The control block of Fig. 7 controls the print density of the marks M.

[0059] First, the density signal from the density sensor 70 is supplied to an amplifier 84. The amplifier 84 amplifies the density signal and supplies the amplified density signal to an integrator 86. The integrator 86 integrates the amplified density signal and supplies the integrated density signal to a subsequent sampling circuit 88. The sampling circuit 88 is opened/closed in response to a synchronization signal S_S and supplies the density signal of a piece of the printed information PI to a latch circuit 90. The latch circuit 90 carries out A/D conversion of the density signal from the sampling circuit 88 and supplies a conversion result to a subsequent comparator 96 while maintaining the result temporarily.

[0060] The density signal from the sampling circuit 88 is supplied to an adjusting circuit 92. The adjusting circuit 92 adjusts a threshold value, based on the supplied density signal, and supplies the adjusted threshold value to a comparator 94.

[0061] The comparator 94 receives the density signal from the amplifier 84 in addition to the comparison threshold value, compares the density signal to the threshold value, and outputs a comparison result. More specifically, the comparator 94 outputs a mark signal S_M only when the density signal is equal to or larger than the threshold value. Therefore, when the tobacco rod TR is normally printed with the information PI, that is, the marks M in pairs, the comparator 94 outputs two mark signals S_M for each piece of the printed information PI.

[0062] At the same time, upper and lower limits are supplied from a CPU board 98 to the comparator 96. When being supplied with the density signal from the latch circuit 90, the comparator 96 compares the supplied density to the upper and lower limits and supplies a comparison result to the CPU board 98.

[0063] Specifically, when the density signal is equal to or smaller than a light lower limit or equal to or greater than a dark upper limit, the comparator 96 outputs an abnormal value as a density value. On the contrary, when the density signal is greater than the lower limit and smaller than the upper limit, the comparator 96 directly outputs the density signal. In addition, the CPU board 98 displays the density corresponding to the received density signal on the display unit 82.

[0064] The CPU board 98 is a microcomputer including a CPU, a memory, peripheral devices and an input/output interface. The CPU board 98 determines whether the density signal from the comparator 96, or the print density of the printed information PI, falls in a correct range. Based on a determination result, the CPU board 98 corrects the drive signal to be supplied to the solenoid of the ink spray 24 by way of the solenoid driver 78, if necessary. As a result, the print density of the printed information PI, namely of the marks M, is adjusted.

[0065] Fig. 8 shows a control routine performed in the CPU board 98 to adjust the print density of the printed information PI.

[0066] Firstly in the control routine, the density signal of the printed information PI, which is sent from the comparator 96, is read (Step S1), and then it is determined whether the read density signal is an abnormal value (Step S2). If the determination result is affirmative (YES), the CPU board 98 outputs a removal signal (Step S3). On the contrary, if the determination result of Step S2 is negative (NO), the process skips Step S3 and advances to the subsequent Step S4.

[0067] Once the removal signal is outputted, the cigarette rod CR having the printed information PI, the print density of which is abnormal, is removed in a process of being transferred from the cigarette-manufacturing machine to the filter attachment or in the inside of the filter attachment.

[0068] Step S4 determines whether the read of the density signal is done a given number of times "X". If the determination result is negative, Steps S1 through S4 are repeated.

[0069] If the determination result of Step S4 is affirmative, an average value A of X density signals is calculated (Step S5), and it is determined whether the average density A is at an abnormal level (Step S6).

[0070] The affirmative determination result of Step S6 means that there are a lot of abnormal values in the read density signals, and that removal signals are frequently outputted. Under such circumstances, it is determined that there is an error in the setting of the basic spray time and/or the basic spray interval in the ink spray 24. The CPU board 98 then outputs an operation stop signal to stop the operation of the cigarette-manufacturing machine (Step S7).

[0071] In a case that the determination result of Step S6 is negative, it is determined whether the average density A is on the light side (Step S8) and whether the average density A is on the dark side (Step S9) in order. Specifically, in Steps S8 and S9, the average density A is compared with a target density range, and if the average density A is smaller than the target density range, the determination result of Step S8 is affirmative. On the contrary, if the average density A is larger than the target density range, the determination result of Step S9 is affirmative.

[0072] If the determination result of Step S8 is affirmative, that is, if the print density of the printed information

PI is lighter than the target density range, a darkening degree ΔD as a control amount for increasing the print density of the printed information PI is calculated (Step S10). The darkening degree ΔD is obtained on the basis of deviation between the average density A and the target density range (namely, a lower limit of the target density range).

[0073] In a case that the determination result of Step S8 is negative and that of Step S9 is affirmative, that is, if the print density of the printed information PI is darker than the target density range, a lightening degree ΔL as a control amount for decreasing the print density of the printed information PI is calculated (Step S11). The lightening degree ΔL is obtained on the basis of deviation between the average density A and the target density range (namely, an upper limit of the target density range).

[0074] After the darkening degree ΔD or lightening degree amount ΔL is calculated as described, the drive signal for the solenoid is changed according to the darkening degree ΔD or lightening degree ΔL (Step S12).

[0075] Specifically, Step S12 changes an output time and/or an output interval of the drive signal. Accordingly, the ink-spray time and/or the ink-spray interval are corrected, and the discharge amount of the ink sprayed from the ink spray 24 is increased or decreased. As a consequence, the print density of the printed information PI on the paper web W in the printing unit 20 is increased or decreased, thereby falling in the target density range.

[0076] Since the basic ink-spray time and the basic ink-spray interval are set according to the delivery speed of the tobacco rod TR as mentioned, the control routine can adjust the print density of the printed information PI to be optimum without being affected by the delivery speed of the tobacco rod TR (manufacturing speed of the cigarette-manufacturing machine).

[0077] The control routine shown in Fig. 8 may include a sub routine for a manual adjustment. In this case, the operator can adjust the discharge amount of the ink from the ink spray 24 according to the displayed result of the density on the display unit 82.

[0078] Fig. 9 shows a control block for detecting and adjusting the arrival timing of the printed information PI.

[0079] As illustrated in Fig. 9, the rotary encoder 17 is electrically connected to a signal-generating circuit 100. The signal-generating circuit 100 is capable of receiving a angular rotation signal of the rotary knife, which is sent from the rotary encoder 17. In response to the angular rotation signal received, the signal-generating circuit 100 outputs an arrival signal Sp each time the printed information PI of the tobacco rod TR arrives at the detection window 72 of the density sensor 70. In other words, the arrival signal Sp is outputted at the moment when the leading one between a pair of marks M included in the printed information PI arrives at the detection window 72.

[0080] Therefore, the signal-generating circuit 100 previously obtains the rotation angle of the rotary knife which reflects output timing of the arrival signal Sp, based on the delivery speed of the tobacco rod TR, the rotation angle of the rotary knife which is indicative of cut timing of the tobacco rod TR, and distance between the cutting position of the tobacco rod TR and the detection window 72 of the density sensor 70.

[0081] The arrival signal S_P is supplied to a detection period-generating circuit 102 together with the angular rotation signal from the rotary encoder 17. The detection period-generating circuit 102 outputs the synchronization signal S_S at the moment of receiving the arrival signal S_P, and the output thereof is continued until the printed information PI finishes passing through the detection window 72 of the density sensor 70.

[0082] In other words, the detection period-generating circuit 102 beforehand obtains the rotary angle of the rotary knife which corresponds to the output completion timing of the synchronization signal S_S, based on the length of the printed information PI with respect to the delivering direction of the tobacco rod TR, that is, length between the front edge of the front mark M and the rear edge of the rear mark (corresponding to the detection period) and the delivery speed of the tobacco rod TR. Accordingly, the output completion timing of the synchronization signal S_S is determined by the angular rotation signal from the rotary encoder 17.

[0083] The synchronization signal S_S is supplied to the sampling circuit 88 (Fig. 7) and at the same time supplied to a determination circuit 104 of the mark signal S_M and a counter 106.

[0084] The determination circuit 104 is supplied with the synchronization signal S_S and the mark signal S_M and counts the number of the mark signals S_M in the detection period of the printed information PI. When the counting result of the mark signals S_M does not agree with 2, the determination circuit 104 determines that there occurs an error in the printing of the printed information PI (namely a pair of marks K). In this case, the determination circuit 104 supplies an abnormality signal to the CPU board 98. In response to receipt of such an abnormality signal, the CPU board 98 outputs the removal signal.

[0085] The mark signal S_M and the arrival signal S_P are each supplied to a first detection circuit 108 and an advance/delay detection circuit 110. The first detection circuit 108 is also supplied with the angular rotation signal from the rotary encoder 17.

[0086] The first detection circuit 108 detects time difference between a receiving time of the mark signal S_M and that of the arrival signal S_P, based on the angular rotation signal of the rotary encoder 17. The time difference indicates a deviation ΔD of the arrival timing of the printed information PI per cigarette rod CR. The deviation ΔD is supplied from the first detection circuit 108 to a determination circuit 112, and the determination circuit 112 determines whether the deviation ΔD falls in a normal range.

[0087] Specifically, the determination circuit 112 is

supplied with upper and lower abnormal threshold values from the CPU board 98, and the abnormal threshold values define the normal range of the deviation ΔD. The determination circuit 112 compares the abnormal threshold values with the deviation ΔD of the arrival timing which is supplied from the first determination circuit 108. When the deviation ΔD is out of the normal range, the determination circuit 112 causes the CPU board 98 to output the removal signal.

[0088] The advance/delay detection circuit 110 detects whether the receiving time of the mark signal S_M is earlier or later than the receiving time of the arrival signal S_P, and supplies the detection result to a second detection circuit 114. The second detection circuit 114 is also supplied with the deviation ΔD of the arrival timing from the first detection circuit 108.

[0089] The counter 106 counts the number of the cigarette rods CR that have passed through the density sensor 70 up to the number of N, based on the synchronization signal S_S and the angular rotation signal from the rotary encoder 17. When the number of the cigarette rods CR having passed through the density sensor 70 reaches N, the counter 106 supplies a reset signal to the second detection circuit 114 and repeats the counting of the cigarette rods CR.

[0090] The second detection circuit 114 integrates the deviation ΔD supplied from the first detection circuit 108, and continues the integration till receiving the reset signal from the counter 106. In response to receipt of the reset signal, the second detection circuit 114 divides the integration value by N to calculate an average deviation ΔAD of the arrival timing of the printed information PI. The calculation result is supplied to a determination circuit 116 with the determination result from the advance/delay detection circuit 110, namely advance or delay information of the mark signal S_M. The determination circuit 116 then determines whether the average deviation ΔAD falls in an allowable range.

[0091] Specifically, the determination circuit 116 is supplied from the CPU board 98 with upper and lower allowable threshold values with respect to the average deviation ΔAD. These allowable threshold values define the allowable range of the average deviation ΔAD.

[0092] The determination circuit 116 determines the average deviation ΔAD on the basis of the allowable threshold values, and supplies the determination result to the CPU board 98. The determination result includes a normal level indicating that the arrival timing of the printed information PI is in a target zone in the allowable range, an advance level indicating that the arrival timing is more advanced than the target zone, a delay level indicating that the arrival timing is more delayed than the target zone, and further an abnormal level indicating that the arrival timing is way out of the allowable range.

[0093] Based on the determination results from the determination circuit 116, the CPU board 98 supplies the drive signal to the step motor 68 of the adjusting device 62 through the motor driver 80 and controls the arrival timing of the printed information PI.

[0094] Fig. 10 shows a control routine of the arrival timing, which is performed in the determination circuits 112 and 116 and the CPU board 98.

[0095] Firstly in the routine, the deviation ΔD of the arrival timing is read (Step S13), and it is determined whether the deviation ΔD is abnormal (Step S14). If the determination result is affirmative, the CPU board 98 outputs the removal signal for removing the cigarette rod CR in which the position of the printed information PI is abnormal (Step S15). On the contrary, if the determination result is negative, the process skips Step S15 and advances to the subsequent Step S16.

[0096] Step S16 reads the determination result from the determination circuit 116 and determines whether the determination result is at the abnormal level or the advance level or the delay level, in sequence (Steps S17, S18 and S19).

[0097] If the determination result is at the advance level, that is, if the determination result of the Step S18 is affirmative, the CPU board 98 outputs a forward drive signal by a given pulse number to the step motor 68 through the motor driver 80 (Step S20). In this case, the step motor 68 causes the control arm 66 (guide roller 64) of the adjusting device 62 to rotate at a given rotation angle in the forward direction. This lengthens the feeding path or travel path of the paper web W between the printing unit 20 and the wrapping section 4. As a result, the arrival timing of the printed information PI at the cigarette rod CR is changed to the regular position.

[0098] During the forward rotation of the control arm 66, the paper web W is drawn out extra by sliding with respect to the print roller 28, the press roller 30 and the guide roller at the downstream side from the control arm 66. The extra draw of the web is absorbed by accumulation of the paper web W in the reservoir 18.

[0099] If the determination result is at the delay level (if the determination result of Step S19 is affirmative), the CPU board 98 outputs a backward drive signal by a given pulse number to the step motor 68 through the motor driver 80 (Step S21). In this case, the step motor 68 causes the control arm 66 to rotate at a given rotation angle in the backward direction. This shortens the travel path of the paper web W. In this case, the arrival timing of the printed information PI is similarly changed to the regular position.

[0100] In a case that the determination result is at the abnormal level (in a case that the determination result of Step S17 is affirmative), the CPU board 98 stops the operation of the cigarette-manufacturing machine (Step S22).

[0101] According to the control routine of the arrival timing, since the density sensor 70 is utilized also for the detection of the arrival timing of the printed information PI, no dedicated sensor is required for detecting the deviation of the arrival timing.

[0102] Every time the cigarette rod CR in which the arrival timing of the printed information PI is abnormal

is detected, the CPU board 98 outputs the removal signal, so that defective cigarette rods CR are removed without fail. As a consequence, the defective cigarette rods CR are never mixed in the non-defective cigarette rods CR.

[0103] If the average deviation ΔAD of the arrival timing is out of the target zone, the CPU board 98 causes the step motor 68 of the adjusting device 62 to rotate in the forward or backward direction to vary the length of the travel path of the paper web W between the printing unit 20 and the wrapping section 4. As a result, the arrival timing of the printed information PI is corrected aiming at the target zone.

[0104] In addition, when the correction control for the arrival timing of the printed information PI is performed, the pulse number of the drive signal supplied from the CPU board 98 through the motor driver 80 to the step motor 68 may be changed according to the degree of the average deviation ΔAD in Step S18 or S19.

[0105] The present invention is not limited to the aforementioned embodiment, and various modifications of the invention may be made.

[0106] For instance, with regard to the adjusting device 62, a slider with the guide roller 64 may be utilized in place of the control arm 66. The slider linearly moves in a direction intersecting the feeding path of the paper web W.

Claims

1. A printer for a cigarette-manufacturing machine, said cigarette-manufacturing machine including a wrapping section for receiving a paper web fed along a feeding path at a given speed with filling material, wrapping the filling material in the paper web to form a tobacco rod, and continuously delivering the formed tobacco rod, and a cutting section for cutting the tobacco rod delivered from the wrapping section at a given cut timing and forming cigarette rods of a given length,

said printer comprising:

a printing section having a print roller interposed in said feeding path and an ink supply source for supplying ink to said print roller, said printing section for printing given information on the paper web by using said print roller to provide the information to each of said cigarette rods;

a density sensor disposed between the wrapping section and the cutting section , for detecting density of each piece of the printed information on the paper web to output a density signal;

a density-controlling device for controlling print density of the printed information, based on the density signal from said density sensor;

a calculating device for calculating time deviation between an arrival time point at which the printed information provided to the tobacco rod is supposed to arrive at said density sensor and an actual detection time point at which the printed information is actually detected by said density sensor and outputting a calculated deviation; and

a timing-controlling device for controlling arrival timing of the printed information at said density sensor in order to correct the deviation from said calculating device.

2. The printer according to claim 1, wherein:

the cigarette rod has a to-be-cut position so as to be cut at the center with respect to a longitudinal direction thereof, and is cut at the to-be-cut position after being fed to a filter cigarette-manufacturing machine to be formed into two cigarettes, and

the printed information includes a pair of marks located at the both side of the to-be cut position of the cigarette rod, respectively.

3. The printer according to claim 2, wherein:

said density-controlling device includes:

abnormality-determining means for determining whether the density signal of each cigarette rod falls in a correct range, and outputting a removal signal when the density signal is out of the correct range; and

density-adjusting means for calculating average density of the printed information on the basis of the density signal of a given number of cigarette rods and adjusting an ink supply amount from ink supply means on the basis of the average density calculated.

4. The printer according to claim 3, wherein:

said density-controlling device outputs an operation stop signal for the cigarette-manufacturing machine when the average density is at an abnormal level.

5. The printer according to claim 3, wherein:

said ink supply means includes an ink spray for spraying ink, and

said density-controlling device varies at least either one of an ink-spray time and an ink-spray interval.

6. The printer according to claim 2, wherein:

said timing-controlling device includes:

abnormality-determining means for determining whether the deviation of each cigarette rod falls in a correct range, and outputting a removal signal when the deviation is out of the correct range, and
path length-adjusting means for calculating an average deviation of the printed information on the basis of the deviation of a given number of cigarette rods and adjusting length of said feeding path between the printing section and the wrapping section according to the average deviation calculated.

7. The printer according to claim 6, wherein:

said timing-controlling device outputs an operation stop signal for the cigarette-manufacturing machine when the average deviation is at an abnormal level.

8. The printer according to claim 6, wherein:

said path length-adjusting device includes:

a guide roller interposed in said feeding path between the printing section and the wrapping section, for guiding travel of the paper web;
a roller carrier for rotatably supporting the guide roller, the roller carrier being displaceable in a direction intersecting said feeding path; and
a drive source for causing the roller carrier to displace.

9. The printer according to claim 8, wherein:

the roller carrier is a rotatable arm having the guide roller at a tip end thereof, and a base end of the rotatable arm is rotatably supported.

FIG. 1

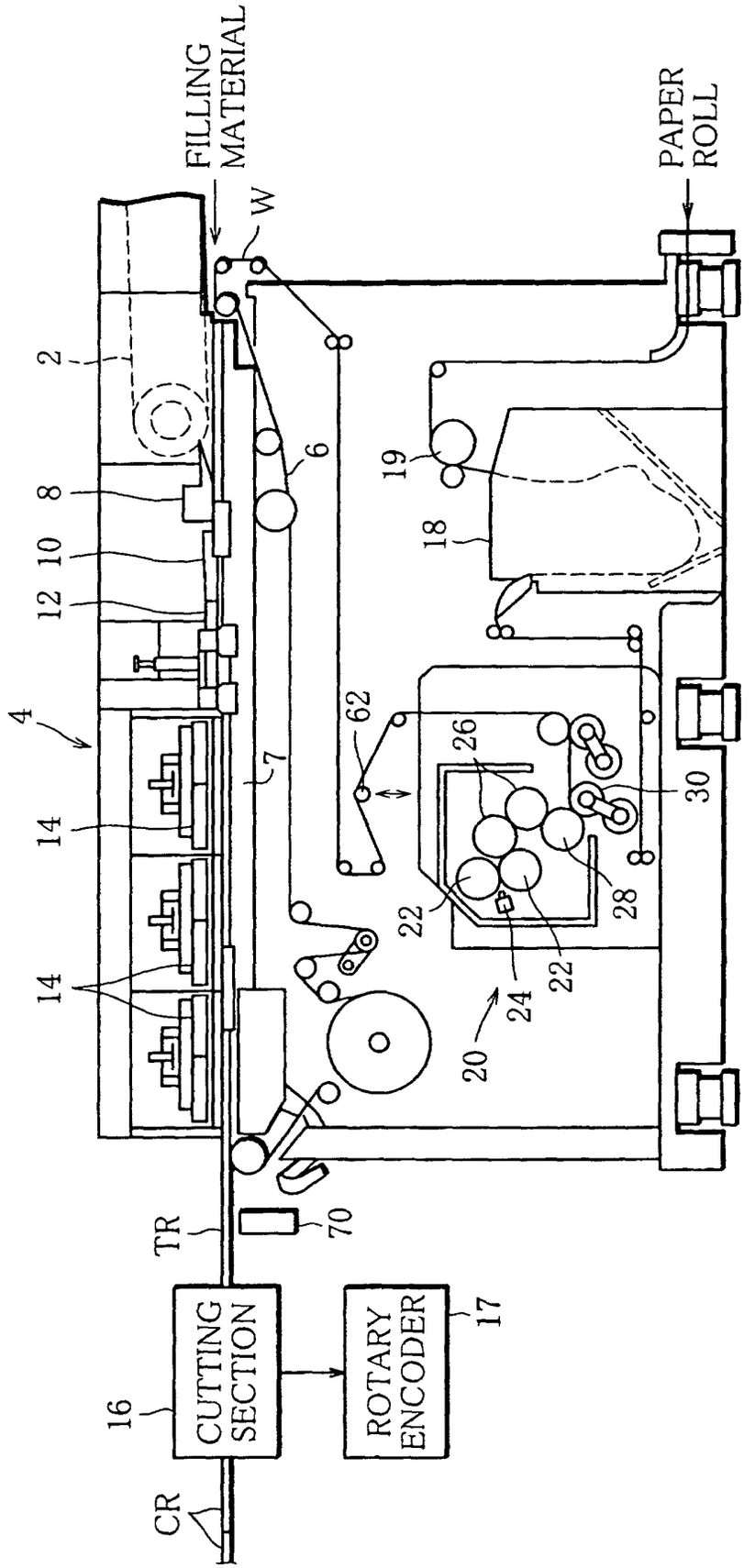

FILLING MATERIAL
W
PAPER ROLL
2
6
8
10
12
4
14
14
14
7
62
26
30
22
28
22
24
20
19
18
TR
70
CR
16
CUTTING SECTION
ROTARY ENCODER
17

FIG. 2

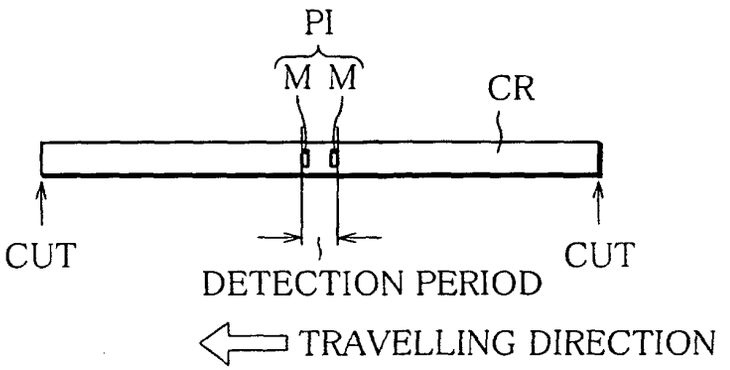

PI
M M
CR
CUT
CUT
DETECTION PERIOD
TRAVELLING DIRECTION

FIG. 3

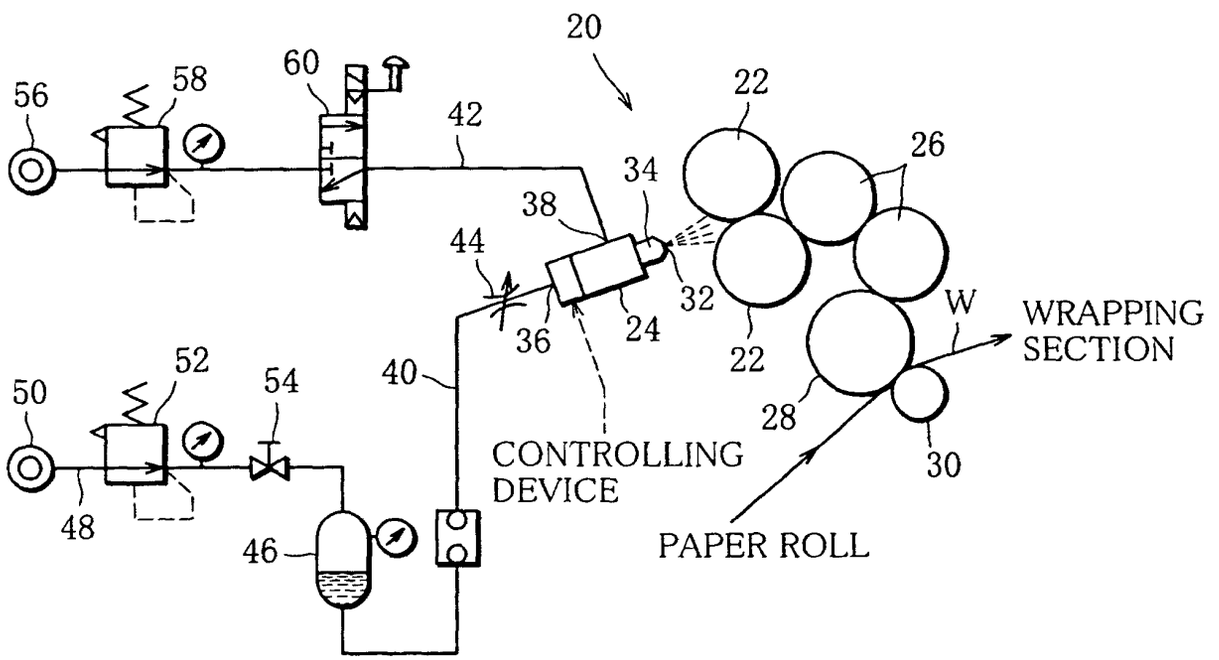

20
56
58
60
42
22
26
34
38
44
32
36
24
22
W
WRAPPING SECTION
52
50
54
40
28
30
CONTROLLING DEVICE
48
46
PAPER ROLL

FIG. 4

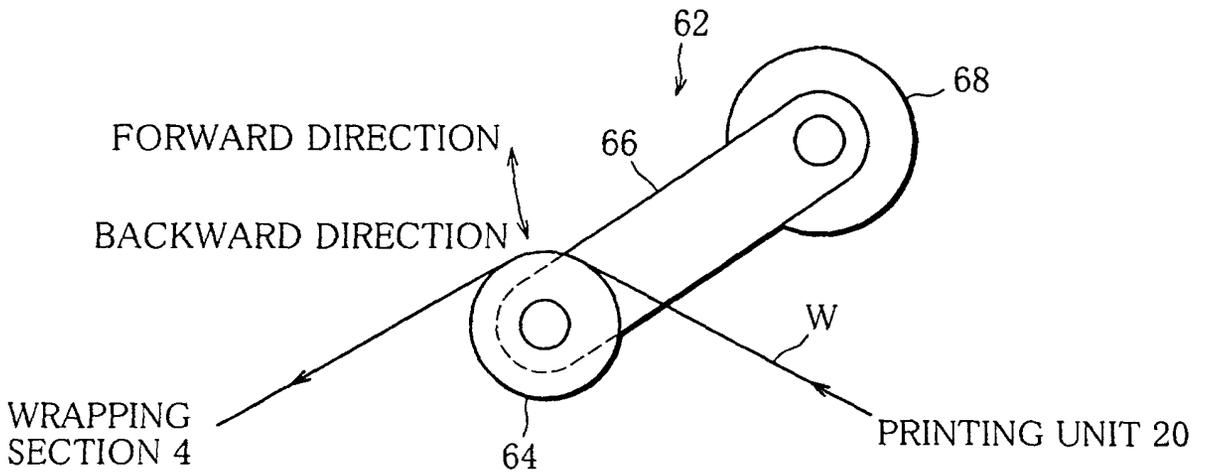

62
68
FORWARD DIRECTION
66
BACKWARD DIRECTION
W
WRAPPING
SECTION 4
64
PRINTING UNIT 20

FIG. 5

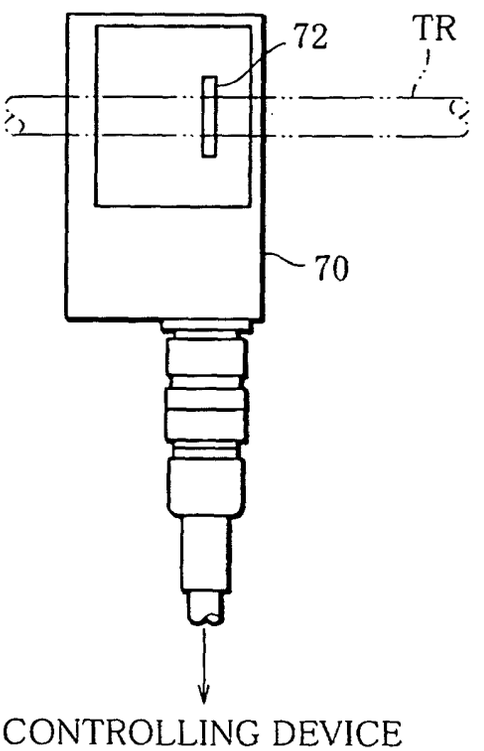

72
TR
70
CONTROLLING DEVICE

FIG. 6

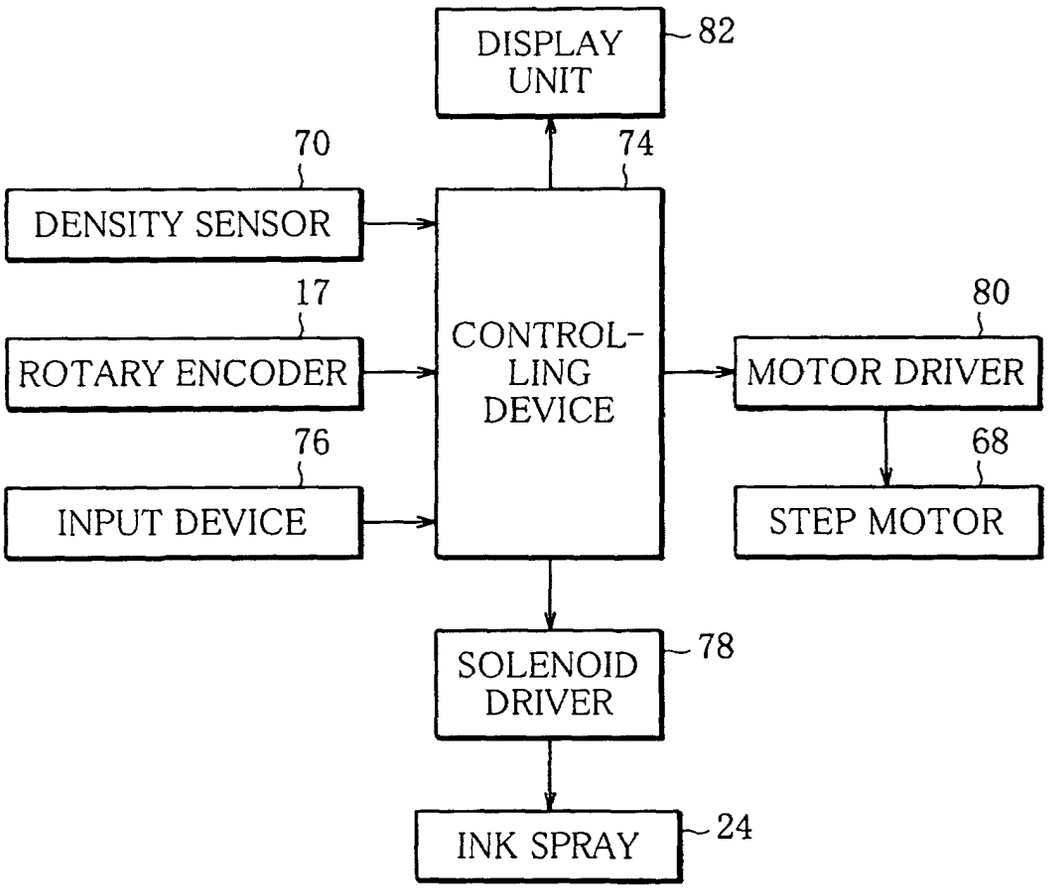

DISPLAY UNIT
82
70
74
DENSITY SENSOR
17
80
ROTARY ENCODER
CONTROL-LING DEVICE
MOTOR DRIVER
76
68
INPUT DEVICE
STEP MOTOR
SOLENOID DRIVER
78
INK SPRAY
24

FIG. 7

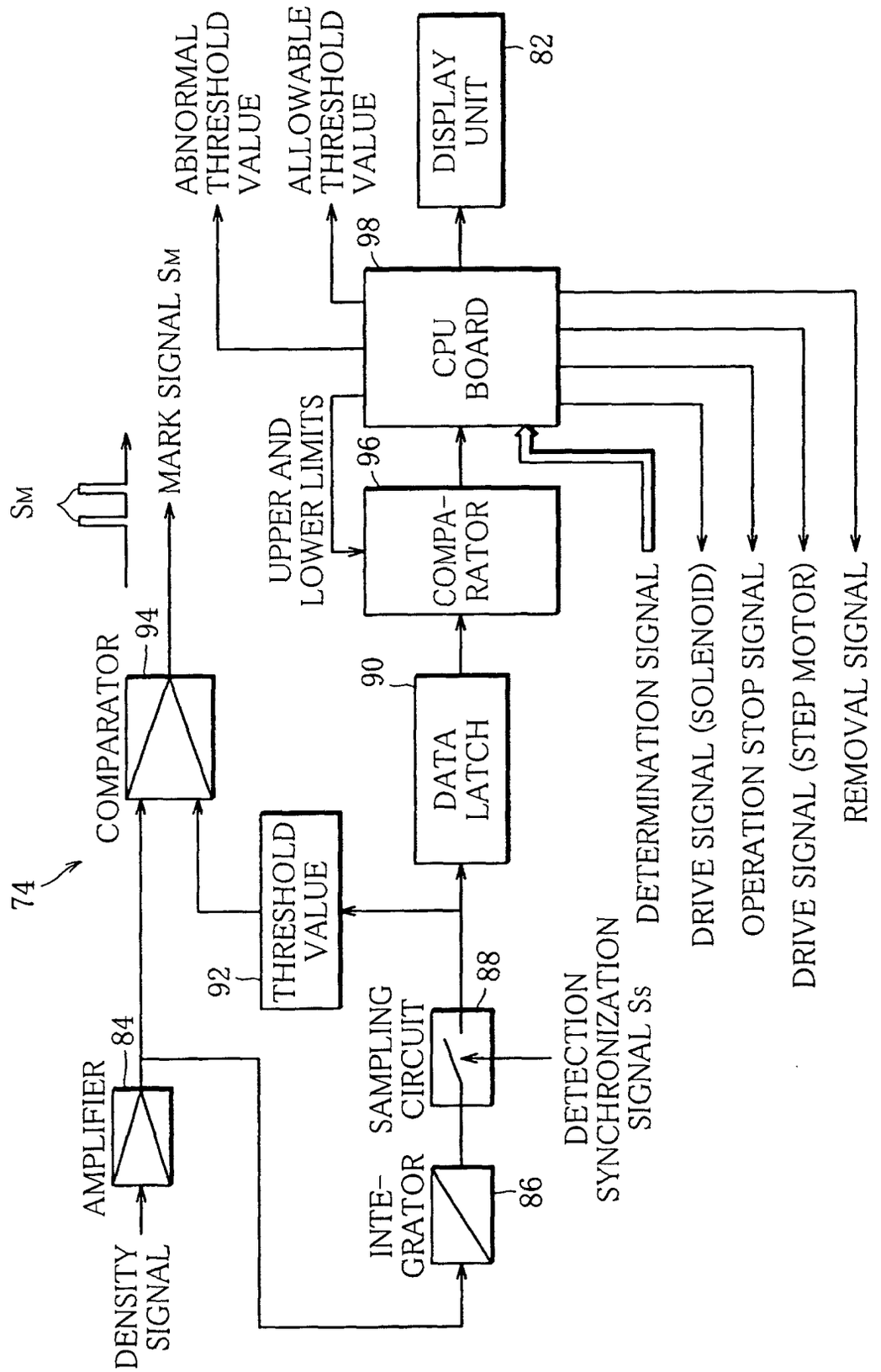

74
DENSITY SIGNAL
AMPLIFIER
84
INTE-GRATOR
86
SAMPLING CIRCUIT
88
DETECTION SYNCHRONIZATION SIGNAL Ss
92
THRESHOLD VALUE
COMPARATOR
94
SM
MARK SIGNAL SM
90
DATA LATCH
UPPER AND LOWER LIMITS
96
COMPA-RATOR
ABNORMAL THRESHOLD VALUE
ALLOWABLE THRESHOLD VALUE
98
CPU BOARD
DISPLAY UNIT
82
DETERMINATION SIGNAL
DRIVE SIGNAL (SOLENOID)
OPERATION STOP SIGNAL
DRIVE SIGNAL (STEP MOTOR)
REMOVAL SIGNAL

FIG. 8

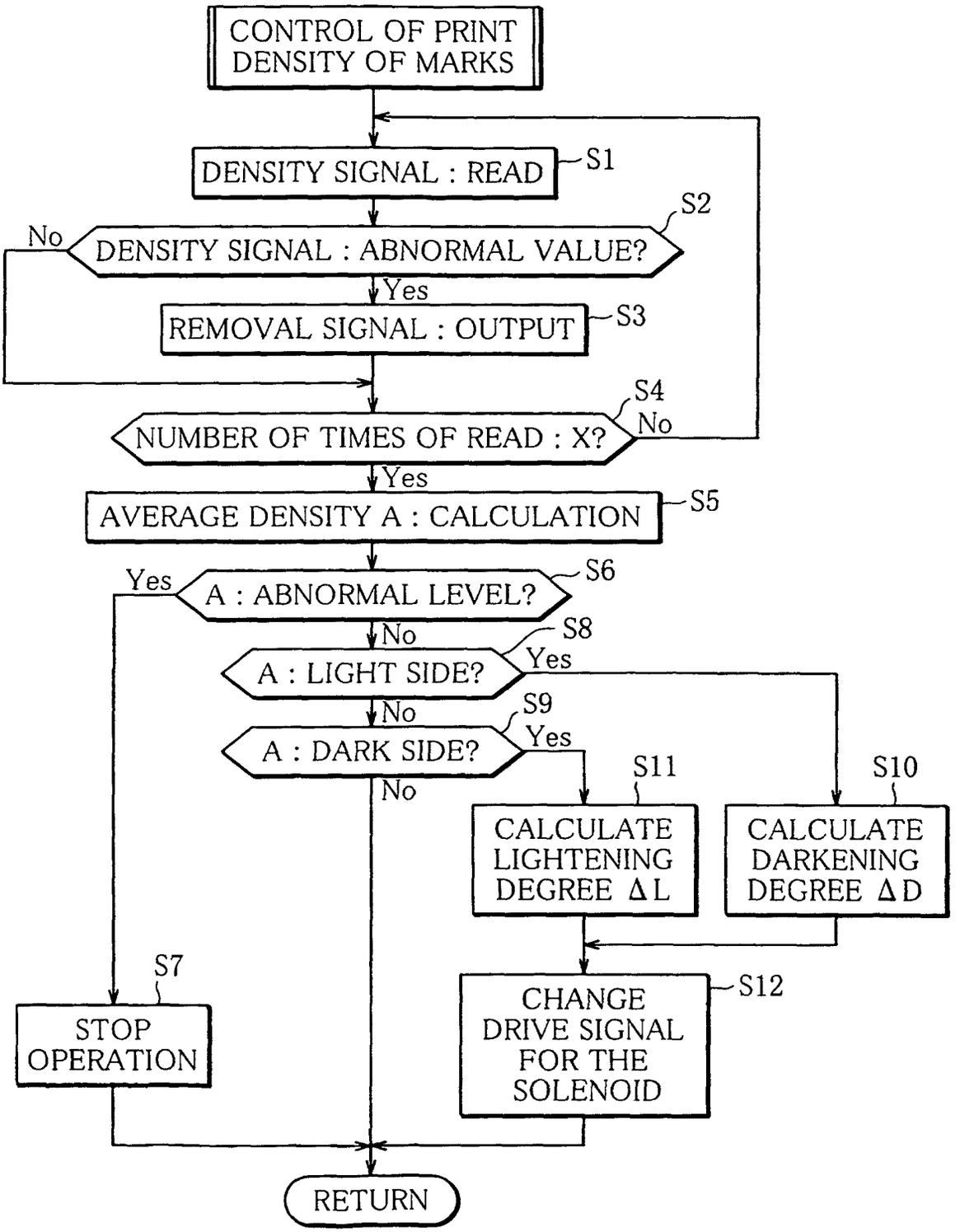

CONTROL OF PRINT DENSITY OF MARKS
DENSITY SIGNAL : READ
S1
S2
No
DENSITY SIGNAL : ABNORMAL VALUE?
Yes
REMOVAL SIGNAL : OUTPUT
S3
S4
NUMBER OF TIMES OF READ : X?
No
Yes
AVERAGE DENSITY A : CALCULATION
S5
Yes
A : ABNORMAL LEVEL?
S6
No
S8
A : LIGHT SIDE?
Yes
No
S9
A : DARK SIDE?
Yes
No
S11
S10
CALCULATE LIGHTENING DEGREE ΔL
CALCULATE DARKENING DEGREE ΔD
S7
S12
STOP OPERATION
CHANGE DRIVE SIGNAL FOR THE SOLENOID
RETURN

FIG. 9

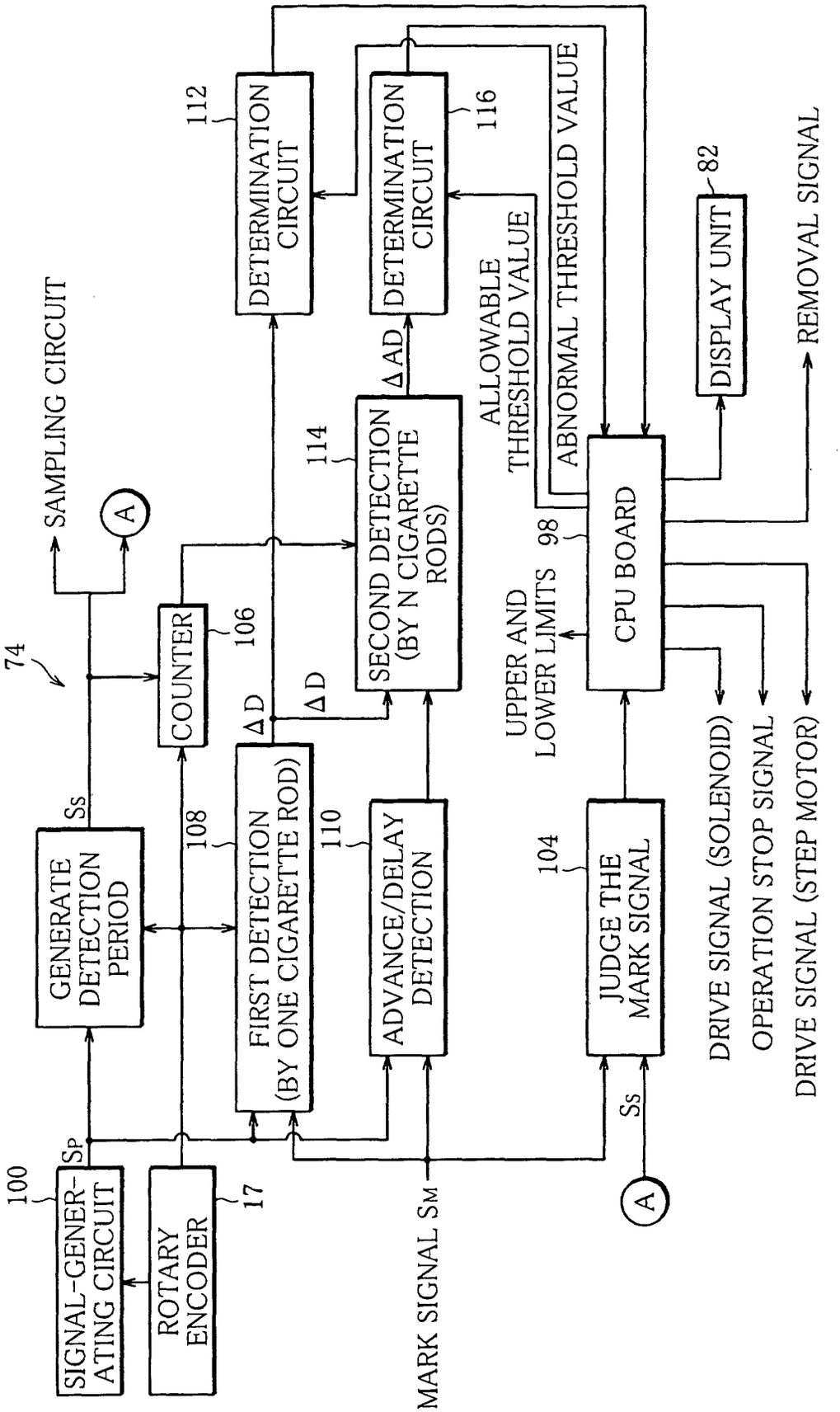
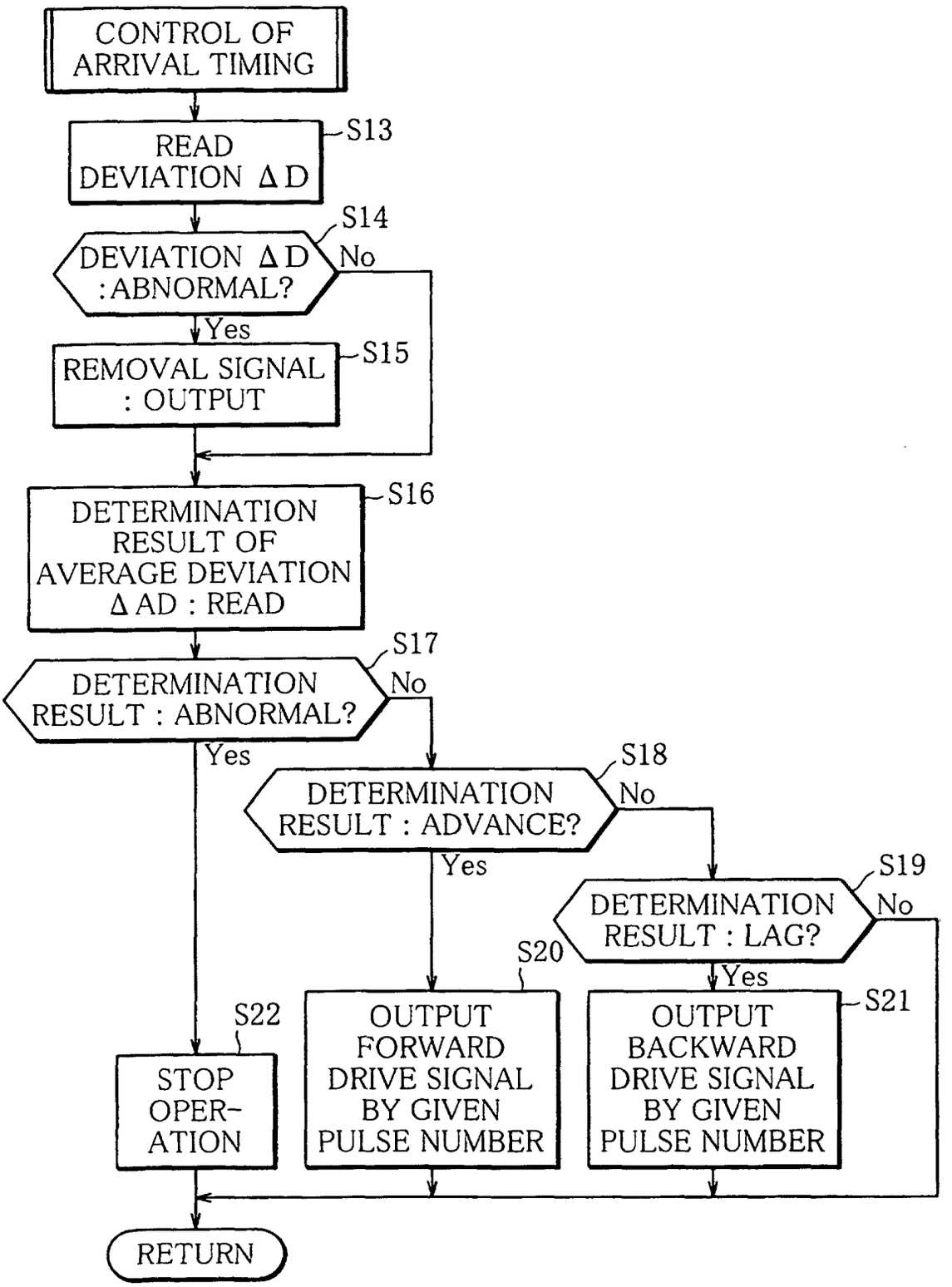

SAMPLING CIRCUIT
74
A
GENERATE DETECTION PERIOD
Ss
SIGNAL-GENERATING CIRCUIT
100
Sp
ROTARY ENCODER
17
COUNTER
106
108
FIRST DETECTION (BY ONE CIGARETTE ROD)
110
ΔD
ΔD
ADVANCE/DELAY DETECTION
MARK SIGNAL SM
SECOND DETECTION (BY N CIGARETTE RODS)
114
ΔAD
DETERMINATION CIRCUIT
112
DETERMINATION CIRCUIT
116
ALLOWABLE THRESHOLD VALUE
ABNORMAL THRESHOLD VALUE
UPPER AND LOWER LIMITS
98
CPU BOARD
JUDGE THE MARK SIGNAL
104
Ss
A
DISPLAY UNIT
82
DRIVE SIGNAL (SOLENOID)
OPERATION STOP SIGNAL
DRIVE SIGNAL (STEP MOTOR)
REMOVAL SIGNAL

FIG. 10


CONTROL OF ARRIVAL TIMING
READ DEVIATION ΔD
S13
DEVIATION ΔD :ABNORMAL?
S14
No
Yes
REMOVAL SIGNAL : OUTPUT
S15
DETERMINATION RESULT OF AVERAGE DEVIATION ΔAD : READ
S16
DETERMINATION RESULT : ABNORMAL?
S17
No
Yes
DETERMINATION RESULT : ADVANCE?
S18
No
Yes
DETERMINATION RESULT : LAG?
S19
No
Yes
S20
OUTPUT FORWARD DRIVE SIGNAL BY GIVEN PULSE NUMBER
OUTPUT BACKWARD DRIVE SIGNAL BY GIVEN PULSE NUMBER
S21
STOP OPER-ATION
S22
RETURN

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/03018

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] A24C5/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. *FIELDS SEARCHED*

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] A24C5/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1926-1996	Toroku Jitsuyo Shinan Koho	1994-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Jitsuyo Shinan Toroku Koho	1996-2003

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 5-227938 A (Japan Tobacco Inc.), 07 September, 1993 (07.09.93), Full text (Family: none)	1-2 3-9
Y	JP 2001-275641 A (Japan Tobacco Inc.), 09 October, 2001 (09.10.01), (Family: none)	3-9
A	JP 62-83880 A (Japan Tobacco Inc.), 17 April, 1987 (17.04.87), (Family: none)	1-9

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April, 2003 (10.04.03)	22 April, 2003 (22.04.03)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)