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## (54) FOIL GUIDING DEVICE, FOIL PRINTING MODULE OF A PRINTING PRESS, AND METHOD FOR CONTROLLING SHININESS OF FOIL PORTIONS TO BE PRINTED ON A SUBSTRATE

(57) A foil printing module (50) has a printing area (23) that is configured to enable a printing process in which transfer portions of a foil (3) are transferred to a substrate (4) being provided with ultraviolet curable adhesive in a pattern to be printed. The printing area (23) accommodates a pair of pressing cylinders (27, 28) for pressing together the foil (3) and the substrate (4) in a nip between them so as to form a substrate foil assembly (5), and further accommodates an ultraviolet light source (51) arranged at a downstream side of the nip for the purpose of curing the adhesive. The foil printing module (50) is equipped with a foil guiding device (60) for setting the time that the substrate foil assembly (5) is under the influence of the ultraviolet light source (51) and thereby determining the shininess of printed foil portions on a substrate (4).

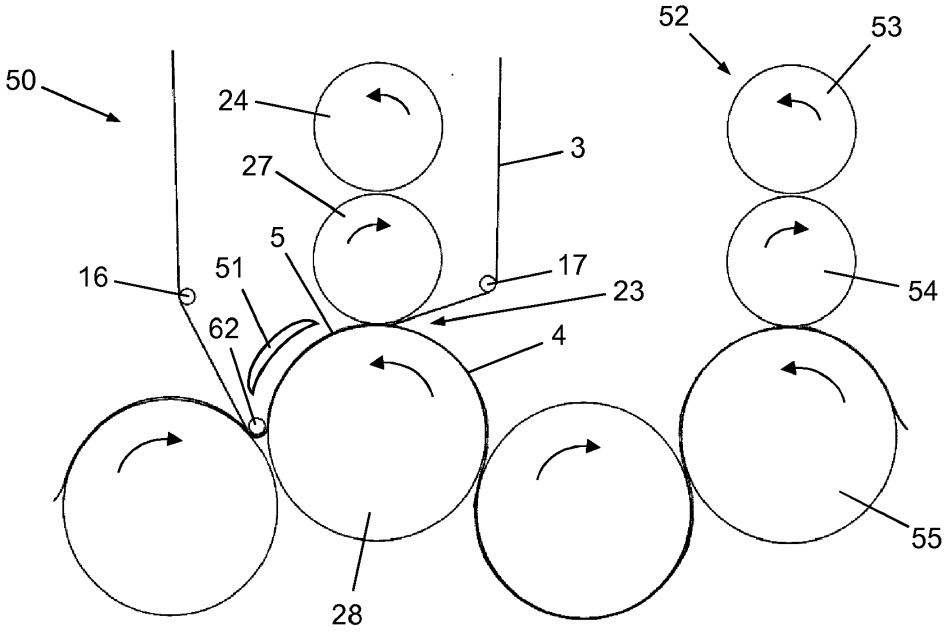


Fig. 2

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## Description

**[0001]** In the first place, the invention relates to a foil guiding device that is designed to be used in a printing module of a printing press, namely a foil printing module having a printing area that is configured to enable a printing process in which transfer portions of a foil are transferred to a substrate being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area accommodates a pair of pressing cylinders for pressing together the foil and the substrate in a nip between them so as to form a substrate foil assembly, and which printing area further accommodates an ultraviolet light source arranged at a downstream side of the nip for exposing the substrate foil assembly to ultraviolet light for the purpose of curing the adhesive, the foil guiding device comprising a guide roller being designed for close arrangement to one of the pressing cylinders and to direct used foil away from the cylinder and the substrate after having made the substrate foil assembly to move along with the cylinder over a portion of a revolution thereof.

**[0002]** In the second place, the invention relates to a computer program product comprising a program code of a computer program of a controller system of a foil guiding device as mentioned.

**[0003]** In the third place, the invention relates to a foil printing module of a printing press, having a printing area that is configured to enable a printing process in which transfer portions of a foil are transferred to a substrate being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area accommodates a pair of pressing cylinders for pressing together the foil and the substrate in a nip between them so as to form a substrate foil assembly, and which printing area further accommodates an ultraviolet light source arranged at a downstream side of the nip for exposing the substrate foil assembly to ultraviolet light for the purpose of curing the adhesive, the foil printing module being equipped with a foil guiding device as mentioned.

**[0004]** In the fourth place, the invention relates to a method for controlling shininess of foil portions to be printed on a substrate by means of a foil printing module as mentioned.

**[0005]** In general, the invention is applicable in the field of applying a thin layer of a metal such as aluminium to a substrate such as paper or carton during a printing process. In this field, it is important to have useful methods aimed at realizing proper transport of a foil comprising the thin metal layer and a carrier layer through a printing area of a printing module of a printing press, i.e. an area where the printing process takes place during operation of the printing module and where components having a direct function in the printing process are located. In this respect, techniques for transferring the metal layer from the carrier layer of foil to a substrate have been developed which do not require any heating process for letting the desired transfer take place. The foil that is used in carrying out these techniques usually comprises a carrier layer made of polyethylene, wherein a layer of aluminium is deposited on this carrier layer. In the following, for sake of clarity, the term "transfer layer" will be used as a general term for the layer that is suitable for transfer to the substrate.

**[0006]** By using the foil as described in the foregoing, it is possible to realize printed matter having shiny, silver-like or gold-like portions, wherein the exact colour of the portions is dependent on the colour of the transfer layer of the foil which has been used during the printing process. It is known per se to obtain the shiny portions by performing the following steps: applying a specific type of glue to predetermined areas on the substrate to be printed; and pressing the substrate and a length of the foil against each other, with the transfer layer of the foil facing the substrate. During the latter step, a transfer of the transfer layer from the carrier layer of the foil to the substrate to be printed takes place at the areas where the glue is present, so that the material of the transfer layer is arranged on the substrate according to the pattern of the glue. As mentioned, examples of the substrate include paper or carton. The substrate may be a piano that is intended to be folded to a box for packing one or more articles, for example.

**[0007]** The foil is normally taken as a web from a reel, which is unwound during a printing process in which the foil is used, so that the supply of foil can be continuous. In the printing module, the foil web is moved through a nip between two pressing cylinders of the printing module, wherein the substrate to be printed is arranged on one of the cylinders. At a position where the foil web is pressed against the substrate on the basis of pressing forces which are exerted on the foil due to interaction of the two pressing cylinders of the printing module, predetermined portions of the transfer layer are transferred from the foil web to the substrate. After a length of foil web has passed the nip between the pressing cylinders of the printing module, and some portions of the transfer layer of the length of foil web have been used in the process of printing a substrate, the length of remaining foil is disposed of. For example, the foil web moves on to a device that is adapted to shred the foil, or the foil web is wound on a reel.

**[0008]** A device as defined in the opening paragraph is known, for example, from EP 2 340 936 A1. This patent publication relates to a method and a device for supplying foil to a printing press, which are suitable to be applied for reusing a length of foil web which has already been used in a printing process. In a practical embodiment of the device, a foil reuse unit is present, which is adapted to receive a used length of foil web from the printing press, to change a mutual position of the length of foil web and the printing press, and to feed the length of foil web back to the printing press. By changing the mutual position as mentioned, it is ensured that portions of a substrate to which transfer portions of a transfer layer of the foil need to be transferred are covered by unused portions of the length of foil web. The actions performed by the foil reuse

unit can be repeated until there are no portions left on the length of foil web which can be used for covering portions of the substrate which need to be provided with the transfer portions. In general, reuse of a length of foil web, which may take place one time or more than one time, leads to reduction of waste of foil and thereby to reduction of costs.

**[0009]** In some practical cases, the glue that is used on the substrate is chosen so as to be an ultraviolet curable adhesive. In such cases, in order to realize a proper curing process of the adhesive and thereby a proper adherence of the transfer portions of a foil to a substrate, the printing module is equipped with an ultraviolet light source arranged at a downstream side of the nip between the pressing cylinders. A printing module as mentioned is known from CN 203528069 U, for example. The known printing module is one of a number of printing modules of a printing press and comprises a foil unwinding mechanism, a foil winding mechanism, a substrate supplying and moving mechanism, an adhesive application unit, a combination of an upper pressing cylinder and a lower pressing cylinder, an ultraviolet lamp and a peeling guide roller. During operation of the printing module, a substrate is advanced through the printing module by the substrate supplying and moving mechanism towards the adhesive application unit. In the adhesive application unit, the substrate is partially coated with an ultraviolet curable adhesive, in a pattern corresponding to a pattern of transfer portions of foil on the substrate as desired. The substrate is then transported to the pressing cylinders. In the nip between the pressing cylinders, foil being transported from the foil unwinding mechanism to the foil winding mechanism is pressed on the substrate, whereby a substrate foil assembly is formed. In an area downstream of the nip, the substrate foil assembly is irradiated with ultraviolet light shining from the ultraviolet lamp, as a result of which the adhesive is solidified. As a result, it is achieved that transfer portions of the foil adhere to the substrate in a pattern as desired. Foil from which the transfer portions have been removed, i.e. used foil, is transported to the foil winding mechanism.

**[0010]** In view of the fact that when the substrate and the foil are pressed together in the nip between the pressing cylinders, the adhesive is not yet cured, the substrate foil assembly is kept on the lower pressing cylinder. The substrate foil assembly is irradiated with ultraviolet light while moving along with the cylinder over a portion of a revolution thereof. In the process, the adhesive cures and at a certain point, the used foil can be separated from the substrate with the printed foil pattern. This is done at the position where the used foil is partially wrapped around the peeling guide roller.

**[0011]** Putting to practice a foil printing process in which use is made of an ultraviolet curable adhesive for letting transfer portions of foil and a substrate stick together allows for a most accurate transfer of transfer portions of foil. In conventional situations in which using a conventional adhesive and pressing together foil and substrate are relied upon, when the design of a substrate is such that only portions of a substrate need to be provided with a shiny look, it is practical to print a metal layer first and then partially cover the metal layer by at least one other layer, i.e. a non-metal layer. Alternatively, the substrate can be provided as a piece of metallized carton to be printed with the at least one non-metal layer, which may be a layer of some type of plastic, for example. Especially when the at least one non-metal layer is white or has another light colour, it may happen that the underlying metal layer is visible through the at least one non-metal layer, so that no more than a rather bad quality of the appearance as desired is achieved. Contrariwise, when the foil printing process involving the use of ultraviolet curable adhesive is applied, it is possible to apply metal to the substrate only at the exact portions where it is desired to produce the shiny look. This does not only allow a possibility of avoiding the need to have an opaque non-metal layer, but also involves environmental advantages.

**[0012]** It is an object of the invention to provide a way of applying the foil printing process and achieving a high level of shininess of the metal portions on a substrate. In view thereof, the invention relates to a foil guiding device that is designed to be used in a printing module of a printing press, namely a foil printing module having a printing area that is configured to enable a printing process in which transfer portions of a foil are transferred to a substrate being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area accommodates a pair of pressing cylinders for pressing together the foil and the substrate in a nip between them so as to form a substrate foil assembly, and which printing area further accommodates an ultraviolet light source arranged at a downstream side of the nip for exposing the substrate foil assembly to ultraviolet light for the purpose of curing the adhesive, the foil guiding device comprising a guide roller being designed for close arrangement to one of the pressing cylinders and to direct used foil away from the cylinder and the substrate after having made the substrate foil assembly to move along with the cylinder over a portion of a revolution thereof, and the guide roller having an adjustable position in the foil guiding device so as to allow for control of a rotation angle between the position of the nip and the position where the used foil is directed away from the cylinder and the substrate when the foil guiding device is used in a foil printing module.

**[0013]** The invention further relates to foil printing module of a printing press, having a printing area that is configured to enable a printing process in which transfer portions of a foil are transferred to a substrate being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area accommodates a pair of pressing cylinders for pressing together the foil and the substrate in a nip between them so as to form a substrate foil assembly, and which printing area further accommodates an ultraviolet light source arranged at a downstream side of

the nip for exposing the substrate foil assembly to ultraviolet light for the purpose of curing the adhesive, the foil printing module being equipped with a foil guiding device comprising a guide roller that is closely arranged to one of the pressing cylinders and that is designed to direct used foil away from the cylinder and the substrate after having made the substrate foil assembly to move along with the cylinder over a portion of a revolution thereof, wherein the guide roller has an adjustable position in the foil guiding device so as to allow for control of a rotation angle between the position of the nip and the position where the used foil is directed away from the cylinder and the substrate.

**[0014]** On the basis of experiments performed in the context of the invention, it has been found that the shininess of printed metal portions is dependent on the rotation angle as mentioned in the above definitions of the foil guiding device and the foil printing module according to the invention. Apparently, the time during which a substrate foil assembly is made to move along with one of the pressing cylinders after the substrate and the foil have been pressed together in the nip between the pressing cylinders, i.e. the time during which the ultraviolet curable adhesive is made to cure under the influence of the ultraviolet light source, has a significant influence on the shininess of printed metal portions. It has been found that printed metal portions can be as shiny as metallized carton.

**[0015]** It follows from the foregoing explanation that the invention can also be defined as relating to a method for controlling shininess of foil portions to be printed on a substrate by means of a foil printing module of a printing press, namely a foil printing module having a printing area that is configured to enable a printing process in which transfer portions of a foil are transferred to a substrate being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area accommodates a pair of pressing cylinders for pressing together the foil and the substrate in a nip between them so as to form a substrate foil assembly, and which printing area further accommodates an ultraviolet light source arranged at a downstream side of the nip for exposing the substrate foil assembly to ultraviolet light for the purpose of curing the adhesive, wherein the foil printing module is equipped with a foil guiding device comprising a guide roller that is closely arranged to one of the pressing cylinders and that is designed to direct used foil away from the cylinder and the substrate after having made the substrate foil assembly to move along with the cylinder over a portion of a revolution thereof, and wherein the guide roller has an adjustable position in the foil guiding device so as to allow for control of a rotation angle between the position of the nip and the position where the used foil is directed away from the cylinder and the substrate, the method comprising controlling a position of the guide roller of the foil guiding device of the foil printing module with respect to the pressing cylinders of the foil printing module. In fact, the method boils down to controlling a time during which a substrate foil assembly is made to move along with one of the pressing cylinders while being irradiated with ultraviolet light having a curing effect on the ultraviolet curable adhesive for making the foil and the substrate stick together at predefined positions.

**[0016]** As a default, it is possible to have a rotation angle of 90° between the position of the nip between the pressing cylinders of the foil printing module and the position where used foil is directed away from one of the pressing cylinders and the substrate. A level of shininess of printed foil portions may be enhanced by setting the rotation angle to be higher, such as 96°. According to a preferred possibility existing within the framework of the invention, the rotation angle is variable between 90° as a minimum value and 96° as a maximum value. It is also possible that the rotation angle can be set between two discrete values, such as 90° and 96° as mentioned. In any case, the values of the rotation angle can be chosen differently within the framework of the invention, and other aspects of the invention are in no way directly linked to these exemplary values.

**[0017]** It is practical for the foil guiding device according to the invention to comprise a mounting frame that is designed to be fixedly mounted in a foil printing module and an angle adjusting mechanism that is designed to adjust a position of the guide roller with respect to the mounting frame. In such a case, the angle adjusting mechanism may comprise a carrier element that is slidably arranged with respect to the mounting frame and that carries the guide roller. Further, in such a case, it may be so that the angle adjusting mechanism comprises at least one actuator element that is arranged and configured to act on the carrier element for the purpose of moving the carrier element with respect to the mounting frame, wherein the foil guiding device comprises a controller system having a user interface for receiving input from an operator about the rotation angle between the position of the nip and the position where the used foil is directed away from the cylinder when the foil guiding device is used in a foil printing module, the controller system being designed to process such input, to determine an associated position of the carrier element, and to control operation of the actuator element so as to bring about movement of the carrier element in case an actual position of the carrier element deviates from such associated position.

**[0018]** The controller system as mentioned may be configured to run a computer program and to apply output of the computer program in a process of performing the functions of processing input received from the operator through the user interface, determining an associated position of the carrier element, and transmitting a control signal for controlling operation of the actuator element in case an actual position of the carrier element deviates from such associated position. The invention also relates to a computer program product comprising a program code of the computer program of the controller system.

**[0019]** Advantageously, the foil printing module ac-

cording to the invention comprises an adhesive application unit that is arranged and configured to provide a substrate with ultraviolet curable adhesive in a pattern to be printed at a position upstream of the nip. The configuration of such an adhesive application unit may be comparable to the configuration of an offset printing module, and may comprise an assembly of a plate cylinder, a blanket cylinder and an impression cylinder, the plate cylinder being configured and arranged to transfer a pattern of ultraviolet curable adhesive to the blanket cylinder, and the blanket cylinder and the impression cylinder constituting a pair of cylinders for pressing a substrate in a nip between them so as to enable transfer of the pattern of ultraviolet curable adhesive from the blanket cylinder to the substrate. In this way, accurate application of ultraviolet curable adhesive according to a pattern as desired can be realized.

**[0020]** It is very practical if the foil printing module according to the invention is designed to function as an offset printing module, comprising an assembly of a plate cylinder, a blanket cylinder and an impression cylinder, the blanket cylinder and the impression cylinder constituting the pair of pressing cylinders accommodated in the printing area, and the guide roller of the foil guiding device being closely arranged to the impression cylinder.

**[0021]** In general, it may be so that the foil printing module according to the invention comprises a foil reuse unit, like the device known from EP 2 340 936 A1. In particular, the foil printing module according to the invention may comprise a foil reuse unit that is arranged and configured to receive a length of used foil from the printing area and feeding the same length of foil back to the printing area in a longitudinally shifted position so as to enable use of a length of foil in at least two stages, wherein, in a later stage, transfer portions are taken from the length of foil at positions of the length of foil which have not been addressed during the preceding stage(s). In this respect, it is noted that it is possible for the foil reuse unit to reuse a single length of foil one time or even two or more times.

**[0022]** The present invention will be further explained on the basis of the following description, wherein reference will be made to the drawing, in which equal reference signs indicate equal or similar components, and in which:

figure 1 illustrates how a conventional foil handling device is used with a conventional printing press comprising a number of printing modules;
figure 2 shows components of a foil printing module according to the invention and foil supplied to and retrieved from the foil printing module; and
figure 3 shows components of a foil guiding device that is applied in the foil printing module according to the invention and illustrates a positioning of a guide roller of the foil guiding device with respect to pressing cylinders of the foil printing module.

**[0023]** The figures are of a diagrammatical nature only and not drawn to scale.

**[0024]** Figure 1 illustrates a combination of a conventional foil handling device 1 and a conventional printing press 2 comprising a number of printing modules 21, 22, two of which are shown in figure 1. The foil handling device 1 serves for handling foil for use in a printing process to be performed in a printing area 23 of one of the printing modules 21, 22 of the printing press 2. In the shown example, the foil is provided in the form of at least one foil web 3. In particular, the foil comprises two layers, namely a transfer layer such as a metal layer, and a carrier layer. It is intended to have a transfer of portions of the transfer layer from the carrier layer to a substrate (not shown in figure 1) such as a sheet of paper or a web of paper in the printing press 2, so that shiny portions are obtained on this substrate. The transfer may be realized in a way known per se, for example, by applying glue to the substrate to be printed and pressing the foil against the substrate, in such a way that the transfer layer of the foil contacts the substrate and is removed from the carrier layer at the areas where the glue is present.

**[0025]** With respect to the printing press 2, it is noted that this may be any type of printing press 2 that is capable of processing the foil and making shiny portions on printed matter by using the foil. In the example as shown in figure 1, the printing press 2 is a so-called offset press, wherein one printing module 21 is used as a foil printing module for adding foil to the substrate to be printed, and wherein at least one other printing module 22 is used as an ink printing module for adding various colours to the substrate. A number of cylinders as present in the foil printing module 21 of the printing press 2 are diagrammatically depicted in figure 1. Generally speaking, the foil handling device 1 is arranged at a position above/in the foil printing module 21, so that application of the foil handling device 1 with the printing press 2 does not add to the amount of floor space that is needed for the printing press 2.

**[0026]** In each of the printing modules 21, 22 of the printing press 2, a plate cylinder 24 is arranged, which is used as a carrier of a printing plate in an ink printing process. During such a printing process, oil-based printing ink is supplied to the printing plate, and to this end, ink cylinders 25 are arranged in the printing module 21, 22 as well. Furthermore, dampening cylinders 26 are arranged in the printing module 21, 22. Areas of the printing plate which are not having an image to be transferred to the substrate are kept in a humid state, as a result of which the ink cannot settle in these areas. According to the principles of offset printing technology, the image is not transferred directly from the printing plate to the substrate. Instead, an intermediate step is performed, in which a blanket is used for receiving the image from the printing plate and transferring the image to the substrate. In the printing module 21, 22, the blanket is mounted on a blanket cylinder 27 that is arranged at a position between the plate cylinder 24 and a cylinder 28 for supporting the substrate. This substrate supporting cylinder 28

could be an impression cylinder in case of a sheet fed press or a blanket cylinder in case of a web press.

**[0027]** As the offset printing process is known per se, this process will not be further explained here. In the context of the present invention, it is important to note that the foil web 3 is intended to be supplied to the printing area 23 of the foil printing module 21, which is an area where an actual process of transfer of portions of the foil web 3 to a substrate takes place during operation of the foil printing module 21.

**[0028]** The foil web 3 is normally taken from a reel 31, and the foil handling device 1 is adapted to realize a continuous supply of foil to the foil printing module 21. Furthermore, the foil handling device 1 comprises a roller system for directing the at least one foil web 3 to the foil printing module 21 and retrieving at least one used foil web 3 from the foil printing module 21. In the shown example, the roller system as mentioned comprises a non-driven input roller 11 that is situated at a foil input side of the foil printing module 21, two driven direct foil supply rollers 12, 13 which are also situated at the foil input side of the foil printing module 21, two non-driven output rollers 14, 15 which are situated at a foil output side of the foil printing module 21, and two non-driven rollers 16, 17 which are situated near the combination of the blanket cylinder 27 and the substrate supporting cylinder 28, one roller 16 at the foil input side of the foil printing module 21, and another roller 17 at the foil output side of the foil printing module 21. The foil handling device 1 as shown is suitable for handling one or two foil webs 3, whatever the case may be. In view thereof, there are two direct foil supply rollers 12, 13, wherein only one direct foil supply roller 12, 13 is driven in a case one foil web 3 is used, and wherein both direct foil supply rollers 12, 13 are driven in case two foil webs 3 are used.

**[0029]** The foil handling device 1 is equipped with a suitable controlling arrangement 10 for controlling operation of the device 1, which is only diagrammatically depicted in figure 1 as a block. Among other things, the controlling arrangement 10 is adapted to process information about the speed at which a substrate is advanced through the foil printing module 21 during operation, and to control the way in which one of the direct foil supply rollers 12, 13 is driven or both of the direct foil supply rollers 12, 13 are driven, so as to continually adjust the speed of a foil web 3 at the position of the relevant foil supply roller 12, 13 in order to exactly realize an intended speed of the foil web 3 in the printing area 23, which corresponds to an actual speed of the substrate to be printed.

**[0030]** The foil handling device 1 comprises a foil input unit 32 for supporting a reel 31 of foil web 3 to be used in a printing process, and further comprises a foil collection unit 33. The latter serves for receiving a portion of foil web 3 that is no longer destined to be used. In the shown example, the foil collection unit 33 is adapted to wind the portion of foil web 3 as mentioned on a reel, which does not alter the fact that other possibilities for processing the used portion of foil web 3 are feasible within the framework of the invention.

**[0031]** The foil printing module 21 is equipped with a unit 40 that is adapted to receive a used length of foil web 3 from the foil printing module 21, and to feed the length of foil web 3 back to the foil printing module 21, while changing a mutual position of the length of foil web 3 and the foil printing module 21. In view thereof, the unit 40 is referred to as foil reuse unit 40. For example, the foil reuse unit 40 comprises two adjustable angle bar arrangements and two frame portions 41, 42 as can be seen in figure 1, wherein each of the angle bar arrangements is arranged in another of the frame portions 41, 42, and wherein a level of each of the frame portions 41, 42 with respect to the foil printing module 21 is adjustable. During operation of the foil printing module 21, the foil reuse unit 40 is used for feeding one or two foil webs 3 an additional, second time to the printing area 23 of the foil printing module 21. The positioning of foil webs 3 as necessary for realizing the second input of foil webs 3 to the printing area 23 is accurately controlled, both in the longitudinal direction and the transverse direction, by controlling the level of the frame portions 41, 42 and the positions of the angle bar arrangements in the frame portions 41, 42. To this end, the controlling arrangement 10 of the foil handling device 1 may be adapted to process information about the extent to which the foil webs 3 need to be displaced in both directions as mentioned, and to set the frame portions 41, 42 and the angle bar arrangements in the frame portions 41, 42 at the positions which are correct for realizing an appropriate displacement of the foil webs 3 with respect to the original input of the foil webs 3 to the printing area 23. On the basis of the displacement of the foil webs 3 in the transverse direction, it is realized that other portions of the substrate can be covered by the foil webs 3, wherein it is to be noted that the foil webs 3 may have a significantly smaller width than the substrate. On the basis of the displacement of the foil webs 3 in the longitudinal direction, it is realized that another portion of the foil webs 3 than the portion where the transfer layer is no longer present is put in contact with the substrate at positions where new transfers of material from the foil to the substrate need to take place. When the foil webs 3 have moved through the foil printing module 21 two times, the foil webs 3 are moved to the foil collection unit 33.

**[0032]** It follows from the foregoing that applying the foil reuse unit 40 offers the important advantage of efficient use of the foil. In a situation without a foil reuse unit 40, only one portion of the transfer layer of a foil web 3 is used in a printing process, whereas in a situation with the foil reuse unit 40, multiple portions of the transfer layer of the same foil web 3 are used in a printing process.

**[0033]** With reference to figure 2, the particulars of the invention will now be explained. Figure 2 shows components of a printing module 50 according to the invention, including a plate cylinder 24, a blanket cylinder 27 and a substrate supporting cylinder 28 as described in the fore-

going. The printing module 50 is a foil printing module equipped with a foil handling device 1. In figure 2, only the two rollers 16, 17 of the foil handling device 1 arranged near the combination of the blanket cylinder 27 and the substrate supporting cylinder 28 are shown. Also, a foil web 3 and a substrate 4 are shown in figure 2. The substrate 4 may be supplied to the printing area 23 as a continuous web, but it is also possible that a number of substrates 4 are successively supplied to the printing area 23 as separate sheets. Directions of rotational movement of the various cylinders and rollers shown in figure 2 are indicated by means of arrows.

**[0034]** An ultraviolet light source 51 such as an ultraviolet lamp is located in the printing area 23 of the foil printing module 50 according to the invention, at a downstream side of the nip between the blanket cylinder 27 and the substrate supporting cylinder 28. Furthermore, the foil printing module 50 comprises an adhesive application unit 52 designed to provide the substrate 4 with an ultraviolet curable adhesive. As known per se from the field of foil printing, only portions of the substrate 4 which are to be covered with foil 3 are provided with adhesive, so that it is possible to obtain a printed foil pattern on the substrate 4 as desired. What happens in the printing area 23 during operation of the foil printing module 50 is that the foil 3 and the substrate 4 are pressed together in the nip between the blanket cylinder 27 and the substrate supporting cylinder 28, i.e. the cylinders constituting a pair of pressing cylinders in the foil printing unit 50, so that a substrate foil assembly 5 is formed. The substrate foil assembly 5 is made to move along with the substrate supporting cylinder 28 over a portion of a revolution of the cylinder 28 and is under the influence of the ultraviolet light source 51 during that time. As a result, the adhesive cures and when the foil 3 is peeled from the substrate foil assembly 5, only transfer portions of the foil 3 remain on the substrate 4, in a pattern determined by the pattern of glue.

**[0035]** The adhesive application unit 52 may be realized in any practical manner. For example, the adhesive application unit 52 may be designed so as to have an offset configuration, and may comprise an assembly of a plate cylinder 53, a blanket cylinder 54 and an impression cylinder 55 as shown in figure 2. In such a case, the plate cylinder is used for the purpose of accurately transferring a pattern of ultraviolet curable adhesive to the blanket cylinder, the pattern being determined by the foil printing pattern as desired. The blanket cylinder 54 and the impression cylinder 55 constitute a pair of cylinders for pressing a substrate 4 in a nip between them so as to enable transfer of the pattern of ultraviolet curable adhesive from the blanket cylinder 54 to the substrate 4.

**[0036]** For the purpose of making the substrate foil assembly 5 to move along with the substrate supporting cylinder 28 over a portion of a revolution of the cylinder 28, thereby keeping the substrate foil assembly 5 under the influence of the ultraviolet light source 51 during a certain time, the foil printing module 50 according to the invention is provided with a foil guiding device 60. The foil guiding device 60 has a function in directing away used foil 3 from the substrate supporting cylinder 28 and the substrate 4 at a certain peripheral position of the substrate supporting cylinder 28 with respect to the nip between the blanket cylinder 27 and the substrate supporting cylinder 28. A notable feature of the foil guiding device 60 is that the foil guiding device 60 is designed so as to allow for variation of that position, as will now be explained with reference to figure 3.

**[0037]** In the embodiment of the foil guiding device 60 shown in figure 3, the foil guiding device 60 comprises a mounting frame 61, a guide roller 62 and a carrier element 63. Figure 2 only shows the guide roller 62 of the foil guiding device 60. The carrier element 63 carries the guide roller 62 and is slidably arranged with respect to the mounting frame 61. For the purpose of setting the position of the carrier element 63 with respect to the mounting frame 61, the foil guiding device 60 comprises a suitable actuator element 64, which may be an arm driven by a servo motor, for example. The actuator element 64 is controlled by a suitable controlling arrangement 65 that is only diagrammatically depicted in figure 3 as a block. The controlling arrangement 65 is designed to determine the position of the actuator element 64 on the basis of input provided by an operator. In view thereof, it is practical if the controlling arrangement 65 comprises a user interface.

**[0038]** The reason for having an adjustable positioning of the guide roller 62 with respect to the substrate supporting cylinder 28, i.e. for having adjustable curing time of the adhesive, is that it was found that the shininess of foil portions printed on a substrate 4 can be influenced in that way. For example, the foil guiding device 60 may be used for setting a rotation angle $\varphi$ along which a substrate foil assembly 5 is made to move along with the substrate supporting cylinder 28 so as to be an angle $\varphi_1$ of 90° as a default. When a high degree of shininess of the foil portions is desired, the foil guiding device 60 may be used for setting the rotation angle $\varphi$ so as to be angle $\varphi_2$ of 96°. In figure 3, the position of the guide roller 62 in the latter situation is indicated by means of dashed lines. The values of the rotation angle $\varphi$ are only examples and should in no way be understood such as to be limiting to the scope of the invention. Also, it is possible for the foil guiding device 60 to be designed to set the rotation angle $\varphi$ at one of at least two discrete values, or to be designed to set the rotation angle $\varphi$ at one of a whole range of values.

**[0039]** All in all, it is an achievement of the invention that a very accurate and reliable way of providing a substrate 4 with a printed foil pattern is obtained. The invention is a practical implementation of an inventive insight that in a context of using ultraviolet curable adhesive between substrate 4 and foil 3, the shininess of foil portions on a substrate 4 can be influenced by varying a rotation angle $\varphi$ along which a substrate foil assembly 5 is made to move along with the substrate supporting cylinder 28,

i.e. a rotation angle φ between the nip between the blanket cylinder 27 and the substrate supporting cylinder 28 where the substrate 4 and the foil 3 are pressed together and a position where used foil 3 is separated from the substrate 4. In this way, the time during which a substrate foil assembly 5 is under the influence of an ultraviolet light source 51 is determined independently of other system parameters such as a speed at which a substrate 4 and a foil web 3 are moved through the foil printing module 50.

**[0040]** It will be clear to a person skilled in the art that the scope of the present invention is not limited to the examples discussed in the foregoing, but that several amendments and modifications thereof are possible without deviating from the scope of the invention as defined in the attached claims.

**[0041]** Application of the invention may in many practical cases involve use of an end printing module of a printing press 2 as a foil printing module 21. Nevertheless, for realizing maximum flexibility of use, it is preferred if a user of a combination of a foil handling device 1 and a printing press 2 is allowed to choose which printing module of the printing press 2 is used as a foil printing module 21. In view thereof, it is preferred if the foil handling device 1 is arranged in a displaceable support.

**[0042]** In respect of the mounting frame 61 of the embodiment of the foil guiding device 60 as shown, it is to be noted that in the definitions of the invention, this mounting frame 61 may actually be a separate frame connected to a larger frame of a foil printing module 50, but may also be integrated with such a larger frame.

**[0043]** A possible summary of the invention reads as follows. In one aspect, the invention relates to a foil printing module 50 of a printing press 2, the foil printing module 50 having a printing area 23 that is configured to enable a printing process in which transfer portions of a foil 3 are transferred to a substrate 4 being provided with ultraviolet curable adhesive in a pattern to be printed. The printing area 23 accommodates a pair of pressing cylinders 27, 28 for pressing together the foil 3 and the substrate 4 in a nip between them so as to form a substrate foil assembly 5, and further accommodates an ultraviolet light source 51 arranged at a downstream side of the nip for exposing the substrate foil assembly 5 to ultraviolet light for the purpose of curing the adhesive. The foil printing module 50 is equipped with a foil guiding device 60 for setting the time that the substrate foil assembly 5 is under the influence of the ultraviolet light source 51 and thereby determining the shininess of printed foil portions on a substrate 4.

## Claims

1. Foil guiding device (60) that is designed to be used in a printing module (50) of a printing press (2), namely a foil printing module (50) having a printing area (23) that is configured to enable a printing process in which transfer portions of a foil (3) are transferred to a substrate (4) being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area (23) accommodates a pair of pressing cylinders (27, 28) for pressing together the foil (3) and the substrate (4) in a nip between them so as to form a substrate foil assembly (5), and which printing area (23) further accommodates an ultraviolet light source (51) arranged at a downstream side of the nip for exposing the substrate foil assembly (5) to ultraviolet light for the purpose of curing the adhesive, the foil guiding device (60) comprising a guide roller (62) being designed for close arrangement to one of the pressing cylinders (27, 28) and to direct used foil (3) away from the cylinder (28) and the substrate (4) after having made the substrate foil assembly (5) to move along with the cylinder (28) over a portion of a revolution thereof, and the guide roller (62) having an adjustable position in the foil guiding device (60) so as to allow for control of a rotation angle (φ) between the position of the nip and the position where the used foil (3) is directed away from the cylinder (28) and the substrate (4) when the foil guiding device (60) is used in a foil printing module (50).

2. Foil guiding device (60) according to claim 1, wherein the position of the guide roller (62) is adjustable in the foil guiding device (60) so as to allow variation of the rotation angle between the position of the nip and the position where the used foil (3) is directed away from the cylinder (28) and the substrate (4) between 90° and 96° when the foil guiding device (60) is used in a foil printing module (50) .

3. Foil guiding device (60) according to claim 1, wherein the position of the guide roller (62) is adjustable in the foil guiding device (60) so as to be one of two positions, namely one position that is associated with a rotation angle between the position of the nip and the position where the used foil (3) is directed away from the cylinder (28) and the substrate (4) of 90° when the foil guiding device (60) is used in a foil printing module (50), and another position that is associated with a rotation angle between the position of the nip and the position where the used foil (3) is directed away from the cylinder (28) and the substrate (4) of 96° when the foil guiding device (60) is used in a foil printing module (50).

4. Foil guiding device (60) according to any of claims 1-3, comprising a mounting frame (61) that is designed to be fixedly mounted in a foil printing module (50) and an angle adjusting mechanism that is designed to adjust a position of the guide roller (62) with respect to the mounting frame (61).

5. Foil guiding device (60) according to claim 4, wherein the angle adjusting mechanism comprises a carrier

element (63) that is slidably arranged with respect to the mounting frame (61) and that carries the guide roller (62).

**6.** Foil guiding device (60) according to claim 4 or 5, wherein the angle adjusting mechanism comprises at least one actuator element (64) that is arranged and configured to act on the carrier element (63) for the purpose of moving the carrier element (63) with respect to the mounting frame (61), and wherein the foil guiding device (60) comprises a controller system (65) having a user interface for receiving input from an operator about the rotation angle ($\varphi$) between the position of the nip and the position where the used foil (3) is directed away from the cylinder (28) when the foil guiding device (60) is used in a foil printing module (50), the controller system (65) being designed to process such input, to determine an associated position of the carrier element (63), and to control operation of the actuator element (64) so as to bring about movement of the carrier element (63) in case an actual position of the carrier element (63) deviates from such associated position.

**7.** Foil guiding device (60) according to claim 6, wherein the controller system (65) is configured to run a computer program and to apply output of the computer program in a process of performing the functions of processing input received from the operator through the user interface, determining an associated position of the carrier element (63), and transmitting a control signal for controlling operation of the actuator element (64) in case an actual position of the carrier element (63) deviates from such associated position.

**8.** Computer program product comprising a program code of the computer program of the controller system (65) of the foil guiding device (60) according to claim 7.

**9.** Foil printing module (50) of a printing press (2), having a printing area (23) that is configured to enable a printing process in which transfer portions of a foil (3) are transferred to a substrate (4) being provided with ultraviolet curable adhesive in a pattern to be printed, which printing area (23) accommodates a pair of pressing cylinders (27, 28) for pressing together the foil (3) and the substrate (4) in a nip between them so as to form a substrate foil assembly (5), and which printing area (23) further accommodates an ultraviolet light source (51) arranged at a downstream side of the nip for exposing the substrate foil assembly (5) to ultraviolet light for the purpose of curing the adhesive, the foil printing module (50) being equipped with a foil guiding device (60) according to any of claims 1-7.

**10.** Foil printing module (50) according to claim 9, comprising an adhesive application unit (52) that is arranged and configured to provide a substrate (4) with ultraviolet curable adhesive in a pattern to be printed at a position upstream of the nip.

**11.** Foil printing module (50) according to claim 10, wherein the adhesive application unit (52) comprises an assembly of a plate cylinder (53), a blanket cylinder (54) and an impression cylinder (55), the plate cylinder (53) being configured and arranged to transfer a pattern of ultraviolet curable adhesive to the blanket cylinder (54), and the blanket cylinder (54) and the impression cylinder (55) constituting a pair of cylinders (54, 55) for pressing a substrate (4) in a nip between them so as to enable transfer of the pattern of ultraviolet curable adhesive from the blanket cylinder (54) to the substrate (4).

**12.** Foil printing module (50) according to any of claims 9-11, being designed so as to function as an offset printing module and comprising an assembly of a plate cylinder (24), a blanket cylinder (27) and an impression cylinder (28), the blanket cylinder (27) and the impression cylinder (28) constituting the pair of pressing cylinders (27, 28) accommodated in the printing area (23), and the guide roller (62) of the foil guiding device (60) being closely arranged to the impression cylinder (28).

**13.** Foil printing module (50) according to any of claims 9-12, comprising a foil reuse unit (40) that is arranged and configured to receive a length of used foil (3) from the printing area (23) and to feed the same length of foil (3) back to the printing area (23) in a longitudinally shifted position so as to enable use of a length of foil (3) in at least two stages, wherein, in a later stage, transfer portions are taken from the length of foil (3) at positions of the length of foil (3) which have not been addressed during the preceding stage(s).

**14.** Method for controlling shininess of foil portions to be printed on a substrate (4) by means of the foil printing module (50) according to any of claims 9-13, the method comprising controlling a position of the guide roller (62) of the foil guiding device (60) of the foil printing module (50) with respect to the pressing cylinders (27, 28) of the foil printing module (50).

**15.** Method according to claim 14, wherein a rotation angle ($\varphi$) between the position of the nip between the pressing cylinders (27, 28) of the foil printing module (50) and the position where used foil (3) is directed away from one of the pressing cylinders (27, 28) and the substrate (4) is varied between 90° and 96°.

**16.** Method according to claim 14, wherein a rotation angle ($\varphi$) between the position of the nip between the

pressing cylinders (27, 28) of the foil printing module (50) and the position where used foil (3) is directed away from one of the pressing cylinders (27, 28) and the substrate (4) is set to be one of 90° and 96°.

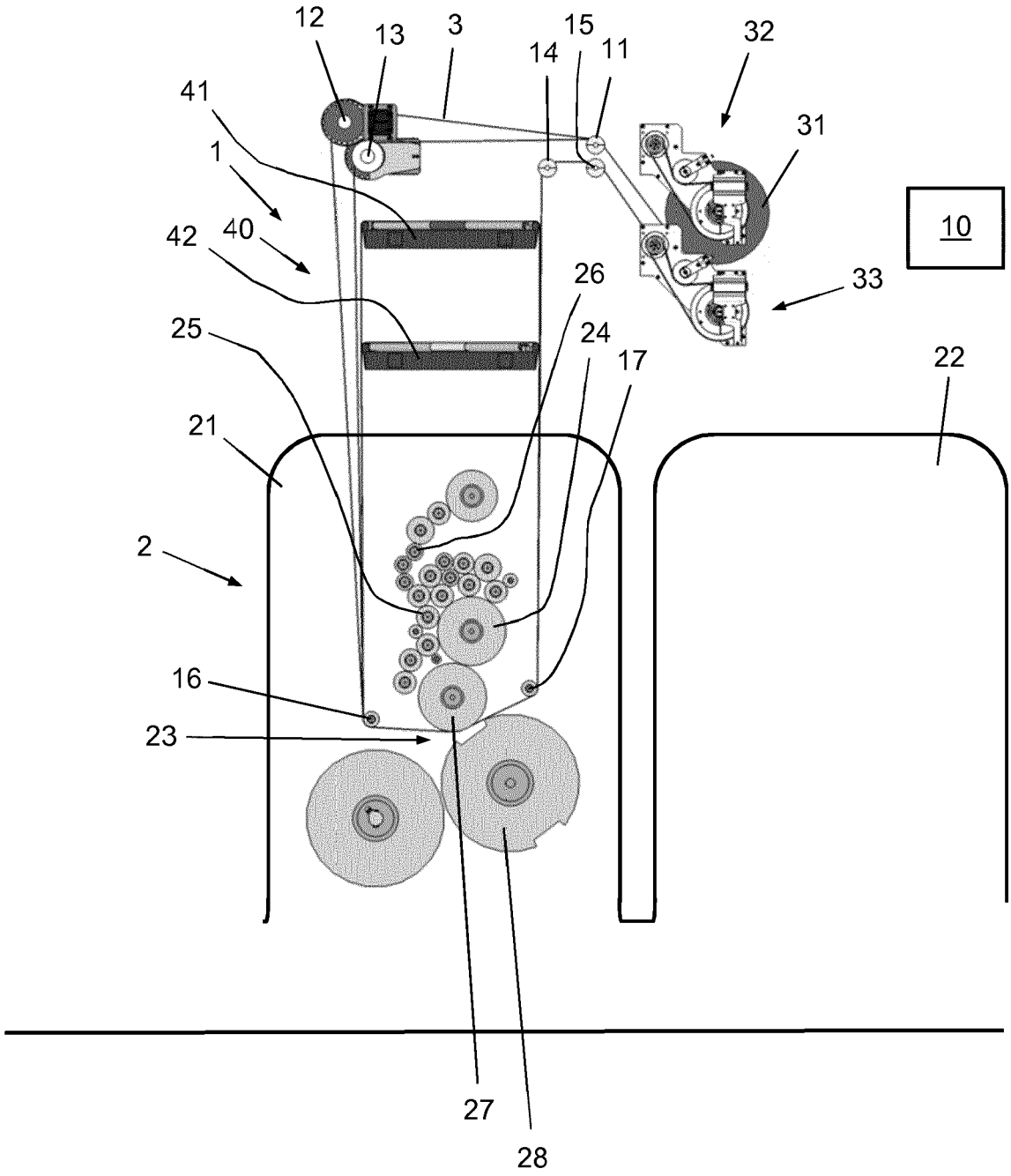


Fig. 1

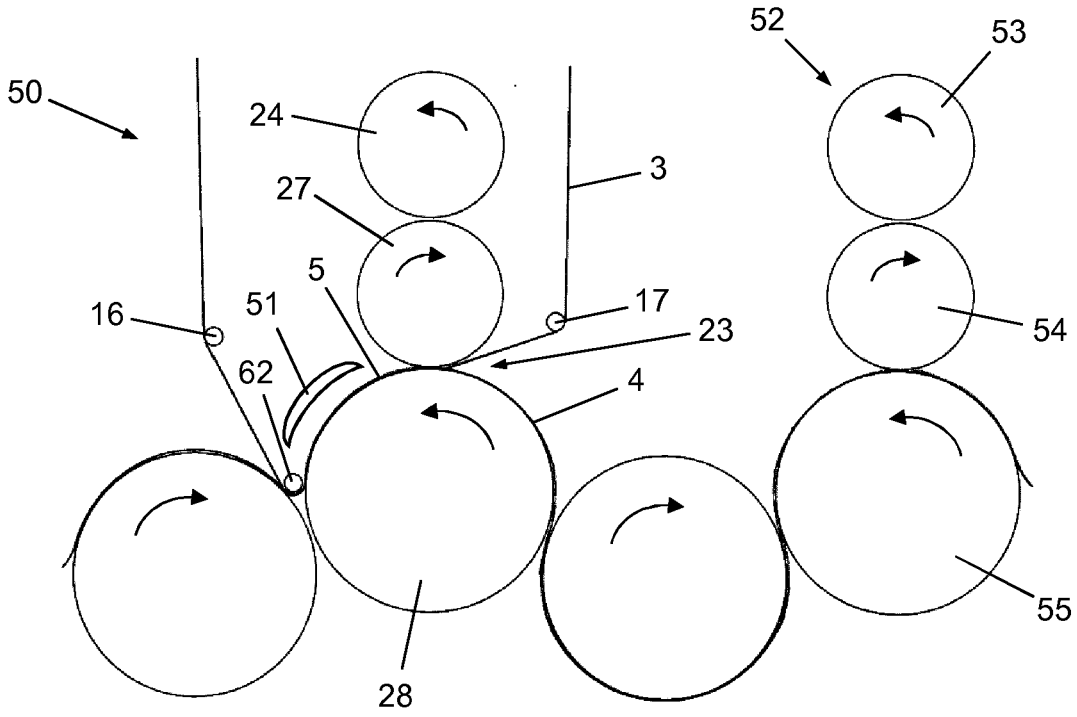


Fig. 2

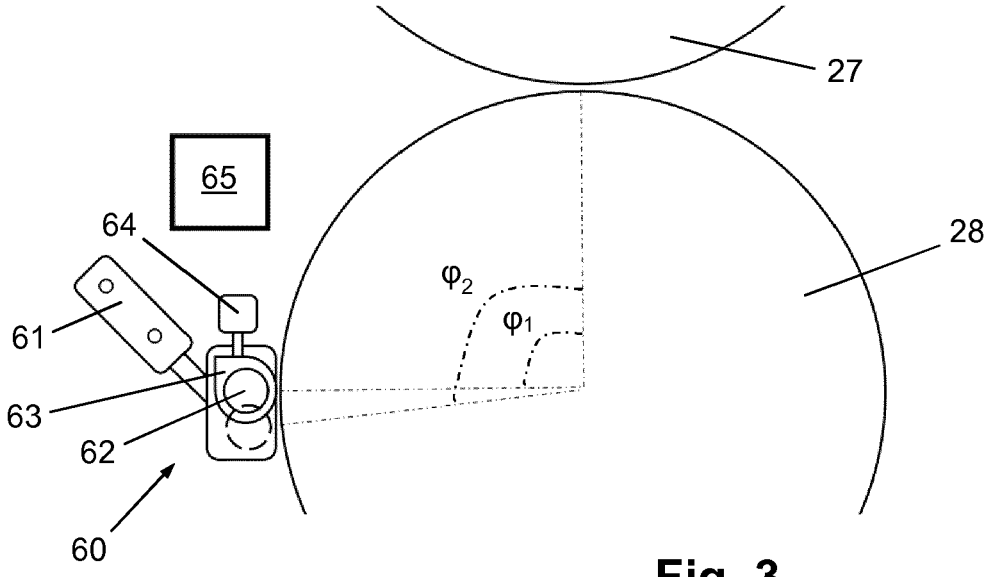


Fig. 3

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# EUROPEAN SEARCH REPORT

Application Number
EP 18 02 0258

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| Place of search | Date of completion of the search | Examiner |
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| Munich | 24 September 2018 | Bellofiore, Vincenzo |

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