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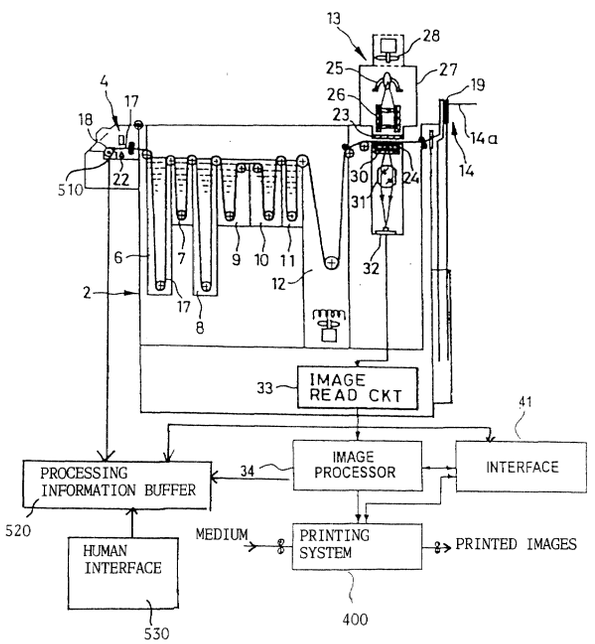
(54) System for printing digitised images

(57) Photo printer system for printing photographic images comprising: a data provider for providing image data representing a plurality of images, a plurality of printing modules, each printing module being capable of receiving image data from the data provider and printing at least one image of said plurality of images on a medium based on the received image data, a receptor which receives the printed images from the printing modules.

Fig. 2



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Description

[0001] The present invention relates to a photo printer system using at least one printer, e.g. ink-jet printer, and more particularly to a photo printer system for making a hard copy such as a photo print of a photographic image obtained from a data source like e.g. an electronic memory, a data net work, or an exposed photographic film.

[0002] The term photographic relates to the capturing of images by means of electromagnetic radiation (in particular light) by means of image capturing devices, e.g. still cameras, video cameras.

[0003] The field of the present invention relates to the processing of image data which represent photographic images and in particular to the printing of the photographic images on suitable media. The photographic image information which represents the image is usually stored on a photographic film. These kind of image information may then be digitalised e.g. by means of a scanner. Of course, the present invention also relates to the processing of image information which has been captured digitally by means of e.g. a digital still camera, comprising e.g. a CCD chip. The digitalised or digital image data may be stored in typical digital storing media, e.g. CD or DVD or memory stick etc. or may be transferred via a network (e.g. LAN or internet).

[0004] During the capturing of the photographic image, additionally to the image data, additional data may be collected, e.g. the position or number of the image in a sequence of images, the film type, optical details of the image capturing etc. The present invention also relates to the suitable handling of these additional data in a photo finishing system or a photographic laboratory, e.g. a so called minilab at least as far as these additional data relate to the processing of image information and are therefore called processing data. Processing data also relate to particular wishes of the customer concerning the processing of the image data, e.g. a format of a print.. A minilab is a photographic laboratory which allows the processing of image data and the visualizing of image data on a suitable medium. In contrary to a conventional photographic laboratory, a minilab has smaller spatial dimensions. In particular the standing area of a minilab is only a few square meters or even less than a square meter.

[0005] A conventional photographic laboratory or conventional photo finishing system, such as a photographic mini-lab, is described in US 5,432,580 and is explained with reference to figs. 5 and 6.

[0006] Fig. 5 shows a known photo finishing system and is constructed of a film processor 2 and a printer processor 3.

[0007] The film processor 2 has a film setting unit 4, various processing vessels 6 to 11, a drying unit 12, an image pickup unit 13, and a film stacker unit 14. An exposed photographic film, e.g. a color negative film 17, is wound up and accommodated within a cassette 18. In developing the color negative film 17, first the leader of the color negative film 17 is pulled out of the cassette 18 by using a known leader catching jig and the leader is joined with a leader sheet 19. The leader sheet 19 has perforations formed at the center thereof at an equal pitch. These perforations engage with an endless belt or sprocket having a number of protrusions also formed at the same pitch. Through this engagement, the film 17 is transported into the film processor 2.

[0008] The film setting unit 4 is loaded with the cassette 18 having the leader of the color negative film 17 joined to the leader sheet 19. As the leader sheet 19 advances, the color negative film 17 is pulled out of the cassette 18 and guided through the various processing vessels 6 to 11. When the color negative film 17 is completely pulled out of the cassette 18, the film trailing end is cut by a cutter 22 to separate the color negative film 17 from the cassette 18. As is well known, the processing vessels 6 to 11 include a color development vessel 6, a bleach vessel 7, a bleach-fix vessel 8, super rinsing vessels 9 and 10, and a stabilizing vessel 11. The negative film 17, after being processed in the processing vessels 6 to 11, is dried with hot air in the drying unit 12. The leader sheet 19 of the color negative film 17 exiting from the drying unit 12 is held by a hook 14a of the film stacker unit 14, after signals representing images of original frames of the film 17 have been generated by the image pickup unit 13 in the manner described below.

[0009] The color negative film 17 enters the image pickup unit 13 immediately past the drying process and passes between two transparent glass plates 23 and 24 and the images of original frames are read. In order to read the images of original frames, a light source unit 27, made of a lamp 25 and condensor lens unit 26, is mounted above the transparent glass plate 23. A cooling fan 28 is provided to circulate air around the lamp 25. Mounted under the transparent glass plate 24 are a slit plate 30, a lens 31, and a CCD line sensor 32. A narrow slit is formed in the slit plate 30 in the widthwise direction of the color negative film 17. Light passed through the color negative film 17 under transportation falls incident on the light-receiving surface of the color line sensor 32 via the slit plate 30 and lens 31.

[0010] The color line sensor 32 is constructed of a number of CCD elements disposed in a matrix and R, G, and B color mosaic filters mounted on each CCD line. Instead of a color image line sensor for reading an image, line-by-line, synchronously with the film advance, a color image area sensor may be used for reading an entire image of a film at one time. An image read circuit 33 drives the color line sensor 32 to read the image data corresponding to one line of the image on the film. This image data is sent to the printer-processor 3.

[0011] In the printer-processor 3, an image processing unit 34 processes the image data sent from the film processor 2. At the image processing unit 34, the color and density are corrected in a known manner. The image data with the corrected color and density is sent to a video printer unit 35 for printing and exposing a color

photographic paper 36 developed by a paper processor unit 37 and cut by a cutter 38 and ejected onto tray 39.

[0012] Fig. 6 shows a printer-processor of the prior art for performing color negative film printing and video printing.

[0013] This printer-processor has a first exposure system 70 using the developed color negative film 17, and a second exposure system 76, whereby three color image data supplied from the film processor is displayed on a monochrome CRT 71 to perform three color frame sequential exposure while respectively inserting three color filters 72 to 74 into a print optical path 75. The first exposure system 70 is mainly used for extra printing of additional photoprints from previously processed film, and the second exposure system 76 is used for developing a new exposed photographic film and making photoprints.

[0014] In the first exposure system 70, the light source unit 80 applies light to a frame of the color negative film 17 to be printed, and focuses the light via a print lens 81 onto a color photographic paper 82, to thereby print the image frame onto the paper 82. The light source unit 80 has a light source 83, three color filters 84 to 86 for controlling the light intensity and balance of the light source 83 corresponding to each color, a color filter driving unit 88 for inserting the three color filters 84 to 86 into a print optical path 87, and a mixing box 89 for uniformly diffusing a printing light having controlled intensity and color balance. The color negative film 17 is set on a film carrier 90 which, as well known, sets the frame to be printed at a printing position.

[0015] The second exposure system 76 has the monochrome CRT 71, a printing lens 95 for focusing an image displayed on CRT 71 onto a color photographic paper 82, and a filter setting unit 96 for the three color frame sequential exposure of the image displayed on CRT 71 onto the color paper 82. A mirror 97 is mounted so as to be movable into and out of the print optical path 87 to focus an image to the color paper 82, by selecting one of the first and second exposure systems 70 and 76. A selecting unit 98 operates to set the mirror 97 either to a retracted position from the print optical path 87 or to a position where the mirror 97 is inserted into the print optical path 87 at an inclined angle of 45 degrees. Instead of the mirror 97 and selecting unit 98, a half mirror or half prism may be used to direct light in a known manner. TV camera 100 is used to display the image and the color negative film 17 on a monitor CRT 101. Reference numeral 102 represents a shutter driver for opening and closing a shutter 103.

[0016] A printed color paper 82 is transported to a paper processor unit 105 having a paper reservoir 106 for reserving a loop of the color paper 82 so as to absorb a difference between the printing speed and paper developing speed. The reserved color paper 82 of a predetermined length is thereafter developed at processing vessels 107 to 111, dried by a dryer drum 113, cut into each frame by a cutter 114, and ejected onto a print tray 115.

[0017] It is the object of the present invention to provide a photo printer system and a photographic laboratory which increases the printing speed and improves the printing quality.

[0018] The above object is solved by the subject-matter of the claims 1 and 14.

[0019] The photo printer system of the present invention comprises a image data source or data provider which provides the image data for the printing modules. Preferably the data provider supplies the image data to at least most of the printing modules in order to constitute a centralized image data provider for all of the printing modules or at least most of the printing modules. The data provider receives the image data for instance directly from a network or from an image data processor. Preferably the data provider receives not only image data but additionally processing data which are assigned image by image to the different image data. The processing data define characteristics of the images relevant for the printing process and/or for the sequence, according to which the images have to be output from the photo printer system. For instance, the processing data define the format of the image or the position of the image in a set of images.

[0020] The photo printer system of the present invention has a plurality of printing modules. Each printing module has at least one printer unit which is able to print an image on a medium. Preferably the medium is sheet material. The printing modules perform the printing based on image data which are received from the image data source and which respectively represent a photographic image.

[0021] The photo printer system of the present invention further comprises a receptor or collector which receives or collects the media or sheet materials received from the different printing modules. The medium or sheet material usually carries an image printed by the printing module. Preferably the medium or sheet material is transported mechanically from a printing module to the collector. The collector may e.g. stack and/or sort and/or relay the received medium or sheet material. Thus the data provider preferably represents a bottle neck for received image data (and processing data) while the receptor or collector preferably represents a bottle neck for the physical transport of the printed images. Between these bottle necks there is a (parallel) transformation of the image data into the printed images by means of the plurality of printing modules.

[0022] Preferably a controller is provided in order to control the image data flow from the image data provider to the printing modules and/or in order to control the physical transport of the medium or sheet materials from the printing modules to the collector. Preferably the controller controls the timing of the data transmission from the image data source to the printing modules and/or the timing of the (parallel) printing process of the printing modules and/or the timing of the transport of the printing

sheets on the printing modules to the collector. The control of the afore-mentioned timing is preferably such that the transformation of image data into printed images is performed at an optimal rate under given conditions. For this purpose, the controller preferably performs an imagewise distribution of the image data based on the transformation rate of each printing module which describes the speed of transformation of the image data into the image for each printing module. The transformation rate may be calculated based on type of printing module, format of image to be printed, amount of image data which represent an image and/or type of image data (e.g. kind of colors and abundance of certain colors). The controller may further optimize the transformation rate of the printer system based on the lengths of the conveyance path from each printing module to the collector and/or based on the time needed to transfer the data of an image from the data provider to a printing module. The lengths of the conveyance path depends on the special arrangement of the printing modules relative to the collector.

[0023] The image data may be distributed among the different printing modules such that the printing data which have arrived first at the image data source are first output to one of the printing modules. Preferably the controller decides the distribution of the image data based on the status of the progress of printing of each of the printing modules or based on the availability of each printer to receive new image data for printing. For this purpose the controller may (regularly) contact each printing module in order to get information about the availability of the printing module or the progress of printing. Alternatively or additionally the printing modules may (regularly) report on their progress or on their availability. For instance, the printers may issue a signal to the controller if they have completed a printing process and are now available to print a new image.

[0024] The receptor or collector of the present invention may have sorter functions or may comprise a sorter in order to sort the images printed on the sheet materials in accordance with a preferred sequence. Furthermore, the collector may distribute or relay the sheet materials on different trays. Preferably the controller controls the distribution of the image data and the collection of the printed images such that the printed images carried on sheet materials or a medium arrive in a sequence which corresponds to the sequence of arrival of the image data at the data provider or is a function of the arrival sequence. For this purpose, the controller preferably monitors or notes the sequence of arrival of the image data in the image data source by means of communication with the data provider.

[0025] The controller may control the printing modules in line with the output of the image data from the data provider to the printing modules and the corresponding timing. Alternatively or additionally the controller may control the printing modules based on processing information or processing data. These processing data (also referred to as "processing information" in the following) relate the each single image or to a set of images. The processing information relates to the processing of the image data by means of the photo printer system of the present invention. For instance, if the data source is a buffer for buffering the incoming image data, the processing information allow to identify the position of a particular image in a sequence of image data received by the data source. In this case, the data provider may generate the position number or corresponding position information. Alternatively or additionally the data source may receive processing information and may relay the processing information to the controller, or the processing information is directly input into the controller.

[0026] The controller may consist of a number of control units which communicate with each other, e.g. via a bus. For instance, a control unit may be assigned to the data source, another control unit may be assigned to the printing modules and a further control unit may be assigned to the monitor.

[0027] Besides the definition of a position of an image in a sequence, the possessing information may additionally or alternatively relate to other processing relevant aspects.

[0028] For instance, the processing information may define to which set of images a certain image belongs. For instance, a set of images is defined by images which belong to a film strip which was processed and scanned and which belongs to a certain film cartridge. If the photographic image information was produced by means of a APS camera, the requested format of each image is encoded in a magnetic code information of the film cartridge. The format requested by the customer, e.g. H (HDTV) C (classic) and P (panoramic), represents processing information which is assigned to the corresponding image. Depending on the requested format, a printing module is selected by the controller which is capable of printing images of that format. Furthermore, the controller causes the printing module to print the image data on a medium having a suitable format. Alternatively the format information may be transferred from the data provider to the printing module in order to cause the printing module to print the image in the requested format. Furthermore, the controller may select a certain printing module, which is suitable for printing index prints and may choose a particular position in the sequence of printed images for the index print. A index print represents a low resolution print of a set of images (thumb nail pictures).

[0029] A customer may also prefer a particular quality of the medium on which the image is printed. For instance, the light reflectance of the medium may be different. In this case the controller selects a suitable printing module which is capable of printing the image on the requested medium.

[0030] The processing information may further contain information about the date or time of image capture.

Based on this information, the controller may cause the data source and the printing modules to print the images chronologically or may cause the receptor, if the receptor has a sorting function, to sort the printed images chronologically. Furthermore the controller may cause a printing module to print the time and/or date on the medium.

[0031] The type of film and/or type of camera used for the image capturing may have an influence on the color spectrum or color values represented by the image data. The controller may choose, based on this kind of possessing information, a printing module which harmonizes with the particular type of film or camera in order to achieve the best possible printing quality.

[0032] The processing information may also identify the customer (e.g. name, address). In this way stored preferences of the customer may be used for the processing.

[0033] The camera settings, e.g. the use of a flash, the f-number, periods of exposure time and so on may have an influence on the characteristic of the image. Certain printing modules may be adapted to achieve the best printing results for the different characteristics. The controller selects the best suitable printing modules based on this information.

[0034] The type of an image may be analyzed in an image processor which processes the image data before they are transferred to the data source. The type of image may for instance be classified in different classes, e.g. images dominated by human persons, image dominated by blue sky, images dominated by landscape, image captured at night by using a flash etc. This classification may be performed by an image analysator which analyses for instance the spectral distribution of color values in the image or the spatial distribution of the color values in the image. Depending on the type of image, particular colors or dyes used for the printing are most suitable. The different printing modules may be constituted such that they respectively print the images by using respectively different kind of colors (e.g. inks or dyes). For instance, a particular printing module can be able to use a special color which represents the color of the human skin. Another printing module may have a color which best represents the blue of the sky etc. The controller selects that printing module which is most suitable to print the image of a certain type or class.

[0035] There may be other customers specific preferences which are defined by the processing information. For instance, a certain customer may prefer images having a sharp contrast another may prefer smooth images. Depending on this, a corresponding printer may be choosen which best reflects to the preference of the customer.

[0036] The time, a printer module needs, to print a certain image, may depend on the type of the printing module, the format to be printed and/or the image data of the image to be printed. The controller preferably estimates the time a printer needs for printing a particular image based on at least some of those conditions. Based on this estimation, the printer distributes the image data in order to increase the through put and/or in order to achieve a preferred sequence of printed images output by the plurality of modules.

[0037] Preferably the photo printing system of the present invention comprises a monitor. This monitor is preferably arranged such that it may monitor or detect or sense printed images printed by different printing modules. For instance, the monitor is arranged at or after the receptor.

[0038] The monitor preferably monitors the printed images optically. For instance, the monitor may detect the color density of the images, the spectrum of the images or spatial information, like the format of the image, the arrangement or registration of the image on the medium (e.g. skip or shift of the image on the medium) etc. The monitor may perform the detection with high or low spatial resolution, i.e. the monitor may detect the image as a whole or may even detect the colors of single dots of the images. The monitor may further sense, e.g. optically or mechanically, the position of the medium (e.g. sheet material). The monitor may be implemented by means of a camera (CCD) and/or spectrometer.

[0039] Preferably the monitor communicates the detection results with the printing modules. This communication may be performed directly for via a control unit. This control unit may be part of the above-mentioned controller. Preferably the monitoring data are related to the printing module which has produced the image to which has been analyzed by the monitor. This assignment between the monitor data and the printing module may be for instance performed by marks placed on the medium. Each mark is preferably typical for the printing module such that the printing module may be identified based on the mark. Additionally or alternatively, the controller may assign the printing module to the monitor data based on the control of the medium transport and/or based on the control or monitoring of the timing of the printing process, of the distribution of printed images and/or of the reception process of printed images.

[0040] By assigning the monitoring data to the particular printing module, the controller may influence the printing of the different printing modules in correspondence with the monitoring data assigned to the printing module. In particular, the controller may initiate a test printing process which results in the print art of test images by the printing modules. This test print out allows to assess the quality of the images printed by the different printing modules by relating the monitoring data to the different printing modules and by analyzing the monitoring data e.g. by the controller or by a separate monitoring data analyzer.

[0041] Preferably the controller changes the distribution of the image data based on the analysation result. For instance, the controller bypasses a printing module in the process of transforming image data into printed images if the quality of the images printed by the printing

module are below a certain value. The quality of the image is assessed based on the monitoring data assigned to the printing module. Alternatively, the controller may cause the printing module to perform some self maintenance operations like a cleaning process of the nozzles in the case of an ink jet printer. The controller may also cause the printing module to change the assignment of image data to image dot producing members. Image dot producing members are for instance the nozzles of the ink jet printer. In a laser printer, the image dot producing members are lasers. By changing the assignment of image data to the image dot producing members, the errorness image dot producing members may be bypassed. In other words the task of the errorness image dot producing member is performed by another image dot producing member. In order to identify a errorness image dot producing member, the monitor preferably detects each dot of a printed image. The controller may assign the particular dots of the printed image to the image dot producing member based on the image data used for printing the image and based on information about the assignment of image data to image dot producing members in the printing modules. As already mentioned above, the controller may be decentralized, in other words there may be a plurality of different control units which perform the above-mentioned tasks.

[0042] The controller may cause the issuance of a warning signal or may start a certain control process if the quality of an image is below a predetermined threshold value. If for instance the printed image is skipped relative to the medium a warning signal is issued. An operator may then check the paper supply to the respective printing module. A certain angle of skipping may serve as a threshold value. Correspondingly, a certain deviation of a color value of a certain dot measured by the monitoring device from a target color value assigned to the dot based on the corresponding image data may represent a threshold value.

[0043] The controller may even communicate with the image processor which provides the image data to the data source. The controller may cause the image processor to change the image processing of image data of a certain image in dependence on the printing module which the controller assigns to the certain image. This change of image processing may be based on the monitoring data in order to achieve a best match between the capability of the printing module and the image data assigned to the printing module.

[0044] The medium used for printing the images may be for instance paper or foils. The medium may be sheet like material or a web. In the case of sheet like material or cut sheets, the different sheets from the different printing modules are collected by the receptor. In the case of web material, a plurality of printing modules may be disposed along the web in order to print a plurality of images (in parallel). The web is than received by the receptor. The following description relates, as an example only, to the use of ink jet printers and sheet like material.

[0045] The photo printer system of the present invention can be embodied in a compact apparatus, like a mini-lab, and comprises an image data source for providing image data, which can be a film processor including one or more features of the film processor described above which can have a developing unit and a drying unit to execute a developing process and a drying process of an exposed photographic film. The apparatus can be arranged so as to perform simultaneously the developing and drying process to process exposed photographic films in a continuous manner. The processed photographic film is then transformed by an image scanner, which can be a line scanner or a scanner using arrays of picture sensing elements, such as CCD devices, into image signals which can have any physical representation, like being electrical signals, optical signals in an optical fibre and so on. The thus generated electrical image signal representing the image data of the processed photographic film is then transferred to at least one ink-jet printer for printing the image on a sheet material to obtain a hard copy or photoprint of the image of the exposed photographic film. The image data source can also be a data source providing directly digital data, e.g. a memory device like a memory stick or the memory of a digital camera, or a data network, like the Internet, so that a user can transmit image data. The present invention may use any kind of printer (e.g. laser printer, DMD printer) however, ink jet printer are preferred. The use of an ink-jet printer for printing images as hard copies is advantageous compared to the above described technology using color filters and CRT devices, since an ink-jet printer is more compact and allows therefore the construction of a smaller and more compact photo finishing system compared to the known prior art photo finishing systems. Additionally, ink-jet printers are advantageous regarding maintenance and reliability, since less mechanical complicated devices are used in ink-jet printers compared to the above-described technology being based on various different elements, like a mirror, color filters and CRT devices. This leads to an ecological advantage, since the production of the inventive system consumes less resources. Furthermore, the operation of ink-jet printers is also ecologically advantageous compared to the prior art technology, since less chemicals are used. There is for example no need for a specific fluid in processing vessels, as required by the prior art technology.

[0046] In a preferred embodiment a multiplicity of printers (e.g. ink-jet printers) for printing images on sheet material in accordance with the image data are provided. It is advantageous to arrange the printers (e. g. ink-jet printers) in modules having input and output devices for the sheet material so that two or more modules each comprising at least one printer can be put together or stacked in a simple manner so that sheet material can be distributed to the respective modules and can be sorted, preferably by a sheet distributing means arranged in the modules, after the printing process is

finished. Alternatively each module may have its own source of sheet material. The sheet material sources belonging to each module may have the same format for each module or may have different formats. The sheet input and sheet output devices for distributing the sheet material are preferably arranged at basically the same place in each module so that in a defined arrangement of these modules, like stacking the modules, the sheet input and sheet output devices can interact with sheet input and sheet output devices of an adjacent module. Although it is advantageous to arrange the sheet input and sheet output devices in basically the same place in each module, ink-jet printers of a different type can be arranged in different modules to print pictures in different desired formats or different qualities as, for example, low resolution pictures or high resolution pictures.

[0047] In a preferred embodiment, the sheet distributing means as, for example, sheet input or sheet output devices, are switching elements, which can receive a sheet material at an input of the switching element or can transport the sheet material to one of at least two outputs of the switching element, depending on control signals applied to the switching element. In general, the input or output devices can be switched electronically or by a software. For example, a multiplicity of modules each comprising at least one ink-jet printer and at least one input switching elements are stacked, and input sheet material is forwarded to the input of the input switching element of a first module and then transported either to a first output of the switching element, which is connected to the printer of the module or transported to a second output of the switching element to be entered into the input of a switching element of an adjacent module, depending on control signals based on customer requirements regarding the image to be printed. In such a manner, a sheet material can be transported to a specific printer in a stack of modules. Using the same mechanism for the output of the respective printers in each module, an output switching element can be provided in each module to transport the printed image to a tray located at the module or to trays located at other modules, or to an output sorter to sort the printed images according to user requirements.

[0048] In an embodiment, several devices for feeding sheet material, like roll feed devices or devices for feeding sheets already cut into different formats are provided. Thus, e.g. each printer might have one or more separate sheet feeding devices to enable the printing of several formats and the use of several paper qualities, e.g. for greeting cards.

[0049] Preferably the sheet feeding devices or the sheet input devices are operated according to the distribution of print tasks by the above-mentioned controller (a printer control device or a printer control software). The output of the respective printers is switched to sort the printed images or to convey the images to the receptor (separate sorter).

[0050] In a preferred embodiment the printers in the modules are controlled by signals transmitted via a bus system. Interfaces can be provided at the respective modules to communicate via the bus system and a central controller can be provided to control the switching elements at the input and/or the output and/or the at least one ink-jet printer of each module to control a printing process such that preferably a continuous printing process using a single or more ink-jet printers can be performed.

[0051] It is advantageous that the ink supplied to the respective ink-jet printers in each module is provided at the respective modules via an ink supply line being connected to one or more central reservoirs, preferably for ink of different colors, which can, for example, be located in a basic module so that all ink-jet printers can be provided with ink from a single or more central reservoirs, which is advantageous regarding maintenance and use of the inventive photo finishing system. The ink supply line in each module can be constructed to contact the ink supply line of adjacent modules to obtain ink from a first, for example, lower module, which can on the one hand be provided to the ink-jet printer of the respective module and can on the other hand be transported to an adjacent module to feed other ink-jet printers.

[0052] In a preferred embodiment a tension cylinder is provided, which can be rotably driven, which tension cylinder comprises means for attaching or fixing sheet material, on which images should be printed by the at least one ink-jet printer of the invention, on the curved surface of the tension cylinder. The ink-jet printer can be in a fixed positional relationship to the tension cylinder. Holding means for a role of sheet material can be provided inside or outside the tension cylinder, which sheet material can be transported through a slit in the curved surface of the tension cylinder from the inside to the outside or by another conveying means onto the outside so that the automatic supply of sheet material for printing and waste of sheet material due to cutting or clipping this sheet material into different formats can be reduced. For the teaching regarding the tension cylinder and preferred embodiments thereof, reference is made to EP 1 009 158 A1 of the applicant, which is included herein by reference.

[0053] The above-mentioned tension cylinder can also be used for a multiplicity of ink-jet printers, which are, for example, stacked using the above described module technique. Thus, each single ink-jet printer or a defined group of ink-jet printers can be supplied with sheet material using one or more tension cylinders. The operation of each tension cylinder can then be controlled via a bus system, which can also transmit picture data or control signals for the printers or associated switching elements.

[0054] Alternatively or additionally, a number of print head sets may be arranged around the tension cylinder . Each print head set may be able to print one image on the web tensioned on the cylinder. In this case, each print head set belongs to a different printing module ac-

cording to the present invention. The web output by the tension cylinder is received by the receptor and preferably analyzed by the monitoring device. This monitoring device analyses the images respectively produced by different print head sets.

[0055] In a preferred embodiment an interface is provided at the inventive photo finishing system to connect this system with an external device or a data net as, for example, the Internet. Thus, picture data or instructions of a customer regarding specific features of hard copies of pictures (i.e. processing information) can be sent via the data net from a terminal, such as the personal computer of a customer, to the inventive photo finishing system. Features of the photoprint to be selected by the customer can be, for example, a specific format of the hard copy, the selection of a specific sheet material or the selection of a desired resolution or quality of the picture to be printed. Based on these customer instructions, the inventive photo finishing system can be controlled to print the desired hard copies. For instance a printing module may be selected which complies with the desired resolution.

[0056] Additionally, it is possible that an exposed photographic film of a customer can be developed and scanned to generate digital image data, which is sent to the customer via the data net using the interface. The customer can then decide which pictures should be printed. Additionally, the above-mentioned selection regarding features of the pictures to be printed, can be made by the customer and can be sent back to the photo finishing system of the invention.

[0057] The interface provided at the inventive photo finishing system or photo printer system can additionally be used for all purposes of e-commerce, like electronic payment for the development of the film and/or the printing of hard copies.

[0058] Advantageously a method and/or a corresponding program for obtaining a printed image is provided which uses the aspects disclosed herein. For instance, in a first step, image data is obtained from an image data source. This can e.g. be the processing of an exposed photographic film to obtain a printed image comprising the steps of developing the exposed photographic film, and scanning the developed film to generate image signals representing an image of the photographic film. It is also possible to use a data provider providing directly digital image data, as described above. The printing of the image is based on the generated image signal using a plurality of printing modules

[0059] The advantages of the present invention will become more apparent upon reading the detailed description of preferred embodiments in connection with the accompanying drawings, wherein:

Figure 1 is a schematic diagram showing a preferred embodiment of a photo printing system according to the present invention;

Figure 2 is a schematic diagram showing a preferred embodiment of a photographic laboratory according to the present invention;

Figure 3 is a schematic diagram showing an arrangement of a multiplicity of modules each comprising an ink jet printer stacked on each other for printing images;

Figure 4 is a perspective view of a tension cylinder;

Figure 5 is a schematic diagram showing a photo finishing system of the prior art; and

Figure 6 is a schematic diagram showing a printer processor of the prior art.

[0060] In the following, identical reference numbers designate identical or similar parts.

[0061] The photo printer system 400 of figure 1 receives processing information and image data. The processing information and image data is fed into a data provider. This data provider may comprise a storage medium or a buffer memory as well as interfaces in order to receive the data or information and in order to output the data and information. The data provider 410 is controlled by the controller 420 and outputs the image data to the printing modules 432, 434, and 436 in accordance with the control of the controller 420. The image data may be output from the data provider to the printing modules in parallel or in sequence. The controller 420 preferably controls each of the printing modules 432, 434, and 436. The printing modules 432, 434, and 436 output printed images. The printed images are carried by a medium. The medium may be single sheet material or a web. The printed images are received in a medium receptor 440. The medium receptor 440 may be a collector, a sorter, a distributor or a medium stacker. The medium receptor may additionally comprise a cutter in order to cut the medium, in particular in this case, the medium is a web. The medium receptor 440 outputs the printed images, preferably in a sequence. The printed images are checked by a monitor 450, preferably image by image. The monitor is used as a centralized quality monitor. This allows to spare respective monitors in each of the printing modules. The controller controls the monitor 450 and supervises the flow of the printed images from the printing modules to the medium receptor. In particular, the controller may determine which printed image passes at the monitor at a certain time. The monitor 450 is preferably integrated in the medium receptor and has a defined position at the transport path of the received of printed images.

[0062] The monitor 450 optically detects the printed images and transfers the detection result to the controller 420. The controller assesses the quality of the printed image based on the detection result and relates the quality to the printing module which has produced the

image. If the quality is outside of a predetermined tolerance range, the controller changes the control of the photo printer system, e.g. a maintenance operation of a certain printing module is initiated, a warning signal is issued, and/or the distribution of image data is changed.

[0063] In order to facilitate the assessment of the quality of the printing modules, preferably test patterns are printed by the printing modules. The data for the test pattern may be centrally stored in the data provider or in a separate data storage. In order to check the quality of the printing modules, the test data for the test pattern are preferably transferred to the respective printing modules upon request of the controller. The test pattern are monitored by the monitor 450 and the result of the monitoring is reported to the controller 420. In this way, the quality of the print outs may be checked by means of the controller. If for instance, the quality of some printed images were not sufficient, the print out of the test patterns allows to identify the reason for the minor quality of some of the test patterns and to identify the printing module which is responsible for the minor quality.

[0064] In the case of cut sheet material, there are respective transport path between each of the printing modules and the medium receptor. Preferably, each of the transport path comprises conveyors which are used to transport the sheet material carrying the printed image along the respective transport path. These conveyors are preferably controlled by the controller in order to achieve an optimal through put of the printed sheets and in order to achieve a desired arrival sequence of the printed images at the medium receptor.

[0065] In summary the controller may communicate with the data provider, the printing modules, conveyors, the medium receptor, and the monitor. In order to supervise the flow of image data and of printed images, the printing modules may report the controller about the arrival of image data and about the progress of printing. Furthermore, detectors and sensors may be arranged along the transport path between the printing module and the medium receptor and within the medium receptor in order to report about the actual position of each of the printed images during the transport.

[0066] Fig. 2 shows a schematic diagram of a preferred embodiment of a photo finishing system according to the present invention. As far as the photo finishing system can be constructed as known in the prior art, the same reference numerals are used for designating the same devices as shown and described in fig. 5.

[0067] The image read circuit 33 outputs data based on image data read from the processed film to the image processor 34, which can process the image signals to correct color and density or other features of the image. The image data processed by the image processor 34 is sent to the photo printer system 1 for generating a hard copy, such as a photoprint, of the image data. An interface 41 is in bidirectional communication with the image processor 34 and the ink-jet printer 40. Digital image signals output by the image processor 34 can be transferred via the interface 41 to a data network, such as the Internet, to send such image data to a customer. The customer can either further process the image data and send the further processed image data back via the interface 41 either to the image processor 34, or directly to the photo printer system 40, for obtaining a desired hard copy. Alternatively, the customer can simply send printing instructions to the inventive photo finishing system, which are translated into control signals for the photo printer system 40.

[0068] The cassette or cartridge 18 may comprise magnetic code information which relates to the firm type and image capturing. This information is read by a reader 510 and input in a processing information buffer 520. The possessing information buffer 520 may also receive possessing information from a human interface, e.g. a conventional PC comprising a monitor and a keyboard. The possessing information may also be received from the interface 41. The photo finishing system or photographic laboratory of figure 2 may also comprise a optical character reader in order to read specific processing requests of the customer, e.g. the number per image. Also this information is input as processing information into the processing information buffer 520. The image processor 34 provides the image data to the printer system 400 and the processing information buffer 520 provides the processing information to the printer system 400 which is shown in detail in figure 1.

[0069] Fig. 3 shows a stack of modules M1 to M6, each comprising ink-jet printers P1 to P6 to be used in the present invention. A basic module M0 is arranged below the module M1 and a top module M7 is disposed on the uppermost module M6 and serves as a cover element for the modules. For the arrangement, construction and function of these printer modules including their devices, reference is made to European patent application no. 00 105 345.3, "Vorrichtung zum Bedrucken von Blattmaterial", of the applicant, which is included herein by reference. In general, the shown modules represent only an embodiment of the present invention, so that e. g. a different number of printers can be employed.

[0070] Sheet material is provided on a roll R and cut by a cutter C into single sheets S. These sheets S are supplied to the basic module M0 and either printed by the ink-jet printer P0 or transferred to the adjacent module M1 depending on the setting of the first switching element WE. If the sheet material S is transferred to the adjacent module M1, it is output at the external output of the switching element WE and input to the switching element WE of the module M1. As in the switching element WE of the basic module M0, the sheet material S can either be directed to the printer P1 of the module M1 or can be directed to the switching element of the adjacent module M2 and so on. After the sheet material S is transferred to the desired printer in the desired module and printed, it is output to the output switching element WA of the respective module. Depending on the setting of the output switching element WA the sheet

material S and can be transferred to a tray F at the module or can be transferred to an adjacent module above or below the current module to output the print in an order determined by the different customers.

[0071] Each input switching element WE has an external input 1, which can be arranged to receive sheet material S in a horizontal, vertical or tilted manner. An external output 2 is provided to output the input sheet material S in a desired direction, for example, to an adjacent module. An internal output 3 is provided to output the input sheet material S to the printer P of the respective module.

[0072] The output switching element WA has an internal input 6 for obtaining printed sheet material S from the printer P, an external input 4 for inputting the sheet material from outside, for example, from an adjacent module M, a first external output 5 for outputting the sheet, for example, to an adjacent module and a second external output 7 for outputting the sheet, for example, to a tray F.

[0073] The basic module M0 has a reservoir IT for ink of different color, which can be fed via lines provided in the respective modules to the ink-jet printers P of different modules.

[0074] In general, it is advantageous to construct the modules, especially the input and output switching elements WE and WA so, that several modules can be stacked while the input and output of the switching elements WE and WA are registered, namely in a horizontal and vertical arrangement allowing the forwarding of sheets S.

[0075] Fig. 4 shows a tension cylinder 100 having a holding means 120 inside for holding sheet material M in a roll 130. A slit 140 is provided in the surface 110 of the tension cylinder to allow the sheet material M to pass from the inside of the tension cylinder 100 to the outside surface 110 thereof. A holding means 160 is disposed near the slit 140 for holding the sheet material M. After outputting the sheet material M through the slit 140 using the rolls 152 and 153, the sheet material M is guided on the surface of the tension cylinder 100 and fixed via the holding means, e.g. a clamp 160. A motor 190 is not active while transferring the sheet material M onto the outside of the tension cylinder 100. After the sheet material M is fixed by the clamp 160, the cylinder 100 is rotated in direction of the arrow D by the motor 190.

[0076] An ink-jet printer 200 having a set of several print heads 201 to 206 can print a picture onto the sheet material M. After the printing process is finished, the cylinder 100 is rotated again and the clamp 160 is moved to an open position so that the sheet material M is only held by a roll disposed outside the cylinder 100, or the motor 190, which can be in a position different from that shown in fig. 4. A cutter 170 is provided to cut the end of the printed portion of the sheet material M so that different formats of photoprints can be generated without wasting sheet material.

[0077] The tension cylinder arrangement shown in figure 4 may comprise a plurality of ink jet printers 200 arranged around the mantle of the cylinder. Each ink jet printer as a set of several print heads. Each ink jet printer represents a printing module according to the present invention.

[0078] In general any input device can be used as the image data source for providing image data. However, any combination of two our more of the shown input devices is possible. As data source for providing image data, an exposed film can be taken, which is processed and scanned. If a film already being processed is used as data source, the processing step can be omitted and the processed film can directly be scanned. Additionally, slides, prints or other graphical representations of images to be printed can be used by the present invention for generating image data by scanning the respective representation of the image to be printed or otherwise processed. Further devices for providing image data can be memory devices, like memory sticks, CDs, DVDs, magnetical discs or other known memory devices capable to store data. These memory devices can for example directly be read using for example a disc drive. Additionally, it is possible that image data be transmitted using a network, which can be any data connection from an image data source to the input device according to the present invention. Thus, for example a modem can be used to transmit image data via a telephone. Other networks, like the internet can be used to receive image data to be printed, so that an user can for example send an e-mail with image data attached to the inventive photo finishing system. It is also possible to use wireless data transmission to obtain image data from an user like for example a picture taken with a camera and transmitted via a mobile phone.

[0079] The image data obtained in the above mentioned manner is provided to an image processing device, which may be a commercial available PC. Digital data is received at a digital data input, like an interface, and optionally can be subjected to one or more processing steps, like image enhancement, wherein for example a clear image is generated from a blurred image or an aberration resulting for example from a systematic error in an imaging device like the lens system of a camera can be corrected. Other image processing steps can be the manipulation of an image, like for example the brightening of an image, or adding of artificial features, like for example artificial fog or snow if requested by a user. Furthermore, a colour management of an image can be performed, wherein the hue of colours can be adjusted or corrected, or gamma correction can be performed. The unprocessed image or image data processed by one or more of the above mentioned steps is then transmitted to a photo printer system of the present invention. Data output devices can be provided, like for example an interface to transmit processed image data via a network, like the internet. It is also possible to provide other output means, like a disk drive or other means for writing data.

[0080] In the photo printer system, a plurality of printers can print images having different features regarding format, quality and so on, depending on instructions of a user, which instructions can have the form of picture associated data transmitted separately or together with the picture image data. A first printer of the plurality of printing modules can for example print greeting cards, and a separate feeder for feeding unprinted greeting cards having a specified quality can be associated to this printer. A second printer can for example print pictures having a first format and is provided with sheet material from a role. A third printer can for example print images having a second format and is provided with sheet material being previously cut to print for example panorama prints. Further printers can be provided to print pictures based on the instructions of user. The printed pictures output of the respective printers can be conveyed to a receptor, which acts as a sorter and sorts the printed pictures in a desired order, so that for example the pictures of a first customer are output on a first tray, the picture of a second customer are output on a second tray, and so on. This distribution my be controlled by the controller which refers to the processing information. The processing information relates each image to a customer. Any other arrangement of pictures is possible, so that the sorter can for example output a first set of picture printers for a specific customer onto a first tray, a first copy of the printed pictures onto a second tray, and so on. In general the receptor or sorter acts to convey printed images provided by one or more printers on to one or more trays according to customer instructions, wherein also specific images can be stored within the sorter, if for example not all print jobs for a customer are completed and it is desired that only a full set of printed images for a customer is output onto a specific tray.

Claims

1. Photo printer system for printing photographic images comprising:

   a data provider for providing image data representing a plurality of images,
   a plurality of printing modules, each printing module being capable of receiving image data from the data provider and printing at least one image of said plurality of images on a medium based on the received image data,
   a receptor which receives the printed images from the printing modules.

2. Photo printer system of claim 1, wherein
   a controller controls distribution of the image data of the data provider among the printing modules and/or controls a sequence of arrival of the printed images at the receptor.

3. Photo printer system of claim 2, wherein
   said controller controls the distribution of the image data based on the time of arrival of the image data in the data provider and/or based on the availability of the different printer modules for printing images.

4. Photo printer system of claim 2 to 3, wherein
   the controller performs the control such that the sequence in which the image data representing images arrive at the data provider corresponds to the sequence of arrival of the printed images at the receptor.

5. Photo printer system of claim 2 to 4, wherein
   said controller performs said control based on processing information, said processing information being respectively assigned to the image data of an image or a set of images and relating to the processing of the image data by the photo printer system.

6. Photo printer system of claim 5, wherein said processing information defining at least one of the following for the images to be printed and collected: the position of the image in a sequence of images, a set of images to which the image belongs, format in which the image is to be printed, qualitiy or characteristics of the medium be used for printing, time and/or date of photographic image capture of the image, type of film and/or camera used for image capture, camera settings used for image capture, type of the image, preferred printing resolution, identification of customer, customer specific preferences for the processing.

7. Photo printer system of claim 2 to 6, wherein said controller estimates the time which each printing module needs to print the image based on the image data and performs said control based on the estimated time.

8. Photo printer system of claim 1 to 7, comprising
   a monitoring device which centrally monitors the images printed by different printing modules.

9. Photo printer system of claim 8, as far as depending on claim 2, wherein the controller receives monitoring data from the monitoring device and assignes the monitoring data to one of said printing modules which has printed the image corresponding to the monitoring data.

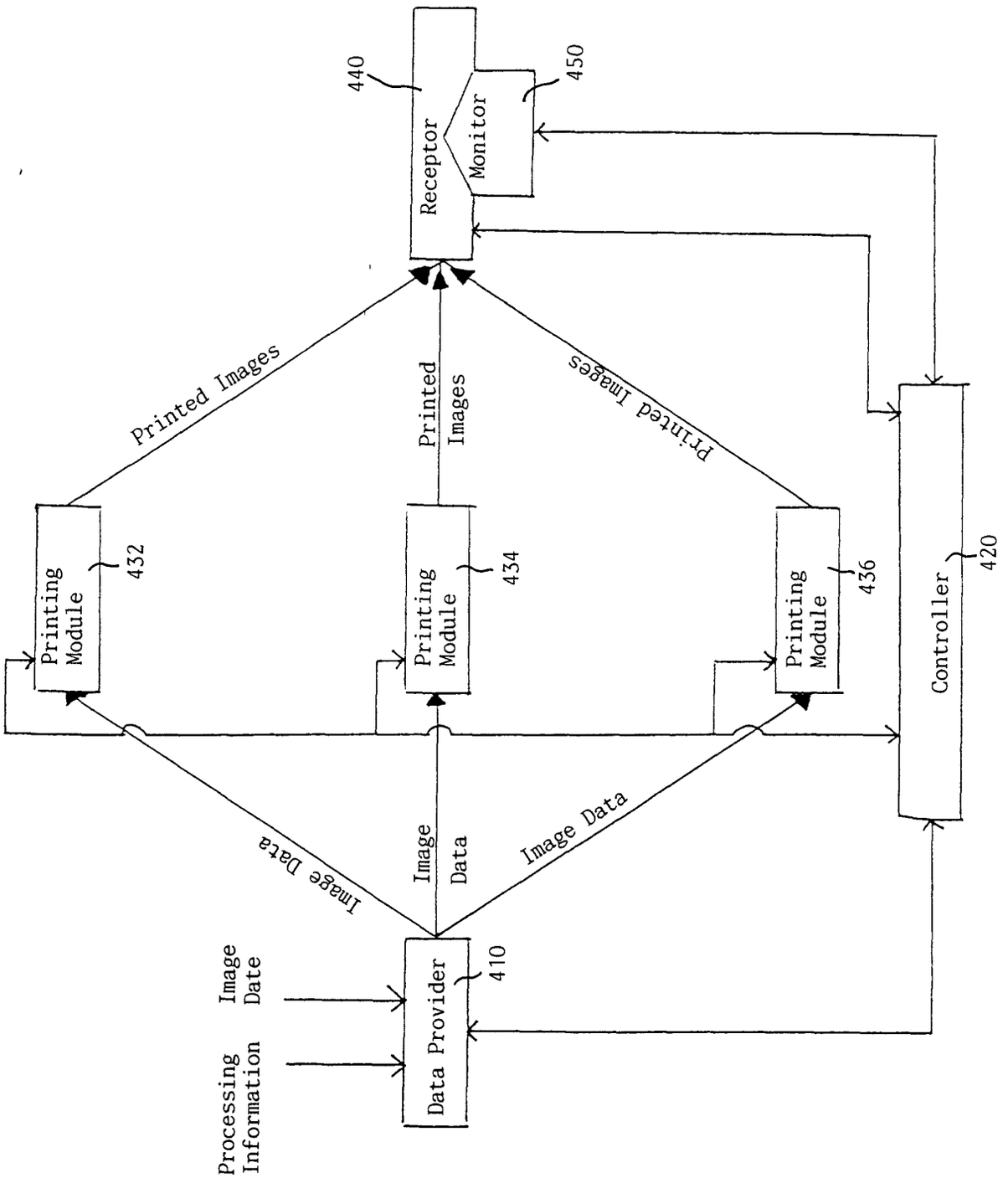
10. Photo printer system of claim of claim 9. wherein said controller performs said control of distribution of image data and/or said control of arrival of printed images based on the monitoring data.

11. Photo printer system of claim 9 or 10, wherein said controller intiates a self maintainance operation of the printing module assigned to the monitoring data if said monitoring data fullfil predetermined conditions and/or causes the printing module assigned to the monitoring data to do not further print any images and changes the distribution of image data accordingly and/or causes the printing module assigned to the monitoring data to change the assignment of image data to image dot producing members of the printing module assigned to the monitoring data and/or causes a change of image processing of those image data which are transferred to the printing module assigned to the monitoring data.

12. Photo printer system of claim 9 wherein said controller performs said assignment of the monitoring data based on the control of the arrival time of the printed images at the monitoring device or based on identification of marks printed by the printing modules on the medium.

13. Photo printer system of claim 8 to 12, wherein the monitoring device detects test patterns produced by the printing modules for allowing assessment of the printing quality of the printing modules.

14. Photo finishing system or photographic laboratory, in particular minilab comprising the photo printer system of claims 1 to 13.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Monitor
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Printed Images
Printing Module
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Printing Module
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Controller
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Image Data
Image Data
Image Data
Image Date
Processing Information
Data Provider
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Fig. 1

Fig. 2

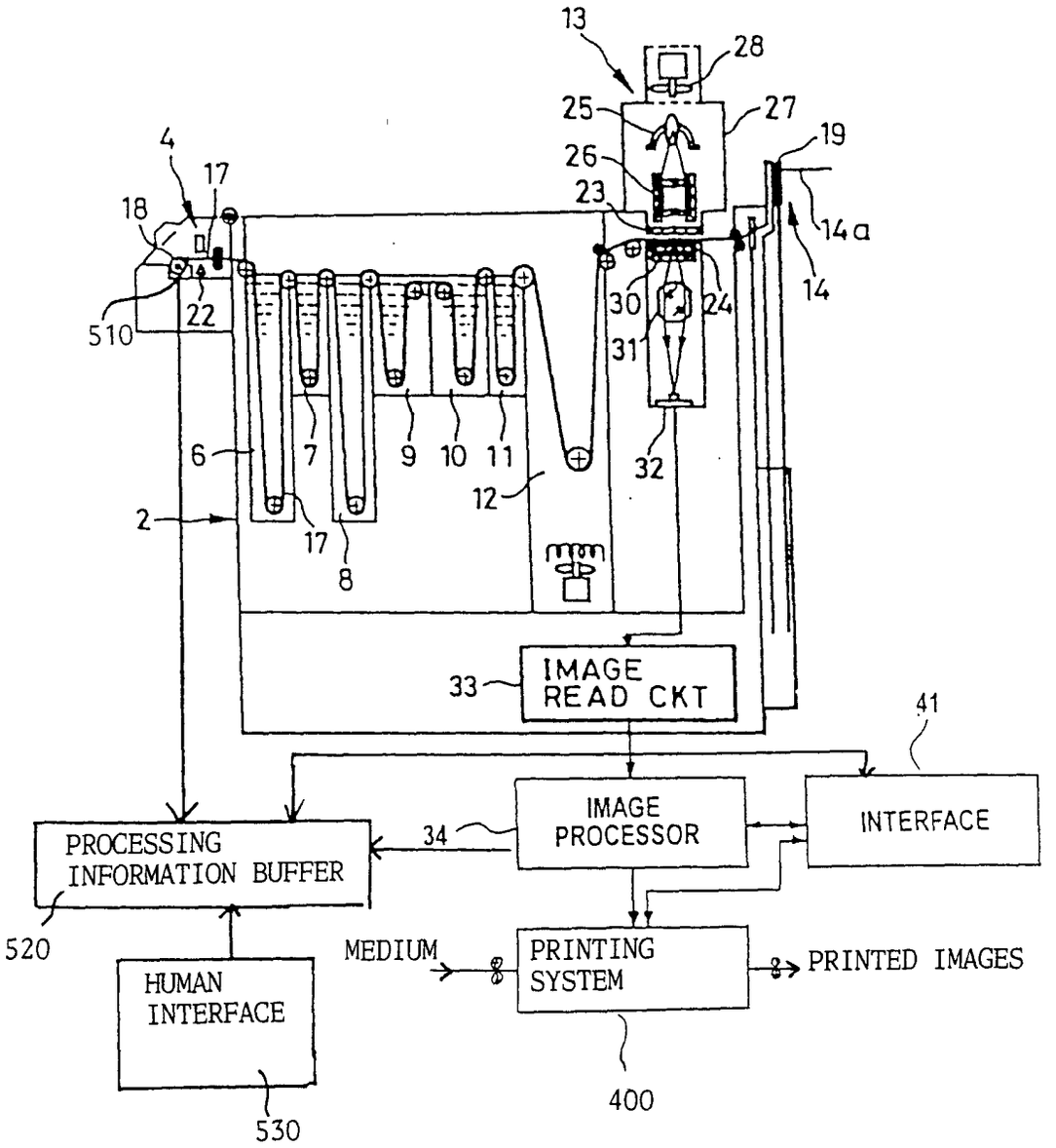
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IMAGE READ CKT
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IMAGE PROCESSOR
INTERFACE
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PROCESSING INFORMATION BUFFER
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MEDIUM
PRINTING SYSTEM
PRINTED IMAGES
HUMAN INTERFACE
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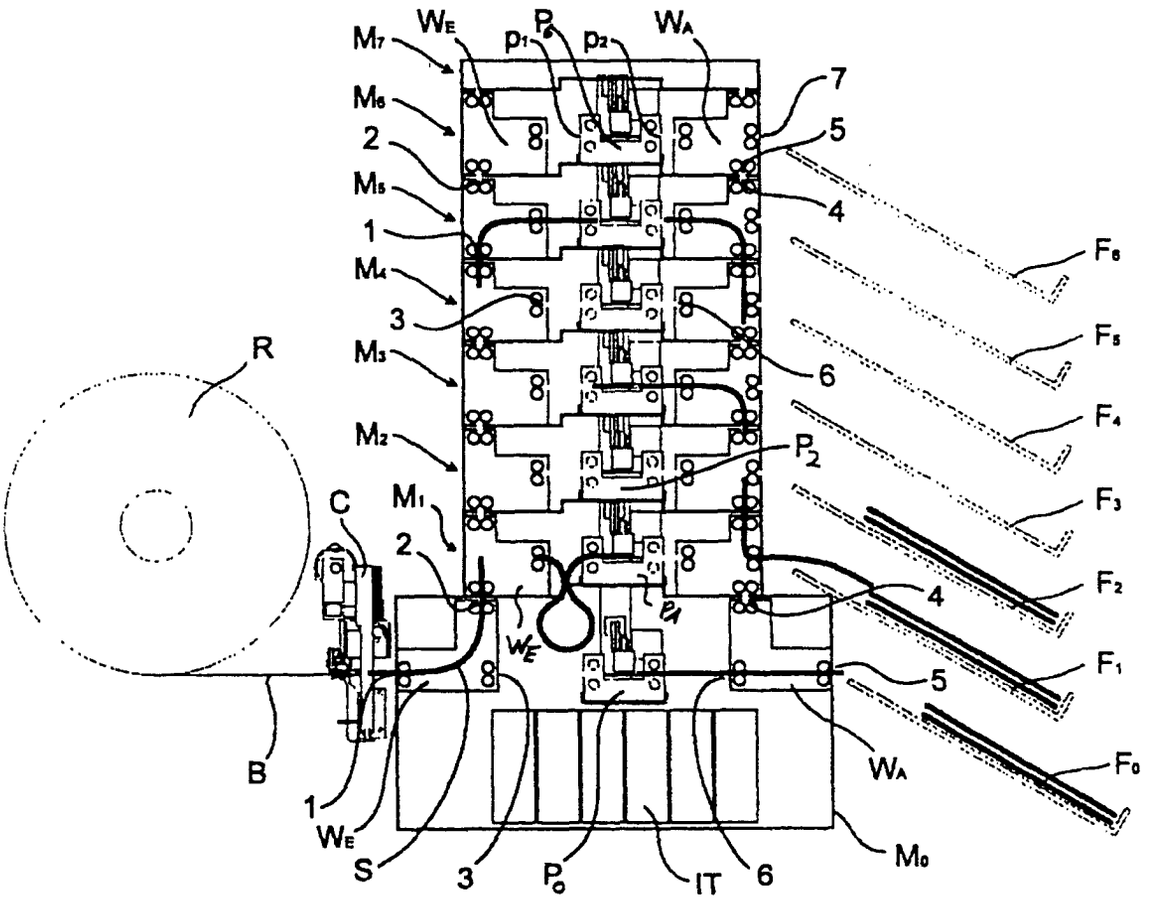
400

Fig. 3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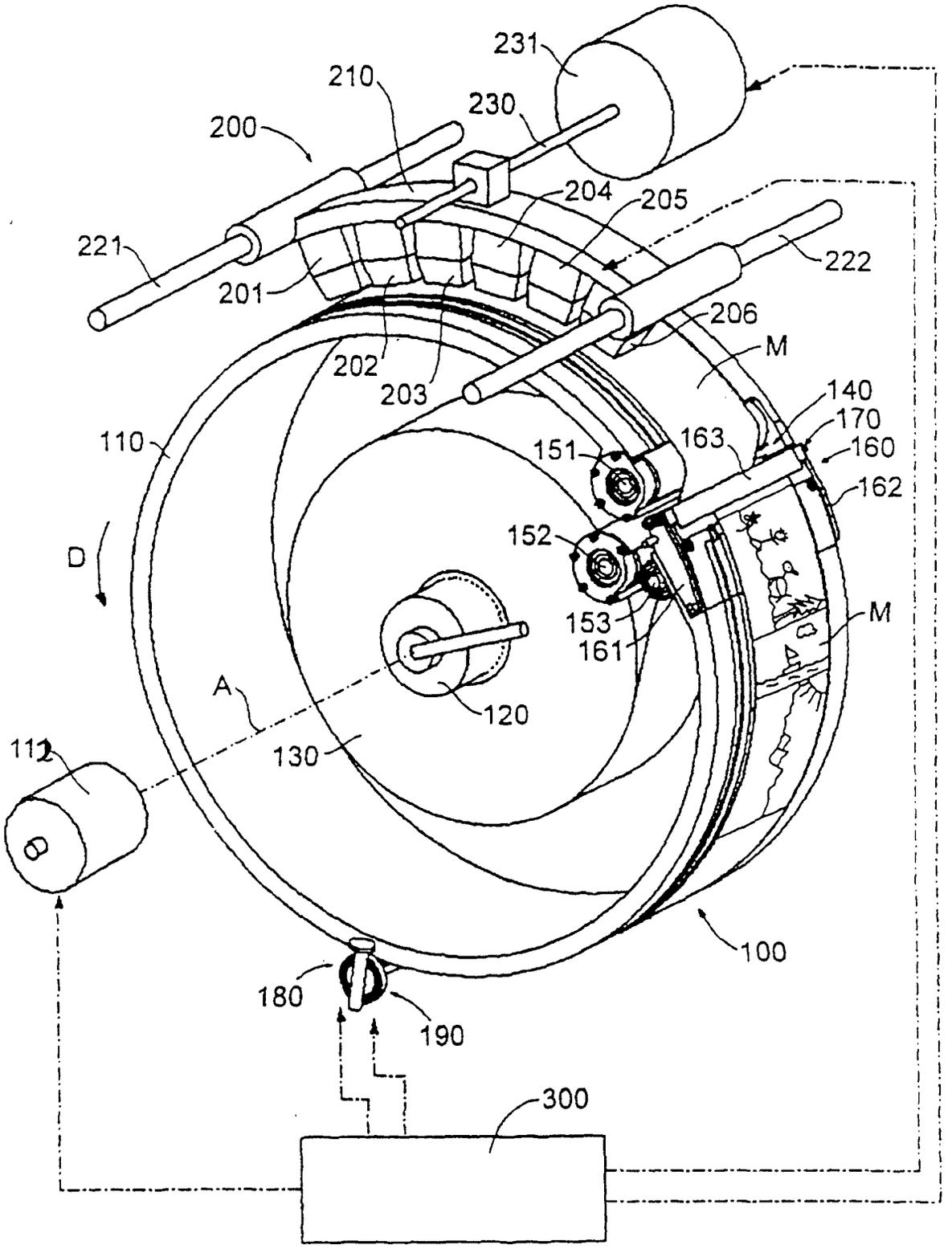
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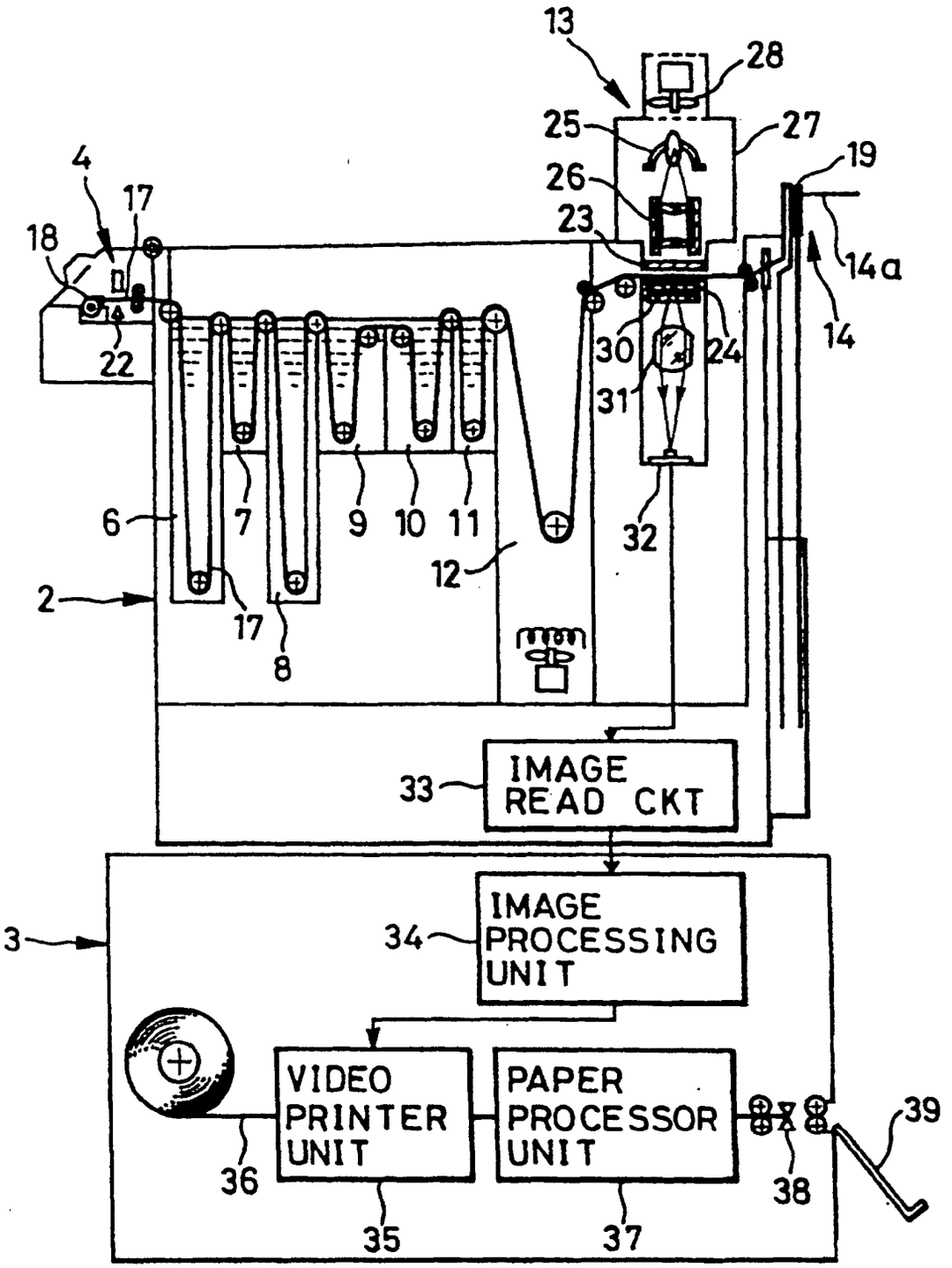
Fig. 4

Fig. 5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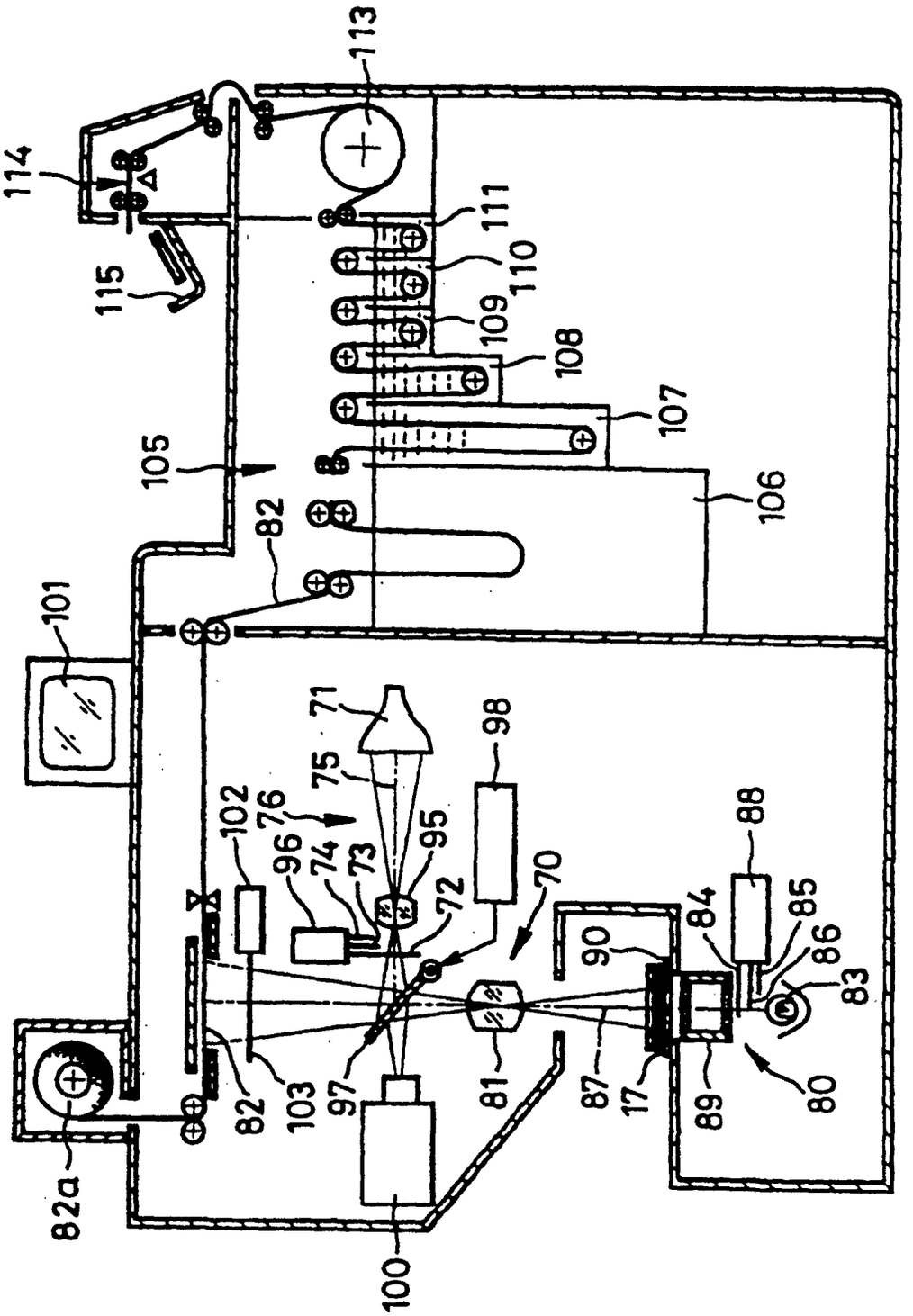
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Fig. 6