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(54) **INK DUCT AND METHOD OF ENGRAVING INK DUCT**

(57) The subject-matter of invention is a novel shape of an ink duct and a method of engraving of a novel shape of an ink duct. The ink duct according to the invention and the method of engraving said ink duck on anilox rolls can be used in the flexographic printing process.

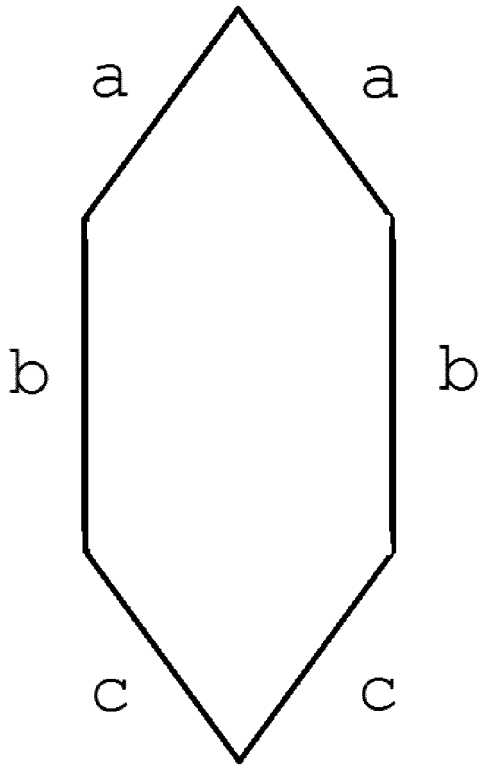

Fig. 1

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Description

[0001] This invention relates to a new shape for an ink duct and a method of engraving an ink duct.

[0002] Anilox rolls are widely used elements of printing machines. They are, among others, widely used in flexography, namely a type of relief printing process, in which a relief plate is used. Flexography is a rotary technology, which means that with each rotation of the printing cylinder a printed sheet is obtained.

[0003] A printing assembly in the flexographic printing machines is composed of a squeegee chamber, an anilox roll, a plate cylinder and an impression cylinder. Flexographic printing utilizes low-viscosity inks. Ink is spread onto a printing plate only on image areas. The ink is transferred from ink ducts with help of an ink roll onto the anilox roll, and then onto the plate cylinder to which the printing plate is attached, and the image from the printing plate is transferred to the substrate pressed down by the impression cylinder.

[0004] Ink ducts are principally formed in the process of subjecting the working surface of the anilox roll to a laser beam, which results in obtaining the ink duct structure as a result of engraving. The volume of ink transferred to the appropriate substrate depends among others on the ink ducts' structure, their volume, as well as their frequency of presence measured in lines per a unit of length.

[0005] Professional literature currently knows a few methods of obtaining anilox rolls as well as ink ducts present thereon.

[0006] The Polish patent application no. P-400602 discloses a method of manufacturing anilox rolls, wherein an anilox sleeve comprises an inner sleeve made of a compressible material and an outer sleeve. Ink ducts are engraved on the outer surface. The method disclosed in that publication is characterised, among others, in that ink ducts are engraved with use of a NIR laser with a laser beam having a near-infrared wavelength range of 1070 nm.

[0007] A process of making anilox rolls that include ink ducts is also disclosed in the patent application no. US 2010/0015354. In that publication, a pattern is formed with laser on the roller surface coated with a ceramic material, and the whole element is subject to polishing and cleaning of the outer surface.

[0008] Patent PL 172007 discloses a method and apparatus for engraving cylindrical moulds. The method disclosed therein is characterised in that with the aid of a laser beam a coating of lacquer residing on the surface of a hollow cylindrical, rotating metal screen is removed at prescribed sample regions. The removal of the coating of lacquer inside the sample regions is performed with a laser beam turned on continuously, the laser beam being turned off at the end of a respective sample region within a specified period of time. Radiation retroreflected into the laser beam path at the metal screen is coupled out of the laser beam path in order not to delay switching off the laser beam. As a result of the method it is possible to produce samples having particularly sharp edge structures

[0009] Even though so far a number of solutions had been disclosed in relation to methods of obtaining anilox rolls as well as ink ducts residing thereon, the state of the art still does not include a solution which would enable obtaining a suitable structure of ink ducts, which would in turn allow increasing the actual ink efficiency and, by the same, increase the rotation of ink during the printing process and improve its transfer onto the printing plate.

[0010] The purpose of the invention thus became to develop a new structure of an ink duct, different from the generally used hexagonal structure (standard structure), in which all sides of the structure are equal and proportional. An additional goal of the invention was to develop a method of obtaining the intended, novel ink duct structure.

[0011] The subject-matter of the invention is an ink duct engraved on the surface of an anilox roll. The ink duct is composed of upper walls (a), side walls (b) and bottom walls (c) and is characterised in that the length of the side walls (b) of the ink duct is greater than the length of the upper walls (a) and the bottom walls (c). Preferably, the ink duct according to the invention is characterised in that the length of the side walls (b) of the ink duct is equal to or greater than 1.2 times the length of the upper walls (a) and the bottom walls (c), and most advantageously the ink duct is characterised in that the upper walls (a) of the ink duct are connected to the bottom walls (c) of the ink duct via channels.

[0012] The subject-matter of the invention is also a method of engraving an ink duct, which consists in that the ink duct is engraved by a beam of a NIR laser operating in a continuous mode within a system involving an external modulator. This method is characterised in that a single laser beam is used, with shift of the laser head being between 8.3 μm and 31.3 μm. The linear velocity around the perimeter of the anilox roll subject to engraving is between 58.0 cm/s and 87.0 cm/s, while pulse duration was between 6.7 μs and 20 μs. The method was carried out with pulse amplitude between 110 W and 200 W, and wave frequency between 8.04 kHz and 26.8 kHz. The angle of engraving was 60°.

[0013] The subject-matter of the invention is represented by an example embodiment, in a drawing, in which:

Fig.1 is a schematic representation of an ink duct according to the invention, with indication of upper walls "a", side walls "b", and bottom walls "c".

Fig.2 is an axonometric projection of a fragment of an anilox roll, with an ink duct marked with a dashed line and a channel connecting the individual ink ducts marked with a double dotted line.

Fig.3 is a horizontal projection on the surface of an anilox roll, with an ink duct marked with a dashed line and a channel connecting the individual ink ducts marked with a double dotted line.

[0014] Examples of a method of engraving an ink duct are presented in the below embodiments.

Example 1

[0015] An anilox cylinder, earlier produced in a manufacturing process, was subjected to engraving with use of light source of a NIR laser operating in a continuous mode, with maximum power of 200 W, within a system involving an external modulator.

[0016] Calibration parameters of the laser were adapted to 500 lines per centimeter and ink capacity of 2.6 cm^3/m^2. The engraving was carried out on a surface of a ceramic material such as Cr_2O_3 with thickness of 200 μm, hardness of 1250 Hv, porosity of 3,50% and roughness Ra of 0,10. During the engraving process the shift of the laser head was set at 9.1 μm; and the linear velocity along the perimeter of the cylinder/anilox sleeve subject to engraving was 85.0 cm/s. The laser beam's pulse duration was set to 6.7 ms with pulse amplitude of 200 W. The generated wave frequency was 26,8 kHz. The angle of the laser beam during the engraving was 60°.

[0017] As a result of the engraving process carried out in that manner, it was possible to produce an ink duct structure in which the length of the ink duct's side walls "b" is greater than 1.2 times the length of the upper walls "a" and bottom walls "c", specifically it was 1.75. Additionally, such manner of engraving allowed to connect the upper walls and bottom walls via channels, which resulted in a hybrid structure, combining the features of closed structures and open (flow-through) structures. An advantage resulting from the engraving process carried out in this manner is the obtaining of an ink duct which provides improved ink efficiency.

Example 2

[0018] An anilox cylinder, earlier produced in a manufacturing process, was subjected to engraving with use of light source of a NIR laser operating in a continuous mode, with maximum power of 200 W, within a system involving an external modulator.

[0019] Calibration parameters of the laser were adapted to 160 lines per centimeter and ink capacity of 7.5 cm^3/m^2. The engraving was carried out on a surface of a ceramic material such as Cr_2O_3 with thickness of 200 μm, hardness of 1250 Hv, porosity of 3.50% and roughness Ra of 0.16. During the engraving process the shift of the laser head was set at 31.3 μm; and the linear velocity along the perimeter of the cylinder / anilox sleeve subject to engraving was 87.0 cm/s. The laser beam's pulse duration was set to 20 ms with pulse amplitude of 110 W. The generated wave frequency was 8.04 kHz. The angle of the laser beam during the engraving was 60°.

[0020] As a result of the engraving process carried out in that manner, it was possible to produce an ink duct structure in which the length of the ink duct's side walls "c" is greater than 1.2 times the length of the upper and bottom walls , specifically it was 1.60.

[0021] Additionally, such manner of engraving allowed to connect the upper walls and bottom walls via channels, which resulted in a hybrid structure, combining the features of closed structures and open (flow-through) structures. An advantage resulting from the engraving process carried out in this manner is the obtaining of an ink duct which provides an improved ink efficiency.

Example 3

[0022] An anilox cylinder, earlier produced in a manufacturing process, was subjected to engraving with use of light source of a NIR laser operating in a continuous mode, with maximum power of 200 W, within a system involving an external modulator.

[0023] Calibration parameters of the laser were adapted to 600 lines per centimeter and ink capacity of 3.0 cm^3/m^2.

[0024] The engraving was carried out on a surface of a ceramic material such as Cr_2O_3 with thickness of 200 μm, hardness of 1250 Hv, porosity of 3.50% and roughness Ra of 0.09. During the engraving process the shift of the laser head was set at 8.3 μm; and the linear velocity along the perimeter of the cylinder anilox sleeve subject to engraving was 58.0 cm/s. The laser beam's pulse duration was set to 7.5 ms with pulse amplitude of 200 W. The generated wave frequency was 20.09 kHz. The angle of the laser beam during the engraving was 60°.

[0025] As a result of the engraving process carried out in that manner, it was possible to produce an ink duct structure in which the length of the ink duct's side walls "c" is greater than 1.2 times the length of the upper and bottom walls , specifically it was 1.45.

[0026] Additionally, such manner of engraving allowed to connect the upper walls and bottom walls via channels, which resulted in a hybrid structure, combining the features of closed structures and open (flow-through) structures. An advantage resulting from the engraving process carried out in this manner is the obtaining of an ink duct which provides an improved ink efficiency.

Claims

1. An ink duct engraved on a surface of an anilox roll, composed of upper walls (a), side walls (b) and bottom walls (c), **characterised in that** the length of the side walls (b) is greater than the length of the upper walls (a) and the bottom walls (c).

2. An ink duct according to claim 1 **characterised in that** the length of the side walls (b) of the ink duct is equal to or greater than 1.2 times the length of the upper walls (a) and the bottom walls (c).

3. An ink duct according to claim 1 **characterised in**

that the upper walls (a) of the ink duct are connected to the bottom walls (c) of the ink duct via channels.

4. A method of engraving an ink duct consisting in engraving it by a beam of a NIR laser operating in a continuous mode within a system involving an external modulator **characterised in that** a single laser beam is used, with shift of the laser head being between 8.3 μm and 31.3 μm, the linear velocity along the perimeter of the anilox roll subject to engraving being between 58.0 cm/s and 87.0 cm/s, pulse duration being between 6.7 μs and 20 μs, pulse amplitude being between 110 W and 200 W, wave frequency being between 8.04 kHz and 26.8 kHz, and the angle of engraving being 60°.

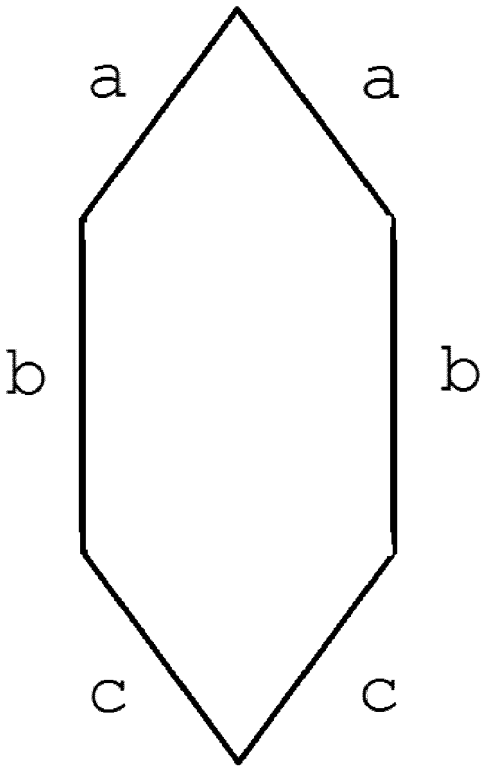

Fig. 1

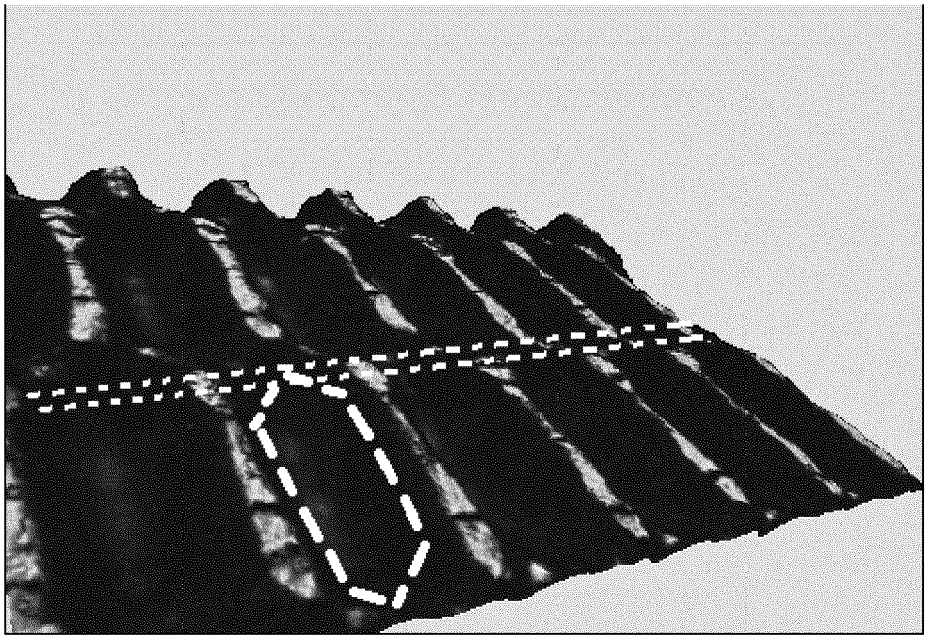

Fig. 2

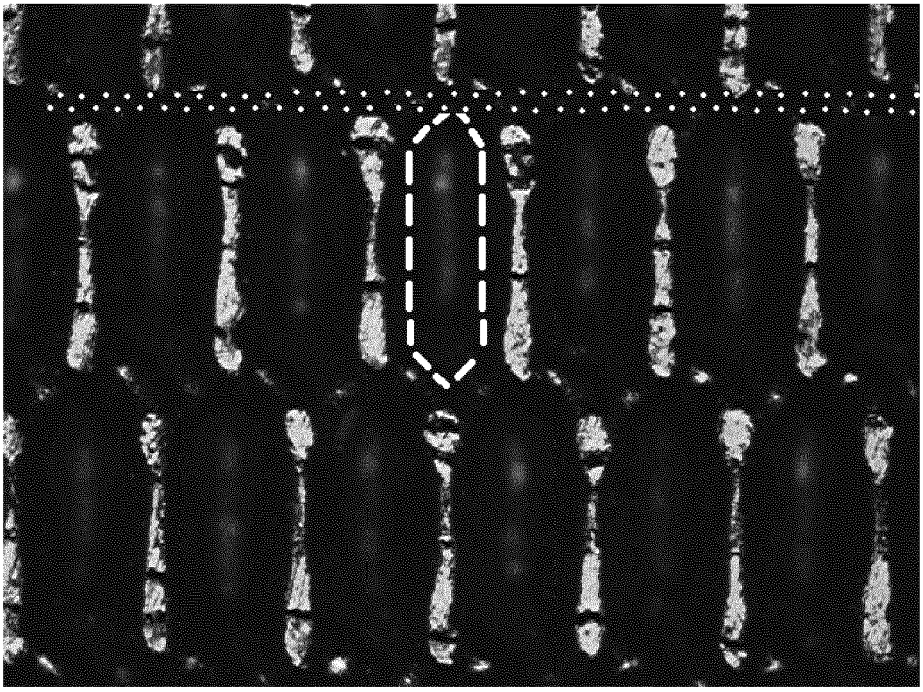

Fig.3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- PL P400602 **[0006]**
- US 20100015354 A **[0007]**
- PL 172007 **[0008]**