A rotary screen printing machine with a plurality of rotary screens has individual screen lifting devices. Cam shafts have cam plates mounted thereon which raise rams. Each ram has two lifting surfaces. The first lifting surface raises the dye supply and squeegee device within the rotary screen. Then, the second lifting surface raises the rotary screen.

9 Claims, 6 Drawing Figures
ROTARY SCREEN INTERRUPTER WITH SQUEEGEE LIFT MEANS

BACKGROUND OF THE INVENTION
This invention relates to a rotary screen printing machine having at least two screen printing devices the individual rotary screens of which are lifted to temporarily interrupt the printing process.

The temporary lifting of rotary screens in rotary screen printing machines is known hitherto in the case where the rotary screens have been produced by rolling up flat screens in order to form a circular cylinder. By the lifting process the joint area unsuitable for printing has been brought out of contact with the sheet of material.

SUMMARY OF THE INVENTION
The object of the present invention is to provide a device enabling an alternate lifting and lowering of rotary screens when printing designs having patterns which are of relatively long overall length, such patterns being repeated by the rotary screens. Hereinafter, the length of the overall pattern will be referred to as the "long repeat distance." The long repeat distance of the overall repeated pattern may be distributed over the circumferences of several rotary screens and, with multicolor printing, the individual rotary screens or groups of rotary screens may be brought into contact, according to the design, with the surface to be printed for the purpose of printing the overall repeated pattern.

According to the invention this is achieved by having the lifting device for lifting the rotary screens constructed so as to preliminarily lift the elements for the dye supply and the squeegee device which are inside each rotary screen. Upon lifting of a rotary screen, the elements as, e.g., dye box, dye tube, squeegee device, arranged inside the rotary screen, therefore are lifted first according to the invention by means of the lifting device arranged at each printing device. In that way the dye supply timely is interrupted on one hand, and on the other hand damage to the mostly thin-walled screen cylinder by the force of the weight of the above-mentioned elements, which would otherwise act on the screen, is avoided upon lifting. The lowering of each printing device takes place in inverse order, i.e., the rotary screen is lowered first and subsequently the elements inside thereof.

It is especially advantageous to provide the lifting device with at least one cam plate per screen printing device. This results in an extremely simple construction of the lifting and lowering mechanism. The use of cam plates permits a simple adjustment of the time of lifting and lowering of each individual printing device. This is important if, conditional on the design, the number of the screen printing devices in the individual groups has to be changed or if the specific times of lifting and lowering have to be adjusted due to necessary changes of the portion of the overall pattern to be printed by each group of screens. Hereinafter, the length of the portion of the overall pattern printed by each rotary screen will be referred to as a "partial repeat distance." The cam plates then may be exchanged or in a simpler way, may be changed in their angular position with relation to a cam shaft on which the cam plates advantageously are arranged.

It is furthermore advantageous, if one cam shaft each is provided at the opposite sides of the machine extending in the direction of the material to be printed, and if each of the two cam shafts support a single cam plate for each screen device. Thus, pairs of cam plates not only cause lifting of the elements in the inside of each rotary screen but also lifting of the rotary screen itself. The cam shafts are divided at points between the individual screen printing devices and are connected at these points by means of disengagable couplings which enable, besides mounting advantages, also a coarse adjustment of the angular positions of rotation of the cam surfaces of the cam plates towards each other. It is possible to construct an embodiment having only one cam shaft and one cam plate per screen device, this requires however higher technical resources, above all stiffness of the construction of the lifting device to ensure a uniform lifting and lowering at both ends of a rotary screen.

The height of lift, depending on the shape of the cam plate advantageously is inferior to the depth of the teeth of the gears used to cause rotation of the cylinder screens.

Thus the rotary screens continue to rotate even when in the lifted condition which prevents a pulsating rotational acceleration of the screen cylinders upon lowering. This pulsating rotational acceleration would cause destruction, above all with only one-sided drive of the rotary screens, due to the mostly small wall thickness of the screen cylinder. Rotary accelerations of the roller squeegee inside the screen cylinder are also prevented.

The drive of the cam plate shaft advantageously is effected by a positive drive system, such as gears or chains, but also may be accomplished by means such as belts. The shaft for rotating the rotary screens is positively driven by means of gears and the not positively driven guide roller of the printer's blanket. The power requirement of the driving and lifting device being relatively small, practically no slippage occurs between the printer's blanket and the sheet of material moved therewith and the non-driven guide roller. This ensures accurate control of the lifting operations. According to another variant of this invention the drive of the cam shaft may be achieved directly by the non-driven guide roller without using the shaft for rotating the rotary screens.

The ratio of the rate of revolutions of the rotary screens and the cam shaft is conditional on the design but in such a way that the rate of revolutions of the rotary screens is always an integral multiple of the rate of revolutions of the cam shaft. According to another feature of the invention this ratio of rate of revolutions is adjustable by replacing gears between the cam shaft and driving shaft, in order to be able to print, with the same machine, with rotary screen sets having different diameters or to be able to print different long repeat distance designs comprising a variable number of partial repeat distances. The correct angular position of the cam plates on the cam shaft is roughly effected, as already mentioned, by means of the disengagable couplings. Separate adjusting devices are provided for precision adjustment and advantageously adjusting devices with worm gears known with roller printing machines are used.

Embodiments of the present invention are hereinafter described with reference to the diagrammatic draw-
BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are side and plan respectively, of a rotary screen printing machine according to the invention with three screen devices,

FIGS. 3 and 4 show one cam plate each,

FIG. 5 shows the mounting of the cam plates on the cam shaft by means of an adjusting device,

FIG. 6 shows the stepwise lifting of the dye feeding elements and of the squeegee device on one hand and of the rotary screen on the other hand.

DETAILED DESCRIPTION OF THE INVENTION

In FIGS. 1 and 2 the endless printer's blanket 1 runs over guide roller 3 positively driven by the driving motor 5 and imparts rotation to the non-driven guide roller 2. Rotary screens 4 are rotated by shaft 9 by means of transmission devices (not shown in the drawings) and are supported on the screen holders 10. The shaft 9 is positively driven by the guide roller 2 by means of the two bevel gears 11 and 12 and passes on its rotary motion to lifting operation shafts, such as cam shafts 6. Bevel gear pairs 13,14 and 15,16 may be replaced individually or both of them by worm gears, furthermore transmission of the rotary motion from the shaft 9 onto cam shafts 6 by means of a chain is possible. Cam shafts 6 being divided in the area of disengagable couplings 8, bear the cam plates 7 for each screen device. The shape and the angular position of rotation of the individual cam plates 7 on cam shafts 6 is chosen in such manner that, according to the design to be printed, i.e., the distribution of the long repeat distance to the individual screen circumferences, only certain rotary screens are in contact with the sheet of material and the remaining screens are lifted during the printing process.

FIGS. 3 and 4 show cam plates 7 which differ in lifting angle 20 indicating the time of lifting of a rotary screen. Distance 21 is equal to the required height of lift.

Adjusting device according to FIG. 5 comprises a ring 22 tightly connected with cam shaft 6. Cam plate 7 is loosely mounted on shaft 6 and has a gearing 23. Cam plate 7 may be angularly adjusted relative to the cam shaft 6 by rotation of worm 24 mounted on ring 22 and engaging gearing 23.

FIG. 6 shows a lifting device for the sequential lifting of the elements of the dying device, the lifting device being provided with a cam plate according to the invention and including a dye supply 30 and a squeegee device 31 on one hand as well as rotary screen 4 on the other hand. The lifting motion caused by cam plate 7 upon rotation of cam shaft 6 is passed on by roller 25 to the lower cross bar 18 and the two rams 19, the rams 19 having shoulders 28 spaced from their upper ends. Ramps 19 first lift with their upper end means or contact surfaces 26 the dying device support 17 and therewith the elements in the inside of the rotary screen (dye supply 30 and squeegee device 31). Then, after a given interval, screen holder 10 and rotary screen 4 are lifted by means of the shoulder 28, having moved by a distance 27 to the undersurface 29 of screen holder 10. Elements 25, 18 and 19 form a lifting device member which is movable from a first position wherein the rotary screen 4 is lowered into contact with the material and the squeegee device 31 is lowered into contact with the rotary screen 4, to a second position wherein end means 26 contact support 17 to move squeegee device 31 out of contact with rotary screen 4, to a third position wherein shoulders 28 contact undersurface 29 of screen holder 10 to move rotary screen 4 out of contact with the material. Cam shaft 6 and cam plate 7 form means for moving the lifting device member to and from the first, second and third positions.

What is claimed is:

1. A rotary screen printing machine comprising:
   a frame means for supporting material to be printed;
   at least two printing devices supported on said frame means for printing said material;
   each of said printing devices including a rotary screen, a screen holder having an undersurface and supporting said rotary screen, and a dye supply and a squeegee device positioned inside said rotary screen by means of a support;
   each of said printing devices having operatively connected thereto a lifting device means for first lifting said squeegee device and said dye supply within the rotary screen thereof so that said squeegee device is raised out of contact with said rotary screen, and for then lifting said rotary screen, thereby avoiding damage to said rotary screen due to the weight of said squeegee device and said dye supply during the lifting of said rotary screen;
   each of said lifting device means including a member mounted for movement from a first position wherein the respective rotary screen is lowered into contact with said material and said squeegee device is lowered into contact with said rotary screen, to a second position wherein said member contacts said squeegee device and said dye supply to move said squeegee device out of contact with said rotary screen, and thereafter to a third position wherein said member contacts said undersurface of said screen holder for moving said rotary screen out of contact with said material; and
   means operatively connected to said member of each of said lifting device means for moving said members to and from said first, second and third positions thereof.

2. A rotary screen printing machine as claimed in claim 1, wherein said means for moving comprises at least one cam shaft mounted for rotation on said frame means; and one cam plate per screen printing device positioned on each cam shaft of said at least one cam shaft.

3. A rotary screen printing machine as claimed in claim 2, wherein said at least one cam shaft comprises two cam shafts, one of each of which is provided at opposite sides of said machine extending in the direction of movement of said material to be printed, and each of said two cam shafts has one cam plate per screen device.

4. A rotary screen printing machine as claimed in claim 3, wherein each of said cam shafts are divided into sections connected by means of disengagable couplings, each of said sections having one of said cam plates thereon.

5. A rotary screen printing machine as claimed in claim 2, further comprising a driven roller and non-
driven roller, a printer's blanket running over said rollers, said at least one cam shaft being driven from said non-driven roller.

6. A rotary screen printing machine as claimed in claim 5, further comprising a shaft driven by said non-driven roller, said at least one cam shaft being driven by said shaft.

7. A rotary screen printing machine as claimed in claim 6, wherein the ratio between the rates of revolution of said at least one cam shaft and said rotary screens is integral.

8. A rotary screen printing machine as claimed in claim 2, wherein said cam plates are attached to said at least one cam shaft by means of adjusting devices, each comprising a ring tightly mounted on said cam shaft, said cam plate being adjustable with relation to said ring.

9. A rotary screen printing machine as claimed in claim 2, wherein each of said member of said lifting device means comprises a vertically movably guided cross bar having thereon a roller in contact with the respective said cam plate, said cross bar having rams extending therefrom, each of said rams having upper end means for contacting the respective said support of said dye supply and squeegee device, each of said rams further having spaced from said upper end means thereof shoulder means for contacting said undersurface of the respective said screen holder after said upper end means contact said support.

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