(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 595 698 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
**16.11.2005 Bulletin 2005/46**

(51) Int Cl.[7]: **B41F 15/10**, B41F 15/08

(21) Application number: **05103919.6**

(22) Date of filing: **11.05.2005**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
**AL BA HR LV MK YU**

(30) Priority: **13.05.2004 IT MI20040963**

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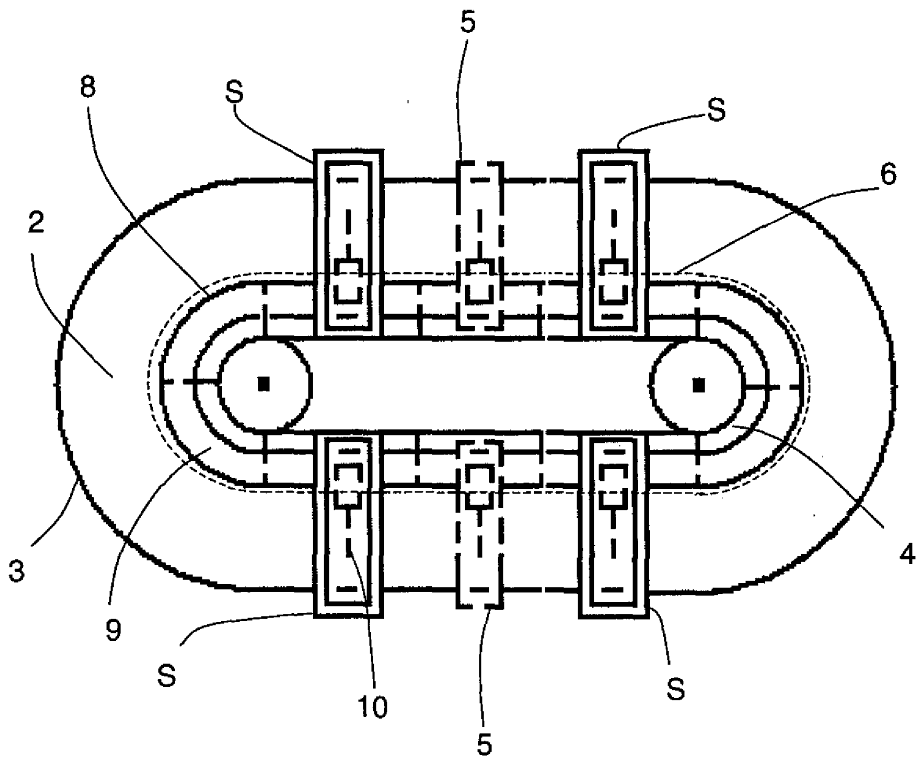
# (54) A multistation screen printing machine

(57) Screen printing machine, including a curved structure (2) that defines a working path, along which a plurality of processing stations (S) and a plurality of printing tables (5), moving along said path and intercepting such processing stations (S), are placed.

Said machine further includes a vacuum chamber (8), placed along said curved structure (2) and associated to such a path, aimed at generating a vacuum inside it, each mobile table having an upper surface, over which a printing substrate is held by the vacuum generated by said vacuum chamber and transferred to said table.

Fig. 1

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## Description

**[0001]** The present invention relates to a multistation screen printing machine. In particular, the present invention relates to a multistation screen printing machine wherein a number of colours, and perhaps a number of sheets, can be printed at the same time.

**[0002]** At the present state of the art, multistation screen printing machines, i.e. machines able to treat a number of colours, and perhaps sheets, at the same time, are known. Such machines typically have a circular shape, or a shape similar to that of a more or less flattened oval (e.g. the shape of a rectangle, whose shorter sides are semicircles). The machine has a frame of such a shape, along which a moving system, e.g. a chain, slides. The moving chain, in turn, drags a number of printing tables, whose structure will be described in a while. A number of processing stations are fixed to the above-mentioned frame. Among such stations, some act as printing islands for a given colour. Other stations, instead, act as screen printing furnaces, aimed at drying the colour layer deposited by the previous printing island. Loading and unloading stations are also provided. The number and sequence of such stations may, of course, vary according to the specific model and, perhaps, to customer needs.

**[0003]** In the above-mentioned machine, it is possible to print a number of colours at the same time and maybe also parallelize the treatment of a number of printed supports (more precisely, to implement a pipeline). Typically, there are a number of printing, drying, loading and unloading stations and an equal number of mobile tables. The mobile tables, dragged by the chain, translate, while the processing stations are fixed. A sheet, loaded by a loading station, is then transferred to a printing station, wherein the suitable parts are printed with the corresponding colour. At the same time, another sheet is ready for loading. The tables, fixed to the chain, then translate by the same length as the distance between the stations, while the first sheet is intercepted by the drying section and the second sheet by the previously mentioned printing station. The process goes on in the obvious way so that, asymptotically, as many sheets as printing and drying station pairs can be treated in parallel.

**[0004]** In a possible embodiment, there are e.g. 12 printing stations, 12 drying stations and 6 loading and unloading stations, for a total of 30 stations and, consequently, 30 mobile tables.

**[0005]** Applicant has observed that the mobile tables, of course, need a fixing system for the supports to be printed. A conventional solution in this respect is a table including many small holes, under which a vacuum, that keeps the support fixed to the table, is created. In the conventional approaches, every mobile table is equipped with its own vacuum system, e.g. an extractor fan, with the obvious complications in terms of weight, cost and maintainance.

**[0006]** Systems wherein a vacuum is created in a fixed structure and distributed to the mobile table are also known. Two such approaches are described in the following. In the first approach, a vacuum is created in a C-shaped tube that follows the profile of the chain. The open side (or, more exactly, fitted with many large holes) of such a tube faces the outer side of the machine. A suitable mobile belt rests on such outer side, thanks to both the vacuum and the suitable L-shaped guides that prevent it from falling down when the device is not powered and, in any case, constrain its motion. The belt is equipped with suitable pipe unions, connected to the vacuum chamber of the mobile table by flexible tubes. The belt, driven by the chain, slides along the outer side of the C-shaped tube, thus preventing the mobile tables from loosing their vacuum. Applicant has noticed that in such a first approach the above-mentioned mobile belt system has some disadvantages, connected to the fact that tensions, and consequently misalignments, develop between the belt and the chain. Typically, in order to avoid the above-mentioned troubles, as many swivel joints with a fork, fitted with a pin, as pipe unions, are fixed to the belt. The fork pins are connected to an equal number of pins fixed to the chain and each pin is free to rotate and translate, within limits, in a slot in the chain pin.

**[0007]** In the second approach, presumably only relevant to circular machines, the fixed vacuum chamber consists of a C-shaped tube bent in the shape of a toroid, with its open side facing upwards. The mobile vacuum chamber, to which the mobile tables are connected, is made up of a similar toroid, with a larger cross section and its open side facing downwards. The mobile vacuum chamber is wedged into the fixed chamber, so that the former can slide along the latter. The mobile chamber is in turn coated, throughout all its diameter, by a suitable elastic membrane that, through the effect of the vacuum, tightens up and acts as a sealed interface between the fixed chamber and the mobile chamber. With such an approach, one takes care of the troubles given by the tensions that, in the previously mentioned approach, arise between the belt and the chain. However, at least in the simple version proposed up to now, such an approach is, of course, only relevant to circular machines. On the other hand, Applicant has noticed that simple geometrical considerations show that a circular machine exploits the available floor area worse than a nearly oval machine and that the floor area is more efficiently exploited the closest the shape is to a rectangle.

**[0008]** As already pointed out, the conventional multistation screen printing machines with a mobile vacuum and a fixed vacuum chamber are affected by very serious drawbacks, which require serious consideration. Such drawbacks are connected to the fact that the belt and the chain travel at the same linear velocity but, in the curved sections, cover arcs of circumference of a slightly different radius. The angular velocities of the belt and the chain are then slightly different in the curved sections. Tensions are then generated that prevent the machine from working properly. In particular, Applicant has observed that the belt tends to crumple in one curve, while in the opposite curve it tends to tighten up. In both cases, dangerous tensions develop and it is possible to loose the vacuum, since the belt tends to loose its grip on the chamber. Without suitable expedients, the above-mentioned tensions may even cause the belt to be ripped off the chain.

**[0009]** As previously noticed, the wedged toroid solution only applies to circular machines, which on one side is a commercial limitation and, on the other side, refers to a machine that exploits the available floor space less efficiently than the quasi-oval machines. As previously mentioned, it is possible to achieve a flexible link between the mobile belt and the chain. Applicant has however pointed out that, by employing such a solution, it is only possible to alleviate, as opposed to solve, the tension problem. In any case, Applicant has observed that even if it were possible, after further development work, to develop and build a fixed-chamber-and-mobile-belt system wherein the tension problem would be solved, the system would suffer anyway from a further disadvantage, related to the belt movement. In fact a moving chain, if exposed to the above-mentioned stresses, tends with time to stretch and loose its elasticity, thus weakening its grip on the fixed chamber. For this reason among the other things, it has been observed that a fixed belt solution is preferable to a mobile belt solution, provided, of course, that a system is found to link a mobile table to a fixed belt without loosing the vacuum. The invention proposed here is related to a possible solution to this problem.

**[0010]** Applicant has realized a mobile vacuum system which is able to take care of the above-mentioned troubles, wherein the vacuum is produced in a fixed structure and intercepted by the mobile tables of the machine through a fixed belt, on which the mobile tables are sliding through a sliding block.

**[0011]** An embodiment of present invention concerns a screen printing machine, including a curved structure that defines a working path, along which a plurality of processing stations, a plurality of mobile printing tables, dragged along said path and intercepting said processing stations and a vacuum chamber, placed along said curved structure, associated to such a path and aimed at generating a vacuum inside it, are placed, each mobile table having an upper surface that restrains a printing substrate through the vacuum generated by said vacuum chamber and transferred to said table, characterized in that it includes a fixed belt that covers the holes and openings in said vacuum chamber, a sliding block, linked to each mobile table, that moves together with it and transfers the vacuum generated by said vacuum chamber to said table by lifting the belt off said holes and letting the vacuum expand into said sliding block.

**[0012]** Further objects and advantages of the screen printing machine object of the present invention shall become clear from the description below and appended drawings, provided purely as a non-limiting explanatory example, in which:

- in figure 1 we show a schematic view of a multistation screen printing machine according to present invention;
- in figure 2 we show a schematic top view of a moving sliding block of the screen printing machine of figure 1;
- in figure 3 we show a schematic cross section of a moving sliding block of the screen printing machine of figure 1.

**[0013]** The screen printing machine of figure 1 includes a curved structure 2, e.g. a rectangular structure whose smaller sides are actually semicircles, defining a working path. Along said structure there are guides (an external guide 3 and an internal guide 4) for the printing tables 5 that move along said working path. Preferably a chain 6, or an equivalent device that drags said mobile tables along said path, moves along said curvilinear structure.

**[0014]** A number of processing stations S are placed in a fixed position with respect to the curved structure. Some of said stations act as printing stations for a given colour. Other stations, instead, consist of screen printing furnaces, aimed at drying the colour layer deposited in the previous printing island. Loading and unloading stations are also provided. The number and sequence of such stations may of course vary according to the specific model and, perhaps, to customer needs. To this end, for the sake of simplicity and purely as an example, in figure 1 four processing stations are shown. Within the present invention, the number and structure of said processing stations may freely vary.

**[0015]** Such curved structure includes a vacuum chamber 8, wherein a vacuum is created by e.g. an extractor fan, made up of e.g. an open C-shaped tube (or fitted with large holes or openings), whose perforated side e.g. faces the outer side of the machine. Against such tube lays a fixed belt 9, perhaps held in place by suitable L-shaped guides, pushed against the vacuum chamber by its vacuum. Each mobile table is fitted with a sliding block 10, preferably placed under the table, that slides along the belt and is linked to the vacuum chamber. The sliding block slides along the fixed belt and lifts it, thus allowing a vacuum to be created into the sliding block, since the belt is narrower than the sliding block. The structure of the above-mentioned sliding block is schematically shown in figures 2 and 3. In such figures, the support structure 11, typically made up of Teflon, or an equivalent low-friction material, three pins 12, 13 and 14, sliding along said belt 9 and placed in such a way that at least one of them lifts the belt from said vacuum chamber, can be seen. The sliding block also includes a pipe union 15, linked to the vacuum chamber 8 of the mobile table 5, that allows the sliding block to intercept the vacuum generated by the vacuum chamber and transmit it to the mobile table, which is fitted with suitable holes on its upper surface, in such a way as to keep the printed substrate, e.g. a paper sheet, on which the processing stations are operating, in touch with such a surface.

**[0016]** In such a device, one has a fixed belt and, at the same time, the tables are allowed to move between the processing stations while retaining the vacuum needed to restrain the supports to be printed.

**[0017]** With respect to the conventional approaches, the proposed invention gets rid of the troubles caused by the tensions that arise between the belt and the dragging chain due to their different lengths, that may even cause the belt to rip off or, less pessimistically, to either crumple or tighten up, resulting in a lower-quality vacuum or even in a vacuum loss. Finally, the belt wears down less than in the conventional approaches.

## Claims

**1.** Screen printing machine including

- a curved structure (2) that defines a working path along which a plurality of processing stations (S) are placed,
- a plurality of mobile printing tables (5), movable along said path, that intercept said processing stations (S),
- a vacuum chamber (8) placed along said curvilinear structure (2) and associated to such a path, aimed at generating a vacuum inside it,
- each mobile table having an upper surface that restrains a printing substrate through the vacuum generated by said vacuum chamber and transferred to said table,

**characterized in that** it includes

- a fixed belt (9) that covers holes or openings of said vacuum chamber,
- a sliding block (10), associated to each mobile table (5), that moves synchronously to it and transfers the vacuum generated by said chamber to said table by lifting the belt from said holes and causing the vacuum to expand into said sliding block.

**2.** Machine according to claim 1, wherein said vacuum chamber includes a C-shaped tube open towards its outer side and such that said fixed belt covers said external area.

**3.** Machine according to claim 1, wherein said vacuum chamber includes a tube with a plurality of holes, covered by said fixed belt.

**4.** Machine according to claim 1, wherein said sliding block includes a support structure (11) and three rotating pins (12, 13, 14) that slide along said belt (9), placed in such a way that at least one of them lifts the belt off said vacuum chamber and introduces the vacuum inside said support structure.

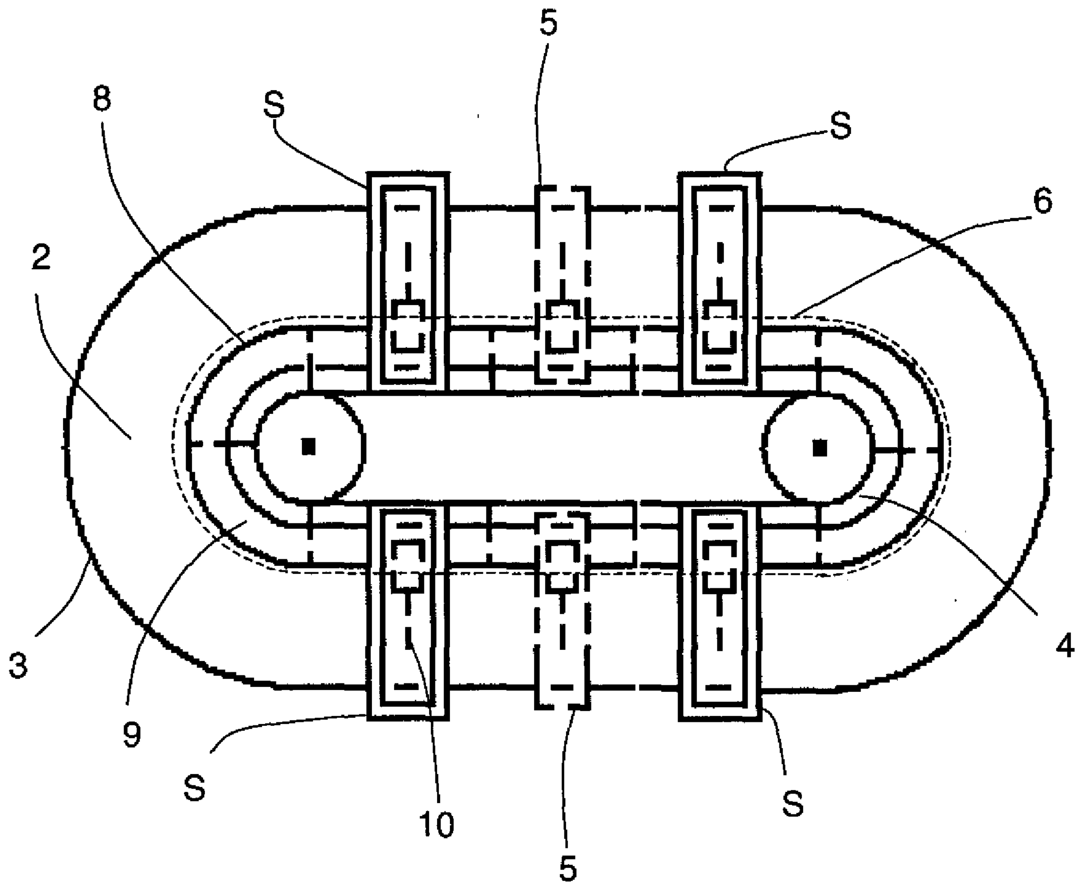
**5.** Machine according to claim 1, wherein said sliding block includes a pipe union (15) that connects it to the vacuum chamber (8) of the mobile table (5), that allows the sliding block to transfer the vacuum generated by the vacuum chamber to the mobile table.

**6.** Machine according to claim 1, wherein said mobile tables are fitted with holes on their upper surface, in such a way as to keep the printed substrate, on which the processing stations operate, in touch with such a surface.

**7.** Machine according to claim 1, wherein said curvilinear structure (2) includes an external guide (3) and an internal guide (4), through which the printing tables (5) move along said working path.

**8.** Machine according to claim 1, wherein a chain (6), that drags said printing tables along said working path, slides around said curvilinear structure.

Fig. 1



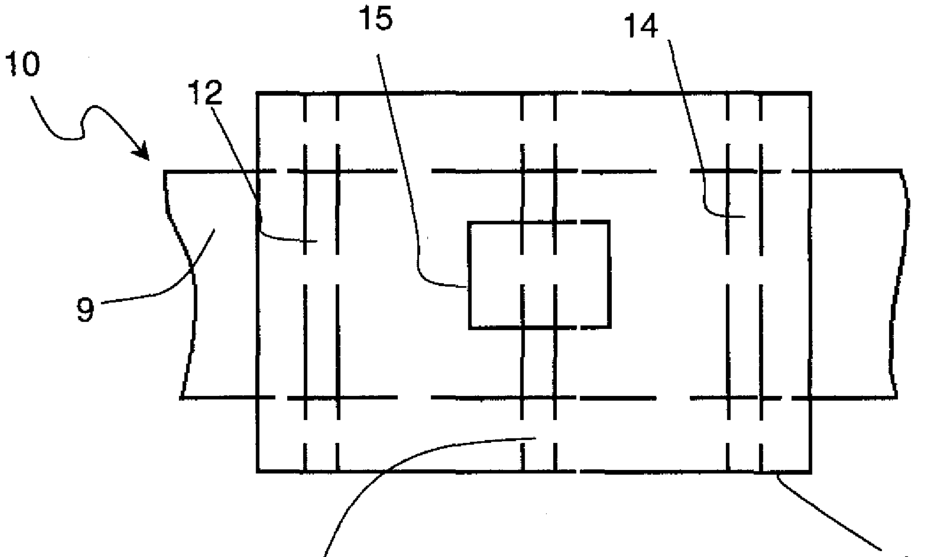



Fig. 2

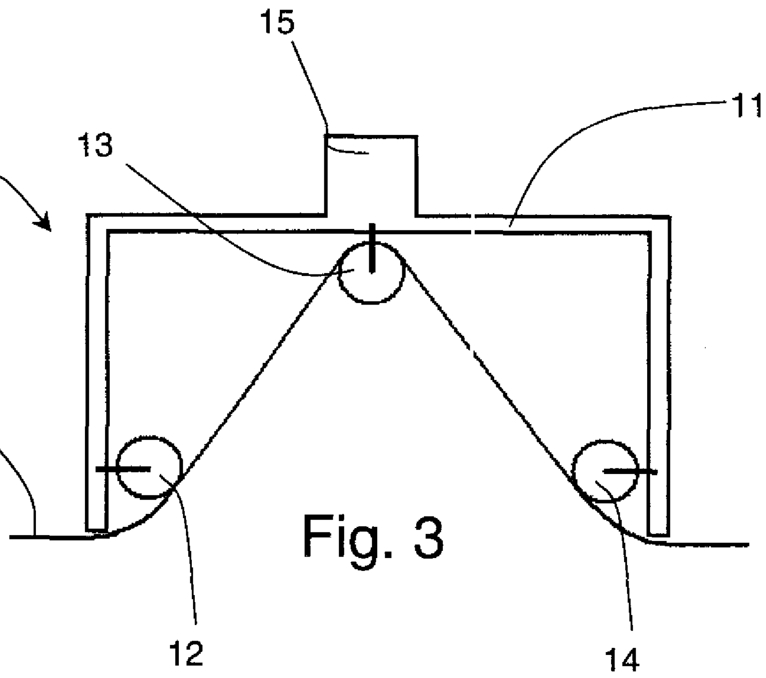



Fig. 3