OVERLAP DETECTION APPARATUS AND OVERLAP DETECTION METHOD

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ABSTRACT
An overlap detection apparatus mounted to a printing press includes a sheet detection sensor for detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion; a signal output section for outputting an overlapping signal on the basis of the detected results of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and a determination section for determining that the sheets of paper are being correctly conveyed while each being displaced by a given amount from an upstream sheet of paper in the conveying direction and overlapping the same when a portion of the overlapping signal taking the first form is equal to a given reference portion, and determines that the sheets of paper are not being correctly conveyed when the portion of the overlapping signal taking the first form is not equal to the given reference portion.
F I G. 2

START

S1 DETECT AN OVERLAPPING STATE OF SHEETS

S2 OUTPUT AN OVERLAPPING SIGNAL

S3 COMPARE A REFERENCE PORTION WITH A PORTION OF THE OVERLAPPING SIGNAL TAKING THE FIRST POSITION

S4 EQUAL TO EACH OTHER?

EQUAL

S5 OUTPUT A STOP SIGNAL

S7 FEEDER BOARD STOPS

S6 OUTPUT AN ANNUNCIATION SIGNAL

S8 LAMP TURNS ON

FINISH
START

S11 DETECT AN OVERLAPPING STATE OF SHEETS

S12 OUTPUT AN OVERLAPPING SIGNAL AND A ROTATION SIGNAL

S13 TIMING IS MEASURED

S14 COMPARE A REFERENCE TIMING WITH THE MEASURED TIMING

S15 EQUAL TO EACH OTHER?

EQUAL

S16 OUTPUT A STOP SIGNAL

S18 FEEDER BOARD STOPS

S17 OUTPUT AN ANNUNCIATION SIGNAL

S19 LAMP TURNS ON

FINISH
OVERLAP DETECTION APPARATUS AND OVERLAP DETECTION METHOD

CROSS REFERENCE TO RELATED APPLICATION


BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to an overlap detection apparatus and an overlap detection method that are capable of detecting whether a sheet conveyed is a single or not.

[0004] 2. Related Art

[0005] A hitherto known overlap detection apparatus, which includes a sheet conveying section for successively conveying sheets of paper (hereinafter referred simply to sheets), while each being displaced by a given amount from an upstream sheet in a conveying direction and overlapping the same, and a printing section for printing on sheets fed one by one from the sheet conveying section, includes a sheet detection sensor for detecting whether a sheet passing a given position is a single or not, a signal output section for outputting at periodic intervals overlapping signals that each take a first form (e.g., an H form) when the sensed sheet is a double or other multiple and each take a second form (e.g., an L form) when the sensed sheet is a single, and a determination section for determining on the basis of the detected result that sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same when an overlapping signal takes the second form and determining that the sheets are being not correctly conveyed when an overlapping signal takes the first form. The apparatus of this type is disclosed in Japanese Patent Application laid-open No. Hei-11-180595.

[0006] In the overlap detection apparatus of the type mentioned above, when sheets each are passing a given position, the sheet detection sensor detects whether each passing sheet is a single or not. Then, on the basis of the detected result of the sheet detection sensor, overlapping signals are output by the signal output section at given periodic intervals.

[0007] The overlapping signals are output at given period intervals, such as periodic intervals at which single sheets are to pass a given position, and take a first form when sheets overlap each other and takes a second form when sheets do not overlap each other.

[0008] The output overlapping signals are input into the determination section, which in turn determines that the sheets are being correctly conveyed for the second form and determines that the sheets are not being correctly conveyed for the first form.

[0009] Thus, according to the conventional overlap detection apparatus, for example, overlapping signals are output at given period intervals, such as periodic intervals at which single sheets are to pass a given position, and when an overlapping signal takes the first form representative of that the sheet is a double or other multiple, the determination is made so that sheets are not being correctly conveyed.

Whereby, a trouble in sheet feeding, such as a trouble of feeding multiple sheets to the printing section at a time, is detected.

[0010] Such a sheet feeding trouble in a printing press is caused when a sheet passing the given position is a double or multiple at periodic intervals at which single sheets are to pass the given position, and sometimes caused when a sheet is displaced from an upstream sheet by an amount greater or smaller than a given amount in the sheet conveying direction and overlaps the same. In the latter case, a trouble of feeding double or multiple sheets to the printing section at a time or a trouble of feeding no sheet at a timing at which a sheet must be fed, may be caused.

[0011] However, according to the conventional overlap detection apparatus, overlapping signals are output at given periodical intervals such as periodic intervals at which single sheets are to pass the given position. Therefore, even when a sheet is conveyed while being displaced from an upstream sheet by an amount greater or smaller than a given amount and overlapping the same and a non-overlapping portion (single sheet portion) of these sheets happens to pass the given position at a timing at which single sheets are to pass the given position following the given periodical intervals, an overlapping signal takes the second form (e.g., the L form). As a result, the determination section may determine that the sheets are being correctly conveyed even when it is not being correctly conveyed in the actual operation.

[0012] It is an object of the present invention to provide an overlap detection apparatus and an overlap detection method that are capable of detecting a trouble in sheet feeding by determining whether or not sheets are being conveyed while each being displaced by a given amount from an upstream sheet in a sheet conveying direction and overlapping the same.

SUMMARY OF THE INVENTION

[0013] According to an aspect of the present invention, there is provided an overlap detection apparatus mounted to a printing press in which sheets are successively conveyed while each being displaced by a given amount from an upstream sheet in a sheet conveying direction and overlapping the same, including: a sheet detection sensor for detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion; a signal output section for outputting an overlapping signal on the basis of the detected results of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and a determination section for determining that the sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same when a portion of the overlapping signal taking the first form is equal to a given reference portion, and determines that the sheets are not being correctly conveyed when the portion of the overlapping signal taking the first form is not equal to the given reference portion.

[0014] According to the overlap detection apparatus having the above arrangement, the sheet detection sensor detects whether a portion of the sheets passing the given position, which sheets being successively conveyed while each being displaced from an upstream sheet in the conveying direction and overlapping the same, is a non-overlapping portion or an overlapping portion. Then, the signal output section outputs
an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes the first form (e.g., an H form) for the overlapping portion (double sheet portion) and takes the second form (e.g., an L form) for the non-overlapping portion (single sheet portion). Then, the overlapping signal output from the signal output section is input to the determination section.

[0015] Then, the determination section compares the portion of the overlapping signal taking the first form with the given reference portion, and when both the portions are equal to each other, it determines that the sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same, and when both are not equal, it determines that the sheets are not being correctly conveyed.

[0016] According to another aspect of the present invention, there is provided an overlap detection apparatus mounted to a printing press in which sheets are successively conveyed while each being displaced by a given amount from an upstream sheet in a sheet conveying direction and overlapping the same, including: a sheet detection sensor for detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion; a signal output section for outputting an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and a determination section for determining that the sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same, when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to a printing reference of the printing press, is equal to a given reference timing; and determines that the sheets are not being correctly conveyed, when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to the printing reference of the printing press, is not equal to the given reference timing.

[0017] According to the overlap detection apparatus having the above arrangement, the sheet detection sensor detects whether a portion of the sheets passing the given position, which sheets being successively conveyed while each being displaced from an upstream sheet in the conveying direction and overlapping the same, is a non-overlapping portion or an overlapping portion. Then, the signal output section outputs an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes the first form (e.g., an H form) for the overlapping portion (double sheet portion) and takes the second form (e.g., an L form) for the non-overlapping portion (single sheet portion). Then, the overlapping signal output from the signal output section is input to the determination section.

[0018] Then, the determination section compares the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to the printing reference of the printing press, with the given reference timing, and when both the timings are equal to each other, it determines that the sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same, and when both are not equal, it determines that the sheets are not being correctly conveyed.

[0019] In the above overlap detection apparatus, the printing press preferably includes a sheet feeding cylinder, and an encoder that outputs a rotation signal with reference to the rotation of the sheet feeding cylinder, and the rotation signal output by the encoder is employed as the printing reference of the printing press.

[0020] It is preferable to employ an arrangement, in which the printing press includes a feeder board that conveys the sheets placed thereon towards a downstream side; the sheet detection sensor comprises a pair of upper and lower members disposed vertically with a downstream end of the feeder board therebetwen so as to detect whether a portion of the sheets passing between the upper and lower members of the sheet detection sensor is the non-overlapping portion or the overlapping portion.

[0021] It is preferable that the overlapping signal takes an H form for the overlapping sheet portion and takes an L form for the non-overlapping portion.

[0022] It is preferable to employ an arrangement, in which the printing press includes a feeder board that conveys the sheets placed thereon towards a downstream side; the determination section outputs a stop signal when it determines that the sheets are not being correctly conveyed; and the printing press further includes a feeder board stop device that stops the feeder board on the basis of the stop signal.

[0023] It is preferable to employ an arrangement, in which the printing press includes a feeder board that conveys the sheets placed thereon towards a downstream side; and the determination section outputs an announcement signal when it determines that the sheets are not being correctly conveyed; and the printing press further includes an announcement device that is actuated on the basis of the announcement signal.

[0024] The signal output section is preferably made up of an amplifier.

[0025] According to still another aspect of the present invention, there is provided an overlap detection method of determining whether or not sheets are being correctly conveyed in a printing press, in which the sheets are conveyed while each being displaced by a given amount from an upstream sheet in a sheet conveying direction and overlapping the same, on the basis of detection of an overlapping state of the sheets, including: detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion by a sheet detection sensor; outputting an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion; and determining that the sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same when a portion of the overlapping signal taking the first form is equal to a given reference portion, and determining that the sheets are not being correctly conveyed when the portion of the overlapping signal taking the first form is not equal to the given reference portion.

[0026] According to another aspect of the present invention, there is provided an overlap detection method of determining whether or not sheets are being correctly conveyed in a printing press, in which the sheets are conveyed while each being displaced by a given amount from an upstream sheet in a sheet conveying direction and overlapping the same, on the basis of detection of an overlapping...
state of the sheets, including: detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion by a sheet detection sensor; outputting an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and determining that the sheets are being correctly conveyed while each being displaced by a given amount from an upstream sheet in the conveying direction and overlapping the same when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to a printing reference of the printing press, is equal to a given reference timing, and determining that the sheets are not being correctly conveyed when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to the printing reference of the printing press, is not equal to the given reference timing.

**[0027]** According to the overlap detection apparatus and the overlap detection method, it is possible to produce an advantage of detecting a trouble in sheet feeding.

**BRIEF DESCRIPTION OF THE DRAWINGS**

**[0028]** The above, and other objects, features and advantages of the present invention will become apparent from the detailed description thereof in conjunction with the accompanying drawings wherein.

**[0029]** FIG. 1 is a schematic view of a part of a printing press equipped with an overlap detection apparatus according to a first embodiment of the present invention.

**[0030]** FIG. 2 is a flowchart illustrating a control method of the overlap detection apparatus of the first embodiment.

**[0031]** FIG. 3 is a schematic view of a part of a printing press equipped with an overlap detection apparatus according to a second embodiment of the present invention.

**[0032]** FIG. 4 is a flowchart illustrating a control method of the overlap detection apparatus of the second embodiment.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

**[0033]** Now, the description will be made for an overlap detection apparatus according to a first embodiment of the present invention with reference to the drawings attached hereto.

**[0034]** FIG. 1 illustrates a printing press 1 equipped with an overlap detection apparatus 2 of this embodiment. The printing press 1 includes a printing section 3 and a conveying section 4 that conveys sheets to the printing section 3 one by one. The conveying section 4 includes a feeder board 5 for conveying sheets P, which are successively fed from a lifting table (not shown) and mounted on the feeder board 5, towards a downstream side, a front abutting member 6 for abutting with a leading edge of the oncoming sheet P conveyed by the feeder board 5 to correct the position of the sheet P, and a swing claw 8 for picking up the leading edge of the sheet P whose position has been corrected and feeding the same to a sheet feeding cylinder 7 of the printing section 3.

**[0035]** According to the correct operation, the sheets P fed onto the lifting table are each displaced from the upstream sheet P in the conveying direction by a given amount and overlaps the same on the feeder board 5 and these sheets P are successively conveyed in this overlapping state. In other words, in the correct conveying operation, a preceding sheet P is placed on the feeder board 5 while being displaced from the subsequent sheet P by a given amount in the conveying direction and overlapping the same. By the given amount (a so-called stream pitch) is herein meant a distance between the leading edge of the preceding sheet P and the leading edge of the subsequent sheet P. This may be set to be about 180 mm.

**[0036]** The preceding sheet P conveyed on the feeder board 5 abuts with the front abutting member 6 that in turn corrects the position (sheet alignment) of the preceding sheet P, and the leading edge thereof is picked up by the swing claw 8 so that it is drawn out at a speed higher than the conveying speed. Thus, the sheets P are fed onto the sheet feeding cylinder 7 one by one.

**[0037]** The overlap detection apparatus 2 mounted in the printing press 1 includes a sheet detection sensor 9 for detecting whether a portion of the sheets P passing a given position is a non-overlapping portion or an overlapping portion, an amplifier 10 as a signal output section for outputting an overlapping signal on the basis of the detected result of the sheet detection sensor 9, and a determination section 11 for determining the conveying status of the sheets P by the comparison between the overlapping signal and a given reference portion, so that when the comparison indicates a given condition, it is determined that the sheets P are being correctly conveyed while each being displaced from the upstream sheet P by a given amount in the conveying direction, and when the comparison indicates otherwise, it is determined that the sheets 1 are not being correctly conveyed.

**[0038]** The sheet detection sensor 9 is made up of a pair of upper and lower members disposed around the downstream end of the feeder board 5, and more specifically disposed vertically along the path between the feeder board 5 and the front abutting member 6, allowing the sheets P to pass therebetween. For the sheet detection sensor 9, it is possible to employ a known sensor, such as a photoelectric sensor that detects the overlapping state of the sheets P on the basis of the difference in the intensity of light that has been irradiated to an oncoming sheet P and passed therethrough, and an ultrasonic sensor that detects the overlapping state of the sheets P by irradiation of supersonic waves, on the basis of the presence and absence of an air layer, which occurs between the sheets P when two or more sheets P overlap each other.

**[0039]** Herein, as mentioned above, in the correct conveying operation, the sheets P are successively conveyed while each precedent sheet being displaced from the subsequent sheet P by a given amount, so that they successively and continuously pass between the upper and lower members of the sheet detection sensor 9 without a gap between the preceding and subsequent sheets P. That is, when the sheets P are being conveyed in a correct overlapping state, non-overlapping portions (single sheet portions) and overlapping portions (double sheet portions) alternately pass an area between the upper and lower members of the sheet detection sensor 9 at constant periodic intervals. Accordingly, the detected result in the correct conveying state indicates that non-overlapping portions (single sheet portions) and overlapping portions (double sheet portions) alternately appear at constant periodic intervals.
[0040] Now, the description will be made for the case where the sheets P are being conveyed in a correct overlapping manner.

[0041] A first (leading) one of the sheets P conveyed in a correct overlapping manner passes between the upper and lower members of the sheet detection sensor 9 and then abuts with the front abutting member 6, and accordingly the motion of the first sheet P in the conveying direction is stopped. At this moment, a non-overlapping portion (single sheet portion) of the sheets is located between the upper and lower members of the sheet detection sensor 9. The position of the first sheet P is thus aligned or corrected by the front abutting member 6.

[0042] Then, the first sheet P has its leading edge gripped by a gripper 81 of the swing claw 8, while the subsequent sheet P is being continuously conveyed by the feeder board 5 even until the leading edge of the first sheet P has been gripped by the gripper 81 after the motion of the first sheet P in the conveying direction is stopped, so that the leading edge of a second (subsequent) sheet P passes the area between the upper and lower members of the sheet detection sensor 9. From this moment, an overlapping portion (double sheet portion) is located between the upper and lower members of the sheet detection sensor 9. That is, an overlapping portion (double sheet portion) continues to exist until the trailing edge of the first sheet P passes between the upper and lower members of the sheet detection sensor 9 after the leading edge of the second sheet P reaches between the upper and lower members of the sheet detection sensor 9.

[0043] Then, the first sheet P has its leading edge gripped by the gripper 81, drawn out at a speed higher than the conveying speed and fed onto the sheet feeding cylinder 7. When the trailing edge of the first sheet P is drawn out between the upper and lower members of the sheet detection sensor 9, the overlapping portion (double sheet portion) ends and again a non-overlapping portion (single sheet portion) reaches between the upper and lower members of the sheet detection sensor 9.

[0044] Then, the second sheet P becomes a first (leading) sheet P as the first sheet P mentioned above, and subsequently conveyed and fed to the sheet feeding cylinder 7 in the same manner as above.

[0045] Thus, when the sheets P are conveyed in a correct overlapping manner, a preceding sheet P is displaced from the subsequent sheet P by a given amount and hence overlaps the same, so that a non-overlapping portion (single sheet portion) and an overlapping portion (double sheet portion) alternately appear at constant periodic intervals between the upper and lower members of the sheet detection sensor 9. That is, the time intervals in which the sheet detection sensor 9 detects non-overlapping sheet portions and the time intervals in which the sheet detection sensor 9 detects overlapping sheet portions are respectively constant. Thus, the detection in a correct conveying state results in that overlapping portions (width) of the sheets P and non-overlapping portions (width) of the sheets P alternately appear at constant periodic intervals.

[0046] The amplifier 10 outputs an overlapping signal on the basis of the detected result of the sheet detection sensor 9. The overlapping signal takes a first form (H form) for an overlapping portion of the sheets P, and takes a second form (L form) for a non-overlapping portion of the sheets P. Specifically, according to the detected result of the sheet detection sensor 9, the overlapping signal signal keeps taking the first form during the sheet detection sensor 9 detects an overlapping portion of the sheets P and keeps taking the second form during the sheet detection sensor 9 detects a non-overlapping portion of the sheets P.

[0047] According to the detected result in a correct conveying state, an overlapping portion (double sheet portion) and a non-overlapping portion (single sheet portion) alternately appear at constant periodic intervals, so that the overlapping signal output by the amplifier 10 becomes a signal having a wave pattern with the first form and the second form alternately and repeatedly appearing at constant periodic intervals. In other words, the overlapping signal in a correct conveying state resulting has portions each taking the first form and portions each taking the second form, those portions alternately appearing at constant periodic intervals. The amplifier 10 of this embodiment, along with the determination section 11 and a memory section 12, those will be hereinafter described, constitute a CPU, while the amplifier 10 may be connected to an external member or part or mounted in the sheet detection sensor 9.

[0048] The determination section 11 determines that the sheets P are being correctly conveyed while each being displaced from the upstream sheet P by a given amount in the conveying direction and overlapping the same when the portion of the overlapping signal taking the first form is equal to a given reference portion, and determines that the sheets P are not being correctly conveyed when it is not equal to the given reference portion.

[0049] By the given reference portion is herein meant an overlapping portion of the sheets P when the sheets are being correctly conveyed and, in other words, a portion of the overlapping signal taking the first form or second form in the sheet conveying when the sheets P are being conveyed in a correct overlapping manner. Specifically, the given reference portion may be represented by the time interval in which the sheet detection sensor 9 detects a non-overlapping portion (single sheet portion) or an overlapping portion (double sheet portion) when the sheets P, each being conveyed while being displaced from the upstream sheet P in the conveying direction, pass a given position (between the upper and lower members of the sheet detection sensor 9). Alternatively, the given reference portion may be represented by the displaced amount of each sheet P from the upstream sheet P in the conveying direction. This given reference portion is stored in the memory section 12 of the CPU by, for example, manual inputting by an operator, or automatically stored with designated as a reference an overlapping sheet portion or non-overlapping sheet portion of the first and second sheets P when they pass the sheet detection sensor 9.

[0050] When a preceding sheet P is not displaced from the subsequent sheet P by a given amount when they overlap, it is determined that the sheets P are not being correctly conveyed. For example, such incorrect conveyance of the sheets P represents that the displaced amount is larger or smaller than a given amount.

[0051] The overlap detection apparatus 2 further includes a feeder stop solenoid SOL as a feeder board stopping device for stopping the feeder board 5 upon receiving a stop signal from the determination section 11 when the determination section 11 has determined that the sheets P are not being correctly conveyed, and an annunciation lamp as an annunciation device that turns on or blinks upon receiving an
annunciation signal from the determination section 11 when the determination section 11 has determined that the sheets P are not being correctly conveyed. For the annunciation lamp, an LED or the like may be used, which is designed to change the color in addition to a turning-on action and a blinking action.

[0052] Now, the description will be made for a control method of the overlap detection apparatus 2 of this embodiment, with reference to a flowchart illustrated in FIG. 2.

[0053] First, the printing press 1 is started up to print on the sheets P. Upon the start-up, the respective members or parts such as the swing claw 8 are actuated to be in synchronizion with the rotation of the sheet feeding cylinder 7, so that the sheets P are fed out from the lifting table onto the feeder board 5. When the sheets P are conveyed on the feeder board 5, the sheet detection sensor 9 detects whether a portion of the sheets P passing the sheet detection sensor 9 is a non-overlapping portion (single sheet portion) or an overlapping portion (double sheet portion), and transmits the detected result to the amplifier 10 (Step S1).

[0054] The amplifier 10 which received the detected result of the sheet detection sensor 9 outputs an overlapping signal, which takes the first form (H form) for an overlapping portion (double sheet portion) and the second form (L form) for a non-overlapping portion (single sheet portion), and transmits the same to the determination section 11 (Step S2).

[0055] Upon receiving the overlapping signal, the determination section 11 reads out the reference portion (in this embodiment, the time interval in which the sheet detection sensor 9 detects an overlapping portion (double sheet portion) passing between the upper and lower members of the sheet detection sensor 9 in a correct overlapping manner) stored in the memory section 12, and compares the same with a portion of the overlapping signal taking the first position (Step S3). When, as the reference portion, the time interval in which the sheet detection sensor 9 detects a non-overlapping portion (single sheet portion) passing between the upper and lower members of the sheet detection sensor 9 in a correct overlapping manner, that is, a portion of the overlapping signal taking the second form, is employed, the determination section 11 compares the portion of the overlapping signal taking the second form with the reference portion.

[0056] Accordingly, the determination section 11 determines that the sheets P are being correctly conveyed when both the portions are equal to each other, and subsequently compares the portion of the overlapping signal taking the first form with a corresponding reference portion. When both the portions are not equal to each other, the determination section 11 determines that the sheets P are not being correctly conveyed (Step S4).

[0057] When it is determined that the sheets P are not being correctly conveyed (when the portion of the overlapping signal taking the first form is longer or shorter than the reference portion), the determination section 11 outputs a stop signal and an annunciation signal (Step S5, Step S6), and, upon receiving the stop signal, the feeder stop solenoid SOL stops the conveying of the sheets P by stopping the feeder board 5 (Step S7), and, upon receiving the annunciation signal, the annunciation lamp turns on or blinks to announce this stopping operation to the operator (Step S8).

[0058] Thus, the determination section 11 compares the portion of the overlapping signal taking the first form with the reference portion so as to be able to determine whether the sheets are being conveyed in a correct overlapping manner. As a result, it is possible to detect a trouble in sheet feeding.

[0059] Now, the description will be made for a second embodiment of the overlap detection apparatus 2 of the present invention. In this embodiment, the same reference numerals will be allocated to the identical or corresponding members or parts so as to omit the detailed description thereof. The overlap detection apparatus 2 of this embodiment includes the sheet detection sensor 9, the amplifier 10, the determination section 11, the memory section 12 that stores a reference timing, the feeder stop solenoid SOL, and the annunciation lamp. The overlap detection apparatus 2 further includes an encoder 13 for outputting a rotation signal as a printing reference of the printing press 1.

[0060] The encoder 13 is to output a rotation signal as a printing reference of the printing press 1, and specifically output a rotation signal with reference to the rotation of the sheet feeding cylinder 7. For example, the encoder 13 outputs a signal taking an H form every time when the sheet feeding cylinder 7 is set at a rotational angle of 0 degree. That is, the rotation signal is a signal that takes the H form at constant periodic intervals on the basis of the detected result of the rotational angle of the sheet feeding cylinder 7.

[0061] The determination section 11 determines that the sheets are being correctly conveyed while each being displaced from the upstream sheet P by a given amount in the conveying direction and overlapping the same when the timing, at which the form of an overlapping signal is changed from the first to second forms or vice versa, relative to the printing reference of the printing press 1, is equal to a given reference timing, and determines that the sheets P are not being correctly conveyed when the above timing is not equal to the given reference timing.

[0062] By the timing at which the form of an overlapping signal is changed between the first form and the second form is herein meant the timing at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to the rotation of the sheet feeding cylinder 7. Specifically, when the H form of the rotation signal transmitted from the encoder 13 is employed as a reference, the timing herein meant is the timing at which the form of the overlapping signal is changed from the first form to the second form or vice versa.

[0063] On the other hand, as described above, when the sheets P are being conveyed in a correct overlapping manner, a preceding sheet P is displaced from the subsequent sheet P by a given amount and overlaps the same, so that non-overlapping portions (single sheet portions) and overlapping portions (double sheet portions) alternately appear at constant periodic intervals between the upper and lower members of the sheet detection sensor 9. Since the swing claw 8 is generally operated in synchronization with the rotation of the sheet feeding cylinder 7, so that the sheets P are fed one by one in synchronization with the rotation of the sheet feeding cylinder 7. Therefore, when the sheets P are being conveyed in a correct overlapping manner, the timing, at which a portion of the sheets P passing between the upper and lower members of the sheet detection sensor 9 is changed from a non-overlapping portion (single sheet portion) to an overlapping sheet portion (double sheet portion), or vice versa, is shifted in synchronization with the rotation of the sheet feeding cylinder 7.
By the given reference timing is herein meant a timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, with reference to the rotation of the sheet feeding cylinder 7 when the sheets are being conveyed while correctly overlapping each other. Specifically, by the given reference timing is herein meant a timing at which the form of the overlapping signal is changed from the first form to the second form or vice versa, with reference to the H form of the rotation signal of the encoder 13 when the sheets P are being conveyed while correctly overlapping each other. This given reference timing is stored in the memory section 12 by, for example, manual inputting by an operator, or automatically stored with designating as a reference the timing at which the first (leading) and second (subsequent) sheets pass.

Now, the description will be made for a control method of the overlap detection apparatus 2 of this embodiment, with reference to a flowchart illustrated in FIG. 4.

First, the printing press 1 is started up to print on the sheets P. Upon the start-up, the sheet feeding cylinder 7 is rotated, and the respective members or parts such as the swing claw 8 are actuated to be in synchronization with the rotation of the sheet feeding cylinder 7. For example, the respective members or parts are actuated in synchronization with the rotation of the sheet feeding cylinder 7 so that one sheet P is fed for one rotation of the sheet feeding cylinder 7. Thus, the sheets P are conveyed on the feeder board 5 while the respective parts and members are actuated in synchronization with the rotation of the sheet feeding cylinder 7. Then, the sheet detection sensor 9 detects whether a portion of the sheets P passing between the upper and lower members of the sheet detection sensor 9 is a non-overlapping portion (single sheet portion) or an overlapping portion (double sheet portion), and transmits the detected result to the amplifier 10 (Step S11).

Upon receiving the detected result, the amplifier 10 outputs, on the basis of the detected result, an overlapping signal that takes the first form (H form) for an overlapping portion (double sheet portion) and the second form (L form) for a non-overlapping portion (single sheet portion), and transmits the same to the determination section 11 (Step S12).

On the other hand, the encoder 13 transmits a rotation signal based on the rotational reference of the sheet feeding cylinder 7 (Step S12).

Upon receiving the overlapping signal transmitted from the amplifier 10 and the rotation signal transmitted from the encoder 13, the determination section 11 measures the timing at which the form of the overlapping signal is changed from the first form to the second form, relative to the rotation signal (Step S13). Then, it reads out the reference timing (in this embodiment, the timing at which the form of the overlapping signal is changed from the first form to the second form in a correct conveying state) stored in the memory section 12, and compares the measured timing with the reference timing (Step S14). In a case where the timing, at which the form of the overlapping signal is changed from the second form to the first form, is employed as the reference timing, the determination section 11 measures the timing at which the form of the overlapping signal is changed from the second form to the first form, relative to the rotation signal, and compares the same with the reference timing.

Then, the determination section 11 determines that the sheets P are being correctly conveyed when both the timings are equal to each other, and then compares the subsequently measured timing with the corresponding reference timing. On the other hand, when both the timings are not equal to each other, it determines that the sheets P are not being correctly conveyed (Step S15).

In a case where it has been determined that the sheets P are not being correctly conveyed (for the reason that the measured timing is faster or lower than the reference timing), the determination section 11 outputs a stop signal and an annunciation signal (Step S16, Step S17), and upon receiving the stop signal, the feeder stop solenoid SOL stops the feeder board 5 to stop the conveying of the sheets P (Step S18), while upon receiving the annunciation signal, the annunciation lamp turns on or blinks to announce this stopping operation to the operator (Step S19).

Thus, by comparing the timing, at which the form of the overlapping signal is changed between the first form and the second form, relative to the rotation reference of the sheet feeding cylinder 7, with the reference timing, it is possible to determine whether the sheets P are being conveyed in a correct overlapping manner, and hence to detect a trouble in sheet feeding.

In the first and second embodiments, the description was made by taking for example a case where the amplifier 10 as the signal output section is designed to output an overlapping signal that takes two forms, namely the first form (H form) and the second form (L form). No limitation is intended to this, and therefore the amplifier 10 may be designed to output an overlapping signal that takes three forms. Specifically, the amplifier 10 may be designed to output an overlapping signal that takes a reference form (M form) when no sheet P is passing between the upper and lower members of the sheet detection sensor 9; takes the first form (H form) when the passing sheet P is a double or other multiple; and takes the second form (L form) when the passing sheet P is a single. Thus, it is possible to detect the state in which no sheet P is passing between the upper and lower members of the sheet detection sensor 9 and hence immediately find out the detail of a trouble in sheet feeding.

This specification is by no means intended to restrict the present invention to the preferred embodiments set forth therein. Various modifications to the overlap detection apparatus and the overlap detection method, as described herein, may be made by those skilled in the art without departing from the spirit and scope of the present invention as defined in the appended claims.

What is claimed is:

1. An overlap detection apparatus mounted to a printing press in which sheets of paper are successively conveyed while each being displaced by a given amount from an upstream sheet of paper in a sheet conveying direction and overlapping the same, comprising:

   a. a sheet detection sensor for detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion;
   b. a signal output section for outputting an overlapping signal on the basis of the detected results of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and
   c. a determination section for determining that the sheets of paper are being correctly conveyed while each being
displaced by a given amount from an upstream sheet of paper in the conveying direction and overlapping the same when a portion of the overlapping signal taking the first form is equal to a given reference portion, and determines that the sheets of paper are not being correctly conveyed when the portion of the overlapping signal taking the first form is not equal to the given reference portion.

2. An overlap detection apparatus mounted to a printing press in which sheets of paper are successively conveyed while each being displaced by a given amount from an upstream sheet of paper in a sheet conveying direction and overlapping the same, comprising:
a sheet detection sensor for detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion;
a signal output section for outputting an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and
a determination section for determining that the sheets of paper are being correctly conveyed while each being displaced by a given amount from an upstream sheet of paper in the conveying direction and overlapping the same, when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to a printing reference of the printing press, is equal to a given reference timing; and determines that the sheets of paper are not being correctly conveyed, when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to the printing reference of the printing press, is not equal to the given reference timing.

3. The overlap detection apparatus according to claim 2, wherein the printing press includes a sheet feeding cylinder, and an encoder that outputs a rotation signal with reference to the rotation of the sheet feeding cylinder, and the rotation signal output by the encoder is employed as the printing reference of the printing press.

4. The overlap detection apparatus according to any one of claims 1 and 2, wherein the printing press includes a feeder board that conveys the sheets of paper placed thereon towards a downstream side; the sheet detection sensor comprises a pair of upper and lower members disposed vertically with a downstream end of the feeder board therebetween so as to detect whether a portion of the sheets passing between the upper and lower members of the sheet detection sensor is the non-overlapping portion or the overlapping portion.

5. The overlap detection apparatus according to any one of claims 1 and 2, wherein the overlapping signal takes an H form for the overlapping sheet portion and takes an L form for the non-overlapping portion.

6. The overlap detection apparatus according to any one of claims 1 and 2, wherein the printing press includes a feeder board that conveys the sheets of paper placed thereon towards a downstream side; the determination section outputs a stop signal when it determines that the sheets of paper are not being correctly conveyed; and the printing press further includes a feeder board stop device that stops the feeder board on the basis of the stop signal.

7. The overlap detection apparatus according to any one of claims 1 and 2, wherein the printing press includes a feeder board that conveys the sheets of paper placed thereon towards a downstream side; and the determination section outputs an annunciation signal when it determines that the sheets of paper are not being correctly conveyed; and the printing press further includes an annunciation device that is actuated on the basis of the annunciation signal.

8. The overlap detection apparatus according to any one of claims 1 and 2, wherein the signal output section comprises an amplifier.

9. An overlap detection method of determining whether or not sheets of paper are being correctly conveyed in a printing press, in which the sheets of paper are conveyed while each being displaced by a given amount from an upstream sheet of paper in a sheet conveying direction and overlapping the same, on the basis of detection of an overlapping state of the sheets of paper, comprising:
detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion by a sheet detection sensor;
outputting an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion; and
determining that the sheets of paper are being correctly conveyed while each being displaced by a given amount from an upstream sheet of paper in the conveying direction and overlapping the same when a portion of the overlapping signal taking the first form is equal to a given reference portion, and determining that the sheets of paper are not being correctly conveyed when the portion of the overlapping signal taking the first form is not equal to the given reference portion.

10. An overlap detection method of determining whether or not sheets of paper are being correctly conveyed in a printing press, in which the sheets of paper are conveyed while each being displaced by a given amount from an upstream sheet of paper in a sheet conveying direction and overlapping the same, on the basis of detection of an overlapping state of the sheets of paper, comprising:
detecting whether a portion of the sheets passing a given position is a non-overlapping portion or an overlapping portion by a sheet detection sensor;
outputting an overlapping signal on the basis of the detected result of the sheet detection sensor, in which the overlapping signal takes a first form for the overlapping portion and takes a second form for the non-overlapping portion; and
determining that the sheets of paper are being correctly conveyed while each being displaced by a given amount from an upstream sheet of paper in the conveying direction and overlapping the same when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to a printing reference of the printing press, is equal to a given reference timing, and determining that the sheets of paper are not being correctly conveyed when the timing, at which the form of the overlapping signal is changed from the first form to the second form or vice versa, relative to a printing reference of the printing press, is not equal to the given reference timing.