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(54) **Title**: METHOD AND DEVICE FOR CLEANING PRINTING ROLLS BY A LASER BEAM

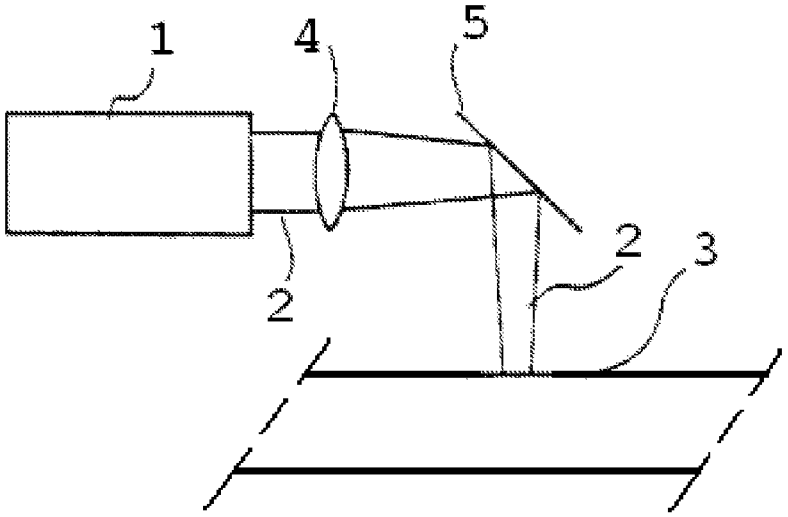

Fig. 1

(57) **Abstract**: Method to remove contamination from a roll, such as a raster roll, within a printing press wherein the surface of the roll is cleaned with a from a by a flexible optical glass fibre to the laser source connected and to it coupled, spatially movable gun, onto the surface of the roll directed laser beam, without changing the surface of the roll, wherein the laser beam is coming from a fibre laser and preferably the cleaning is carried out by exclusively photo effect.

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Method and device for cleaning printing rolls by a laser beam.

The invention relates to a method and device for removing contamination from ink rolls (also called raster rolls) within printing machine, without contacting the rolls, by directing a laser beam onto the roll surface, such that the laser beam does not alter the surface, e.g. of ceramic material or chromium plated of the cylinder/roll. In particular it is cleaning the roll with which the de printing ink is applied onto the cliché roll (e.g. in case of flexography printing).

EP 0607506 discloses a method and device to remove contamination, such as ink residues, fibres, dirt, polymers and further residues in a printing machine wherein the surface of the roll is cleaned with a to the surface of it directed laser beam, without changing the surface of the roll. Discussed are an excimer-laser, CO2-laser or Nd:YAG-laser.

The present laser systems used to clean the raster roll are bulky and heavy, e.g. above 250 kg. They operate with water cooling and need the supply of power electricity (3-phase). They are fragile, maintenance intensive systems. The laser beam is from the source through a flexible optical glass fibre brought to a gun. From the gun the laser beam is directed onto the roll.

For improvement this invention offers to clean the raster roll with a laser beam from a fibre laser. With a fibre laser the laser medium and the laser cavity are integrated within the core of an optical fibre.

An example of a fibre laser is as follows: a typical optical fibre of SiO2 glass (silica glass) is doted with a rare earth element, e.g. erbium, which provides the laser medium. The erbium provides photons having a wave length of 1550 nm when pumped with photons having a wave length of 980 nm. The laser is pumped with e.g. a diode laser (provides the 980 nm) which is optically coupled with the cladding enclosing the core of the fibre laser. From the cladding the 980 nm photons penetrate the core and supply the erbium which provides the 1550 nm photons. The core contains longitudinally two mutually spaced Bragg gratings (providing a locally changed fracture index of the

fibre) which provide the laser cavity. Different convenient rare earth elements for doting the glass fibre of the fibre laser are ytterbium, neodymium, dysprosium, praseodymium, thulium.

Preferably one or more of the following applies: a single, two or more, such as three or four, fibre lasers are assembled into a single, preferably wheeled, unit, e.g. enclosed within a common house and/or coupled with a single gun, preferably wherein the laser beam of the single, two or more fibre lasers within the gun is directed onto a common mirror of the scanner within the gun or directed onto a common lens within the gun; the optical glass fibre guiding the laser beam from the laser source to the gun allows that the gun can be located at a distance of at least three or four metre from the the laser source enclosing house while the laser beam exits the gun, e.g. since the optical glass fibre extends a length between the house and the gun of at least two, three or four metre; the scanner within the gun is designed to allow the from the gun exiting laser beam to scan with a frequency of at least 100 or 300 or 400 Hz; the wave length of the laser beam exiting the gun is at least 1000 or 1200 nm; the laser beam provides onto the surface of the roll to be cleaned a spot having a diameter of at least 0.05 or 0.1 millimetre and/or not more than 0.3 or 0.5 millimetre, such as approximately 0.2 millimetre; the the gun exiting laser beam pulsates, preferably with a frequency above 10 or 20 kHz, such as approximately 30 kHz and/or a pulse duration between 1 ns and 50 ms; the the laser source enclosing house (preferably wheeled) has a volume smaller than 1 or 0.75 or 0.5, such as approximately 0.3 cubic metre; the total system, house, gun and glass fibre between house and gun, weighs not more than 100 kg; the scanner has an amplitude such that onto the surface of the ink roll, with stationary ink roll and gun, the laser beam covers an area with a surface equal to a rectangle with a length between 3 and 6 millimetre and a width of 0.5 millimetre; the scanner operates to scan the laser beam in a single direction; in case of a single scanning mirror within the gun with two or more fibre lasers, the two or more separate laser beams

provide separate laser spots or a common laser spot onto the surface of the raster roll since, in the latter case, the component of the gun, such as the scan mirror or a within the light track upstream or downstream of it located lens, the arriving separate laser beams are combined into a single laser spot onto the surface of the raster roll; in case of a lens within the gun and two or more fibre lasers, the two or more separate laser beams provide separate laser spots or a common laser spot onto the surface of the raster roll since, in the latter case, the lens combines the arriving separate laser beams into a single laser spot onto the surface of the raster roll; in case of a lens within the gun the laser spot onto the surface of the raster roll is stationary relative to the gun; in case of a scanning mirror within the gun the laser spot onto the surface of the raster roll moves relative to the gun.

The invention allows to remove the contamination by photo effect in stead of generation of heat or plasma effect. In case of photo effect there is no thermal interaction with the to be cleaned surface of the raster roll, even not when very small dirt particles, e.g. having a dimension of approximately 1 micrometer, must be removed. On the contrary when using plasma effect there is always the risk for burning the raster roll by the laser beam, such that much attention should be paid to the fine tuning of the system. The system of the invention is less sensitive for this fine tuning.

The laser system of the invention operates three times faster compared to the present prior art system.

It should be appreciated that the word 'laser source' here means the part of the optical glass fibre containing the laser cavity and the laser medium. The house contains both the laser source and the pump (typically a diode laser) and the electrical supply and the cooling unit (typically directly cooled with forced air, thus without liquid cooling).

It should also be appreciated that by aiming the gun the laser beam hits the to be cleaned surface.

An example is as follows: four fibre lasers are enclosed within a house. From the house a flexible cable extends to the

relative to the house movable gun. The flexible cable contains the four from the four fibre lasers coming optical glass fibres which are directed onto the common scanning mirror within the gun. The gun is continuously aimed onto the raster roll and the scanning mirror scans the four laser spots across the surface of the ink roll such that each scan a rectangle of 4 by 0.5 millimetre. While the raster roll rotates around its shaft with 10 - 40 RPM, the gun is parallel to the shaft of the raster roll advanced with a speed of 1.5-3 metre per hour.

In an alternative embodiment the scanning mirror is replaced by or completed with a lens onto which the four laser beams are directed. After passage of the lens the four laser beams contact the raster roll and provide onto it a common laser spot. Thus the lens combines the four laser beams such that a single laser spot is provided onto the surface of the raster roll.

By way of the attached drawing the invention is further illustrated by a presently preferred embodiment. The drawing show in:

Fig. 1 schematically an assembly in side view;

Fig. 2 and 3 a gun from different view angles, in perspective.

Fig. 1 shows a laser beam 1 coming from the to the fibre laser connected glass fibre 2. On its way to the roll 3 the beam 1 passes first a lens 4 and subsequently a mirror 5. The beam 1 provides a laser spot onto the surface of the roll 3.

Fig. 2 and 3 show a gun 6 and a grip 7. The gun 6 can be aimed onto a roll (not shown) to process the surface of the roll with the from the gun 6 exiting laser beam 1. To the gun 6 are five fibre lasers through five glass fibres 2 connected and the from it exiting laser beams are by a common lens (not visible) within the gun 6 combined into a single laser beam 1 exiting the gun. Downstream from the lens the laser beam within the gun passes a scanning mirror (not visible) before exiting the gun. A supply cable 8 provides energy to drive the scanning mirror, which drive is activated and deactivated by the switch 9.

CLAIMS

1. Method to remove contamination from a roll, such as a raster roll, within a printing press wherein the surface of the roll is cleaned with a from a by a flexible optical glass fibre to the laser source connected and to it coupled, spatially movable gun, onto the surface of the roll directed laser beam, without changing the surface of the roll, wherein the laser beam is coming from a fibre laser and preferably the cleaning is carried out by exclusively photo effect.

2. Method according to claim 1, wherein two or more, such as three or four, fibre lasers are assembled into a single unit, enclosed within a common house and coupled to a single gun.

3. Method according to claim 1 or 2, wherein the laser beam of all fibre lasers within the gun are directed onto a common mirror of the scanner within the gun or are directed onto a common lens within the gun; the optical glass fibre guiding the laser beam from the laser source to the gun allows that the gun can be brought to a distance of at least three or four metre from the the laser source enclosing house while the laser beam exits the gun; the wave length of the laser beam coming from the gun is at least 1000 or 1200 nm; the laser beam provides onto the surface of the roll to be cleaned a spot with a surface equal to a spot with a diameter of at least 0.05 or 0.1 millimetre and/or not more than 0.3 or 0.5 millimetre, such as approximately 0.2 millimetre; the from the gun coming laser beam pulsates, with a frequency above 10 or 20 kHz, such as approximately 30 kHz and a pulse duration between 1 ns and 50 ms; the the laser beam enclosing house (preferably wheeled) has a volume smaller than 0.5 cubic metre; the total system, housing, gun and glass fibre between house and gun included, weighs 100 kg at most.

4. Method according to claim 1, 2 or 3, the scanner has an amplitude such that onto the surface of the ink roll, with stationary ink roll and gun, the laser beam covers an area with a surface equal to a rectangle with a length between 3 and 6 millimetre and a width of 0.5 millimetre; in case of a single scanning mirror within the gun with two or more fibre lasers, the two or more separate laser beams provide a common laser spot onto the surface of the raster roll since a component of the gun, such as the scan mirror or a within the light track upstream or downstream of it located lens, the arriving separate laser beams are combined into a single laser spot onto the surface of the raster roll.

5. Method according to any of claims 1-4, in case of a lens within the gun and two or more fibre lasers, the two or more separate laser beams provide a common laser spot onto the surface of the raster roll since the lens combines the arriving separate laser beams into a single laser spot onto the surface of the raster roll.

6. Device to carry out the method according to any of claims 1-5.

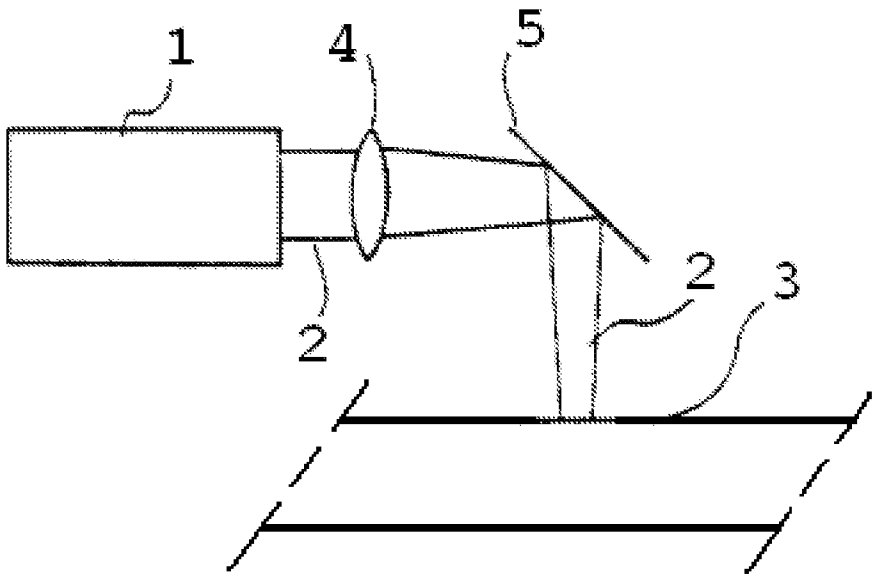

Fig. 1

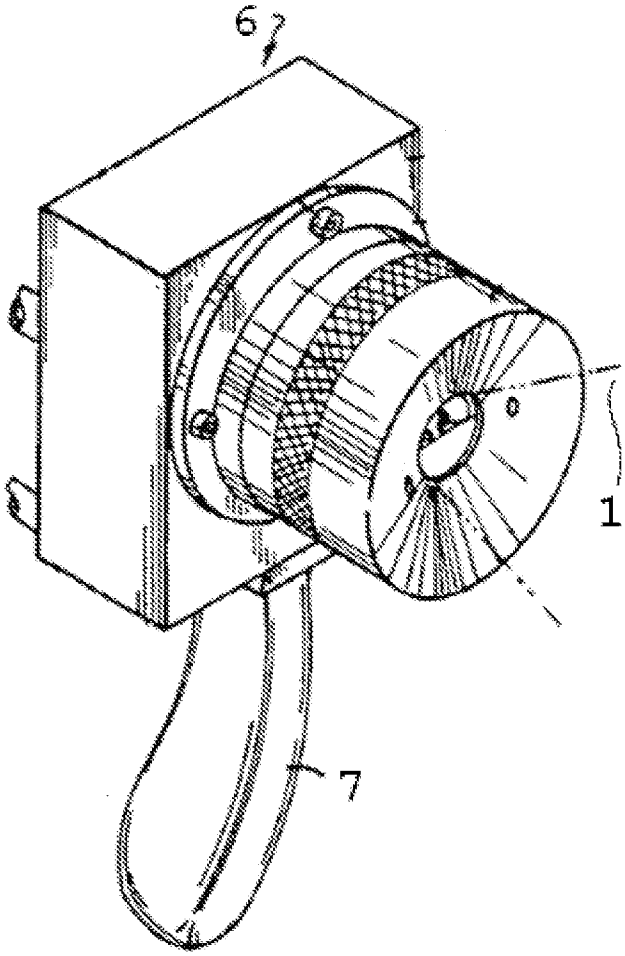

Fig. 2

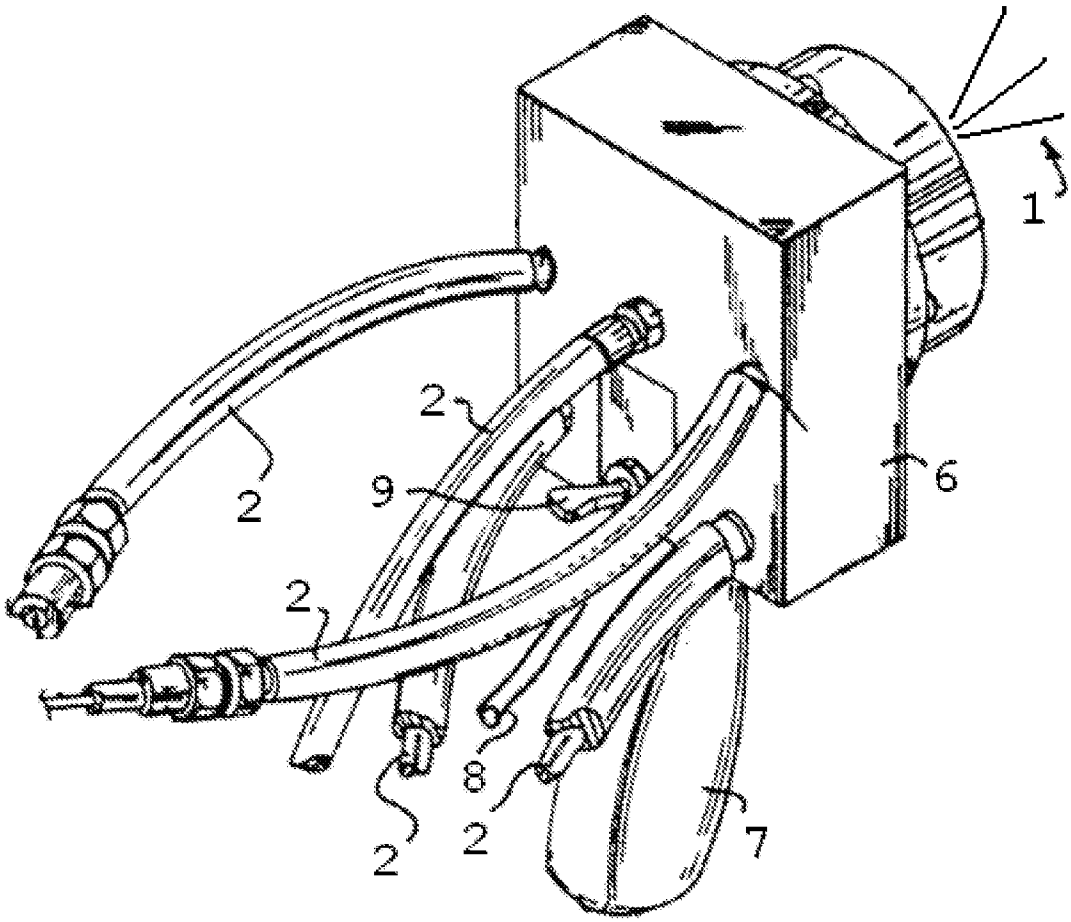

Fig. 3