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(54) Double line electrode unit for electro-coagulation printer and method of making it

(57) A double line electrode unit for use in an electro-coagulation printer contains a pair of electrode plates (211, 212), negative electrodes (211b, 212b) and a prepreg (or an insulating layer) (213). The negative electrodes are linearly arranged with prescribed intervals of distance (L) therebetween on surfaces of the electrode plates respectively and are embedded in insulating resin materials (211d, 212d) being solidified. The insulating resin materials contain fillers that are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica. In addition, connectors (211c, 212c) are arranged on other surfaces of the electrode plates in connection with the negative electrodes respectively. The electrode plates are consolidated under heating and pressurized conditions by way of the prepreg such that the negative electrodes respectively arranged on the surfaces ofthe electrode plates face with each other by intervention of the prepreg, which has a prescribed thickness and is made by fabric material such as glass fibers impregnated with unhardened resin. After filling and solidifying the insulating resin materials on the negative electrodes of the electrode plates, inspection is performed such that electrification is made with respect to each of basic units of negative electrodes to locate an electrification failure area. Then, the complete electrode plate is made by jointing together a prescribed number of the basic units of negative electrodes excluding a basic unit of ncgativc electrodes corresponding to the electrification failure area, which is cut and removed.

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention generally relates to electro-coagulation printers in which electrodes are selectively electrified to coagulate liquid ink to form images, which are transferred onto papers. Particularly, this invention relates to double line electrode units that contain double lines of electrodes, which are selectively electrified to coagulate liquid ink to form images on papers. In addition, this invention also relates to methods of making the double line electrode units.

Description of the Related Art

[0002] Conventionally, there are provided electro-coagulation printers, each of which contains a rotation drum and a number of electrodes. An example of the electro-coagulation printer is disclosed by Japanese Patent No. 2,764,065. Herein, the circumferential surface of the rotation drum functions as a positive electrode against the negative electrodes, which are linearly arranged with prescribed intervals of distance therebetween along an axial direction of the rotation drum. The electrodes are aligned above the surface of the rotation drum and are spaced apart from the surface of the rotation drum by a prescribed gap. From an input side of the rotation drum, liquid ink is sprayed into the gap between the negative electrodes and the circumferential surface of the rotation drum, so that the gap is being filled with the liquid ink. Applying negative voltage to the negative electrodes which are adequately selected, the ink is partially coagulated and temporarily adhered to the circumferential surface of the rotation drum, so that a desired image is formed on the circumferential surface of the rotation drum. At an output side of the gap, remained non-coagulated ink is removed from the circumferential surface of the rotation drum. Thus, the image formed on the circumferential surface of the rotation drum is to be transferred onto a paper.

[0003] Due to the electricity being applied to the negative electrodes in the aforementioned electro-coagulation printer, coagulated ink is sometimes stuck to the negative electrodes and peripheries. If the negative electrodes are partially or entirely covered with the coagulated ink, there occurs electrification failure (or print failure) in the electro-coagulation printer. To solve the problem due to the electrification failure, engineers propose double line arrangement of electrodes which is disclosed by U.S. Patent No. 6,045,674, for example. That is, there are arranged two lines of negative electrodes, which are spaced apart from each other by a predetermined interval of distance in the rotating direction of the rotation drum. Herein, the two lines of negative electrodes are alternately electrified by certain intervals of time, so that each line is intermittently rested in electrification. Such double line arrangement of the electrodes is advantageous because ink almost stuck to the electrodes and peripheries by electrification can be washed away by newly supplied liquid ink during rest periods of the electrification. Thus, it is possible to continuously perform print operations for a long time without failures. However, if positional deviations exist in arrangement of the double lines of the electrodes in the axial direction and rotating direction of the rotation drum, there occurs unwanted non-uniformity in printing densities, which may deteriorate quality of prints. Therefore, it is necessary for the manufacturer to carefully arrange the electrodes in lines with a very high accuracy.

SUMMARY OF THE INVENTION

[0004] It is an object of the invention to provide a double line electrode unit for use in an electro-coagulation printer, which facilitates double line arrangement of electrodes with a high accuracy.

[0005] It is another object of the invention to provide a manufacturing method of the double line electrode unit in which units of electrodes are inspected to exclude failure units so that remained units of electrodes are arranged to adjoin with each other in formation of electrodes plates.

[0006] A double line electrode unit for use in an electro-coagulation printer contains a pair of electrode plates, negative electrodes and a prepreg (or an insulating layer). The negative electrodes are linearly arranged with prescribed intervals of distance (L) therebetween on surfaces of the electrode plates respectively and are embedded in insulating resin materials being solidified. The insulating resin materials contain fillers that are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica In addition, connectors are arranged on other surfaces of the electrode plates in connection with the negative electrodes respectively. The electrode plates are jointed together under heating and pressurized conditions by way of the prepreg such that the negative electrodes respectively arranged on the surfaces of the electrode plates face with each other by intervention of the prepreg, which has a prescribed thickness and is made by fabric material such as cloth made of glass fibers impregnated with unhardened resin.

[0007] In a manufacturing process of the double line electrode unit, after filling and solidifying the insulating resin materials on the negative electrodes of the electrode plates, inspection is performed such that electrification is made with respect to each of basic units of negative electrodes to locate an electrification failure area. Then, the complete electrode plate is made by jointing together a prescribed number of the basic units of negative electrodes excluding a basic unit of negative electrodes corresponding to the electrification failure area, which is cut and removed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] These and other objects, aspects and embodiment of the present invention will be described in more detail with reference to the following drawing figures, of which:

FIG. 1 is a side view partly in section diagrammatically showing selected parts of an electro-coagulation printer that contains a double line electrode unit in accordance with a preferred embodiment of the invention;
FIG. 2 is an enlarged sectional view showing an internal construction of the double line electrode unit;
FIG. 3 is a cross sectional view taken along a line 3-3 in FIG. 2;
FIG. 4 is an enlarged view showing supply of liquid ink into a gap between a print head and a circumferential surface of a rotation drum in the electro-coagulation printer shown in FIG. 1;
FIG. 5 is a side view partly in section showing an electrode formation step in a manufacturing process of the double line electrode unit;
FIG. 6 is a side view partly in section showing a resin filling step in the manufacturing process of the double line electrode unit;
FIG. 7 diagrammatically shows a linear arrangement of negative electrodes on a substrate to locate an electrification failure area in an inspection step of the manufacturing process of the double line electrode unit;
FIG. 8 diagrammatically shows an arrangement of the negative electrodes from which a basic unit of electrodes corresponding to the electrification failure area is excluded by a cut and removal step of the manufacturing process of the double line electrode unit;
FIG. 9 is a cross sectional view showing an arrangement of the negative electrodes on a surface plate;
FIG. 10 is a cross sectional view showing the negative electrodes that are unified together in a unification step of the manufacturing process of the double line electrode unit;
FIG. 11 is a view partly in section showing an electrode plate having negative electrodes and connected with connectors in a connector connection step of the manufacturing process of the double line electrode unit; and
FIG. 12 is a view partly in section showing electrode plates both having negative electrodes and connectors which are jointed together in a joint step of the manufacturing process of the double line electrode unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0009] This invention will be described in further detail by way of examples with reference to the accompanying drawings.

[0010] FIG. 1 diagrammatically shows construction of selected parts of an electro-coagulation printer, which contains a rotation drum 10, a print head 20, a coating device 30, an ink spray device 40, an electrolytic solution supply device 50, a removal device 60, a transfer device 70 and a cleaning device 80.

[0011] The rotation drum 10 has a circumferential surface, which is grounded to secure a function as an positive electrode 11, The rotation drum 10 is supported by a frame (not shown) and is driven by a drive device (not shown) to rotate in a counterclockwise direction in FIG. 1. The print head 20 is elongated in a width direction along an axial direction of the rotation drum 10. That is, the print head 20 is arranged opposite to the circumferential surface of the rotation drum 10 and contains a double line electrode unit 21 and its holder 22.

[0012] Figures 2 and 3 diagrammatically show detailed construction of the double line electrode unit 21, which contains a pair of electrode plates 211, 212, a prepreg 213 and a pair of fixed frames 214, 215 which are made by the FRP material. Herein, the prepreg 213 functions as a joint member between the electrode plates 211 and 212. The electrode plates 211, 212 contain substrates 211a, 212a, negative electrodes 211b, 212b and connectors 211c, 212c respectively. Herein, the negative electrodes are arranged on one side of the substrate with predetermined intervals of distance 'L' therebetween. Each of the negative electrodes has approximately a square shape whose side is approximately 30 μm, so that the interval of distance L is set to approximately 60 μm to realize 400 dpi in printing. In addition, the connectors are arranged on another side of the substrate in connection with the negative electrodes. Spaces formed between the negative electrodes 211b, 212b are filled with insulating resin materials 211d, 212d, which contain fillers and are solidified. As the filler, it is necessary to select from among the prescribed materials that improve corrosion resistance and thermal conductivity. For example, it is preferable to select from among the materials of boron nitride, aluminum nitride, alumina and silica.

[0013] The holder 22 is made by insulating resin material and has a lengthy shape that extends along the axial direction of the rotation drum 10. In addition, the holder 22 is assembled together with the frame (not shown) and is connected with a printed circuit board (not show). Circuit components such as a data processing circuit and a drive circuit are fabricated on the printed circuit board. Herein, the data processing circuit processes print data representing print images output from an external print data output device 23, thus producing negative voltage pulse string signals in response to the print data. Based on the negative voltage pulse string signals, the drive circuit drives the negative electrodes 211b, 212b of the double line electrode unit 21. Further, the printed circuit board also contains a connector (or connectors, not shown) that is electrically connected

with the connectors 211c, 212c of the double line electrode unit 21 via a flat cable or flexible printed wiring.

[0014] The coating device 30 is arranged in an input side of the ink spray device 40 on the rotation drum 10. The coating device 30 coats the circumferential surface of the rotation drum 10 with olefin materials containing metallic oxide, films of which are continuously formed on the circumferential surface of the rotation drum 10. FIG. 4 diagrammatically shows supply of liquid ink A on the circumferential surface of the rotation drum 10 from its input side. That is, the ink spray device 40 sprays the liquid ink A into the gap between tip edges of the negative electrodes 211b, 212b and the circumferential surface of the rotation drum 10. Thus, the gap is entirely filled with the liquid ink A.

[0015] The electrolytic solution supply device 50 has an outlet opening 51, which is directed to the circumferential surface of the rotation drum 10. The outlet opening 51 of the electrolytic solution supply device 50 is carefully placed at a prescribed position in proximity to the double line electrode unit 21 and in connection with the ink spray device 40, wherein it is spaced apart from the double line electrode unit 21 by a prescribed short distance. The outlet opening 51 outputs electrolytic solution C to avoid sticking of the ink on tip edges of the negative electrodes 211b, 212b, wherein the electrolytic solution C do not substantially contain coagulating components due to electrification. The electrolytic solution C is stored in a tank 52 and is pumped up using a pump 53, so that the electrolytic solution C is supplied to the outlet opening 51. One end of a communication pipe (or communication path) 54 communicates with the outlet opening 51, while another end is connected with the tank 52 by way of a control valve 55, which controls a flow of the electrolytic solution C to be supplied to the outlet opening 51. That is, the communication pipe 54 returns an excessive amount of the electrolytic solution C to the tank 52,

[0016] The removal device 60 is arranged apart from the print head 20 along the circumferential surface of the rotation drum 10 in its output side. The removal device 60 has a flexible rubber spatula 61 that removes remained non-coagulated ink from the circumferential surface of the rotation drum 10. The removed ink can be reused for next cycles of printing. The transfer device 70 is arranged apart from the removal device 60 along the circumferential surface of the rotation drum 10 in its output side. The transfer device 70 transfers desired images of coagulated ink, which is adhered to the circumferential surface of the rotation drum 10, to a paper (or print material) B. That is, the transfer device 70 has a pressure roller 71 that rotates in a clockwise direction in FIG. 1 and presses the paper B against the circumferential surface of the rotation drum 10. The cleaning device 80 is further arranged apart from the transfer device 70 along the circumferential surface of the rotation drum 10. The cleaning device 80 continuously cleans the circumferential surface of the rotation drum 10.

[0017] In the aforementioned electro-coagulation printer shown in FIG. 1, the coating device 30 coats the circumferential surface of the rotation drum 10, which rotates in the counterclockwise direction, with the olefin material containing metallic oxide. In addition, the ink spray device 40 sprays liquid ink A into the gap between the print head 20 and the circumferential surface of the rotation drum 10, so that the gap is filled with the liquid ink A. Under the aforementioned condition, negative voltage pulses are applied to the negative electrodes 211b, 212b in response to print data output from the print data output device 23, so that coagulated ink A1 (see FIG. 4) is formed in response to the negative voltage pulses on the circumferential surface of the circumferential surface of the rotation drum 10, which functions as the positive electrode 11 against the negative electrodes due to electrification. Accurately speaking, the coagulated ink A1 is formed on the film of the olefin material containing metallic oxide, which is formed on the circumferential surface of the rotation drum 10 by the coating device 30. In this case, the tip edges of the negative electrodes 211b, 212b are entirely covered with the electrolytic solution C supplied from the electrolytic solution supply device 50. Hence, there is substantially no possibility in that the liquid ink A is coagulated on the tip edges of the negative electrodes 211b, 212b.

[0018] The removal device 60 removes the non-coagulated ink A, excluding the coagulated ink A1, from the circumferential surface of the rotation drum 10. Then, the transfer device 70 transfers desired images, which are formed by coagulation of the ink in response to the print data, from the circumferential surface of the rotation drum 10 to the paper B. Thereafter, the cleaning device 80 cleans the circumferential surface of the rotation drum 10. Thus, the aforementioned operations are repeated on the cleaned circumferential surface of the rotation drum 10. As a result, it is possible to print images successively on the papers.

[0019] In printing, the present embodiment alternately uses double lines of the negative electrodes 211b, 212b, which are changed over by prescribed units of printing. That is, applying negative voltage pulses (or electrification) is changed over between the negative electrodes 211b and 212b by a prescribed number of times of printing, e.g., one-hundred times or two-hundred times. Namely, the double lines of the negative electrodes 211b, 212b are alternately rested in electrification during printing. During electrification rest periods, it is possible to wash away ink that is almost adhered to the negative electrodes and peripheries due to electrification. As compared with printing using a single line of electrodes, it is possible to double the period for washing the electrodes. This brings reduction of frequency of works for removing the coagulated ink on the negative electrodes and peripheries by removal tools such as rotation brushes. Hence, it is possible to perform long-time printing or repetition of printing. In short, it is possible to improve printing efficiencies of the electro-coagulation printers

by using double line electrode units.

[0020] Next, a description will be given with respect to the manufacturing process of the double line electrode unit 21 shown in Figures 2 and 3 with reference to Figures 5 to 12. Namely, FIG. 5 shows an electrode formation step, FIG. 6 shows a resin filling step, FIG. 7 shows an inspection step, FIG. 8 shows a cut and removal step, Figures 9 and 10 show a unification step, FIG. 11 shows a connector connection step, and FIG. 12 shows a joint step.

[0021] In the electrode formation step of FIG. 5, a number of negative electrodes 211b (or 212b) are formed on one surface of the substrate 211a (or 212a) and are arranged apart from each other by the prescribed intervals of distance L therebetween. This step is implemented by the photolithography technique and plating method, which are used in the super fine structure processing technology such as the semiconductor manufacturing technology In the resin filling step of FIG. 6 that is performed after the electrode formation step of FIG. 5, spaces between the negative electrodes 211b (or 212b) are filled with the insulating resin materials 211d (or 212d), which are solidified. If the resin is supplied and solidified on the negative electrodes 211b (or 212b) as well, it is necessary to produce a satisfactory precision by controlling thickness of the resin.

[0022] In the inspection step of FIG. 7, electrification is performed on the negative electrodes 211b (or 212b) by basic units of inspection respectively. Through the electrification, each of the negative electrodes 211b (or 212b) is examined whether it is in a conducting state or a short-circuited state. Thus, it is possible to detect electrification failure with respect to each of the basic units of the negative electrodes. That is, an electrification failure area (see $\times$ mark in FIG. 7) is detected on a certain basic unit of the negative electrodes by the inspection step of FIG. 7. Then, the cut and removal step of FIG. 8 is effected to cut and remove the detected basic unit of the negative electrodes containing the electrification failure area. For example, the inspection step locates the basic unit of the negative electrodes containing the electrification failure location as an area whose width S is greater than L and which is sandwiched between dashed lines in FIG. 7. That is, the inspection step locates the basic unit of the negative electrodes corresponding to all electrodes connected with one connector 211c (or 212c), which are cut and removed by the cut and removal step of FIG. 8. In addition, approximately halves of the insulating resin materials 211d (or 212d) on the left and right sides of the basic unit of negative electrodes, which are cut and removed, are also removed together with their corresponding portions of the substrate 211a (or 212a).

[0023] In the unification step of Figures 9 and 10, the negative electrodes 211b (or 212b) are arranged using a fixed frame 214 (or 215) on a surface plate 100. Herein, a prescribed number of basic units of the negative electrodes are aligned and jointed together on the surface plate 100, so that an electrode plate 211 (or 212) is formed to realize linear arrangement of the negative electrodes whose overall length reaches seventeen inches, for example. Actually, eight to ten sheets of electrode plate elements (see FIG. 7) are linearly aligned and jointed together on the surface plate 100. In this case, alignment and joint operation are performed by confirming that an interval of distance between two negative electrodes 211b (or 212b), which correspond to a joint area encompassed by a circle in FIG. 9, is accurately adjusted to the prescribed interval of distance L.

[0024] In the connector connection step of FIG. 11, the connectors 211c (or 212c) for transmitting negative voltage pulses to the negative electrodes 211b (or 212b) are fabricated on another surface of the substrate 211a (or 212a). The connector connection step of FIG. 11 can be performed after the resin filling step of FIG. 6. In the joint step of FIG. 12, a pair of the electrode plates 211, 212 are jointed together by way of the prepreg 213 by heating and pressurizing adhesion such that the double lines of the electrodes 211b, 212b are arranged opposite to each other. Herein, the prepreg 213 is made by cloth material of glass fibers that is impregnated with unhardened resin. To increase rigidity of the prepreg, it is possible to use other base materials that are impregnated with unhardened resin. The joint step securely determines the prescribed interval of distance between the double lines of the negative electrodes 211b, 212b which are arranged opposite to each other.

[0025] As described above, the double line electrode unit 21 is manufactured such that the electrode plates 211, 212, in which the negative electrodes 211b, 212b are linearly arranged opposite to each other on one sides of the substrates 211a, 212a, are jointed together by using the prepreg 213. Thus, it is possible to consolidate the electrode plates 211, 212 via the prepreg 213. In the electrode plate 211 (or 212), the negative electrodes 211b (or 212b), which are linearly arranged apart from each other by the prescribed intervals of distance L therebetween, are enclosed in the insulating resin material 211d (or 212d) being solidified in advance. Due to solidified enclosure, it is possible to accurately retain the prescribed intervals of distance between the negative electrodes 211b (or 212b) in their alignment direction within the insulating resin material 211d (or 212d). In addition, it is possible to increase compressive rigidity of the negative electrodes 211b (or 212b) due to enclosure of the insulating resin material 211d (or 212d) in a thickness direction of the electrode plate 211 (or 212). In other words, it is possible to secure sufficient strength of the negative electrodes against the external force. Hence, even if pressure is applied in the thickness direction to the electrode plates 211, 212 that are jointed together via the prepreg 213, it is possible to accurately retain the prescribed intervals of distance between the negative electrodes 211b, 212b in their alignment directions. In addition, the negative electrodes 211b, 212b would not be damaged in the operation for cutting and

removing the electrification failure area(s) as well as in the alignment and joint operations. As a result, it is possible to manufacture without troubles, the double line electrode unit 21 in which double lines of the negative electrodes 211b, 212b are arranged opposite to each other with a high accuracy.

[0026] The manufacturing process of the double line electrode unit 21 is characterized by provision of the electrode formation step and resin filling step. Under the heating and pressurized conditions in the joint step, the unhardened resin of the prepreg 213 is softened and may be deformed, however, the base material of the prepreg 213 has a relatively high compressive rigidity. Applying pressure whose value is above a prescribed value, it is possible to control the shape of the prepreg 213 that has the prescribed thickness. In the electrode plates 211, 212, the negative electrodes 211b, 212b are embedded in the insulating resin materials 211d, 212d being solidified, so it is possible to accurately retain the prescribed intervals of distance among the negative electrodes 211b, 212b in their alignment directions. By appropriately controlling prescribed parameters such as the thickness of the base material of the prepreg 213, resin characteristics, pressurizing timing and heating temperature, it is possible to manufacture the double line electrode unit 21 such that prescribed intervals of distance are accurately retained in linear arrangement of the negative electrodes and the prescribed interval of distance (or gap) is accurately retained between the negative electrodes 211 and 212.

[0027] The manufacturing process of the double line electrode unit 21 is characterized by providing the inspection step, cut and removal step and unification step between the aforementioned resin filling step and joint step. As compared with the post-manufacture inspection in which after the joint step (or after completion of manufacture), the ncgative electrodes are examined by electrification to remove defective ones, it is possible to reduce a waste of resources, and it is possible to reduce wastefull operations in manufacture of the double line electrode units. As a result, it is possible to reduce manufacturing cost of products. During the inspection step, cut and removal step and the unification step, the negative electrodes are enclosed in the insulating resin materials being solidified. Hence, there are no troubles due to damaging of the negative electrodes.

[0028] The present embodiment describes such that the double line electrode unit 21 is applied to the print head 20 used in the electro-coagulation printer having the electrolytic solution supply device 50. Of course, it is possible to apply the double line electrode unit to the print head used in the electro-coagulation printer that does not have the electrolytic solution supply device.

[0029] The present embodiment describes the double line electrode unit 21 such that the substrates 211a, 212a respectively have the connectors 211c, 212c. So, it is necessary to perform electrification by switching the connectors or by alternately changing over the connectors. Instead, it is possible to introduce a signal switch device that switches over signals, being supplied to the connectors, by predetermined periods of time. In this case, the signal switch device is incorporated as a part of the double line electrode unit.

[0030] As this invention may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the claims.

[0031] According to its broadest aspect the invention relates to a double line electrode unit comprising: a pair of electrode plates (211, 212); a plurality of electrodes (211b, 212b; and a layer (213) that is sandwiched between the electrode plates.

[0032] It should be noted that the objects and advantages of the invention may be attained by means of any compatible combination(s) particularly pointed out in the items of the following summary of the invention.

SUMMARY OF THE INVENTION

[0033]

1. A double line electrode unit comprising:

   a pair of electrode plates (211, 212);
   a plurality of electrodes (211b, 212b), which are linearly arranged with prescribed intervals of distance (L) therebetween on surfaces of the electrode plates respectively and which are enclosed in insulating resin materials (211d, 212d) being solidified; and
   an insulating layer (213) that is sandwiched between the electrode plates, which are arranged opposite to each other such that the electrodes respectively arranged on the surfaces of the electrode plates face with each other by way of the insulating layer.

2. A double line electrode unit according to item 1 further comprising a plurality of connectors (211c, 212c) which are arranged on other surfaces of the electrode plates in connection with the plurality of electrodes respectively.

3. A double line electrode unit according to item 1 wherein the insulating resin materials contain fillers, which are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica.

4. A double line electrode unit according to item 1 wherein the insulating layer is made of FRP.

5. A double line electrode unit according to item 1 wherein each of the electrodes that are aligned on one surface of the electrode plate is formed in approximately a square shape whose side is approximately 30 μ m, so that the prescribed interval of distance by which two adjacent electrodes are arranged apart from each other is set to 60 μm.

6. An electro-coagulation printer comprising:

a rotation drum (10);
a print head (20) having a double line electrode unit (21) that are arranged slightly above the circumferential surface of the rotation drum with a gap and contains double lines of negative electrodes (211b, 212b) which are arranged by way of an insulating layer (213) having a prescribed thickness therebetween, wherein the negative electrodes are enclosed within insulating resin materials (211d, 212d) and are aligned with prescribed intervals of distance (L) therebetween;
an ink spray device (30) for spraying liquid ink (A) into the gap between the double line electrode unit and the circumferential surface of the rotation drum;
a removal device (60) for removing non-coagulated ink from the circumferential surface of the rotation drum on which the liquid ink is coagulated by selective and alternate electrification of the double lines of the negative electrodes in response to print data; and
a transfer device (70) for transferring coagulated ink remained on the circumferential surface of the rotation drum onto a print material (B).

7. An electro-coagulation printer according to item 6 wherein the insulating resin materials enclosing the negative electrodes contain fillers, which are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica.

8. An electro-coagulation printer according to item 6 wherein the insulating layer by which the double lines of the negative electrodes are arranged opposite to each other is made of FRP

9. A manufacturing method for manufacturing a double line electrode unit for use in an electro-coagulation printer, comprising the steps of:

forming a plurality of electrodes (211 b, 212b) on one surfaces of a pair of electrode plates (211, 212) respectively, wherein the electrodes are aligned with prescribed intervals of distance (L) therebetween;
filling and solidifying insulating resin materials (211d, 212d) into at least spaces between the electrodes, so that the electrodes are substantially embedded within the insulating resin materials being solidified; and
jointing together and consolidating the pair of the electrode plates by way of a prepreg (213) therebetween under heating and pressurizing conditions so that the electrodes arranged on one surfaces of the electrode plates are arranged opposite to each other by way of the prepreg, which is made by base material impregnated with unhardened resin.

10. A manufacturing method of the double line electrode unit according to item 9 further comprising the steps of:

after filling and solidifying the insulation resin materials on the electrodes, performing inspection such that electrification is made with respect to each of basic units of the electrodes to locate an electrification failure area on each of the electrode plates;
cutting and removing the basic unit of the electrodes corresponding to the electrification failure area from the electrode plate; and
unifying together a prescribed number of the basic units of the electrodes excluding the basic unit of the electrodes corresponding to the electrification failure area in the electrode plate.

11. A manufacturing method of the double line electrode unit according to item 9 wherein the insulating resin materials embedding the negative electrodes contain fillers, which are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica.

12. A manufacturing method of the double line electrode unit according to item 9 wherein the prepreg by which the double lines of the negative electrodes are arranged opposite to each other is made by fabric material such as glass fibers that is impregnated with unhardened resin.

Claims

1. A double line electrode unit comprising:

a pair of electrode plates (211, 212);
a plurality of electrodes (211b, 212b), which are linearly arranged with prescribed intervals of distance (L) therebetween on surfaces of the electrode plates respectively and which are enclosed in insulating resin materials (211d, 212d) being solidified; and
an insulating layer (213) that is sandwiched between the electrode plates, which are arranged

opposite to each other such that the electrodes respectively arranged on the surfaces of the electrode plates face with each other by way of the insulating layer.

2. A double line electrode unit according to claim 1 further comprising a plurality of connectors (211c, 212c) which are arranged on other surfaces of the electrode plates in connection with the plurality of electrodes respectively,

and/ or wherein preferably the insulating resin materials contain fillers, which are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica,

and/ or wherein preferably the insulating layer is made of FRP.

3. A double line electrode unit according to claim 1 wherein each of the electrodes that are aligned on one surface of the electrode plate is formed in approximately a square shape whose side is approximately 30 μm, so that the prescribed interval of distance by which two adjacent electrodes are arranged apart from each other is set to 60 μm.

4. An electro-coagulation printer comprising:

a rotation drum (10);
a print head (20) having a double line electrode unit (21) that are arranged slightly above the circumferential surface of the rotation drum with a gap and contains double lines of negative electrodes (211b, 212b) which are arranged by way of an insulating layer (213) having a prescribed thickness therebetween, wherein the negative electrodes are enclosed within insulating resin materials (211d, 212d) and are aligned with prescribed intervals of distance (L) therebetween;
an ink spray device (30) for spraying liquid ink (A) into the gap between the double line electrode unit and the circumferential surface of the rotation drum;
a removal device (60) for removing non-coagulated ink from the circumferential surface of the rotation drum on which the liquid ink is coagulated by selective and alternate electrification of the double lines of the negative electrodes in response to print data; and
a transfer device (70) for transferring coagulated ink remained on the circumferential surface of the rotation drum onto a print material (B).

5. An electro-coagulation printer according to claim 4 wherein the insulating resin materials enclosing the negative electrodes contain fillers, which are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica.

6. An electro-coagulation printer according to claim 4 wherein the insulating layer by which the double lines of the negative electrodes are arranged opposite to each other is made of FRP.

7. A manufacturing method for manufacturing a double line electrode unit for use in an electro-coagulation printer, comprising the steps of:

forming a plurality of electrodes (211b, 212b) on one surfaces of a pair of electrode plates (211, 212) respectively, wherein the electrodes are aligned with prescribed intervals of distance (L) therebetween;
filling and solidifying insulating resin materials (211d, 212d) into at least spaces between the electrodes, so that the electrodes are substantially embedded within the insulating resin materials being solidified; and
jointing together and consolidating the pair of the electrode plates by way of a prepreg (213) therebetween under heating and pressurizing conditions so that the electrodes arranged on one surfaces of the electrode plates are arranged opposite to each other by way of the prepreg, which is made by base material impregnated with unhardened resin.

8. A manufacturing method of the double line electrode unit according to claim 7 further comprising the steps of:

after filling and solidifying the insulation resin materials on the electrodes, performing inspection such that electrification is made with respect to each of basic units of the electrodes to locate an electrification failure area on each of the electrode plates;
cutting and removing the basic unit of the electrodes corresponding to the electrification failure area from the electrode plate; and
unifying together a prescribed number of the basic units of the electrodes excluding the basic unit of the electrodes corresponding to the electrification failure area in the electrode plate.

9. A manufacturing method of the double line electrode unit according to claim 7 wherein the insulating resin materials embedding the negative electrodes contain fillers, which are selected from among prescribed materials of boron nitride, aluminum nitride alumina and silica,

and/ or wherein preferably

the prepreg by which the double lines of the negative electrodes are arranged opposite to each other is made by fabric material such as glass fibers that is impregnated with unhardened resin.

10. A double line electrode unit comprising:

a pair of electrode plates (211, 212);
a plurality of electrodes (211b, 212b; and
a layer (213) that is sandwiched between the electrode plates.

FIG. 1

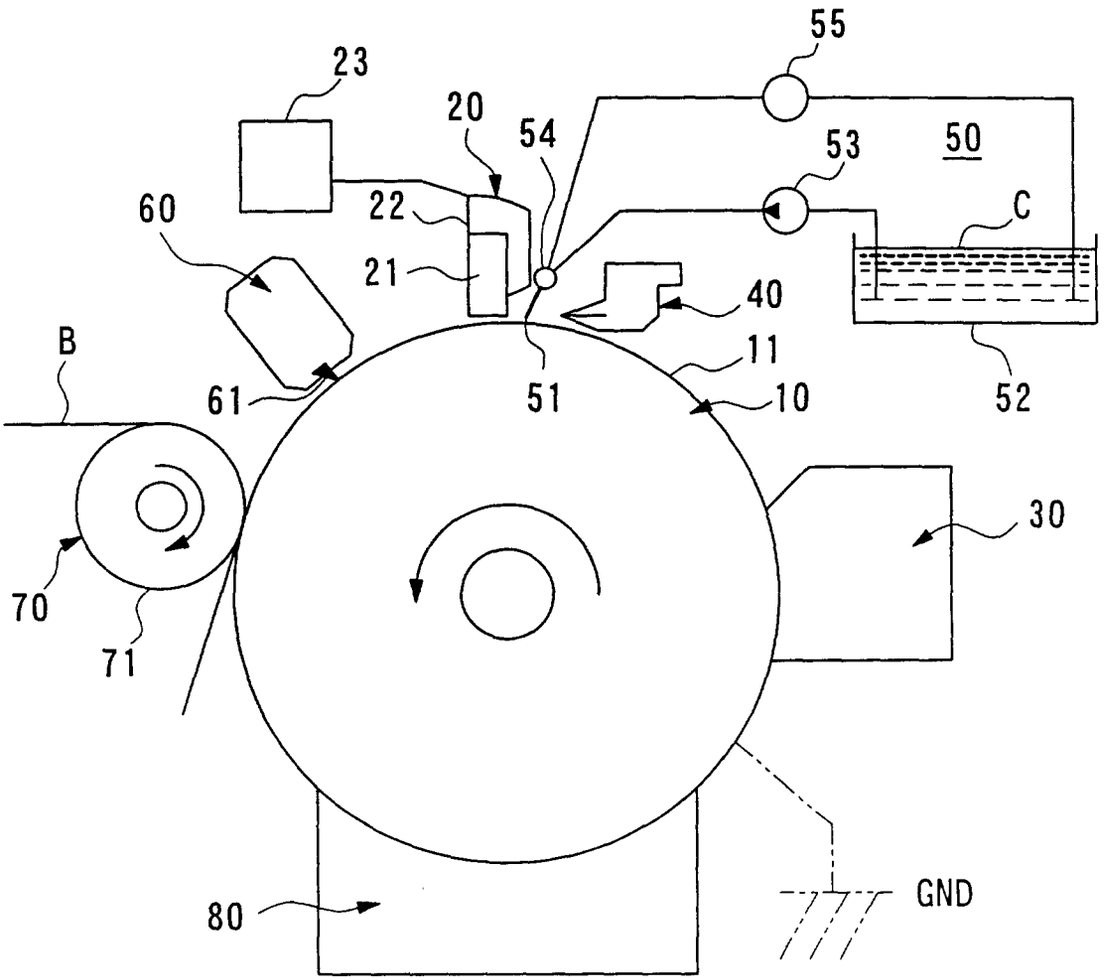


FIG. 2

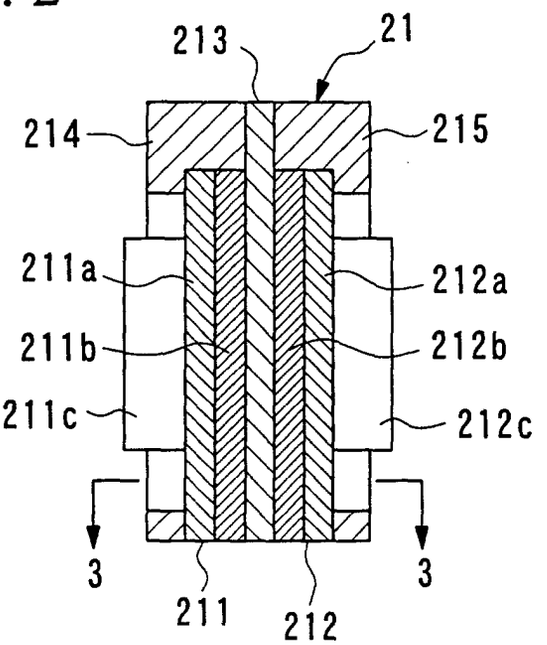

213
21
214
215
211a
212a
211b
212b
211c
212c
3
3
211
212

FIG. 3

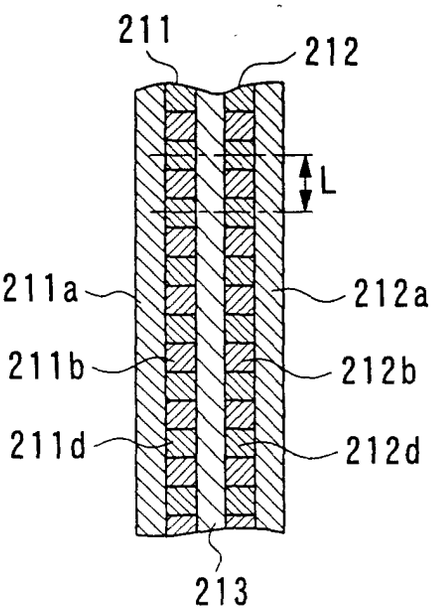

211
212
L
211a
212a
211b
212b
211d
212d
213

FIG. 4

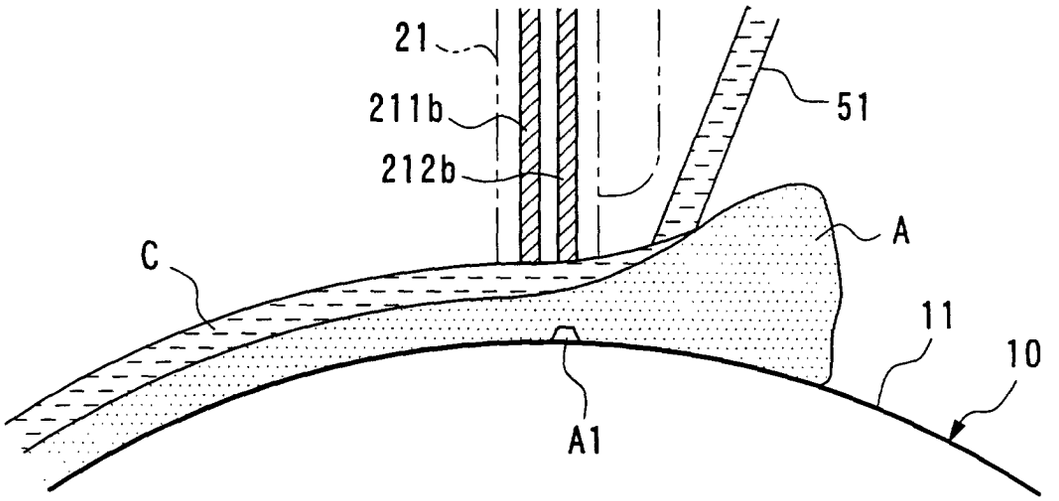


FIG. 5

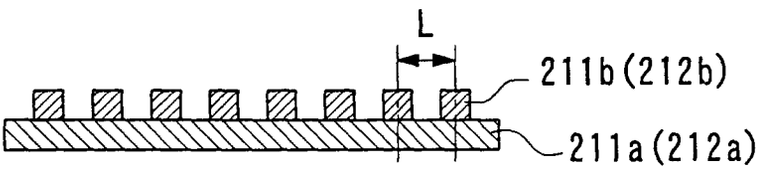


FIG. 6

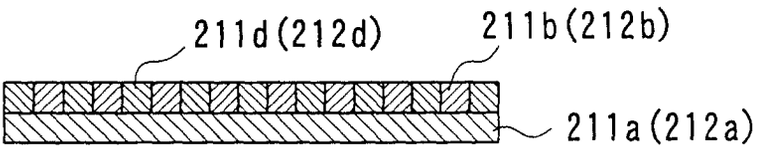


FIG. 7

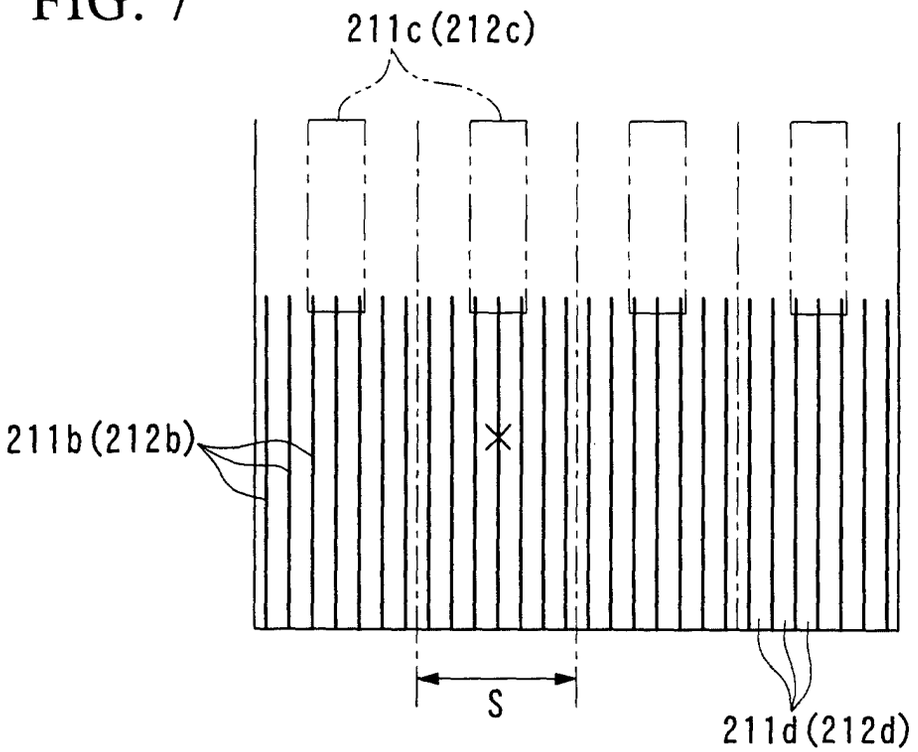


FIG. 8

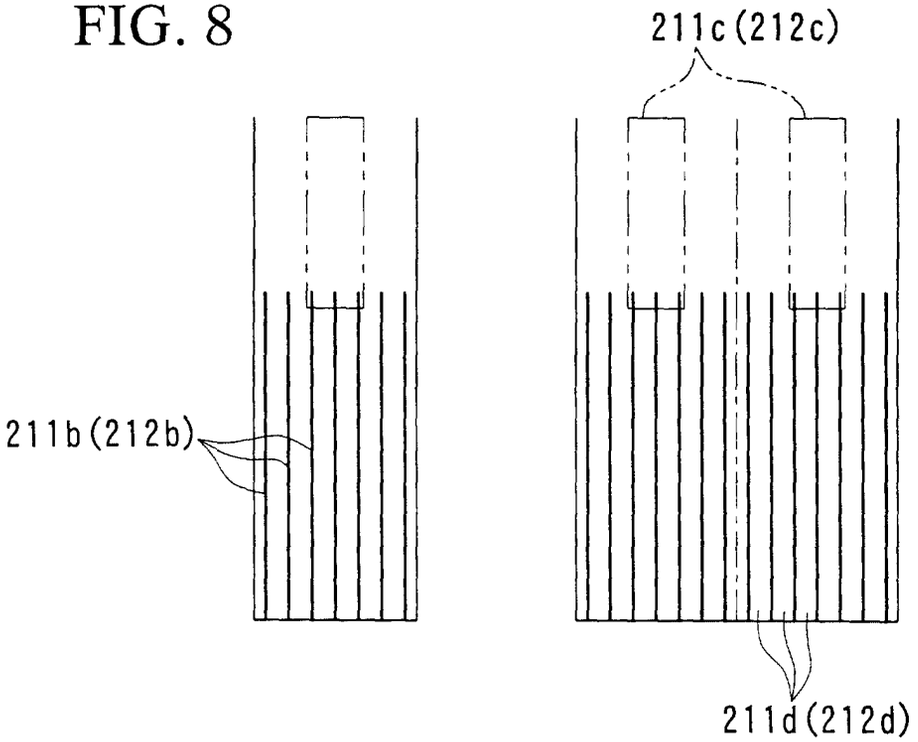


FIG. 9

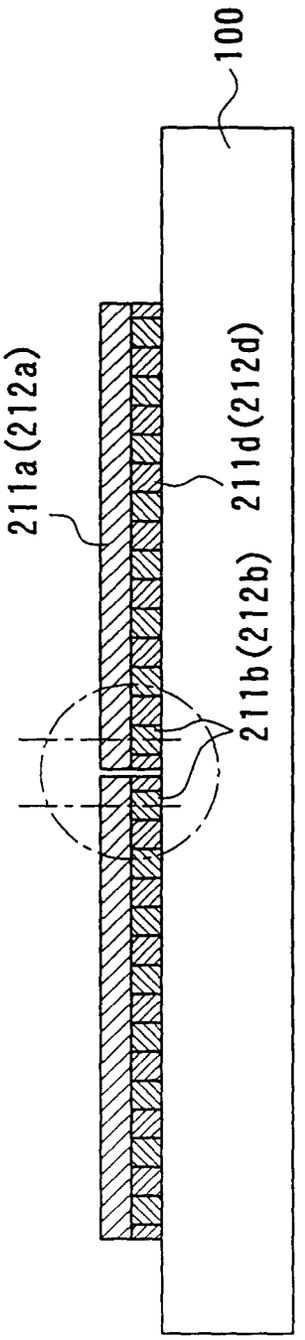

100
211a(212a)
211d(212d)
211b(212b)

FIG. 10

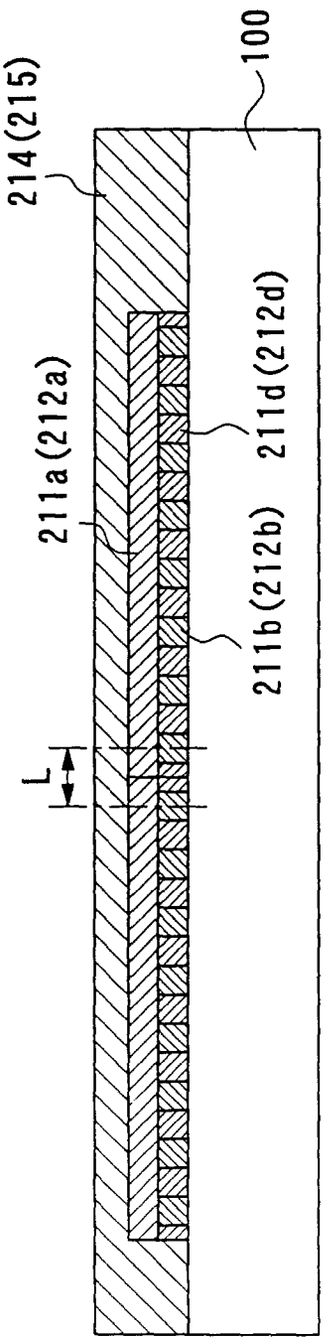

214(215)
100
211a(212a)
211d(212d)
211b(212b)
L

FIG. 11

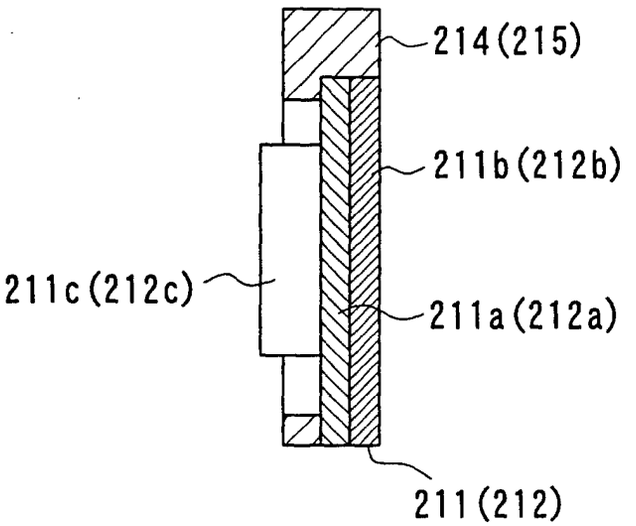
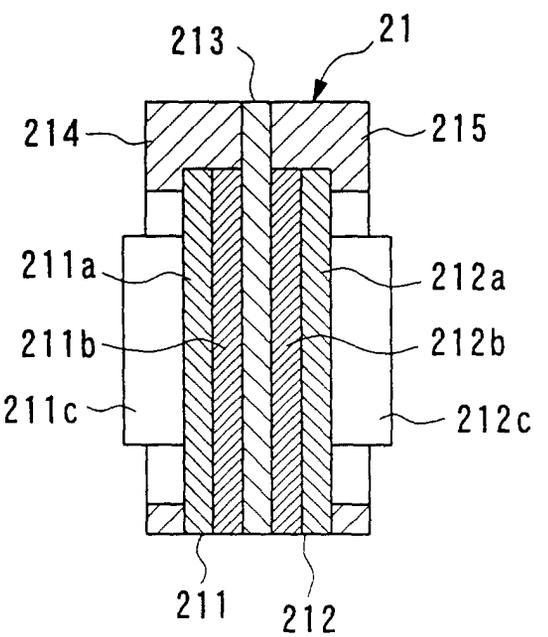

214(215)
211b(212b)
211c(212c)
211a(212a)
211(212)

FIG. 12


213
21
214
215
211a
212a
211b
212b
211c
212c
211
212