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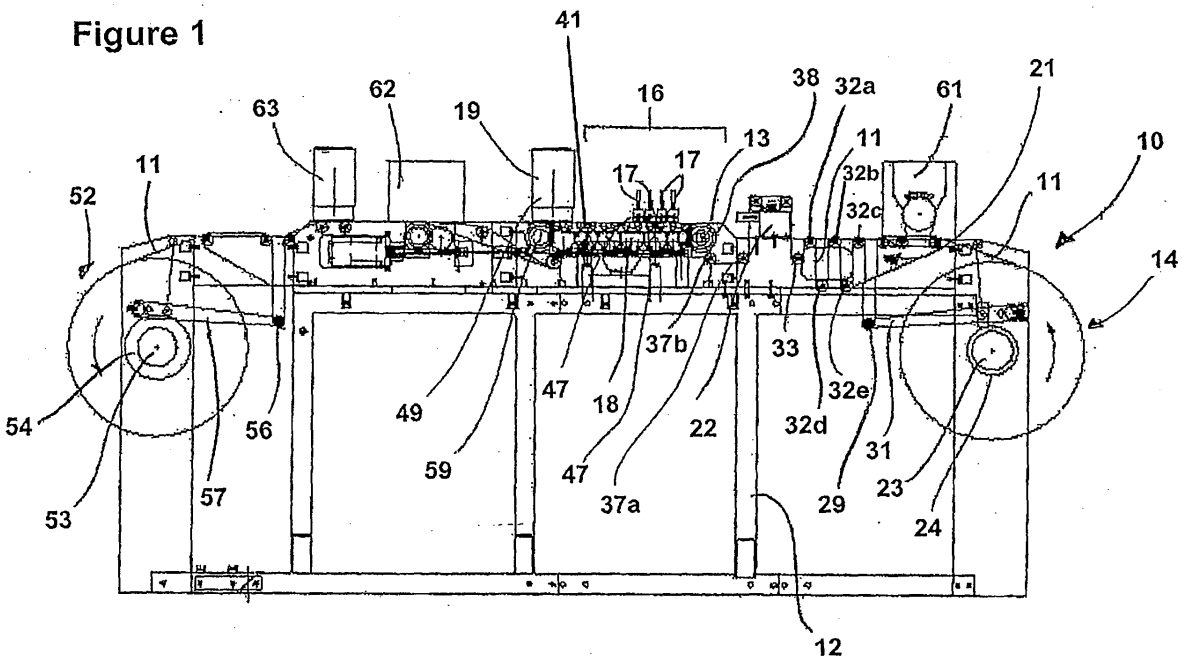
(54) A printing apparatus

(57) A printing apparatus (10) comprises a web feed bed (13) and includes a web supply (14), one or more feed rollers, a powered web guide, a printing zone (16), including one or more printing heads supplied with ink from an ink supply, suction table and an ink curing device, the web supply in use of the apparatus feeding a continuous web (11) of flexible material via the one or more feed rollers to the powered web guide, the web guide being operable to adjust the orientation of the web relative to the web feed bed and permit feeding of the web along the feed bed to the printing zone (16) in which printing of the web material (11) with ink selectively occurs, the or each printing head overlying the suction table in the printing zone and the suction table operating to draw the web passing over it downwardly relative to the printing heads.

Figure 1



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Description

[0001] This invention relates to a printing apparatus.

[0002] Throughout the long history of printing numerous designs of automated printing and paper handling machines have been proposed. Many such designs have successfully been introduced and some have been sold in very large numbers.

[0003] The most commonly used high speed printing machines print onto moving webs of, typically, paper. An example arises in the printing of newsprint, in which very large rolls of newspaper are printed before being guillotined and collated into completed newspapers.

[0004] The packaging industry has been responsible for the development of various specialised printing machines the aim of which has been to enable printing onto eg. non-flat objects such as metal containers. The packaging industry, and especially the food packaging industry, also has introduced numerous machines that enable the printing of labels and stickers.

[0005] In general in the printing of packaging materials there is a marked difference between on the one hand the quality of printed materials that display the livery of a product for the purpose of advertising it on eg. a supermarket shelf, and on the other hand the print quality of items such as labels and stampings that are attached to or impressed onto products in order to convey information relating to weights, prices, "use by" dates and so on. The former kind of printed material, that typically is applied to packaging containers at a filling or cooking plant, is of considerably better quality than the latter (that often is printed using a portable or relatively small device at the point of sale).

[0006] Typically the "livery" quality of printing is completed on empty packages, before they are filled. The printing of labels and stampings most commonly occurs after filling of the packages.

[0007] It would be desirable to improve the quality of printing of materials used in packaging such that materials produced shortly before sales of products can attain the standards associated with product liveries.

[0008] Furthermore there are difficulties associated with the printing of non-paper packaging materials.

[0009] One feature of printing onto paper is that in almost all cases printing inks migrate into the fibrous paper structure to a greater or lesser extent. When printing on paper the extent of this ink migration can be controlled through the choice of ink and paper combinations such that while the inks are curing following printing no noticeable degradation of the print quality occurs. Moreover when printing on paper it is only relatively rarely necessary actively to promote curing of inks since in many cases the inks can successfully be allowed to dry in air.

[0010] When printing onto a non-paper packaging material the ink migration phenomenon usually does not occur. Instead, the ink applied remains attached at the surface of the material.

[0011] This means firstly that a body of ink remains in a wet (uncured) condition on the surface of the printed material. Unless the ink is forcibly cured this means that the material requires careful handling for a considerable time after printing so as to avoid smearing or smudging of the uncured ink.

[0012] Some packaging materials readily lend themselves to aggressive forms of ink curing. An example occurs when printing onto metal containers, that can easily withstand heating in an oven in order to cure the inks employed.

[0013] Such techniques however are not available when the packaging material is polymer-based since heating such a material usually causes rapid, irreversible degradation. Furthermore if the packaging material is flexible the act of conveying it any appreciable distance, after printing, to a curing device such as an oven risks causing smudging of the printing.

[0014] Moreover the inability of printing inks to migrate into the surface of a non-paper web or substrate means that the inks can spread on the surface while awaiting curing. This can lead to a lack of precision of the printing process.

[0015] A further problem of printing onto non-paper substrates is that in the absence of the ink migration effect mentioned above less ink can be accommodated onto the substrate than when printing onto paper.

[0016] This can cause numerous problems associated with the resulting print quality.

[0017] As an example, if it is desired to produce a deep, dark colour it may be necessary to use a significant quantity of ink. When printed onto a non-paper substrate however the ink may as a result produce undulations or other contouring effects that are undesirable. If the substrate is flexible the presence of a large quantity of cured ink can rigidify the substrate. This is generally problematic from the standpoint of storing, moving and using the substrate, and also may result in portions of the ink breaking off from the printed area.

[0018] According to the invention in a first aspect there is provided a printing apparatus comprising a web feed bed and including;

a) a web supply for supplying a web of flexible material for printing in the apparatus;

b) one or more feed rollers for causing feeding of the web in the apparatus;

c) a printing zone including a plurality of printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends, defined with reference to movement of the web in use of the apparatus, for printing in the apparatus, the printing heads being supplied with ink from one or more ink supplies; and

d) a web outfeed,

the web supply and the web outfeed controlling tension in the web during use of the apparatus such that an ink droplet printed onto, or an ink void defined on, the web

by a said printing head passes within at least 20 μm and preferably 15 μm of the location at which a downstream said printing head of the series prints an ink droplet onto, or defines an ink void on, the web.

[0019] An advantage of this arrangement is that it provides for accurate control of the position of any given point on the web relative to the printing heads, when considering the longitudinal dimension of the web (i.e. a direction generally parallel to the direction of feeding of web material through the apparatus in the printing zone).

[0020] It is also desireable to control any transverse movement of the web, i.e. movement in a direction perpendicular to the longitudinal dimension. To this end in accordance with a second aspect of the invention there is provided a printing apparatus comprising a web feed bed and including;

a) a web supply for supplying a web of flexible material for printing in the apparatus;
b) one or more feed rollers for causing feeding of the web in the apparatus;
c) a printing zone including a plurality of printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends, defined with reference to movement of the web in use of the apparatus, for printing in the apparatus, the printing heads being supplied with ink from one or more ink supplies; and
d) a powered web guide,

the web supply in use of the apparatus feeding a continuous web of flexible material via the one or more feed rollers to the web guide that is operable to adjust the translational position of the web relative to the printing heads and/or the web feed bed such that the maximum translational movement of a point on the web during feeding along the series of printing heads does not exceed 20 μm and preferably 15 μm.

[0021] A third possible direction of undesired movement of the web material is perpendicular to the aforesaid longitudinal and transverse directions. In this connection therefore according to a third aspect of the invention there is provided a printing apparatus comprising a web feed bed and including;

a) a web supply for supplying a web of flexible material for printing in the apparatus;
b) one or more feed rollers for causing feeding of the web in the apparatus;
c) a printing zone including a plurality of printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends, defined with reference to movement of the web in use of the apparatus, for printing in the apparatus, the printing heads being supplied with ink from one or more ink supplies; and
d) a suction table,

the series of printing heads overlying the suction table in the printing zone and the suction table operating to draw the web passing over it downwardly relative to the printing heads.

[0022] Each of the aforementioned, broadly stated aspects of the invention provides for considerable improvements in the accuracy and quality of the printing of packaging materials including but not limited to point of sale labels, stickers and sleeves. The various aspects of the invention as stated above also surprisingly make it possible rapidly to change the speed at which a packaging printing apparatus prints onto web material.

[0023] The various benefits of the invention however are maximised when used in combination with one another.

[0024] According to the invention in a fourth aspect therefore there is provided a printing apparatus comprising a web feed bed and including:

a) a web supply,
b) one or more feed rollers,
c) a powered web guide,
d) a printing zone, including one or more printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends defined with reference to movement of the web in use of the apparatus, the printing heads being supplied with ink from an ink supply,
e) a suction table and
f) a web outfeed,

the web supply in use of the apparatus feeding a continuous web of flexible material via the one or more feed rollers to the powered web guide, the web guide being operable to adjust the orientation of the web relative to the web feed bed and permit feeding of the web along the feed bed to the printing zone in which printing of the web material with ink selectively occurs, the or each printing head overlying the suction table in the printing zone and the suction table operating to draw the web passing over it downwardly relative to the printing heads and the web supply and the web outfeed controlling tension in the web during feeding.

[0025] Such an apparatus is very well suited to enable the printing of a flexible, non-paper substrate provided as a web that may be coiled before, and optionally after, printing onto a reel.

[0026] The presence of an optional ink curing device, described below, as part of the apparatus advantageously means that the inks printed by the apparatus can be cured almost immediately after printing has occurred. This in turn avoids the problems, indicated above, of smearing or smudging of the inks.

[0027] This is partly because the path between the printing zone and the ink curing device can be arranged, in embodiments of the invention, to be a short, flat route that avoids smearing of wet inks before they are cured.

[0028] Also of course the ability in the apparatus of the

invention to locate the ink curing device very close to the printing zone means that little time elapses between the printing and curing steps. This means that spreading of the wet ink on the web does not occur.

[0029] The presence of a web guide and the overall layout of the components of the apparatus means that printing inks can be applied to eg. non-paper webs with very high precision. This in turn means that deep colours can be created by accurately overlaying one colour on another without any necessity for large amounts of ink to be applied. Consequently the problems relating to excessive ink presence that would otherwise arise are obviated in the apparatus of the invention.

[0030] The layout and the features of the inventive apparatus mean that printing may take place with very high accuracy, at much higher speeds than has been possible in the prior art.

[0031] This in turn means that the uses of web-type printed materials in eg, the packaging industry may be made more versatile than in the prior art.

[0032] The high speed of printing that is possible means that packaging materials may be printed on a "just in time" basis, shortly before they are required for use. At the same time the high accuracy of printing that is possible using the apparatus of the invention permits the production of very high quality printing, of a standard that hitherto has only been associated with "livery" printing of trademarks and advertising material onto empty packaging before it is filled; and such quality is achieved even though the apparatus permits rapid variations in e.g. the speed of feeding of the web material.

[0033] The invention therefore permits the manufacture of eg. timely advertisements and promotions, news items and other "immediate" messages while at the same time maintaining the print quality that consumers normally associate with particular brands. The fact that the content of the printed items may be created digitally using appropriately configured computers means that in addition to the benefit of immediacy the apparatus of the invention also permits a high degree of "localisation" of the printed material since it can be printed close to the point of sale and hence include data relating to the region of sale.

[0034] As an example, milk packaging materials printed using the apparatus of the invention may include local news and/or sports headlines so that when purchased early in the morning (as milk often is) the packaging can act as a source of local news. Aside from being a useful adjunct to the functions of eg. a food or beverage package this also can improve the loyalty of customers to particular brands.

[0035] Preferably the web feed bed extends generally horizontally and the width of the web feed bed is such as to accommodate a web of a maximum width of 70.5mm.

[0036] This means that the apparatus of the invention is particularly suited to the printing of relatively narrow packaging materials, that are frequently used in the packaging of food products. The invention however is also of utility in the printing of other types of article, that need not necessarily be used in packaging operations *per se*.

[0037] The fact that the web feed bed extends generally horizontally means that there is little or no chance of smearing of printed inks before curing of the inks takes place.

[0038] In a preferred embodiment of the invention the web supply includes a motorised roller supporting thereon a reel core having wound thereon a reel of web material. It is further preferable that the web supply includes a motor having a rotatable output shaft to which the motorised roller is secured and including secured thereto a brake drum, the brake drum being selectively engageable by a brake member that is operable to control the speed of feeding of the web material from the web supply in dependence on the tension in the web.

[0039] Such an arrangement permits the web to be fed at a tension that is appropriate for its physical properties and the speed at which the printing operations of the apparatus are required to take place.

[0040] In more detail, the one or more feed rollers preferably include a dance roller on the periphery of which the web material passes in use of the apparatus, the dance roller being pivotably secured relative to the motorised roller on a pivot member so as to be moveable in dependence on tension in the web, the pivot member being connected to control a feeding brake mechanism including the brake member. Optionally the feeding brake mechanism includes a transducer that generates a signal indicative of the position of the pivot member and an actuator that is operable in dependence on the signal to move a brake member selectively into and out of braking engagement with the brake drum.

[0041] Such an arrangement is advantageously reliable, and is simple to manufacture.

[0042] Preferably the actuator of the brake mechanism is a pneumatic actuator and the brake member is a brake pad secured to an output member of the pneumatic actuator. However other arrangements of the brake of the apparatus are within the scope of the invention and will occur to those of skill in the art.

[0043] In a preferred embodiment of the invention the motorised roller includes an expandable chuck that is selectively expandable to grip an inner periphery of the reel core.

[0044] Such a mechanism, the precise details of which will occur to the worker of skill, beneficially assures that the fixing of a reel of web material in the apparatus is secure. This can be important bearing in mind the heavy requirement, explained above, for accuracy when printing onto non-paper webs in order to achieve depth of colour without having to apply thick layers of ink.

[0045] The use of an adjustable chuck also permits the apparatus to accommodate web reels whose cores are of a range of sizes.

[0046] In order to maximise the benefit of the foregoing features of the invention preferably the apparatus includes an actuator that is connected to permit manual

adjustment of the expansion of the chuck. Such an arrangement is versatile, reliable and comparatively cheap to construct.

[0047] In a preferred embodiment of the invention the one or more feed rollers include a plurality of rotatable path rollers the locations of which relative to the feed bed are fixed. Such rollers permit the reliable feeding of web material that is to receive printing, and define one or more datum points from which during construction and/or setting up of the machine the path of the web can be accurately established.

[0048] Preferably the powered web guide includes a mounting block having secured to an in-use upper face thereof a swivel plate, that is rotatable about a generally vertical axis, the swivel plate including secured thereto one or more web guide rollers; and the mounting block further supporting one or more web alignment sensors and one or more servomotors for selectively effecting rotation of the swivel plate in dependence on signals generated by the one or more web alignment sensors.

[0049] Such an arrangement coupled with an appropriate control scheme allows adjustment of the feeding direction of the web towards the printing zone as often as is needed in order to assure the requisite accuracy of the printing operation.

[0050] In this regard, web material being fed along a bed can "hunt" (ie. veer from side to side of the bed) for no apparent reason. The powered web guide of the apparatus of the invention very beneficially controls hunting of the web on the bed to within predetermined tolerances or limits, and also can be used to account for dimensional variations along the length of the web.

[0051] In preferred embodiments of the invention the or each web alignment sensor is an ultrasound transducer that is arranged to detect the edge of a web moving past it and generate a signal that is proportional to its position relative to a datum.

[0052] Such sensor types are suitable for use with eg. narrow webs of polymeric material. Other types of sensor however are possible and may be used as appropriate in the web guide.

[0053] Conveniently the alignment sensor includes a generally U-shaped member having an ultrasound sensor secured on at least one limb of the "U" so as to face the other said limb. Such a support arrangement for the sensors of the web guide advantageously presents the sensors to either side of the web of material that is to receive printing ink in the apparatus of the invention. Therefore the sensor support arrangement allows reliable edge sensing in relation to the web.

[0054] In a preferred embodiment the mounting block is hollow and supports at least one servomotor within its interior, the servomotor including an output shaft that protrudes so as to engage the swivel plate.

[0055] This arrangement is advantageously compact while providing the desired accuracy of the movements of the web guide.

[0056] An important, optional feature of the apparatus of the invention is located between the web supply and the printing zone and comprises a printing zone feed arrangement including one or more web rollers and a powered, rotatable drum, the or each web roller being located to feed, in use of the apparatus, web material around part of the periphery of the powered drum, the said part being at least 120 degrees of the circumference of the powered drum.

[0057] The powered drum is particularly beneficial in providing an accurate "point of entry" of the feed of the web into the printing zone. The arrangement whereby the web extends around at least 120 degrees of the drum assures there is no slipping of the web material relative to the roller even when feeding occurs at high speeds.

[0058] Preferably the powered drum includes on its outer surface a finish that promotes gripping by the material of the web. Such a surface finish assures that the web does not slip relative to the drum during feeding of the web to the printing zone.

[0059] Conveniently the series consists of four printing heads the series consists of four printing heads and is 135 mm long. Alternatively, the series may consist of eight printing heads and is 175 mm long.

[0060] In an embodiment of the invention the suction table when present includes a plate having extending through it one or more roller apertures through each of which protrudes a respective, rotatable printing zone roller arranged to support web material passing over the vacuum table, the perforated plate defining an upper end of a hollow suction chamber that is capable of being depressurised in order to create an air pressure gradient that acts via the roller apertures so as to draw web material into contact with the said plate.

[0061] The ability of the apparatus of the invention to draw the web into contact with the plate makes the apparatus particularly suited for use with webs made of lightweight polymeric materials.

[0062] As observed these webs when supplied for packaging applications tend to be less than 100 mm wide and in the preferred embodiment of the invention are no more than 70.5 mm wide. This means that the web often does not have enough self-weight to cause it to lie flat on the web feed bed. Forming part of the bed as a suction table as defined means that wrinkles in the mid-portion of the web and curling of the edges, caused by the lightness of the web are eliminated.

[0063] Conveniently the apparatus includes one or more motors for causing powered rotation of the printing zone rollers.

[0064] It is also preferable that the apparatus includes connected to the suction chamber a conduit connected to a suction pump that is operable to depressurise the suction chamber.

[0065] The foregoing features assure adequate operation of the suction table.

[0066] Conveniently the ink curing device includes an ultraviolet lamp that is arranged to transmit ultraviolet light onto web material passing through the apparatus

after printing in the printing zone.

[0067] The use of ultraviolet radiation to cure printing inks is known *per se* but positioning an ultraviolet lamp close to the printing zone hitherto has not occurred in relation to curing of printing of narrow webs in the packaging industry.

[0068] In more detail the lamp transmits ultraviolet light onto the web material at an intensity of at least 200W/cm over a web length of at least 85 mm.

[0069] Such close spacing of the ultraviolet lamp assures in curing the inks printed onto the web material before undesirable spreading of the inks occurs.

[0070] Preferably the ink curing device includes a moveable shutter that selectively moves to shield the web from heat and/or UV light generated by the ink curing device.

[0071] This feature is advantageous because it is not desirable for the web, and indeed the printing zone, to be exposed to heat from the ultraviolet lamp all the time, since this could degrade the web Advantageously the presence of the shutter prevents this effect.

[0072] Furthermore the printing zone includes the jets of the printing heads. If ultraviolet light were to stray from the vicinity of the ink curing device towards the printing zone the ink in the printing head jets could cure with the result that the printing heads would cease functioning. The shutter prevents this phenomenon.

[0073] A preferred embodiment of the invention includes an enclosure at least partially enclosing the printing zone and the ink curing device. This in turn permits the apparatus of the invention advantageously to include an exhaust pipe and gas pump that are connected to draw contaminants from the enclosure. Such features assure that the apparatus meets modern health and safety requirements.

[0074] It is beneficial that in some embodiments the apparatus of the invention includes means for collecting its printed output, eg. for storage or subsequent transportation. To this end the web outfeed optionally includes a web winder comprising a further motorised roller supporting thereon a reel core for winding thereon a reel of printed web material produced in the apparatus.

[0075] Conveniently the web winder includes a motor having a rotatable output shaft to which the further motorised roller is secured and including secured thereto a brake drum, the brake drum being selectively engageable by a brake member that is operable to control the speed of winding of the web material onto the web winder in dependence on the tension in the web.

[0076] It is also preferable that the web winder includes a dance roller on the periphery of which the web material passes in use of the apparatus, the dance roller being pivotably secured relative to the further motorised roller on a pivot member so as to be moveable in dependence on tension in the web, the pivot member being connected to control a winding brake mechanism including the brake member.

[0077] Further, optionally, the winding brake mechanism may include a transducer that generates a signal indicative of the position of the pivot member and an actuator that is operable in dependence on the signal to move a brake member selectively into and out of braking engagement with the brake drum.

[0078] Thus in some embodiments of the invention the web winder operates in a similar, but reversed, fashion to the web supply arrangement defined above.

[0079] However in other embodiments of the invention there may be no need to store the printed web that results from operation of the apparatus. Instead the web may be continuously fed from the apparatus of the invention to a packaging line that includes equipment for cutting the web as needed and applying the printed material eg. as labels or other kinds of adornment onto packaging for foodstuffs or other products.

[0080] In such an embodiment such components and, as necessary, further braking and tension control parts, constitute the web outfeed as defined herein.

[0081] In a preferred embodiment of the invention the apparatus includes a controller for causing operation of at least one said printing head to occur in synchronism with operation of at least one said feed roller.

[0082] There now follows a description of a preferred embodiment of the invention, by way of non-limiting example, with reference being made to the accompanying representations in which:

Figure 1 is a side elevational view of an apparatus according to the invention;

Figure 2 is a side elevational view of part of the Figure 1 apparatus viewed from the opposite side to Figure 1;

Figure 3 is a perspective view of a powered web guide forming part of the Figure 1 apparatus; and

Figure 4 is a perspective view of a suction table also forming part of the Figure 1 apparatus.

[0083] In the following the terms "upstream" and "downstream" are to be construed in accordance with the direction of movement of web material 11 through the apparatus 10 described below. In particular the "downstream" direction of movement is the direction of feeding of the web material 11 through the apparatus 10 when the latter is operating normally, and therefore "upstream" is construed to signify the opposite sense of movement along the apparatus 10.

[0084] The figures show an apparatus 10 according to the invention for printing a narrow web of material 11.

[0085] As shown apparatus 10 includes a machine frame12 that supports and helps to define a horizontally-extending feed bed 13 for the web material.

[0086] Machine frame 12 is constructed as a series of interconnected, rigid (eg. steel) support members. The support members can be secured to one another by any of a range of fixing methods including but not limited to welding or screwing. It is desirable in the apparatus 10 that the machine frame 12 provides an essentially vibra-

tion-proof support for the remainder of the parts of the apparatus 10 so that operation of the apparatus remains accurate.

[0087] The feed bed 13 therefore is supported by and if desired, in some designs, may form part of the machine frame 12. As explained the apparatus 10 is intended accurately to print at high speed a narrow web of material 11. The feed bed therefore is of a width preferably that is capable of supporting, for movement through the apparatus 10, a continuous web that is a maximum of 100 mm wide and in preferred embodiments is no more than 70.5 mm wide. At various locations where the path of the web material 11 through the apparatus is not interrupted either by apertures or the presence of rollers, as discussed below, the feed bed 13 may be defined by eg. plural smooth steel plates secured for example by welding to the in use upper surface of the machine frame 12 such that in the main the web material 11 passes over the feed bed and is supported thereby from underneath.

[0088] As is explained in more detail below, the web material 11 is during use of the apparatus 10 fed from a web supply 14 along the feed bed 13 towards and through a printing zone indicated generally by numeral 16. The printing zone 16 includes in the preferred embodiment a plurality of printing heads 17 that are arranged to print onto the web material 11 passing beneath them during operation of the apparatus.

[0089] Beneath the printing heads is arranged a suction table 18 that in a manner set out below serves to ensure that the web material 11 is maintained in a flat, easily printed condition as it moves through the apparatus 10.

[0090] From the printing zone 16 the web material after printing moves to an ink curing device 19. As mentioned above, the ink curing device is positioned closely "downstream" of the printing zone 16 so that the ink is dried immediately after it is printed onto the web material 11. This is one of the major features of the invention that permits it successfully to print up-to-date information onto web material with a high degree of quality.

[0091] For the purpose of feeding the web continuously in the apparatus 10 there is provided a plurality of feed rollers 21 and a powered web guide 22. This arrangement of components is one of the other very significant features of the apparatus of the invention that permit the rapid printing of high-quality material onto a continuous web.

[0092] As best shown in Figure 2, the web supply 14 comprises a motorised roller 23 that when the apparatus 10 is loaded with web material for printing is rotatively coupled to a reel core 24. The core 24 in a typical application will be a fibreboard tube of the kind well known in the printing and other industries for supporting wound on it a reel of flexible material.

[0093] The web supply includes an electric motor, that is not visible in the figures, having a rotatable output shaft 26 to which the motorised roller 23 is secured. The rotatable output shaft 26 includes secured thereto a brake drum 27, the brake drum being selectively engageable by a brake member (ie. a solenoid actuated brake pad in the embodiment shown) 28 that is operable to control the speed of feeding of the web material from the web supply in dependence on the tension in the web. The precise feeding arrangement is such that as tension in the web material 11 decreases the braking force acting on the output shaft is reduced; and if the tension increases the braking force increases, so as to maintain the tension in the web at approximately an optimum value. The optimum tension value is selected depending on the speed at which the apparatus 10 operates and also in dependence on other factors such as the material from which the web 11 is manufactured.

[0094] The braking arrangement described above is controlled in the preferred embodiment shown by a dance roller 29 constituting one of the feed rollers 21 mentioned above.

[0095] The dance roller 29 is rotatably mounted at one end of a pivot member in the form of arm 31. Arm 31 is pivotably secured at its other end to the machine frame 12 such that the web material 11 loops under the dance roller between the web supply 14 and the remainder of the feed rollers 21. The degree of tension in the web as a result causes adjustment of the position to which arm 31 pivots and the resulting movement of the arm 31 may be used as a control input for controlling the application of the brake member 28.

[0096] This in turn may be effected through the use of a transducer that generates a signal indicative of the position of the arm 31 and an actuator that is operable in dependence on the signal to move a brake member selectively into and out of braking engagement with the brake drum.

[0097] The transducer may of any of a wide range of designs the details of which would be known to the worker of skill; and the actuator in certain embodiments of the invention is a solenoid or a pneumatic actuator 28a. In such an arrangement the brake pad 28 is secured to an output member (typically, a linearly displaceable shaft) of the solenoid or pneumatic actuator 28a.

[0098] As mentioned the motorised roller 23 may include an expandable chuck for the purpose of permitting it to grip and support a range of sizes of the reel core 24 by engaging the hollow interior of the core tube. The exact design of the expandable chuck would be within the knowledge of the skilled worker.

[0099] An actuator, such as but not limited to a handwheel or similar mechanical device, is operatively connected to permit manual adjustment of the expansion of the chuck. Such features are not shown in the figures but are of designs that the worker of skill would be able to embody from his knowledge and experience.

[0100] The one or more feed rollers signified generally by numeral 21 include secured downstream of the dance roller 29 a plurality of rotatable path rollers 32 the locations of which relative to the feed bed are fixed.

[0101] This is achieved by reason of the path rollers 32 being journalled at either end in bearings supported

in the machine frame 12, such that the path rollers 32 extend horizontally widthwise relative to the feed bed 13.

[0102] As is best seen in Figure 1 the path rollers 32 are arranged in the preferred embodiment of the invention as an upper series of three rollers 32a, 32b, 32c arranged as aforesaid and a lower series 32d, 32e. The web material 11 feed is threaded between the path rollers 32 so as to extend upwardly and downwardly as shown. This arrangement assists in ensuring accurate feeding of the web material.

[0103] At the downstream end of the series of path rollers 32 there is provided an intermediate roller 33. Intermediate roller 33 is mounted in essentially the same manner as the path rollers 32, at a height part-way between the heights of the upper and lower series of path rollers mentioned above.

[0104] The purpose of the intermediate roller 33 is to present the web material 11 vertically below the upstream end of the powered web guide 22. The web material 11 therefore extends vertically upwardly from the region of the path rollers to enter the powered web guide 22.

[0105] The web guide 22 includes a swivel plate 34 that is rotatably secured (by means of a bearing that is not visible) on the top of a mounting block 36.

[0106] Mounting block 36 is hollow and supports within its interior a servomotor the rotatable output shaft of which extends upwardly through the top surface of the mounting block for connection to the swivel plate 34. As a consequence swivel plate 34 may be driven to rotate from side to side about a vertical axis in dependence on operation of the servomotor, as indicated by the arrows in Figure 3.

[0107] The servomotor in turn is controlled by, in the preferred embodiment, a pair of web alignment sensors. The alignment sensors are secured on a generally U-shaped member 37 that is located downstream of the swivel plate 34. The U-shaped member has an ultrasound sensor secured on each limb of the "U" so as to face the ultrasound sensor mounted on the other said limb.

[0108] In an alternative embodiment of the invention the servomotor may be replaced or augmented by other kinds of actuator device.

[0109] The swivel plate includes secured thereto two web guide rollers 38. These are mounted, relative to the web guide, in a similar manner to the path rollers 32 described above.

[0110] The overall arrangement of the web guide 22 therefore is to provide a roller support, for the web material, in the form of the swivel plate 34 the orientation of which adjusts during use of the apparatus 10 in dependence on operation of the servomotor. The servomotor operation in turn is controlled by the ultrasound transducers.

[0111] Each latter is arranged to detect the edge of a web moving past it and generate a signal that is proportional to its position relative to a datum. A relatively simple control mechanism (such as a programmable controller) may then be employed to assess whether the web at any given time is closer to one side of the alignment sensor 22 than the other; and effect adjustment of the position of the swivel plate 34 in order to keep the web material centrally on the feed bed in the region immediately upstream of the printing zone 16.

[0112] The web material 11 feeds from the web guide via a further pair of intermediate rollers 37a, 37b installed at the same height and orientation as intermediate roller 33 so as to meet from below at a tangent the outer periphery of a powered drum 38.

[0113] Drum 38 is of a larger diameter than the path rollers 32 and intermediate rollers 33 and 37, which latter are all in the preferred embodiment of the same diameter in order to minimise the number of distinct parts from which the apparatus 10 is manufactured.

[0114] Drum 38 is arranged in generally the same orientation as the rollers 32, 33 and 37 so as to be journalled at either end for rotation about a horizontally extending axis. A drive mechanism described below causes powered rotation of the drum 38 in such a way as to cause controlled and accurate movement of the web material towards the downstream end of apparatus 10.

[0115] The web material 11 in effect is wrapped around at least 120 degrees of the circular outer periphery of the drum 38. This together with the enlarged diameter of drum 38 relative to the other rollers ensures that the web material 11 is fed from the drum 38 towards the printing zone 16 at a constant speed and without slippage. The anti-slip qualities of the drum 38 may be enhanced by forming its outer periphery to have an outer surface that is e.g. roughened and has a high coefficient of friction with the material 11.

[0116] The web material 11 is fed essentially horizontally from the drum 38 so as to meet at its upstream end a horizontally extending top plate 41 forming the upper surface of the suction table 39, that underlies the printing zone 16.

[0117] Suction table 39 includes a housing 44 that is generally cuboidal and defines a plenum. The plenum is connected via appropriate hoses communicating with its interior to one or more air pumps that generate an underpressure in the plenum.

[0118] Top plate 41 has formed in it a plurality of slots 43 that extend from side to side across the suction table. On operation of the air pump(s) therefore an air pressure gradient is created acting across the top plate 41 so as to draw the web material downwardly onto the suction table 39.

[0119] Each of the slots 43 in the top plate has supported therein for rotation about a horizontal axis extending from side to side across the top plate 41 a respective, powered printing zone roller 42.

[0120] Each printing zone roller 42 is arranged so that a relatively small arc of its circumference protrudes through a respective slot 43. As a result the web material during operation of the suction table 39 is drawn into contact with the printing zone rollers 42. The latter are driven

to rotate so as to assist in driving the web material 11 through the printing zone 16.

[0121] In the illustration of Figure 4 three such rollers are shown protruding through three slots in top plate 41; but in other embodiments of the invention more or fewer rollers and slots may be provided.

[0122] At the upstream end of suction table 39 printing zone 16 is defined as a series of printing heads (ink jets in the preferred embodiment, although other kinds of printing head are possible) 17 that are mounted in respective carriages 47. The carriages are such as to permit movement of the printing heads in a side-to-side direction relative to the feed bed during setting up of the apparatus 10. As a result it is possible to set with accuracy the printing head locations.

[0123] A further adjustment mechanism for each printing head 17 is provided in the form of an orientation adjuster that permits setting of the orientation of each printing head 17.

[0124] The printing heads 17 in the preferred embodiment of the invention are inkjet heads of *per se* known design such as but not limited to Xaar 1001 ink jets. They are supplied with ink from an ink supply (that is not visible in the drawings) and are controlled by eg. a digital device such as a personal computer having a print control program stored therein.

[0125] On operation of the apparatus 10 the printing heads 17 selectively apply ink in respective colours onto the web material 11 passing underneath, the accurate feeding of the web material 11 as a result of the layout and components of the apparatus ensuring a print quality that is at least comparable to the best quality of printing available in packaging industries. The arrangement of the apparatus 10 permits the use of only the minimum amounts of ink needed to achieve deep, full colour coverage and thereby obviates the problems of the prior art machines mentioned above.

[0126] An ultraviolet (UV) ink curing device 19 is located at the downstream end of suction table 39, a short distance from the printing heads 17. UV curing device 19 comprises a UV lamp contained within a hollow housing 49. Housing 49 is open at its lowermost end and overlies the suction table 39 such that web material 11 passes underneath it during operation of the apparatus 10.

[0127] A shutter is moveable eg. horizontally or in an arcuate path so as selectively to open and close the open end of housing 49. The UV lamp operates under the control of the digital device selectively to expose the web to UV light. The shutter operates under control of the digital device to shade the UV light except when it is needed for curing of ink on the web material 11, which latter is timed in relation to the production of images, etc., on the web material 11 by the printing heads 17. As a consequence of this arrangement stray UV light is prevented from shining onto the printing heads 17, since this could cause the ink in the heads 46 to cure with consequent problems of blocking of the printing heads 17. More significantly the web material is as a result of the presence of the shutter protected against possible heat damage that could arise from operation of the UV lamp.

[0128] In a preferred embodiment of the invention the wavelength of the UV light is in the approximate range 200-600 nm and more particularly 200-400 nm.

[0129] UV lamps exhibit output energy peaks at certain wavelengths and one lamp suitable for use in the apparatus of the invention produces a strong peak at approximately 360 nm and lesser peaks at 260 nm and 290 nm.

[0130] The precise choice of UV lamp typically is related to the chemistry of the ink being printed since the UV light initiates the curing reaction. The choice of UV lamp therefore assists in promoting rapid curing of the ink.

[0131] The suction table 39 and hence the parts of the printing zone 16 are preferably contained within a hollow enclosure, that has been omitted from the figures for clarity. The enclosure includes entrance and exit slots for the web material 11 respectively at its upstream and downstream ends, and is connected via ducts to an extraction fan or pump that is also omitted from the figures. The arrangement of the enclosure and related components is such as to extract airborne contaminants such as ink dust away from the printing zone 16. This improves the quality of the printing on the web material, and also minimises the risk of an operator encountering the contaminants.

[0132] Since the ink curing device 19 is located very closely downstream of the printing heads 17 curing of the ink on the web material takes place almost immediately after printing has occurred. As explained above, this provides numerous advantages connected with the quality of printing onto the web material 11.

[0133] The web material 11 from the ink curing device 19 feeds downstream via a further geared drum 59 of similar design to drum 38 to, in the embodiment illustrated, a web winder 52 including a motorised roller 53 that supports a reel core 54 on which the printed web material 11 is wound for storage and transportation.

[0134] The web winder 52 essentially is of a similar design to web supply 14 and therefore includes a dance roller 56 mounted on a dance arm 57 so as to control a brake that in turn controls tension in the web material 11 as it is wound onto the reel core 54. Reel core 54 is of a similar design to the core 24 of the web supply 14.

[0135] The web winder 52 however could if desired be dispensed with since it is only needed if the printed web is not required in a continuous production arrangement. In the latter situation the printed web may be fed, by way of appropriately designed rollers, directly to a packaging machine that guillotines the web material 11 into individual labels, sleeves or similar printed packaging artefacts and applies them directly to packaging without any need for intermediate storage. Such arrangements could include powered and/or braked rollers that constitute the web outfeed and hence assist to control the web tension in accordance with the principles disclosed herein.

[0136] The various rollers that are described herein as being "motorised" or "powered" could be driven in a va-

riety of ways. The preferred arrangement is to include a single motor that operates under control of the digital device (personal computer, etc.) referred to above and has one or more drive shafts for driving the rollers and drums in a synchronous manner. In an alternative arrangement however individual motors may be provided, acting under the control of the digital device.

[0137] Figure 1 shows a number of optional components that overlie the feed bed 13.

[0138] Located upstream of the printing zone 16 is a corona treatment device 61. This may be required for example if the web material is such as to require corona treatment for the purpose of preparing one or both of its surfaces to receive printing ink in a *per se* known manner.

[0139] In this regard web 11 in a typical usage of the apparatus 10 would be a thin, flexible sheet of a polymeric material that preferably is pre-coloured eg. white so as to be easily printed in a range of colours. As an alternative to using pre-coloured web material 11 however it is possible additionally to employ a corona treatment section 61 to prepare the web material 11 to receive a base coating layer on the opposite side of the web material that is to receive the printing inks in the printing zone 16. This feature would be of benefit for example if the web material 11 was supplied in a transparent form.

[0140] Downstream of the printing zone is a white powder coating head 62 and a further UV curing device 63. These parts may be included in the apparatus 10 for example if the web material 11 is transparent and it is desired to provide it with an opaque white finish on the reverse side to that printed. However if the web material is pre-coloured with a white (or other-coloured) background the components 62 and 63 may be dispensed with.

[0141] Obviously in embodiments of the invention that omit the parts 52, 61, 62 and 63 the feed bed 13 may be made shorter than in the embodiment illustrated. This has a consequent benefit in saving material used in construction of the apparatus.

[0142] The digital device to which the apparatus 10 is operatively connected for control purposes may have loaded onto it a *per se* known digital printing control program. This may be used for the creation and storage of images to be printed onto the web material and may include various software components the purpose of which is to control the printing heads 46, the supply of ink thereto and the speed of feeding of the web material through the apparatus 10. To this end the motor(s) of the apparatus may be connected to operate under the control of the digital device, as desired.

Claims

1. A printing apparatus comprising a web feed bed and including;

a) a web supply for supplying a web of flexible material for printing in the apparatus;
b) one or more feed rollers for causing feeding of the web in the apparatus;
c) a printing zone including a plurality of printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends, defined with reference to movement of the web in use of the apparatus, for printing in the apparatus, the printing heads being supplied with ink from one or more ink supplies; and
d) a web outfeed,

the web supply and the web outfeed controlling tension in the web during use of the apparatus such that an ink droplet printed onto, or an ink void defined on, the web by a said printing head passes within 20 μm of the location at which a downstream said printing head of the series prints an ink droplet onto, or defines an ink void on, the web.

2. A printing apparatus comprising a web feed bed and including;

a) a web supply for supplying a web of flexible material for printing in the apparatus;
b) one or more feed rollers for causing feeding of the web in the apparatus;
c) a printing zone including a plurality of printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends, defined with reference to movement of the web in use of the apparatus, for printing in the apparatus, the printing heads being supplied with ink from one or more ink supplies; and
d) a powered web guide,

the web supply in use of the apparatus feeding a continuous web of flexible material via the one or more feed rollers to the web guide that is operable to adjust the translational position of the web relative to the printing heads and/or the web feed bed such that the maximum translational movement of a point on the web during feeding along the series of printing heads does not exceed 20 μm.

3. A printing apparatus comprising a web feed bed and including;

a) a web supply for supplying a web of flexible material for printing in the apparatus;
b) one or more feed rollers for causing feeding of the web in the apparatus;
c) a printing zone including a plurality of printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends, defined with reference to movement of the web in use of the apparatus,

for printing in the apparatus, the printing heads being supplied with ink from one or more ink supplies; and
d) a suction table,

the series of printing heads overlying the suction table in the printing zone and the suction table operating to draw the web passing over it downwardly relative to the printing heads.

4. A printing apparatus comprising a web feed bed and including:

a) a web supply,
b) one or more feed rollers,
c) a powered web guide,
d) a printing zone, including one or more printing heads located for printing onto the web during feeding and defining a series having upstream and downstream ends defined with reference to movement of the web in use of the apparatus, the printing heads being supplied with ink from an ink supply,
e) a suction table and
f) a web outfeed,

the web supply in use of the apparatus feeding a continuous web of flexible material via the one or more feed rollers to the powered web guide, the web guide being operable to adjust the orientation of the web relative to the web feed bed and permit feeding of the web along the feed bed to the printing zone in which printing of the web material with ink selectively occurs, the or each printing head overlying the suction table in the printing zone and the suction table operating to draw the web passing over it downwardly relative to the printing heads and the web supply and the web outfeed controlling tension in the web during feeding.

5. An apparatus according to any preceding claim wherein the web feed bed extends generally horizontally and the width of the web feed bed is such as to accommodate a web of a maximum width of about 70.5 mm.

6. An apparatus according to any proceeding claim wherein the web supply includes a motorised roller supporting thereon a reel core having wound thereon a reel of web material.

7. An apparatus according to Claim 6 wherein the web supply includes a motor having a rotatable output shaft to which the motorised roller is secured and including secured thereto a brake drum, the brake drum being selectively engageable by a brake member that is operable to control the speed of feeding of the web material from the web supply in dependence on the tension in the web.

8. An apparatus according to Claim 7 wherein the one or more feed rollers include a dance roller on the periphery of which the web material passes in use of the apparatus, the dance roller being pivotably secured relative to the motorised roller on a pivot member so as to be moveable in dependence on tension in the web, the pivot member being connected to control a feeding brake mechanism including the brake member.

9. An apparatus according to Claim 8 wherein the feeding brake mechanism includes a transducer that generates a signal indicative of the position of the pivot member and an actuator that is operable in dependence on the signal to move a brake member selectively into and out of braking engagement with the brake drum.

10. An apparatus according to Claim 9 wherein the actuator of the brake mechanism is a pneumatic actuator and the brake member is a brake pad secured to an output member of the pneumatic actuator.

11. An apparatus according to Claim 6 or any preceding claim depending therefrom wherein the motorised roller includes an expandable chuck that is selectively expandable to grip an inner periphery of the reel core.

12. An apparatus according to Claim 10 including an actuator that is connected to permit manual adjustment of the expansion of the chuck.

13. An apparatus according to any preceding claim wherein the one or more feed rollers include a plurality of rotatable path rollers the locations of which relative to the feed bed are fixed.

14. An apparatus according to Claim 2, Claim 4 or any preceding claim depending from Claim 2 or Claim 4 wherein the powered web guide includes a mounting block having secured to an in-use upper face thereof a swivel plate, that is rotatable about a generally vertical axis, the swivel plate including secured thereto one or more web guide rollers; the mounting block further supporting one or more web alignment sensors and one or more actuators (e.g. servomotors) for selectively effecting rotation of the swivel plate in dependence on signals generated by the one or more web alignment sensors.

15. An apparatus according to Claim 14 wherein the or each web alignment sensor is an ultrasound transducer that is arranged to detect the edge of a web moving past it and generating a signal that is proportional to its position relative to a datum.

16. An apparatus according to Claim 15 wherein the alignment sensor includes a generally U-shaped member having an ultrasound sensor secured on at least one limb of the "U" so as to face the other said limb.

17. An apparatus according to any of Claims 11 to 13 wherein the mounting block is hollow and supports at least one powered actuator such as a servomotor within its interior, the servomotor including an output shaft that protrudes so as to engage the swivel plate.

18. An apparatus according to any preceding claim including, located between the web supply and the printing zone a printing zone feed arrangement including one or more web rollers and a powered, rotatable drum, the or each web roller being located to feed, in use of the apparatus, web material around part of the periphery of the powered drum, the said part being at least 120 degrees of the circumference of the powered drum.

19. An apparatus according to Claim 18 wherein the powered drum includes on its outer surface a finish that promotes gripping by the material of the web.

20. An apparatus according to any preceding claim wherein the series consists of four printing heads and is 135 mm long.

21. An apparatus according to any proceeding claim wherein the series consists of eight printing heads and is 175 mm long.

22. An apparatus according to Claim 3, Claim 4 or any preceding claim depending from Claim 3 or Claim 4 wherein the suction table includes a plate having extending through it one or more roller apertures through each of which protrudes a respective, rotatable printing zone roller arranged to support web material passing over the vacuum table, the perforated plate defining an upper end of a hollow suction chamber that is capable of being depressurised in order to create an air pressure gradient that acts via the roller apertures so as to draw web material into contact with the said plate.

23. An apparatus according to Claim 22 including one or more motors for causing powered rotation of the printing zone rollers.

24. An apparatus according to Claim 22 or Claim 23 including connected to the suction chamber a conduit connected to a suction pump that is operable to depressurise the suction chamber.

25. An apparatus according to any preceding claim including an ink curing device having an ultraviolet lamp that is arranged to transmit ultraviolet light onto web material passing through the apparatus after printing in the printing zone.

26. An apparatus according to Claim 25 wherein the lamp transmits ultraviolet light onto the web material at an intensity of at least 200 W/cm over a web length of at least 85mm.

27. An apparatus according to Claim 25 or Claim 26 wherein the ink curing device includes a moveable shutter that selectively moves to shield the web from heat and/or UV light generated by the ink curing device.

28. An apparatus according to any of Claims 25 to 27 including an enclosure at least partially enclosing the printing zone and the ink curing device.

29. An apparatus according to Claim 28 including an exhaust pipe and gas pump that are connected to draw contaminants from the enclosure.

30. An apparatus according to Claim 1, Claim 4 or any preceding claim depending from Claim 1 or Claim 4 wherein the web outfeed includes a web winder comprising a further motorised roller supporting thereon a reel core for winding thereon a reel of printed web material produced in the apparatus.

31. An apparatus according to Claim 30 wherein the web winder includes a motor having a rotatable output shaft to which the further motorised roller is secured and including secured thereto a brake drum, the brake drum being selectively engageable by a brake member that is operable to control the speed of winding of the web material onto the web winder in dependence on the tension in the web.

32. An apparatus according to Claim 31 wherein the web winder includes a dance roller on the periphery of which the web material passes in use of the apparatus, the dance roller being pivotably secured relative to the further motorised roller on a pivot member so as to be moveable in dependence on tension in the web, the pivot member being connected to control a winding brake mechanism including the brake member.

33. An apparatus according to Claim 32 wherein the winding brake mechanism includes a transducer that generates a signal indicative of the position of the pivot member and an actuator that is operable in dependence on the signal to move a brake member selectively into and out of braking engagement with the brake drum.

34. An apparatus according to Claims 18 and 22 or any

preceding claim depending from Claims 18 and 22, including a common motor for driving the powered, rotatable drum and the printing zone rollers to rotate.

35. An apparatus according to Claim 34 including a rotatable drive shaft drivingly interconnecting the common motor, the powered, rotatable drum and the printing zone rollers.

36. An apparatus according to any preceding claim including a controller for causing operation of at least one said printing head to occur in synchronism with operation of at least one said feed roller.

37. An apparatus according to any preceding claim including a linkage for operatively linking two or more of the feed rollers to cause them to operate in synchronism.

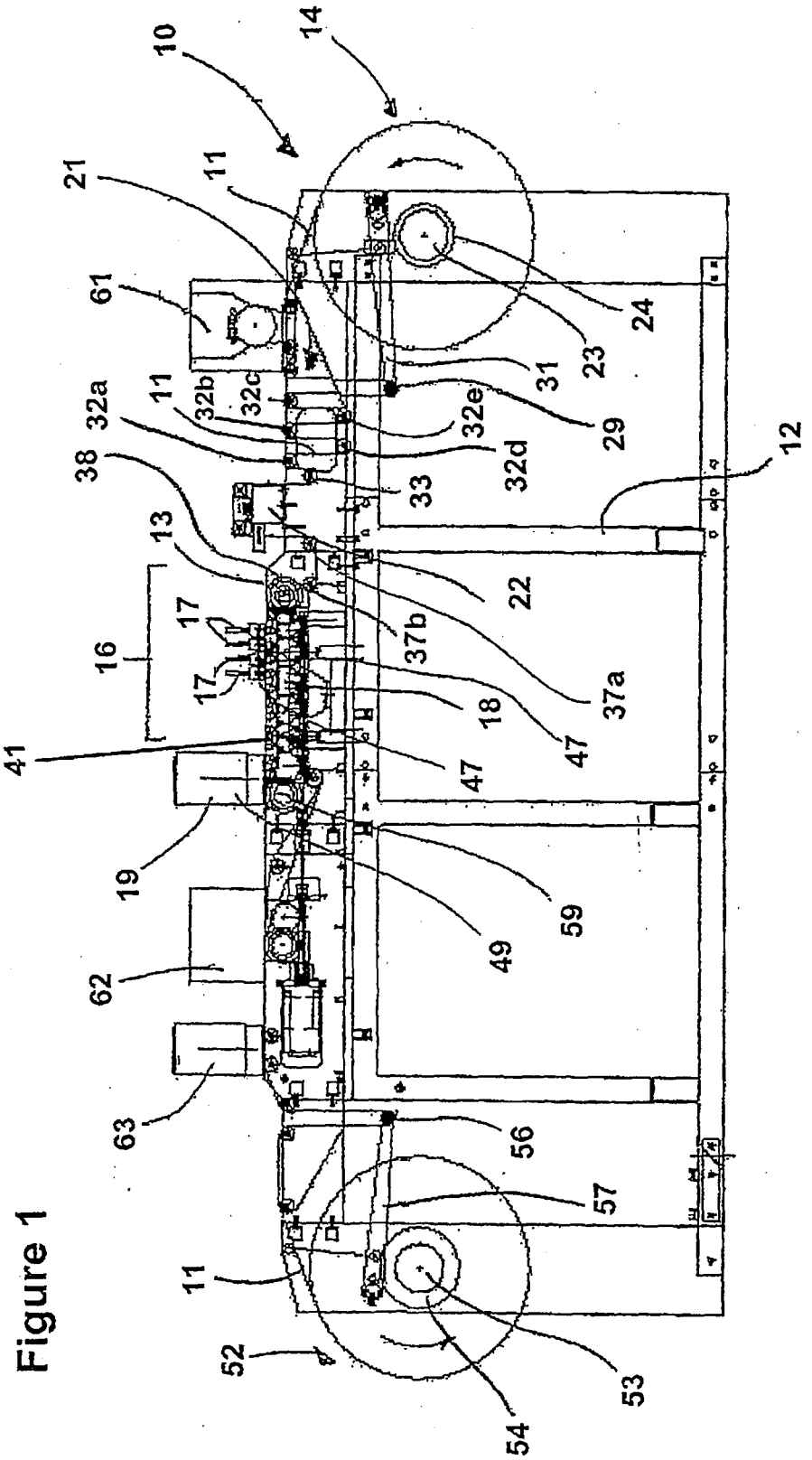
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Figure 1

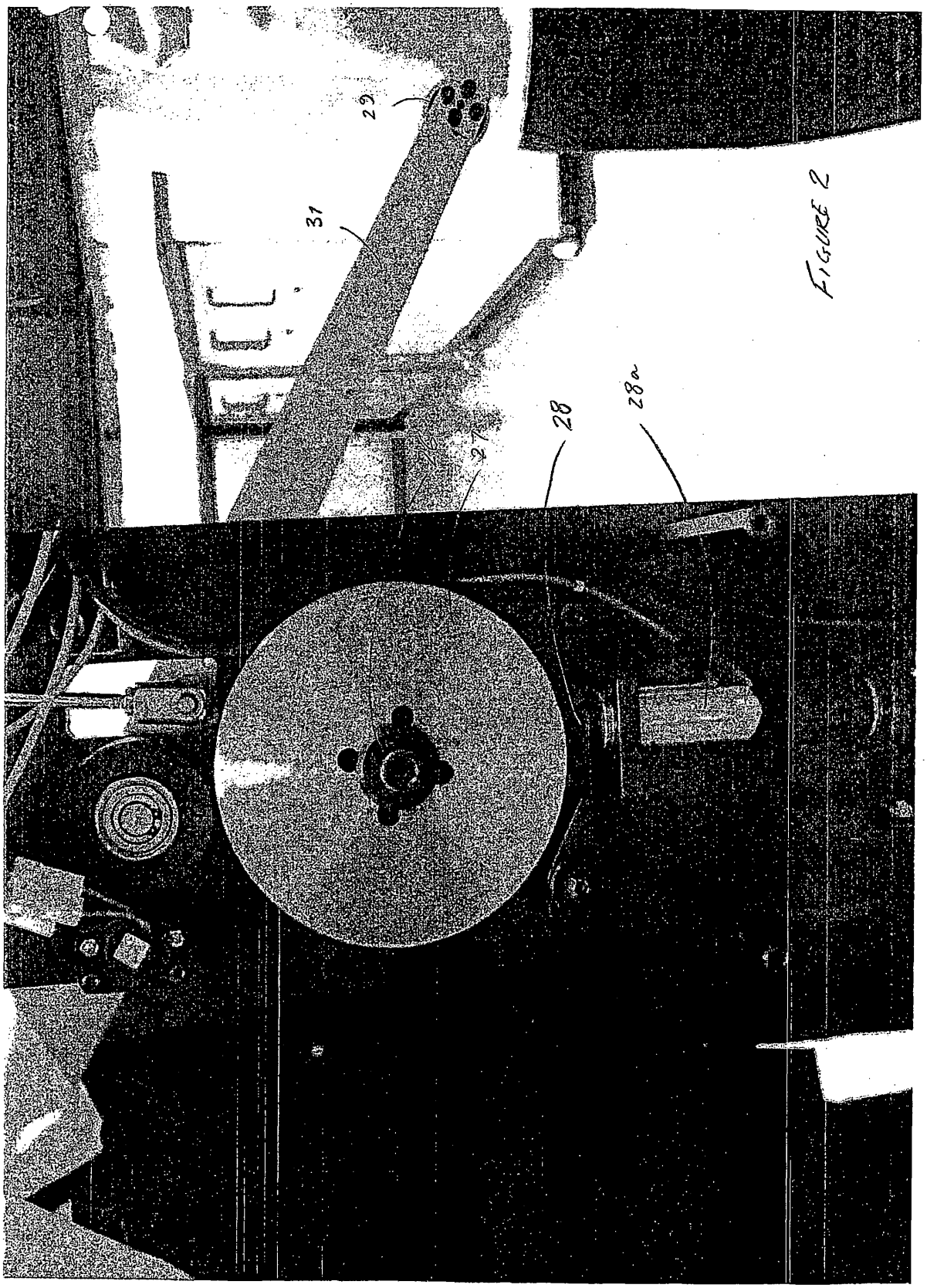

FIGURE 2

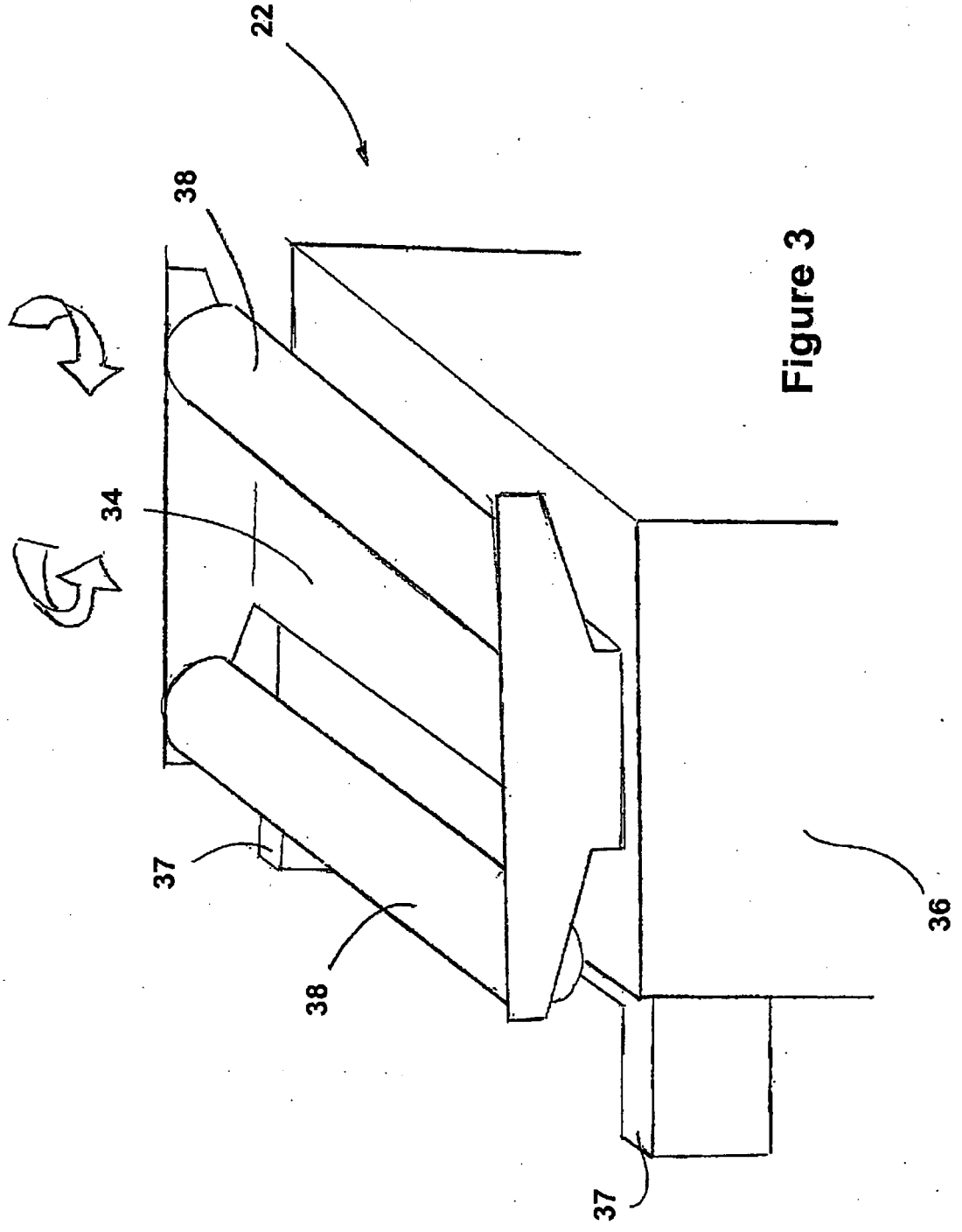

Figure 3

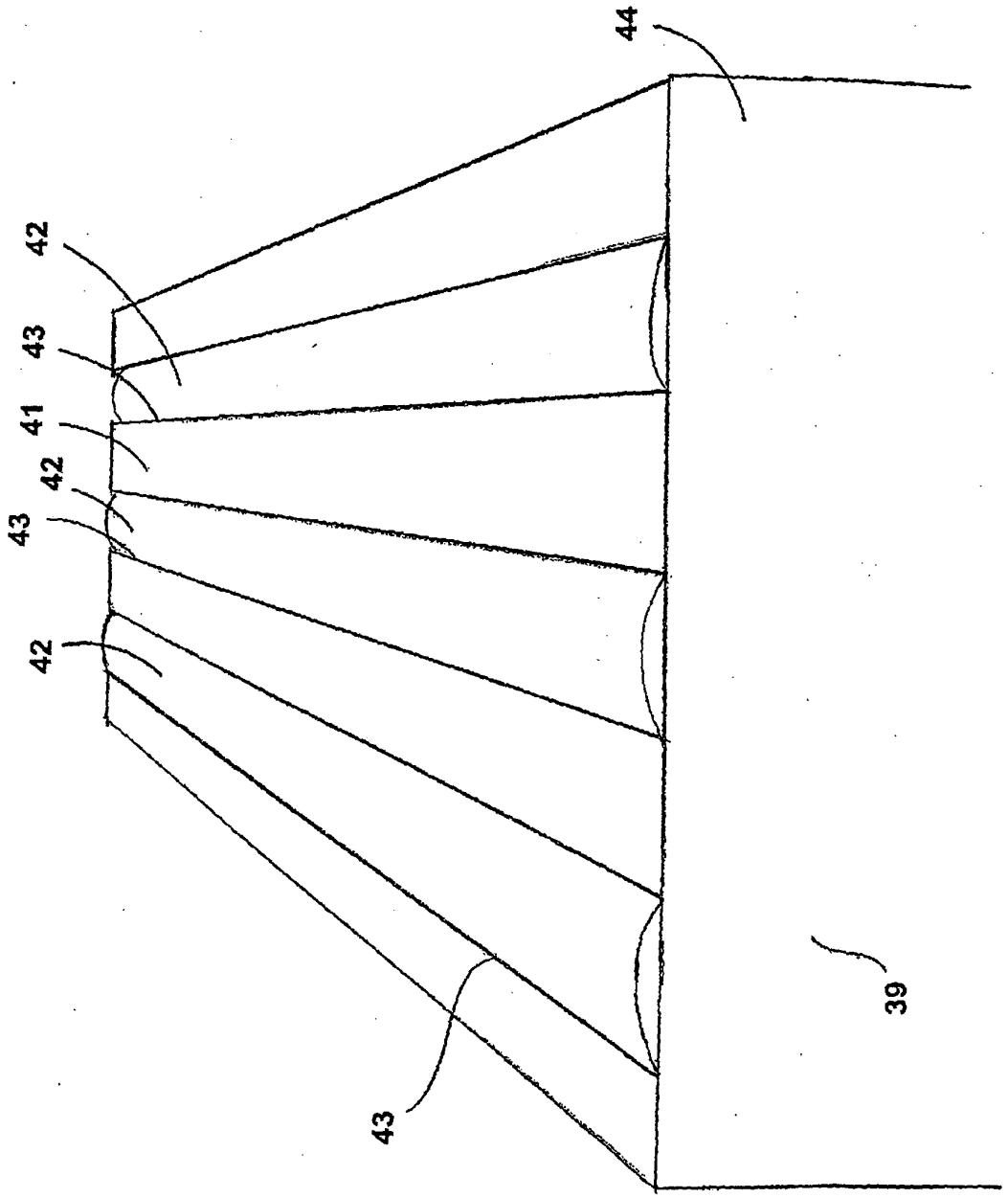

Figure 4

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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 8491

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	DE 10 2006 019994 A1 (KHS AG [DE]) 31 October 2007 (2007-10-31) * paragraph [0020]; figure 2 *	1,5,6, 11-13, 25-28 2-4, 14-16, 18-21, 30,34,35	INV. B41J3/28 B41J11/00 B41J15/16 B41J3/407 B41J15/04
Y	US 2006/147232 A1 (FUCHS WERNER [DE] ET AL) 6 July 2006 (2006-07-06) * paragraph [0036] - paragraph [0037]; figures 1,2 *	2,4, 14-16	
X Y A	DE 199 29 319 A1 (EASTMAN KODAK CO [US]) 28 December 2000 (2000-12-28) * page 3, last paragraph - page 4, paragraph 3; figure 1 *	1,36,37 3,4, 18-21, 30,34,35 13	

TECHNICAL FIELDS SEARCHED (IPC)

B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 April 2009	Wehr, Wolfhard

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X : particularly relevant if taken alone
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22-04-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102006019994 A1	31-10-2007	EP 2013089 A1	14-01-2009
		WO 2007124913 A1	08-11-2007
US 2006147232 A1	06-07-2006	DE 10247456 A1	22-04-2004
		WO 2004035315 A2	29-04-2004
		EP 1551640 A2	13-07-2005
DE 19929319 A1	28-12-2000	NONE	

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