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(54) **PRODUCTION OF IMAGE ELEMENTS**

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(57) **ABSTRACT**

The present invention can increase the number of instances where foils can be fed into a coating module for transferring imaging layers from a transfer foil onto a material that is to be printed. A transfer foil is provided that carries image elements to the foil-guiding mechanism. The image elements are transferred in the coating module from the transfer foil onto the material that is to be printed. The transfer foil can be guided past a pressure roll in an approximately tangential direction.

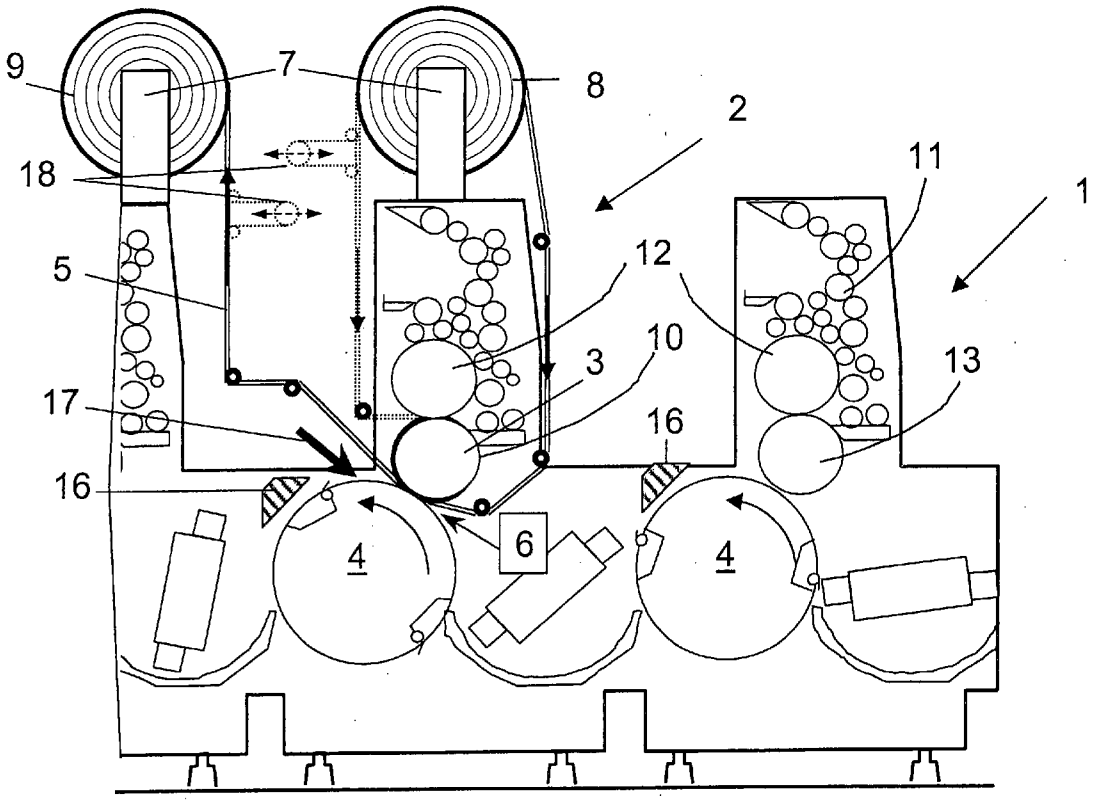
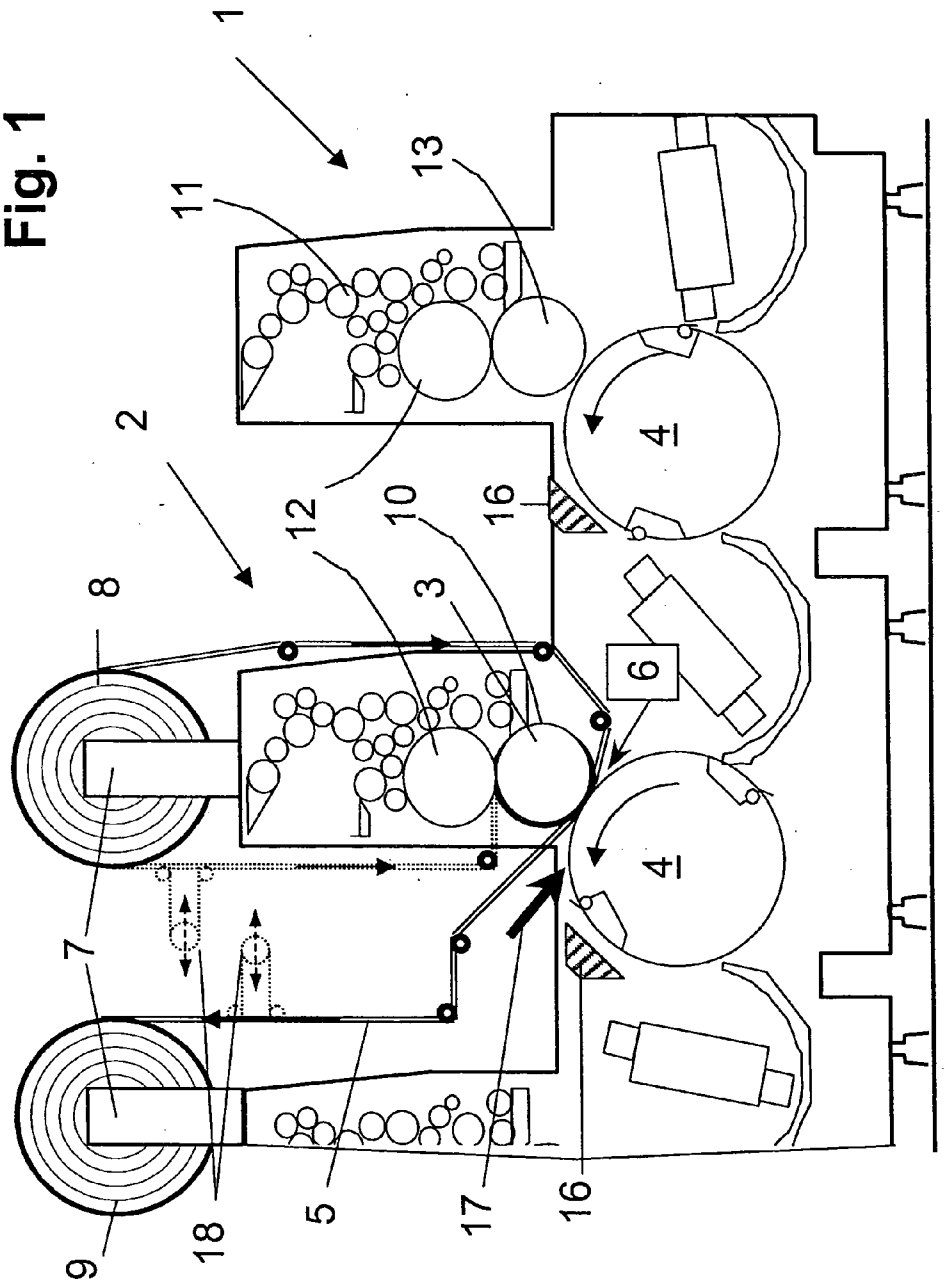


Fig. 1



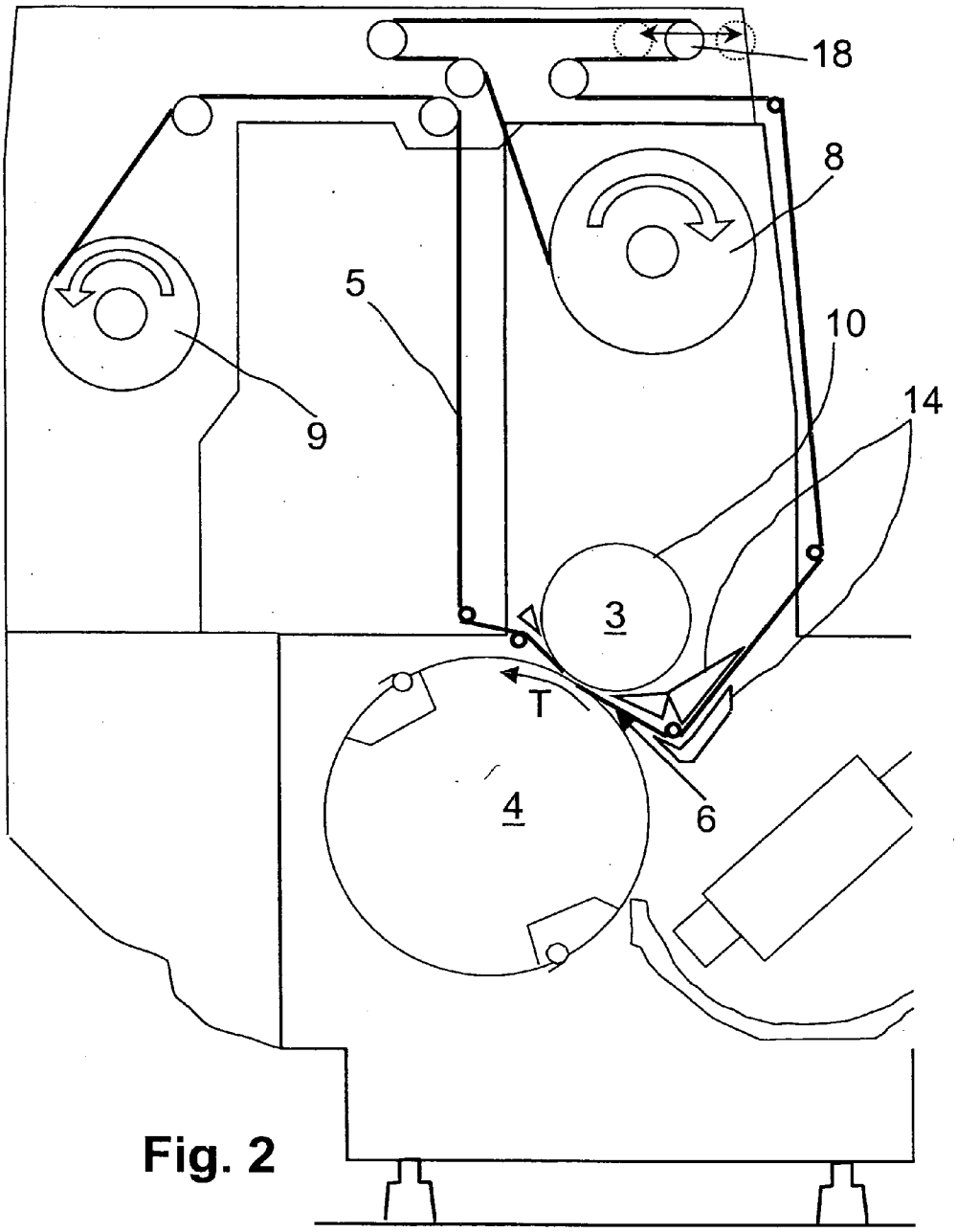
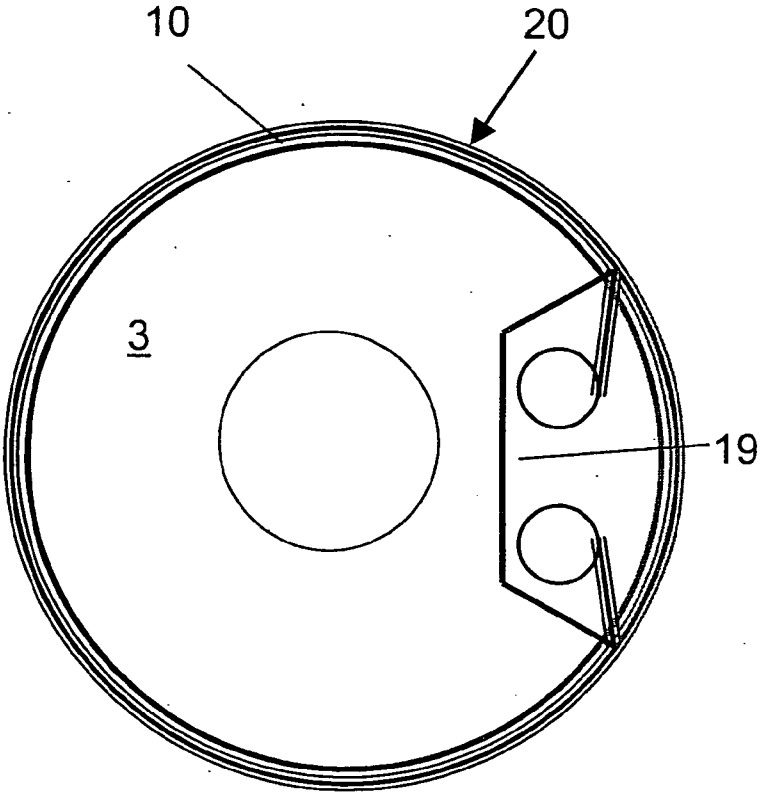


Fig. 2

Fig. 3



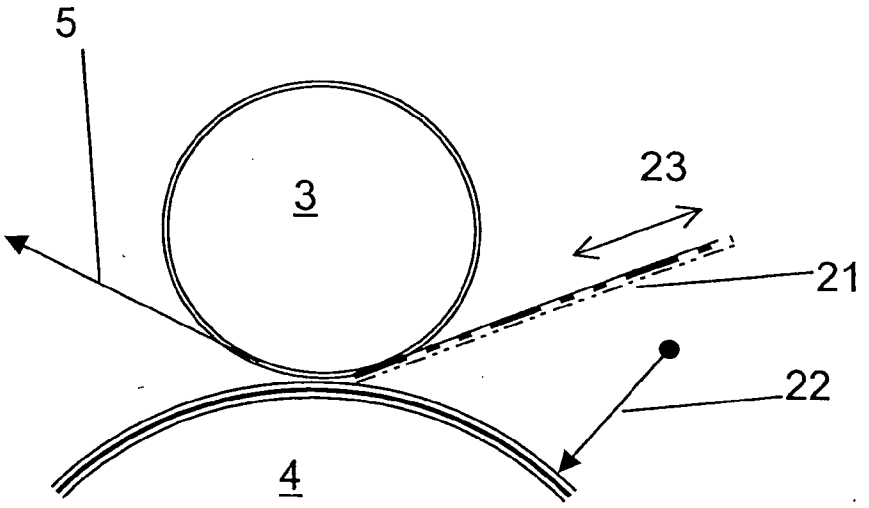


Fig. 4

PRODUCTION OF IMAGE ELEMENTS

FIELD OF THE INVENTION

[0001] The invention relates to a method and to devices for transferring image-forming layers from a carrier foil onto a material to be printed.

BACKGROUND OF THE INVENTION

[0002] It is known to produce metallic foils on material to be printed using a foil transfer method. For example, a printing material and a printing device using foil material are described in EP 0 569 520 B1. In that reference, a sheet-processing machine is disclosed, which has a sheet feeder and a sheet delivery system. Printing units and a coating module are arranged between the sheet feeder and the sheet delivery system. In at least one of the printing units, an adhesive pattern is applied using a flat bed or lithographic printing method. This adhesive pattern is applied using a cold printing method and has a certain image-forming design. In the coating module following the printing unit, a foil guide is provided with a counter-pressure or impression cylinder and a press cylinder. The foil guide is designed such that a foil strip or a transfer foil is guided from a foil storage roll through a transfer gap in the coating module between the impression cylinder and the press cylinder. The foil strip is rewound on the delivery side after leaving the coating module. The transfer foil has a carrier layer, on which image-forming layers, such as metallic layers (for example, made from aluminum), can be applied. A separating layer is arranged between the metallic layer and the carrier foil. The separating layer ensures that the metallic layer can be removed from the carrier layer.

[0003] When printing sheets are transported through the printing unit, each printing sheet is provided with an adhesive pattern. The printing sheet is then guided through the coating module, wherein the printing sheet on the impression cylinder is brought into contact with the foil material via the press cylinder. Here, the metallic layer on the bottom enters into a tight bond with the areas of the printing sheet provided with adhesive. After further transport of the printing sheet, the metallic layer adheres only in the area of the adhesive pattern. As a result, the metallic layer is removed from the carrier foil in the area of the adhesive pattern. The consumed transfer foil is then rewound. The printing sheet is delivered in the coated state.

[0004] It is known to use such coating modules in printing units of printing presses. However, a disadvantage with these modules is that they cannot be employed in a flexible manner.

BRIEF SUMMARY OF THE INVENTION

[0005] In view of the foregoing, an object of the invention is to provide a device that can transfer an image-forming layer or image elements onto a printing material in a reliable, economical, and precise manner. Thus, the device is easy to operate in an expanded spectrum of applications.

[0006] Advantageously, with the present invention, the transfer foil is coated with separate image elements and the image elements are transferred onto the material to be printed as the coating or within the coating. In this way, product security can be achieved advantageously via security elements, e.g., holograms, applied to the transfer foil.

[0007] The device can also be used to improve the use of the foil in that the transfer foil can be divided into one or more partial webs of narrower width. This allows different types of foils to be used adjacent to each other. Furthermore, the divided partial foil webs can be used to apply separate image elements.

[0008] To ensure economic efficiency of the coating method, the advance of the foil can be controlled such that the transfer foil is stopped when an image-forming or metallic layer is not supposed to be transferred and especially when there is no image element. Advantageously, the transfer foil can be controlled such that the advance of the transfer foil is stopped when passing a gripper channel on the sheet-guiding impression cylinder, with the press cylinder then sliding under the transfer foil.

[0009] Advantageously, it is also possible to provide several coating modules one after the other within a sheet-processing machine. In this way, various image-forming coatings or metallic layers can be applied one after the other within a design. In this case, it is possible to transfer the image-forming layers one next to the other via a single adhesive pattern with all of the image pattern elements. It is also possible to provide a first adhesive pattern in a first coating module with a first image-forming coating or metallic layer. Another adhesive pattern can then be deposited in an overlapping manner so as to enclose the first pattern and to provide another image-forming coating or metallic layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a schematic partial side sectional view of an exemplary printing press having a foil transfer device according to the invention.

[0011] FIG. **2** is a schematic side sectional view of an exemplary coating module having a foil transfer device according to the invention.

[0012] FIG. **3** is an enlarged schematic side view of a press cylinder of the coating module of FIG. **2**.

[0013] FIG. **4** is an enlarged schematic partial side view of a further embodiment of an application unit.

DETAILED DESCRIPTION OF THE INVENTION

[0014] A sheet-processing machine is shown in FIG. **1**. In this case, the sheet-processing machine is a printing press, which is composed of at least two printing units. The two printing units can be used as discussed below to transfer an image-forming layer or coating from a transfer foil to a printing sheet.

[0015] In a first processing step, a printing sheet to be coated is provided with an image-forming adhesive pattern. The adhesive coating is produced in an application unit **1**, e.g., a conventional printing unit of an offset printing press. The adhesive coating is produced via varnishing and dampening units **11**, a printing plate on a plate cylinder **12**, a blanket or rubber cylinder **13**, and a counter-pressure or impression cylinder **4**. Similarly, application units in the form of flexographic printing units or varnishing units can be used.

[0016] In a second step, a transfer foil **5** is guided in common with a printing sheet through a transfer gap **6**, with

the transfer foil **5** being pressed against the printing sheet in the transfer gap **6**. In this case, a coating module **2** is used, which can correspond to a varnishing unit, a painting module, a base unit or some other kind of processing unit or module of a sheet-fed offset printing press. The transfer gap **6** in the coating module **2** is formed by a press cylinder **3** and an impression cylinder **4**. The press cylinder **3** can correspond to a blanket cylinder and the impression cylinder **4** can correspond to an impression cylinder of a known offset printing unit. Furthermore, the press cylinder **3** can correspond to a form cylinder and the impression cylinder **4** can correspond to an impression cylinder of a varnishing module of a sheet printing press. A so-called calendaring unit can be arranged downstream of the coating module **2** when the coated printing sheets are to be rolled under elevated pressure in order to increase the adhesion of the coating or increase the smoothness and gloss of the printing sheet.

[**0017**] Within the coating module **2** used for the foil transfer, a web guide is provided for the transfer foil **5**. The transfer foils **5** that are used can have a multi-layer construction. Such transfer foils include a carrier layer, on which an image-forming layer is deposited over a separating layer. The separating layer is used to ease removal of the image-forming layer from the carrier layer. The image-forming layer can be, e.g., a metallic layer, a gloss layer, a textured layer, a painted layer or a layer containing one or more image patterns.

[**0018**] A foil storage roll **8** is allocated to the coating module **2** on the side of the sheet feeder. The foil storage roll **8** can have a controllable rotary drive **7**. The rotary drive **7** continuously controls the feed of the transfer foil **5** to the coating module **2**.

[**0019**] Furthermore, the area of the foil feeder and delivery system is provided with guide devices **14**, such as deflection or tension rolls, pneumatically activated guides, guide plates, or the like. Thus, the web of transfer foil **5** can be guided in a flat, smooth and undistorted manner and at the same tension relative to the press cylinder **3**. The guide devices **14** can also include mechanisms for introducing the transfer foil **5**. In this case, automatic take-in or insertion aids for the foil web of the transfer foil **5** can also be used. In this way, the feeding of the foil in the area of the protective devices **15** surrounding the application unit **2** is simplified. At the same time, the protective function of the protective devices **15** is completely maintained.

[**0020**] In the illustrated embodiment, the transfer foil **5** can be guided around the press cylinder **3** with the transfer foil **5** being fed and discharged only from one side of the coating module **2** to the press gap **6** (see dashed line representation). Advantageously, unlike as shown in FIG. **1**, depending on the available space on one side of the coating module **2**, the foil web can also be run with the incoming and outgoing strands parallel and close to one another. In another embodiment, the transfer foil **5** can also be fed to and discharged from the press gap **6** with the transfer foil passing the press cylinder **3** in a substantially tangential manner or the transfer foil can be wrapped around the press cylinder only over a small circumferential angle. The transfer foil can be fed from one side of the coating module **2** and discharged to the opposite side of the coating module **2**.

[**0021**] A foil collection roll **9** is provided on the delivery side of the printing unit. The used foil material is rewound onto the foil collection roll **9**. In this instance, a controllable rotary drive **7** also can be provided to optimize production. The transfer foil **5** also could be moved on the delivery side by the rotary drive **7** and could be held taut on the feeding side by a brake.

[**0022**] To facilitate the image-forming transfer process (e.g., transferring a usable layer from the transfer foil **5** to the printing sheet in the transfer gap **6** between the press cylinder **3** and the impression cylinder **4**), the surface of the press cylinder **3** (i.e. the blanket cylinder or the plate cylinder) should be equipped with a compressible, damping element. The press cylinder **3** is therefore provided with a press covering **10** or has a corresponding coating (see FIG. **3**). For example, the press covering **10** or coating can be a plastic coating, comparable to a rubber or printing blanket. The surface of the press covering **10** or press coating is preferably very smooth in a press surface area **20**. The surface can also be formed from non-adhesive material or structures. In this case, for example, a relatively rigid structure comprising very fine spherical elements can be used. The press covering **10** can be held on the press cylinder **3** in a cylinder channel **19** using tensioning devices.

[**0023**] To improve the transfer characteristics in the transfer gap **6**, the press covering **10** can have a specific elasticity. This elasticity can be achieved using a compressible intermediate layer. This compressibility is preferably similar to or less than that found in conventional rubber blankets or printing blankets, which can also be used at this position. This compressibility can be produced by a conventional compressible printing blanket. Combination coverings made from a hard printing blanket and a soft bottom layer can also be used. A limited press surface area can be provided directly on the press cylinder **3** or on the press covering **10**. This limited press surface area can be machined from the surface of the press covering **10** or it can be fixed to the press cylinder **3** in the form of a partial area of the material of the press covering **10**.

[**0024**] To improve the economic efficiency of the coating method, the advance of the transfer foil **5** from the foil storage roll **8** to the transfer gap **6** and to the foil collection roll **9** is controllable such that the transfer foil **5** is substantially stopped when there is no transfer of an image-forming layer. In this case, the transfer foil **5** can be controlled so that the foil advance is stopped when passing a gripper channel of the sheet-guiding impression cylinder **4**. The grippers hold the printing sheet on the impression cylinder **4**. The press cylinder **3** has a corresponding cylinder channel **19** (see FIG. **3**) for holding the press covering **10**. In the area of the corresponding cylinder channels, the transfer foil **5** is not pressed between the press cylinder **3** (printing blanket cylinder) and the impression cylinder **4**. In this area, the press cylinder **3** continues to run smoothly on the transfer foil **5**, while the transfer foil **5** is set in without tension between the press cylinder **3** and the impression cylinder **4**. This state lasts until the so-called printing start of the cylinder channel **19** ends and the transfer foil **5** is clamped again together with a printing sheet between the press cylinder **3** and the impression cylinder **4**. The transfer foil **5** can then be transported further. The cycling of the foil advance can begin or stop somewhat earlier than as defined by the cylinder channel edges based on any necessary acceleration or deceleration of the foil storage roll **8** or foil collection roll **9**. As shown, for example in FIG. **1**, fast-

reaction cycling systems using so-called dancer or tension rolls **18** optionally do not require control of the rotary drives **7** for the foil storage rolls **8** or foil collection rolls **9**. The required foil tension can also be maintained by the dancer or tension rolls **18**.

[**0025**] A further improvement in the use of the foil can be achieved by dividing the transfer foil **5** into one or more sub-foil webs of smaller width. In this way, with the help of the devices for cycling the advance of each of the sub-foil webs, the use of the transfer foil **5** to coat areas within a sheet having different lengths from zone to zone can be improved. Each sub-foil web is forwarded in a precise manner only into the area where the image-forming surface layer is to be applied. In the areas not to be coated, each sub-foil web can be stopped independent of the other sub-foil webs, so that there is no unnecessary usage of foil.

[**0026**] For improving the coating method, a dryer **16** can be provided in the area of the adhesive coating and in the area of the foil coating. In particular, the adhesive layer applied over the image area of the printing sheet is dried by first dryer **16** (intermediate dryer I using a UV drying process) so that the usable image-forming layer of the transfer foil **5** will adhere better. The adhesion of the usable image-forming layer can be further improved by use of a second dryer **16** (intermediate dryer II) that additionally accelerates the drying of the adhesive.

[**0027**] Finally, the quality of the coating can be controlled by means of an inspection or monitoring device **17** arranged after the application of the image-forming layer from the foil. The inspection device **17** is directed towards a sheet-guiding area of the coating module **2** after the transfer gap **6**. The inspection device **17** is optionally separated from the dryer **16** or is directed towards a sheet-guiding area of another sheet-guiding module arranged after the coating module **2**. The coated printing sheet passing this location can then be checked for completeness and quality of the coating. Printing sheets identified as defective can be marked or sorted out as waste in a sorting device.

[**0028**] In order to improve the layer transfer and the coating result, the coating module can be provided with devices for conditioning the transfer foil as shown in FIG. **2**. In this way, the foil web **5** can be influenced by the foil guiding device **14**. To improve the adhesion and gloss effect, the image-forming layer can be applied using an adhesive that reacts to ultraviolet radiation. For example, so-called UV-suppression paint can be applied. UV-reactive adhesives require devices for UV drying. UV-reactive adhesives produce an improved smoothness and thus gloss effect of the image-forming layer applied to the printing sheet. The secure attachment of special image elements, such as holograms or partial images is also possible. For this purpose, a UV dryer **15** is arranged after the application unit **1** for drying the adhesive coating. A UV dryer **15** penetrating the image-forming layer can also be arranged after the transfer of the image-forming layer in the application unit **2**, for example, on the impression cylinder **4** of the application unit **2**.

[**0029**] To increase the quality of the printed product, it is possible to use the described device to apply relief printing or embossing, holograms or prefabricated image designs, which also can have surface structures, on the printing sheet. Embossing or relief printing are advantageously applied to the already coated surface. For example, this can be performed in an embossing unit connected after the application unit **2**. In such a case, the printing sheet can be guided over a profiled surface and under pressure against a soft counter surface. Embossing also can be performed from the top side, i.e., the coated side of the printing sheet opposite an elastic bottom layer. The necessary device can be arranged in a printing unit or a coating module. In this position, the embossing or relief form is arranged on a printing blanket or form cylinder or on the impression cylinder **4**. The soft or elastic counter surface is arranged accordingly on the other cylinder of the printing unit or coating module. The image-forming coating can also be used for transferring special image elements by means of such an embossing device.

[**0030**] The application or production of image elements **21** or holograms introduced into the image-forming layer from a transfer foil **5** is shown schematically in FIG. **4**. This process requires an especially precise control of the guidance of the transfer foil **5** in the transfer gap **6** between the press cylinder **3** and the impression cylinder **4** relative to the printing sheet on the impression cylinder **4**. To this end, controllers **22** can be provided that detect the position of the printing sheet to be coated. This position can also be derived from the controller of the sheet-processing machine.

[**0031**] Controllers **23** are also provided for detecting the position marks defining the location of the image elements **21** or holograms applied to the transfer foil **5** next to the image elements **21**. As a result, it is possible to detect the relative position of the printing sheet in the transfer gap **6** with the controller **22** and exactly position the image elements **21** on the printing sheet with the help of the foil controller **23**.

[**0032**] The described device and method can be used to apply specially prefabricated image elements, for example, elements made from multicolor designs or with a profiled surface. In such case, the image elements are applied to a transfer foil **5** in the same way as described for the image-forming layer. The image elements are applied through a corresponding adhesive coating and subsequent transfer of the appropriate image elements in the transfer gap **6** between the press cylinder **3** and the impression cylinder **4** of the coating module **2**.

[**0033**] There can be differences to the described method of applying continuous elements, applying individual elements in a designated area, or applying individual elements in defined positions. In the case of continuous image elements, control of the position of the image elements **21** transverse to the transport direction T is necessary. The relative position of image patterns in the transport direction T results from the arrangement on the transfer foil **5**.

[**0034**] The application of relatively coarsely positioned image elements **21** in a designated area can be achieved via cycling or timing techniques using the normal foil controller. However, positioning in defined locations requires precise measurement and control of the transfer foil **5** and printing sheet as shown in FIG. **4**.

[**0035**] Advantageously, a press surface **20** in the form of a stamped rubber blanket or a high-pressure plate can be cut out within the press covering **10** bearing on the image elements **21** or areas of the image elements **21**. In this case, the press surface **20** can have a flexible, pliant or elastic

structure, especially when a prefabricated image element **21** has a structured surface. Furthermore, position control of the image elements can be performed with the help of the position marks on the transfer foil **5** as described in connection with the processing of holograms.

[**0036**] The benefits of the described method are particularly clear when considering the last embodiment. The application of image elements in cold foil embossing methods is an especially gentle process. In contrast to hot foil embossing methods, the image elements are not exposed to strong heating in cold foil embossing. Special material properties and possibly special production methods may be necessary to protect the image elements **21** from damage during a hot foil embossing process. Simple image elements **21** cannot be transferred in hot foil embossing methods because they would be destroyed. Therefore, especially high-quality, and thus also expensive, transfer foils **5** must be used. In sum, the method according to the invention is relatively simple and can be employed relatively economically.

List of Reference Symbols

[**0037**] **1** Application unit

[**0038**] **2** Coating module

[**0039**] **3** Press cylinder

[**0040**] **4** Impression cylinder

[**0041**] **5** Transfer foil/foil web

[**0042**] **6** Transfer gap

[**0043**] **7** Roll drive

[**0044**] **8** Foil storage roll

[**0045**] **9** Foil collection roll

[**0046**] **10** Press covering

[**0047**] **11** Varnishing/dampening unit

[**0048**] **12** Plate cylinder

[**0049**] **13** Printing blanket/rubber cylinder

[**0050**] **14** Foil guide device

[**0051**] **15** Printing unit protective device

[**0052**] **16** Dryer

[**0053**] **17** Inspection device/monitoring system

[**0054**] **18** Tension roll

[**0055**] **19** Cylinder channel

[**0056**] **20** Press surface

[**0057**] **21** Image element, hologram

[**0058**] **22** Controller

[**0059**] **23** Controller

1-13. (canceled)

14. A method for coating a printing sheet in a sheet-processing printing machine comprising the steps of:

coating an image area of the printing sheet with an adhesive pattern in an application unit;

guiding a transfer foil through a transfer gap defined by an impression cylinder and a press cylinder in a coating module, the transfer foil being guided under pressure together with the printing sheet with a coated side of the transfer foil in contact with the printed sheet such that an image element arranged in an image-forming layer on the coated side of the transfer foil adheres to the adhesive pattern on the image area of the printing sheet, the image element being arranged with an image side adhered on a carrier layer of the transfer foil;

separating the image element adhered to the adhesive pattern from the carrier layer after the printing sheet exits the transfer gap;

controlling the guidance of the transfer foil and the printing sheet to position the image elements on the printing sheet.

15. The method according to claim 14 wherein the step of controlling guidance of the transfer foil comprises detecting the position of the transfer film, detecting the position of the printing sheet, and positioning the transfer film relative to the printing sheet before or during the feeding into the transfer gap.

16. The method according to claim 15 wherein the transfer foil includes a detectable marking for detecting the position of the transfer film.

17. The method according to claim 14 wherein the image element is a hologram.

18. The method according to claim 14 wherein the image element is a plastic embossing element.

19. The method according to claim 14 wherein the image element is a colored image element.

20. The method according to claim 14 further including the step of providing the printing sheet with a plastic embossing using the transfer film.

21. The method according to claim 14 further including the step of providing the printing sheet with a color printing image after adhering the image element on the printing sheet.

22. A device for transferring an image element in an image-forming layer on a transfer foil onto a printing sheet comprising:

an application unit for coating the printing sheet in an image area with an adhesive;

a coating module for transferring the image-forming layer from the transfer foil to the printing sheet, the coating module including an impression cylinder and a press cylinder that define a transfer gap therebetween, the transfer foil being guidable through the transfer gap together with the printing sheet with a coated side of the transfer foil containing the image-forming layer in contact with the printed sheet such that the image element is transferred to the image area of the printing sheet;

a first controller for detecting a position of the printing sheet before or in the transfer gap; and

a second controller for detecting the position of the transfer foil.

23. The device according to claim 22 wherein the press cylinder includes a press surface having a size corresponding to the image element to be transferred and a flexible construction.

24. The device according to claim 22 wherein the press cylinder includes a press surface having a size corresponding to the image element to be transferred and a profiled construction.

25. A device for transferring an image element in an image-forming layer from a transfer foil to a printing sheet comprising:

a transfer foil including a removable image-forming layer that contains an image element having a contoured surface profile;

an application unit for coating the printing sheet in an image area with an adhesive pattern corresponding to an outline of the image element; and

a coating module for transferring the image-forming layer from the transfer foil to the printing sheet, the coating module including an impression cylinder and a press cylinder that define a transfer gap therebetween, the transfer foil being guidable through the transfer gap together with the printing sheet with a coated side of the transfer foil containing the image-forming layer in contact with the printed sheet such that the image element is transferred as a whole to the image area of the printing sheet.

26. The device according to claim 25 wherein the press cylinder includes a press surface having a size corresponding to the image element to be transferred and a flexible construction.

27. The device according to claim 25 wherein the press cylinder includes a press surface having a size corresponding to the image element to be transferred and a profiled construction.

28. A device for transferring an image-forming layer from a transfer foil to a printing sheet comprising:

an application unit for coating the printing sheet in an image area with an adhesive;

a coating module for transferring the image-forming layer from the transfer foil to the printing sheet, the coating module including an impression cylinder and a press cylinder that define a transfer gap therebetween, the transfer foil being guidable through the transfer gap together with the printing sheet with a coated side of the transfer foil containing the image-forming layer in contact with the printed sheet such that the image-forming layer is transferred to the image area of the printing sheet;

a further processing module arranged downstream of the coating module in a printing sheet transport direction, the further processing module applying an image element to the image area of the printed sheet.

29. The device according to claim 28 wherein the image element applied by the further processing module is embossed.

30. The device according to claim 28 wherein the image element applied by the further processing module is applied via relief printing.

31. The device according to claim 28 wherein the press cylinder includes a press surface having a size corresponding to the image element to be transferred and a flexible construction.

32. The device according to claim 28 wherein the press cylinder includes a press surface having a size corresponding to the image element to be transferred and a profiled construction.

33. A device for transferring an image element in an image-forming layer from a transfer foil to a printing sheet comprising:

a transfer foil including a removable image-forming layer that contains an multicolored image element;

an application unit for coating the printing sheet in an image area with an adhesive pattern corresponding to an outline of the image element; and

a coating module for transferring the image-forming layer from the transfer foil to the printing sheet, the coating module including an impression cylinder and a press cylinder that define a transfer gap therebetween, the transfer foil being guidable through the transfer gap together with the printing sheet with a coated side of the transfer foil containing the image-forming layer in contact with the printed sheet such that the image element is transferred as a whole to the image area of the printing sheet.

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