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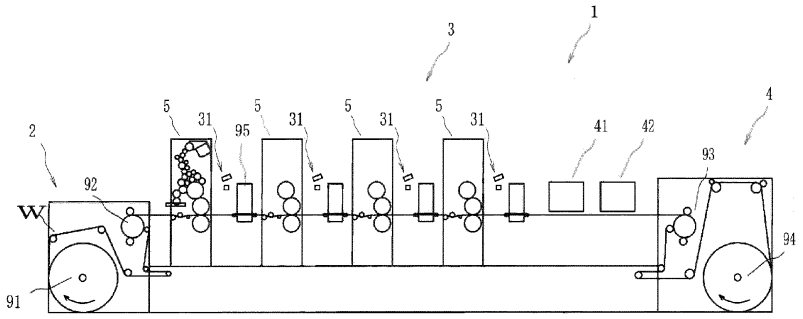
(54) PRINTING SYSTEM OF OFFSET ROTARY PRESS AND OFFSET ROTARY PRESS

(57) There is provided a printing system of an offset rotary press in which an emulsification state of ink can be grasped at real time and make it appropriate on quickly so that a good printing quality can be maintained from the start to the end of printing which results in reduction of paper loss.

The printing system of an offset rotary press 1 comprising a light source 32 that irradiates irradiation light 71 on a surface of a plate cylinder 6 of a printing unit 5, a camera 33 for shooting reflected light 72 of the irradiated irradiation light 71 and a control device 56 for bifurcating a shot image of the camera 33 into a high brightness region and a low brightness region of reflected light 72 and calculates an area ratio of the region of high brightness of the reflected light 72 with respect to the entire area of the shot image of the camera 33, wherein if the area ratio in the high brightness region of the reflected light 72 calculated by the control means 56 is high, the dampening water supply of the dampening water device 11 is controlled such that an appropriate emulsification state of ink is obtained.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to a printing system of an offset rotary press and the offset rotary press comprising its printing system.

Background Art

[0002] In printing with the offset rotary press, dampening water and ink are supplied to a plate cylinder. When a dampening water supply amount is large, excessive emulsification of ink would occur. When the excessive emulsification of ink occurs, print stains and the like would occur, which results in paper loss.

[0003] Since an emulsification state of ink may change depending on various factors such as a print pattern and temperature, conventionally, the emulsification state of ink has been judged through know-how and experience of an operator, so that a dampening water supply has been adjusted. For this reason, problems such as variations and the like in print quality have occurred for each operator.

[0004] On the other hand, as disclosed in Japanese Unexamined Patent Publication No. 2005-007769 (Patent Document 1), there has been conventionally known a printing system that executes machine learning from measurement of color tones of printing results and operation status of the printing press and in turn controls the printing.

Summary of the Invention

Problems to be solved by the Invention

[0005] However, since the printing system disclosed in Patent Document 1 does not detect the emulsification state of ink during printing, a time lag occurs from the time when the ink changes into the excessive emulsification state until control is executed, and it takes time to reach an appropriate emulsification state of ink, and there are problems such as a lot of paper loss and the like.

[0006] The present invention has been made to solve the above problems, and its purpose is to provide the printing system of offset rotary press and the offset rotary press, in which the emulsification state of ink may be grasped in real time, any sign of excessive emulsification state of ink may be noticed on quickly, and the dampening water may controlled, so that an appropriate emulsification state of ink may be achieved, good print quality may be maintained from the start to the end of printing, and consequently, the paper loss can be greatly reduced, and in addition, it can be introduced into existing offset rotary presses inexpensively and easily.

Means to solve Problem

[0007] A printing system of an offset rotary press of the present invention is a printing system of an offset rotary press, the offset rotary press comprises at least one or more printing units, the printing unit comprising a plate cylinder, a dampening water device that supplies dampening water to the plate cylinder, an ink device that supplies ink to the plate cylinder, a light source that irradiates an irradiation light on a surface of the plate cylinder and/or a surface of any roller of the ink device, and a camera for shooting a reflected light reflected from the surface of the roller; and an ink emulsification state detection means having a control means for bifurcating a shot image of the camera into a high brightness region of reflected light and a low brightness region of reflected light and calculates an area ratio of the region of high brightness of the reflected light with respect to the entire area of a shot image of the camera, the printing system of the offset rotary press is characterized by that when the area ratio in the high brightness region of the reflected light calculated by the control means is high, a dampening water supply of the dampening water device is controlled such that an appropriate emulsification state of ink is obtained.

[0008] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the light source irradiates the irradiation light of a specific wavelength, and the camera shoots only the reflected light of the specific wavelength.

[0009] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which a temperature of the dampening water supplied by the dampening water device and a temperature of the ink supplied by an ink device are kept constant.

[0010] With the configuration, the emulsification state of ink can be accurately judged from an area ratio in a high brightness region of the reflected light.

[0011] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the light source is a high color rendering LED.

[0012] With the configuration, changes in the brightness of reflected light can be detected more clearly, control based on its detection result can be executed with higher accuracy.

[0013] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the control means repeatedly calculates an area ratio of the high brightness region of the reflected light and stores it during print executing, mechanically learns a control model in which the dampening water of the emulsification state of ink can be optimized according to the stored area ratio and updates to a control model in which an appropriate emulsification state of ink can be obtained according to the calculated area ratio.

[0014] With the configuration, irrespective of experience and skill of the operator, always stable grasping of emulsification state of ink and an accurate control of the dampening water would be possible.

[0015] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the control means stores, in addition to the area ratio, information on at least one or more selected from the operation status of the offset rotary press, detection information on printing results, temperature and humidity, and mechanically learns the control model using the stored area ratio and stored information on other than the area ratio and updates to a control model corresponding to the information.

[0016] With this configuration, it becomes possible to grasp a stable emulsification state of ink and to accurately control the dampening water, even if the information on at least one selected from the operation status of the offset rotary press, the detection information on the printing results, temperature and humidity changes.

[0017] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the operation status of the offset rotary press includes information on at least one or more selected from a dampening water supply amount at the start of printing, an ink supply amount at the start of printing, information on a pattern to be printed, a printing speed during printing, the dampening water supply amount during printing, and the ink supply amount during printing.

[0018] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the detection information on printing results includes information on at least one or more selected from a dot shape, a dot area ratio and ink concentration which are detected from the printing result.

[0019] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which information on temperature and humidity includes information on at least one or more selected from a dampening water temperature at the start of printing, an ink temperature at the start of printing, an oscillating roller water flow temperature at the start of printing, a plate cylinder water flow temperature at the start of printing, a temperature inside the factory at the start of printing, humidity inside the factory at the start of printing, the dampening water temperature during printing, the ink temperature during printing, the oscillating roller water flow temperature during printing, the plate cylinder water flow temperature during printing, the temperature inside the factory during printing, and the humidity inside the factory during printing.

[0020] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the control model is updated on a cloud server independent of the offset rotary press.

[0021] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the control model can be updated by a control device in the offset rotary machine.

[0022] In the printing system of the offset rotary press of the present invention, the printing system of the offset rotary press may be configured in which the dampening water of the dampening water device is controlled using the updated control model.

[0023] The offset rotary press of the present invention may be an offset rotary press comprising the printing system according to any one of claims 1 to 12.

Advantageous Effect of the Invention

[0024] According to the printing system of the offset rotary press of the present invention, the emulsification state of ink can be grasped in real time, any sign of an excessive emulsification state of ink can be noticed on quickly, and the dampening water is controlled to become the appropriate emulsification state of ink, so that good printing quality can be maintained from the start to the end of printing, and consequently, paper loss can be greatly reduced.

[0025] Moreover, it can be introduced into existing offset rotary presses with inexpensive and ease.

[0026] Furthermore, since the emulsification state of ink is judged by the area ratio in the region of the high brightness of reflected light, the appropriate emulsification state of ink can be set even if in a nonuniform emulsification state of ink.

Brief Explanation of Drawings

[0027]

FIG. 1 is a whole front view showing an example of an offset rotary press to which a printing system of the present invention can be applied.
FIG. 2 is a block diagram of a printing unit.
FIG. 3 is a schematic diagram of a control system related to machine learning.
FIG. 4 is a block diagram showing a second embodiment of a reflected light detection device.
FIG. 5 a block diagram showing a third embodiment of the reflected light detection device.

Embodiments of the Invention

[0028] An offset rotary press according to an embodiment of the present invention will be described with reference to FIG.1. FIG. 1 is a whole front view showing an example of the offset rotary press to which a printing system of the present invention can be applied.

[0029] The offset rotary press 1 according to the embodiment of the present invention includes a paper feed-

ing part 2 for feeding a base material to be printed W, a printing part 3 for printing the base material to be printed W conveyed from the paper feeding part 2, and a paper discharging part 4 for discharging the printed base material to be printed W printed in the printing part 3.

[0030] The paper feeding part 2 comprises a paper feeding shaft 91 to which the base material to be printed W wound in a roll shape is to be attached, and a feeding roller 92 on the paper feeding side that delivers and feeds the base material to be printed W attached to the paper feeding shaft 91 to the printing part 3. The printed base material to be printed W is pulled by rotating and driving the feeding roller 92 on the paper feeding side with a drive motor not shown, and the paper feeding shaft 91 is rotated to deliver the roll-shaped printed base material to be printed W and sent it to the printing part 3.

[0031] The paper feeding part 2 is not limited to this configuration and may be of a configuration of a paper feeding part of a known rotary press such as a configuration for delivering sheet and the like.

[0032] The printing part 3 comprises a plurality of printing units 5, as described later, and printing in one color is performed for each printing unit 5. On the paper discharging side of each printing unit 5, a drying device 95 is provided, but it may not be provided.

[0033] The paper discharging part 4 comprises a feed roller 93 of the paper discharging side in which the base material to be printed W having been printed in the printing part 3 is send to the paper discharging part 4, and a winding shaft 94 that winds the base material to be printed W.

[0034] The paper discharging part 4 is not limited to this configuration and may be of a configuration of a paper discharging part of a known rotary press, such as a delivery device for discharging the base material to be printed W to another processing device or a sheet accumulation device and the like.

[0035] A dot detection device 41 and a pattern inspection device 42 for inspecting print results are provided between the printing part 3 and the paper discharging part 4. The dot detector 41 and the pattern inspection device 42 are not limited to this configuration and can be provided at any position downstream of the printing part 3, such as a position between the feed roller 93 on the paper discharging side and the winding shaft 94 that winds the base material to be printed W.

[0036] The configuration of the offset rotary press 1 to which the printing system of the present invention can be applied is not limited to this configuration and can be freely configured such as to provide a processing portion that performs cutting processing and folding processing of the base material to be printed W and the like between the printing part 3 and the paper discharging part 4.

[0037] The printing system of the present invention can be applied to regardless of the type of base material to be printed W. Therefore, as the base material to be printed W, a material used in a known offset rotary press, such as paper or film and the like can be used. In addition, it can be used regardless of the form of continuous paper, sheet, and the like.

[0038] The configuration of the printing unit 5 will be described with reference to FIG.2. FIG. 2 is a block diagram of the printing unit.

[0039] The printing part 3 is constituted of at least one or more printing units 5. In the printing unit 5, the printing is executed on the base material to be printed W with any ink. In the embodiment of FIG. 1, four printing units 5 are provided, and the printing with ink of yellow (Y), cyan (C), magenta (M), and black (K) is performed, respectively. Each printing unit 5 has the same configuration.

[0040] The number of printing units 5 used in the printing system of the present invention is not limited to that of the embodiment of FIG. 1 but may be any number of printing units 5, and the printing part 3 may be configured with any number of printing units 5 such as only one printing unit for printing with black (K) ink and the like. Further, the ink that can be used is not limited to yellow (Y), cyan (C), magenta (M), and black (K), and any color ink such as a special color and the like can be used.

[0041] As shown in FIG. 2, the printing unit 5 has a plate cylinder 6, a blanket cylinder 7, and an impression cylinder 8. The plate cylinder 6, the blanket cylinder 7, and the impression cylinder 8 are controlled in rotation by each drive motor not shown. The base material to be printed W is conveyed between the blanket cylinder 7 and the impression cylinder 8.

[0042] The printing is executed as follows. Ink and dampening water are supplied to the plate cylinder 6, and ink is transferred from the plate cylinder 6 to the blanket cylinder 7, the printing is executed by transferring the ink from the blanket cylinder 7 to the base material to be printed W.

[0043] For adjusting a surface temperature of the plate cylinder 6, cooling water is flowed through the inside of the plate cylinder 6. Details of water flow of the cooling water will be described later.

[0044] A dampening water device 11 that supplies the dampening water to the plate cylinder 6 and an ink device 21 that supplies ink to the plate cylinder 6 are provided adjacent to the plate cylinder 6.

[0045] The dampening water device 11 comprises a dampening water temperature detection device 12, a water trough 13, a water source roller 14, a metering roller 15, and a watering roller 16.

[0046] The dampening water in the water trough 13 is supplied to the plate cylinder 6 via the water source roller 14, the metering roller 15, and a watering roller 16. A supply of the dampening water into the water trough 13 will be described later.

[0047] The dampening water temperature detection device 12 detects the temperature of dampening water in the water trough 13. The temperature of the dampening water measured by the dampening water temperature detection device 12 is used for machine learning described later as a dampening water temperature.

[0048] The ink device 21 comprises an ink temperature detection device 22, an ink fountain 23, an ink source roller 24, an ink supply kneading roller group 25, ink oscillating rollers 26, and ink rollers 27.

[0049] The ink in the ink fountain 23 is supplied to the plate cylinder 6 via the ink source roller 24, the ink supply kneading roller group 25, the ink oscillating rollers 26, and the ink rollers 27. The ink temperature detection device 22 is provided facing any roller in the ink device 21 and measures a temperature of the ink on the roller surface without contact. The ink temperature detected by the ink temperature detection device 22 is used for the machine learning described later as an ink temperature.

[0050] For controlling the temperature of the ink, cooling water is flowed through the inside of the ink oscillating rollers 26 to control the surface temperature of the ink oscillating rollers 26. Details of a water flow of cooling water will be described later.

[0051] The water flow of cooling water into the plate cylinder 6, a dampening water supply into the water trough 13, and a water flow of cooling water into the ink oscillating roller 26, and an ink supply will be described with reference to FIG.3. FIG. 3 is a schematic view of a control system related to the machine learning.

[0052] For adjusting the surface temperature of the plate cylinder 6, the cooling water that flows through the inside of the plate cylinder 6 is supplied from a plate cylinder cooling water circulation device 9 shown in FIG. 3 provided in the vicinity of the printing unit 5.

[0053] The plate cylinder cooling water circulation device 9 comprises a flow path for supplying cooling water from the plate cylinder cooling water circulation device 9 to the plate cylinder 6, a flow path for circulating cooling water from the plate cylinder 6 to the plate cylinder cooling water circulation device 9, and a plate cylinder cooling water temperature control device 10 for controlling the temperature of the circulating cooling water.

[0054] The temperature of the cooling water controlled by the plate cylinder cooling water temperature control device 10 is used for the machine learning described later as a plate cylinder water flow temperature.

[0055] A supply of dampening water into the water trough 13 of the dampening water device 11 is performed by the dampening water circulation device 17 shown in FIG. 3 provided in the vicinity of the printing unit 5. The dampening water circulation device 17 comprises a flow path for supplying the dampening water from the dampening water circulation device 17 to the water trough 13, and a flow path for circulating dampening water from the water trough 13 to the dampening water circulation device 17.

[0056] The dampening water circulation device 17 comprises a dampening water cooling device 18 for cooling the dampening water and can control circulation of the dampening water.

[0057] In temperature control of the dampening water in the printing system of the present invention, a cooling temperature of the dampening water cooling device 18 is controlled by a command from the control device 56 shown in FIG.3, so that the temperature of dampening water in the water trough 13 detected by the dampening water temperature detection device 12 becomes the set temperature.

[0058] The cooling water that flows through the inside of the ink oscillating roller 26 is supplied from an ink oscillating roller cooling water circulation device 28 shown in FIG. 3 provided in the vicinity of the printing unit 5. The ink oscillating roller cooling water circulation device 28 comprises a flow path for supplying cooling water from the ink oscillating cooling water circulation device 28 to the ink oscillating rollers 26, and a flow path for circulating cooling water from the ink oscillating rollers 26 to the ink oscillating roller cooling water circulation device 28, and an ink oscillating roller cooling water temperature control device 29 for controlling the temperature of the circulating cooling water.

[0059] A set temperature of the ink oscillating roller cooling water temperature control device 29 is used for the machine learning described later as an oscillating roller water flow temperature.

[0060] The temperature of the ink in the printing system of the present invention is controlled by changing the set temperature of the ink oscillating roller cooling water temperature control device 29 by a command from the control device 56.

[0061] The supplies of dampening water and ink are controlled as follows based on a command from the control device 56.

[0062] A dampening water supply amount supplied to the plate cylinder 6 is controlled by controlling a rotational amount of the water source roller 14 and the metering roller 15. The water source roller 14 and the metering roller 15 are rotated and driven by a drive motor not shown. In the printing system of the present invention, rotational amounts of the drive motor of the water source roller 14 and the metering roller 15 output from the control device 56 are used for the machine learning described later as a dampening water supply amount.

[0063] An ink supply amount to the plate cylinder 6 is controlled by controlling the rotational amount of the ink source roller 24. The ink source roller 24 is rotated and driven by a drive motor not shown. In the printing system of the present invention, a rotational amount of the drive motor of the ink source roller 24 output from the control device 56 is used for the machine learning described later as an ink supply amount.

[0064] At the beginning of the printing, the ink supply amount is initially set according to a pattern area ratio of a pattern to be printed as follows.

[0065] A plurality of ink keys (not shown) are provided side by side in the width direction of the ink source roller 24 shown in FIG. 2, and an output amount of ink (ink supply amount) in the width direction is determined by a gap between each ink key and the ink source roller 24, that is, a degree of opening of the ink key.

[0066] The pattern area ratio is a data converted from

a data of a printing plate set on the plate cylinder 6 and represents how much area of the pattern occupies in an area of the top and bottom length of the printing plate (the top and bottom length of a product) × the width same as the width of the ink key.

[0067] The control device 56 obtains the pattern area ratio for each ink key width in the printing plate width direction from an input printing plate data, adjusts the degree of opening of each ink key according to the obtained pattern area ratio and makes initial setting of the ink supply amount.

[0068] The printing system of the present invention comprises an ink emulsification state detection means that detects the emulsification state of ink by measuring the brightness of the reflected light from the surface of the plate cylinder 6 and/or the surface of the roller for supplying ink.

[0069] The ink emulsification state detection means is constituted of a reflected light detection device 31 that detects the reflected light from the surface of the plate cylinder 6 of each printing unit 5 as shown in FIG.1 and a control device 56 shown in FIG.3.

[0070] Hereinafter, a configuration of the reflected light detection device 31 for detecting the reflected light 72 from the surface of the plate cylinder 6 will be described with reference to FIG.2.

[0071] For detecting the reflected light 72 from the surface of the plate cylinder 6, the reflected light detection device 31 is provided in the vicinity of the plate cylinder 6. The reflected light detection device 31 has a light source 32 and a camera 33.

[0072] As the light source 32, a light such as LED can be used. In particular, a high color rendering LED can be used as a suitable light source. The high color rendering LED has high color reproducibility and is generally used as the light source for printing device and the like.

[0073] When the high color rendering LED is used as the light source 32, changes in brightness of the reflected light 72 can be detected more clearly, so that the control based on the detection results can be performed more accurately.

[0074] As the camera 33, it may be used a wide-angle camera capable of shooting the entire width direction (direction parallel to the rotation axis) of the plate cylinder 6 or a camera that shoots any part of the plate cylinder 6. Further, if the camera cannot shoot the entire width direction of the plate cylinder 6, a plurality of cameras may be provided in the width direction of the plate cylinder 6, and a plurality of images to be shot may be combined so that the same result as that of a wide-angle camera can be obtained.

[0075] The light source 32 and the camera 33 are configured to be adjustable in positions and angles, respectively, and they can be thereby adjusted to positions capable of detecting the reflected light 72 with ease.

[0076] As shown by a broken arrow in FIG. 2, an irradiation light 71 is irradiated from the light source 32 toward the plate cylinder 6, and as shown by a dashed arrow in FIG. 2, the reflected light 72 reflected on the surface of the plate cylinder 6 is shot by the camera 33. That is, the camera 33 shoots the area on the surface of the plate cylinder 6 irradiated by the irradiation light 71.

[0077] The light source 32 and the camera 33 can have the following configurations.

[0078] The light source 32 has a configuration that irradiates the irradiation light of a specific wavelength, and the camera 33 has a configuration to shoot only the reflected light of a specific wavelength of the irradiation light irradiated by the light source 32 among the reflected lights reflected from the surface of the plate cylinder 6.

[0079] As shown in FIG. 3, detection results of the reflected light detection device 31 of each printing unit 5, that is, the shot images of the camera 33, are each output to the control device 56. The control device 56 analyzes the detection results (shot images) to judge the emulsification state of ink on the surface of the plate cylinder 6. The reflected light detection device 31 is controlled by the control device 56.

[0080] The control device 56 of the present embodiment is configured to control both the existing offset rotary press 1 and the machine learning described later, but is not limited to this configuration, control can be performed by any configuration, such as controlling the reflected light detection device 31 and analyzing the detection results (shot images) with an independent control device.

[0081] The control of the reflected light detection device 31 and analysis of the detection results (shot images) are performed as follows.

[0082] In response to execution of printing, the control of the reflected light detection device 31 is performed as follows. The light source 32 is always lit during print executing and irradiates the plate cylinder 6 with the irradiation light 71. For detecting the brightness of the reflected light 72 with respect to the irradiated irradiation light 71, that is, the brightness of the surface of the plate cylinder 6, the camera 33 shoots the surface of the plate cylinder 6 during print executing.

[0083] The control device 56 receives the shot image of the camera 33 at a certain period, for example, for every multiple rotation of the plate cylinder 6, and analyzes the shot image.

[0084] With respect to a shooting region, the camera 33 may shoot either to cover whole width direction of the plate cylinder 6 or any part of the plate cylinder 6.

[0085] Further, the camera 33 shoots at any timing when the portion of the print plate attached to the plate cylinder 6 can be shot, with respect to the rotation of the plate cylinder 6. Of the shot image, portions other than the plate cylinder 6 are excluded by the control device 56. Regions to be excluded may be freely set according to the size of the plate cylinder 6 and the mounting position of the camera 33.

[0086] In the present invention, since it is only enough that shooting is performed at any timing when the printing plate attached to the plate cylinder 6 can be shot, it can be performed even if the printing plate is attached only

to a part of the plate cylinder 6.

[0087] Since the emulsification state of ink on the surface of the plate cylinder 6 may be not uniform over the width direction and the peripheral direction, the brightness of the reflected light 72 from the surface of the plate cylinder 6 may be not uniform over the width direction and the circumferential direction, which may result in generation of high portions and low portions. One of reasons of this would be that dampening water is not uniformly supplied to the surface of the plate cylinder 6.

[0088] From this, the shot image of the camera 33 may be of not uniform brightness over the entire screen, there may exist bright portions and dark portions, and the bright portions are portions of high brightness of the reflected light 72, and the dark portions are portions of low brightness of the reflected light 72.

[0089] Therefore, the control device 56 binarizes the received shot image of the camera 33 by determining whether the brightness of the reflected light 72 is higher than a reference value or not. That is, a portion of higher brightness of the reflected light 72 than the reference value (bright portion) and a portion of brightness of the reflected light 72 lower than the reference value (dark portions) are distinguished.

[0090] With respect to a criterion for judgment whether the brightness of the reflected light 72 is high or not, the reference value of the brightness is set by the machine learning described later, so that the portion not less than the reference value is judged as being a high portion and the portion less than the reference value is judged as being a low portion.

[0091] Further, the control device 56 calculates the whole area of the shot image of the camera 33 and adds up the areas of the portions determined as being of a high brightness of the reflected light 72 to obtain an area of a region of high brightness of the reflected light 72, then calculates an area ratio of the region determined as being of high brightness with respect to whole area of the shot image of the camera 33.

[0092] When the calculated area ratio is higher than the set value, it is judged that the dampening water supply amount is large, and the water supply amount is controlled to reduce for preventing the excessive emulsification. In other words, when the dampening water supply amount is large, the bright portion on the surface of the plate cylinder 6 increases, and the area of the region determined as being of high brightness of the reflected light 72 becomes large. The value of the set area ratio may be set by the machine learning based on the detection information on the printing results described later or the like. The control of dampening water (control of quantity of water supply) is performed by controlling rotational amounts of the water source roller 14 and the metering roller 15 by the control device 56.

[0093] When the dampening water supply amount decreases, since the bright portion on the surface of the plate cylinder 6 decreases, the area of the region determined as being of high brightness of the reflected light 72 decreases, and the area ratio becomes bellow the set value of the area ratio, the excessive emulsification of the ink on the surface of plate cylinder 6 can be prevented and an appropriate emulsification state of ink can be obtained.

[0094] Therefore, by measuring the brightness of the reflected light 72 from the surface of the plate cylinder 6, the emulsification state of ink can be grasped in real time.

[0095] From this reason, it is possible to detect any sign of the excessive emulsification state of ink on quickly, and by controlling the dampening water corresponding to the detection, at an early stage, the appropriate emulsification state of ink in which print stains due to ink excessive emulsification do not occur can be obtained, so that a good print quality can be maintained from the start to the end of printing, which in turn results in expectation of significant reduction in paper loss.

[0096] Moreover, since the emulsification state of ink is judged by the area ratio of the region of high brightness of the reflected light 72, even if the emulsification state of ink on the surface of the plate cylinder 6 is not uniform, the appropriate emulsification state of ink can be obtained.

[0097] Furthermore, since it is enough only to provide the reflective light detection device 31 and the control device 56, it can be inexpensively and easily introduced into existing offset rotary presses, so that, not only in a newly developed offset rotary presses but also in existing offset rotary presses that have been already in operation, it is possible to grasp the emulsification state of ink and accurately control it.

[0098] As shown in FIG. 3, the control device 56 communicates with a cloud server 51. The cloud server 51 is provided independently of the offset rotary press 1 and executes machine learning described later.

[0099] In other words, the control means of the present embodiment is constituted of the control device 56 and the cloud server 51, and machine learning processes described later can be freely shared between the control device 56 and the cloud server 51.

[0100] In the printing system of the embodiment, the area ratio in the region determined as being high brightness of the reflected light 72 from the surface of the plate cylinder 6 is repeatedly calculated during print executing, the control device 56 or the cloud server 51 stores calculated area ratio data, judges the emulsification state of ink according to the stored area ratios, and mechanically learns a control model of the dampening water of the appropriate emulsification state of ink.

[0101] The control device 56 or the cloud server 51, using the results of machine learning, updates the control model of the dampening water to a control model of the optimal dampening water supply in which the appropriate emulsification state of ink is to be obtained, according to the calculation results of the area ratio, and outputs it.

[0102] Therefore, by executing the machine learning, it is always possible to grasp a stable emulsification state of ink and to accurately control the dampening water,

regardless of the experience and skill of the operator.

[0103] It should be noted that it is also possible to control the dampening water for each time of calculation of the area ratio and to set an appropriate emulsification state of ink without the machine learning.

[0104] While the embodiment shown in FIG. 2 is shown as being the configuration in which the reflected light detection device 31 is provided opposite to the plate cylinder 6 and the brightness of the reflected light 72 from the surface of the plate cylinder 6 is measured, and objects for detecting the emulsification state of ink is the plate cylinder 6, the objects for detecting the emulsification state of ink in the present invention is not limited to the plate cylinder 6.

[0105] For example, as shown in FIG. 4, the reflected light detection device 31 may be provided opposite to the ink roller 27 to measure the brightness of the reflected light 72 from the surface of the ink roller 27, so that the object for detecting the emulsification state of ink may be the ink roller 27.

[0106] Further, as shown in FIG. 5, the reflected light detection device 31 may be provided opposite to the ink oscillating roller 26 to measure the brightness of the reflected light 72 from the surface of the ink oscillating roller 26 so that the object for detecting the emulsification state of ink may be the ink oscillating roller 26.

[0107] In other words, the printing system of the present invention can be implemented not only in the plate cylinder 6 but also in a configuration of measuring the brightness of the reflected light 72 from the surface of any roller that supplies ink to the plate cylinder 6 such as the ink roller 27 and the ink swinging roller 26.

[0108] Further, measurement of the brightness of the reflected light 72 may not be limited to that executes at one location, a plurality of reflected light detection devices 31 may be provided in one printing unit 5. For example, in addition to detection of the reflected light 72 from the surface of the plate cylinder 6, the reflected light detection device 31 for detecting the reflected light 72 from the surface of the ink roller 27 may be further provided.

[0109] As shown in FIG. 3, the control device 56 detects the following data in addition to the area ratio of high brightness region of the reflected light 72 described above as data for controlling the emulsification state of ink and controls the machine learning described later. FIG. 3 is a schematic diagram of a control system related to the machine learning, showing the control device 56 and objects for receiving and transmitting data related to the printing system of the present invention.

[0110] The control device 56 acquires information on the dampening water supply amount at the start of printing, the ink supply amount at the start of printing, and the pattern to be printed as information on the operation status of the offset rotary press 1.

[0111] Furthermore, during print executing, it acquires a printing speed during printing (rotation speed of plate cylinder 6), the dampening water supply amount during printing, and the ink supply amount during printing from time to time.

[0112] For confirming the emulsification state of ink from the printing results, the control device 56 acquires detection information on the printing results as follows.

[0113] The base material to be printed W that has been printed is shot by the dot detection device 41 provided between the printing part 3 and the paper discharging part 4, and the dot shape and the dot area ratio of the print results are detected.

When the emulsification state of ink is not appropriate, deterioration of the dot shape and change of the dot area ratio would appear. The dot shape and the dot area ratio are detected at any time during printing, they are transmitted to the control device 56.

[0114] The control device 56 can analyze whether the dot shape and the dot area ratio have changed from the appropriate state and judge whether the emulsification state of ink is appropriate or not. The criterion or judging whether change in the dot shape and the dot area ratio are in the appropriate state or not is determined based on the machine learning described later.

[0115] When the control device 56 judges that the emulsification state of ink is not appropriate, it modifies the control model of the dampening water considering the area ratio in the region of high brightness of the reflected light 72 described above.

[0116] For confirming the ink concentration from the printing results, the control device 56 acquires the detection information on the printing results as follows.

[0117] The pattern inspection device 42 provided between the printing part 3 and the paper discharging part 4 shoots the printed pattern and detects the ink concentration. When the dampening water supply amount is large and the ink is excessively emulsified, it appears as a change of being thinner in the ink concentration. The ink concentration is detected from time to time during printing and transmitted to the control device 56.

[0118] The control device 56 can analyze whether the ink concentration has changed from the appropriate state and judge whether the emulsification state of ink is appropriate. The criterion for judging whether the ink concentration is in the appropriate state or not is determined based on the machine learning described later.

[0119] When the ink concentration is not appropriate, the ink supply amount is controlled by the ink device 21.

[0120] In printing with the offset rotary press, it has been known that the state of the ink is affected by temperature and humidity of the offset rotary press 1. For this reason, for accurately judging the emulsification state of ink from the area ratio in the region of the high brightness of the reflected light 72 described above, it is necessary to keep the temperature of dampening water and ink constant.

[0121] Therefore, the control device 56 detects, as temperature and humidity information on the offset rotary press 1, a dampening water temperature at the start of printing, an ink temperature at the start of printing, an oscillating roller water flow temperature at the start of

printing, a plate cylinder water flow temperature at the start of printing, a temperature inside a factory at the start of printing, and humidity inside the factory at the start of printing.

[0122] Further, during printing, a dampening water temperature during printing, an ink temperature during printing, an oscillating roller water flow temperature during printing, a plate cylinder water flow temperature during printing, a temperature in the factory during printing, and humidity in the factory during printing are detected at any time.

[0123] Temperature and humidity inside the factory can be measured by any known thermometer and hygrometer not shown. A thermometer and a hygrometer can be installed at any position in the vicinity of the offset rotary press 1, such as on the upper side surface of the printing unit 5 and the like.

[0124] The control device 56 controls the temperature of dampening water and ink to keep them constant based on the detected temperature and humidity. For example, when a detected temperature of the dampening water temperature detection device 12 is different from the constant temperature, it controls the dampening water cooling device 18 so that the temperature of the dampening water becomes to be constant. When a detected temperature of the ink temperature detection device 22 is different from the constant temperature, it is controlled to become to be the constant temperature by controlling the cooling water temperature with the ink oscillating roller cooling water temperature control device 29.

[0125] Next, control related to the machine learning will be described.

[0126] In the printing system of present invention, the control device 56 acquires, in addition to the area ratio in the region of the high brightness of the reflected light 72 described above, data of the dampening water supply amount at the start of printing, the ink supply amount at the start of printing, information on the patterns to be printed, a printing speed during printing, a dampening water supply amount during printing, an ink supply amount during printing, as the operation status of the offset rotary press 1, data of the dot shape, a dot area ratio and an ink concentration detected from the printing results, as detection information on the printing results of the offset rotary press, and data of a dampening water temperature at the start of printing, an ink temperature at the start of printing, an oscillating roller water flow temperature at the start of printing, a plate cylinder water flow temperature at the start of printing, a temperature inside the factory at the start of printing, humidity inside the factory at the start of printing, a dampening water temperature during printing, an ink temperature during printing, an oscillating roller water flow temperature during printing, a plate cylinder water flow temperature during printing, a temperature inside the factory during printing, humidity inside the factory during printing, as information on temperature and humidity of the offset rotary press 1, and these data are transmitted to the cloud server 51 via the Internet.

[0127] The cloud server 51 stores these data and executes the machine learning. As a result of the machine learning, the cloud server 51 creates and updates a control model that outputs optimal control of the dampening water to make the emulsification state of ink appropriate and optimal control of ink according to the received data.

[0128] For example, the control device 56 adjusts the supply amount and supply timing of dampening water by controlling the rotational amount of the water source roller 14 and the metering roller 15 based on the control model output from the cloud server 51 and controls the emulsification state of ink so that it is optimally maintained.

[0129] In addition to the above, the ink supply amount and the supply timing may be adjusted by controlling the rotational amount of the ink source roller 24.

[0130] Further, by virtue of temperature control of the dampening water in the water trough 13 by controlling the dampening water cooling device 18 and temperature control of the ink by controlling the ink oscillating roller cooling water control device 29, the temperature of the dampening water and the temperature of the ink are controlled to be maintained constant.

[0131] With respect to controls, either all these controls may be executed or any of them may be selectively executed.

[0132] Further, the control may be executed either that the control device 56 may be automatically controlled in response to the output from the cloud server 51, or that the output from the cloud server 51 may be notified to an operator, and the operator may execute the control.

[0133] Therefore, even when the operation status, the printing results, the temperature, and the humidity of the offset rotary press 1 change, irrespective of the experience and skill of the operator, the emulsification state of ink can be always accurately controlled to achieve an appropriate emulsification state of ink.

[0134] The system of the present invention may be controlled by edge AI without using the cloud server 51. As an example of control by edge AI, the machine learning executed on the cloud server 51 is executed by the control device 56. The control device 56 creates and updates the control model in the control device 56 using the detected data. The control device 56 executes the control of the dampening water and ink using the created control model.

[0135] In the case of the control by edge AI, since it is not necessary to transmit and receive data to and from the cloud server 51, communication delay can be avoided and faster processing can be thereby realized as compared with the case of using the cloud server 51.

[0136] The system of the present invention can also execute the control using machine learning by the cloud server 51 or a learnt control model created by the machine learning by edge AI.

[0137] The control device 56 can also control the dampening water and the ink by applying the data detected by the control device 56 to the control model and

control the dampening water and the ink according to the output results without executing the machine learning.

[0138] When the learnt control model is used, the control can be executed even if the processing capacity of the control device 56 is low.

Claims

1. A printing system of an offset rotary press, the offset rotary press comprising;

   at least one or more printing units,
   the printing unit comprising; a plate cylinder; a dampening water device that supplies dampening water to the plate cylinder; an ink device that supplies ink to the plate cylinder;
   a light source that irradiates an irradiation light on a surface of the plate cylinder and/or a surface of any roller of the ink device; and a camera for shooting a reflected light reflected from the surface of the roller; and an ink emulsification state detection means having a control means for bifurcating a shot image of the camera into a high brightness region of reflected light and a low brightness region of reflected light and calculates an area ratio of the region of high brightness of the reflected light with respect to the entire area of a shot image of the camera;
   the printing system of the offset rotary press **characterized by** that when the area ratio in the high brightness region of the reflected light calculated by the control means is high, a dampening water supply of the dampening water device is controlled such that an appropriate emulsification state of ink is obtained.

2. A printing system of the offset rotary press according to claim 1,
   wherein the light source irradiates the irradiation light of a specific wavelength, and the camera shoots only the reflected light of the specific wavelength.

3. A printing system of the offset rotary press according to claim 1 or 2,
   wherein a temperature of the dampening water supplied by the dampening water device and a temperature of the ink supplied by an ink device are kept constant.

4. A printing system of the offset rotary press according to any one of claims 1 to 3,
   wherein the light source is a high color rendering LED.

5. A printing system of the offset rotary press according to any one of claims 1 to 4,
   wherein the control means repeatedly calculates an area ratio of the high brightness region of the reflected light and stores it during print executing, mechanically learns a control model in which the dampening water of the emulsification state of ink can be optimized according to the stored area ratio and updates to a control model in which the appropriate emulsification state of ink can be obtained according to the calculated area ratio.

6. A printing system of the offset rotary press according to claim 5,
   wherein the control means stores, in addition to the area ratio, information on at least one or more selected from operation status of the offset rotary press, detection information on printing results, temperature and humidity, and mechanically learns the control model using the stored area ratio and stored information other than the area ratio and updates to a control model corresponding to the information.

7. A printing system of the offset rotary press according to claim 6,
   wherein the operation status of the offset rotary press includes information on at least one or more selected from a dampening water supply amount at the start of printing, an ink supply amount at the start of printing, information on a pattern to be printed, a printing speed during printing, the dampening water supply amount during printing, and the ink supply amount during printing.

8. A printing system of the offset rotary press according to claim 6 or 7,
   wherein the detection information on printing result includes information on at least one or more selected from, a dot shape, a dot area ratio and ink concentration which are detected from the printing results.

9. A printing system of the offset rotary press according to any one of claims 6 to 8,
   wherein the information on temperature and humidity includes information on at least one or more selected from a dampening water temperature at the start of printing, an ink temperature at the start of printing, an oscillating roller water flow temperature at the start of printing, a plate cylinder water flow temperature at the start of printing, a temperature inside the factory at the start of printing, humidity inside the factory at the start of printing, the dampening water temperature during printing, the ink temperature during printing, the oscillating roller water flow temperature during printing, the plate cylinder water flow temperature during printing, the temperature inside the factory during printing, and the humidity inside the factory during printing.

10. A printing system of the offset rotary press according to any one of claims 5 to 9,

wherein the control model is updated on a cloud server independent of the offset rotary press.

11. A printing system of the offset rotary press according to any one of claims 5 to 9,
wherein the control model can be updated by a control device in the offset rotary machine.

12. A printing system of the offset rotary press according to any one of claims 5 to 9,
wherein the dampening water of the dampening water device is controlled using the updated control model.

13. An offset rotary press comprising the printing system according to any one of claims 1 to 12.

FIG. 1

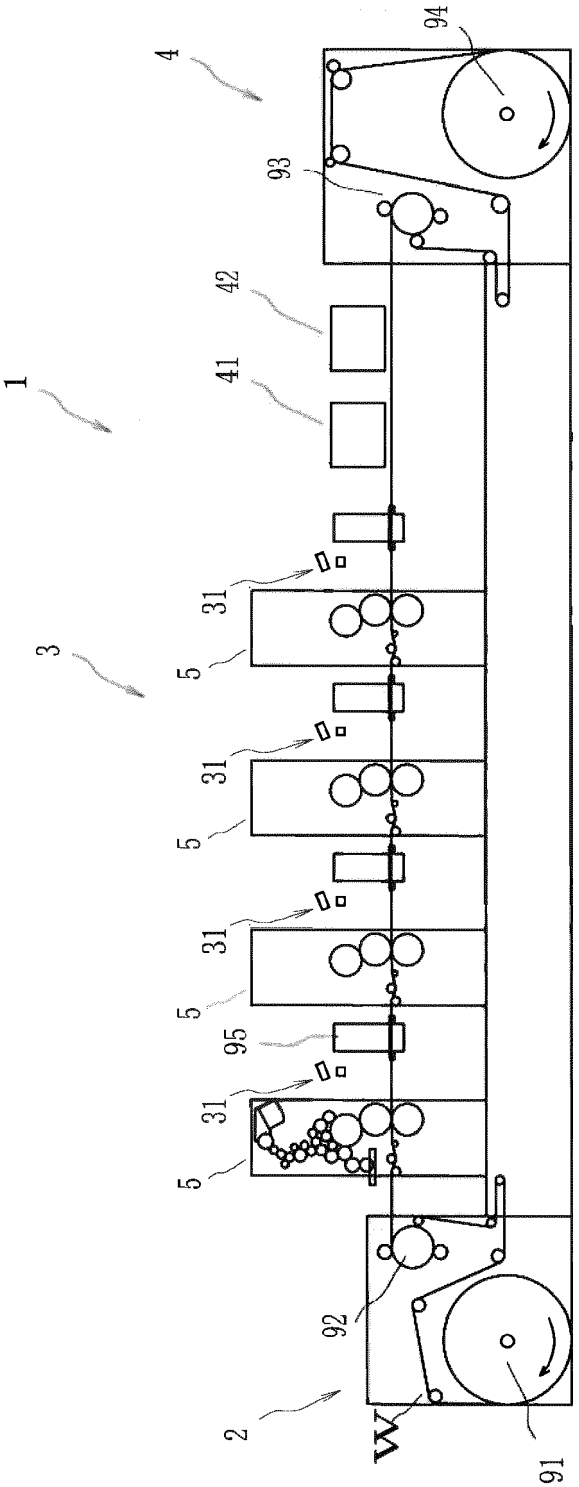


FIG. 2

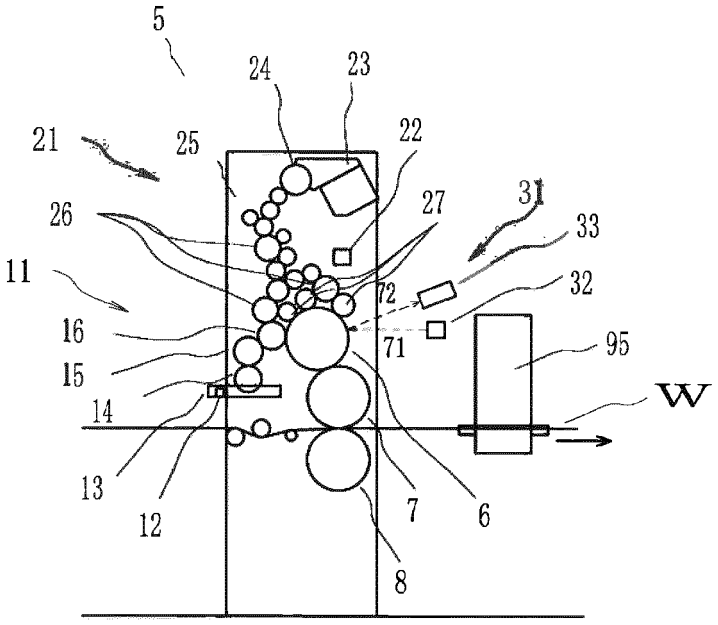


FIG. 3

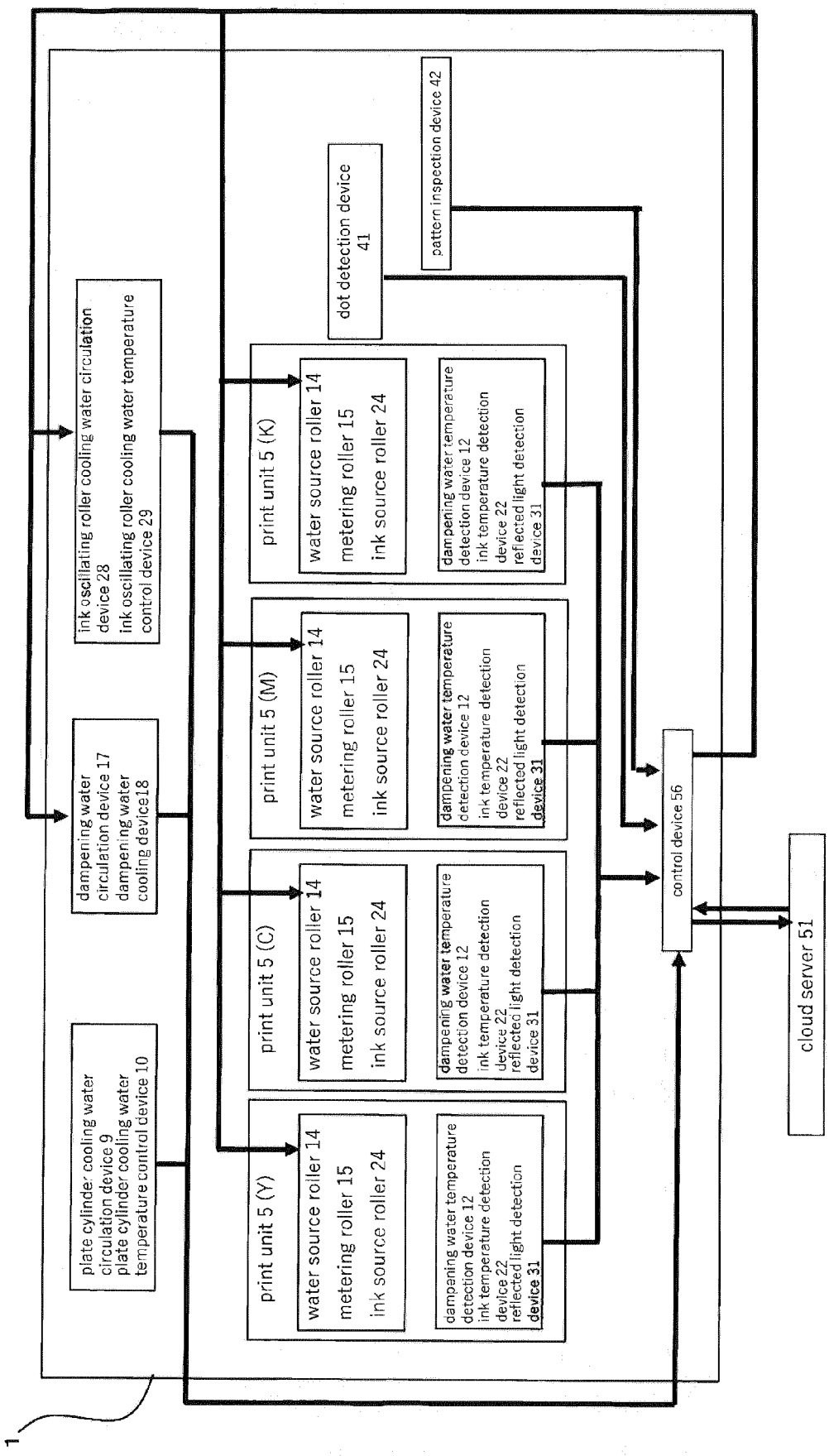

1
plate cylinder cooling water circulation device 9
plate cylinder cooling water temperature control device 10
dampening water circulation device 17
dampening water cooling device18
ink oscillating roller cooling water circulation device 28
ink oscillating roller cooling water temperature control device 29
print unit 5 (Y)
water source roller 14
metering roller 15
ink source roller 24
dampening water temperature detection device 12
ink temperature detection device 22
reflected light detection device 31
print unit 5 (C)
water source roller 14
metering roller 15
ink source roller 24
dampening water temperature detection device 12
ink temperature detection device 22
reflected light detection device 31
print unit 5 (M)
water source roller 14
metering roller 15
ink source roller 24
dampening water temperature detection device 12
ink temperature detection device 22
reflected light detection device 31
print unit 5 (K)
water source roller 14
metering roller 15
ink source roller 24
dampening water temperature detection device 12
ink temperature detection device 22
reflected light detection device 31
dot detection device 41
pattern inspection device 42
control device 56
cloud server 51

FIG. 4

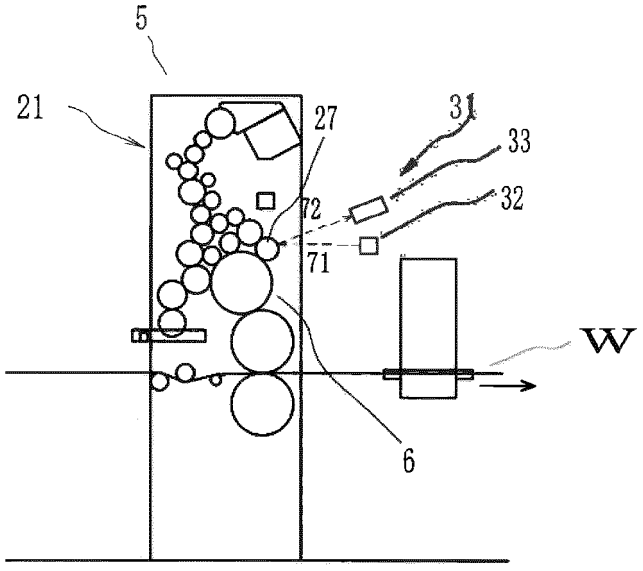
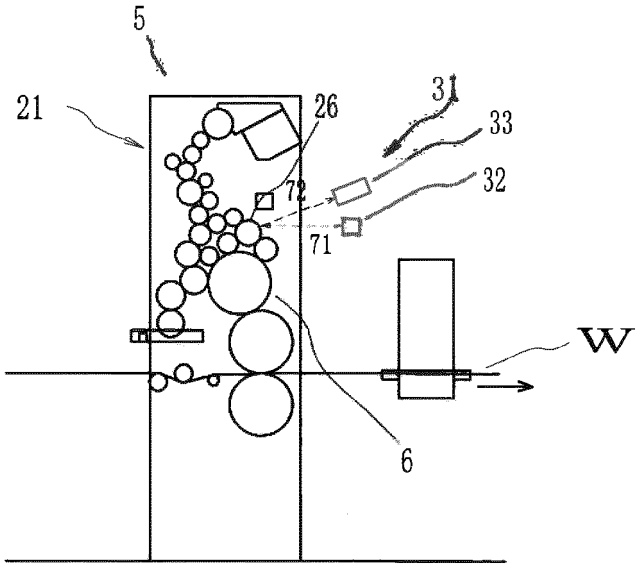


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 9680

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			B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	5 March 2023	Durucan, Emrullah

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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