

[54] TANK FILLED WITH DEVELOPING LIQUID IN ELECTROPHOTOGRAPHIC APPARATUS

[72] Inventors: **Wilhelm Josef Knechtel**, 6301 Rodheim, Paulinen Str. 24, Rodheim; **Detlef Schaffer**, 6330 Wetzlar, Kornmarkt 6, Wetzlar, both of Germany

[22] Filed: **July 13, 1970**

[21] Appl. No.: **54,389**

[30] Foreign Application Priority Data

July 14, 1969 Germany.....P 19 35 615.1

[52] U.S. Cl.355/10, 95/89 R, 95/94 R, 117/37 LE

[51] Int. Cl.G03g 15/10

[58] Field of Search68/DIG. 5; 95/89, 94; 355/10; 34/115; 117/37 LE; 118/426

[56] References Cited

UNITED STATES PATENTS

3,467,975	9/1969	Fleissner.....	68/DIG. 5
3,123,500	3/1964	Bushway.....	118/426
3,367,791	2/1968	Lein.....	117/37 LE
3,543,543	12/1970	Fleissner.....	68/DIG. 5

2,940,288	6/1960	Walker.....	68/DIG. 5
3,412,474	11/1968	Fleissner.....	34/115
3,379,553	4/1968	Dowley.....	117/17.5
3,311,490	3/1967	Fausser et al.	117/37 LE
3,511,066	5/1970	Fleissner.....	68/DIG. 5
3,380,175	4/1968	Fleissner et al.	68/DIG. 5
2,348,355	5/1944	Miller.....	271/DIG. 2
3,307,457	3/1967	Hunstiger.....	355/10 X

FOREIGN PATENTS OR APPLICATIONS

1,153,098 5/1969 Great Britain.....355/10

Primary Examiner—John M. Horan

Assistant Examiner—Alan A. Mathews

Attorney—Watson, Leavenworth and Kelton

[57] ABSTRACT

Developing apparatus for electrophotographic use includes a tank containing developing liquid, a cylinder having an apertured sidewall supported for rotation in the tank and a propeller creating reduced pressure within the cylinder. Sheets bearing electrostatic images are attracted to the cylinder and maintained in contact with the apertured sidewall by suction. Upon development the sheets are peeled from the cylinder by fingers juxtaposed with reduced diameter sidewall areas.

7 Claims, 3 Drawing Figures

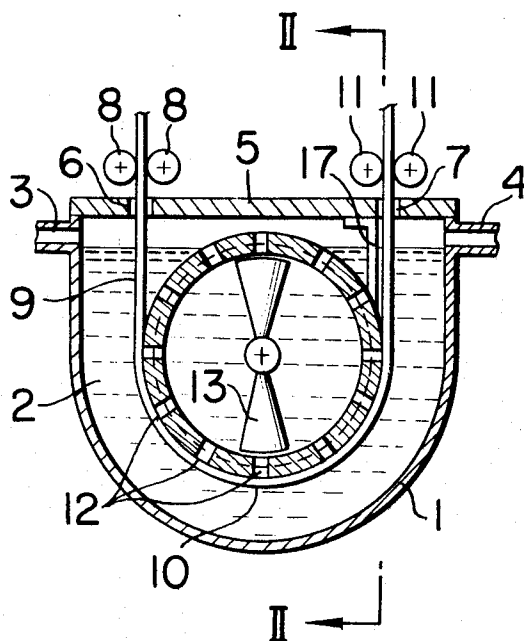


FIG. 1

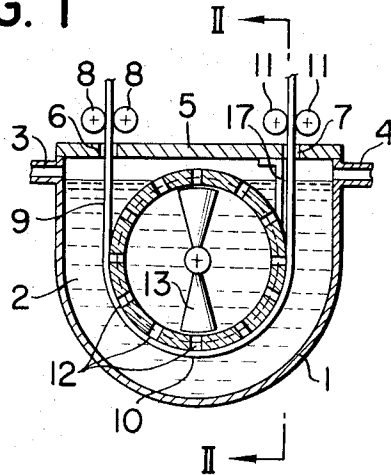


FIG. 2

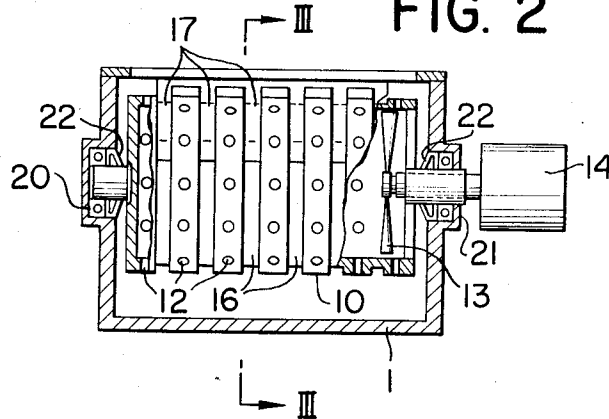
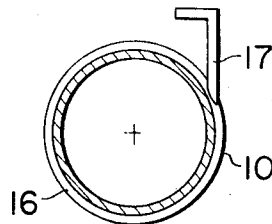


FIG. 3



TANK FILLED WITH DEVELOPING LIQUID IN ELECTROPHOTOGRAPHIC APPARATUS

FIELD OF THE INVENTION

This invention relates tank apparatus for the liquid development of electrostatic latent images.

DESCRIPTION OF THE PRIOR ART

Known tank apparatus comprises a flat dish, into which paper, foil or like material having a latent image formed thereon is introduced by guide means.

These tanks achieve their purposes completely, but are not adapted for use with a photocopying machine which must produce copies at a very high speed, requiring, on the one hand, that the electrostatic latent image stay in developing liquid for a predetermined minimum length of time so as to provide a good copy, while requiring on the other hand, that the copying paper having the latent image thereon pass through the developing liquid as fast as possible.

The latter requirement can be met by providing a sufficiently long path for the image-carrying paper in the liquid. However, this leads to a very large size for the tank. In addition, the long path in the liquid results in an inconvenience that transport rollers must be provided in the liquid when a larger size of copying paper such as standard format DIN A4 or a smaller size of copying paper such as format DIN A5 must be developed. These transport rollers disposed in the liquid may hamper the development of the latent image.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a tank through which both long and short sized copy paper can pass at high speed through a relatively long path in developing liquid.

Such object of the present invention can be achieved by a rotatable cylinder providing a sucking action within the tank so that paper sticks to the cylinder while passing through the liquid.

The cylinder is rotatable at high speed and moreover, it is incapable of damaging the paper. The cylinder directly holds both long and short sized copying paper and the diameter of the cylinder may be selected to provide a minimum length of time for developing an electrostatic latent image at a predetermined peripheral speed of the cylinder. The paper conveniently sticks at its reverse (non-image bearing) side to the cylinder.

In another arrangement according to the present invention, the cylinder comprises a hollow member having grooves formed circumferentially thereon, and a motor-driven propeller is provided within the cylinder or at one end thereof. When one end of the cylinder is closed, the solution is continuously drawn into and then forced out of the cylinder into a space surrounding the cylinder. The expelled liquid again passes through openings formed in the cylinder and resumes its flow. By the process of this flow, the paper is firmly attracted to the cylinder.

The propeller may be of a relatively large size so that it generates a great negative pressure within the cylinder and a great force of circulation at the same time. Such an output could not be attained, for exam-

ple, by a circulating pump disposed outwardly of the tank because it requires an inlet and an outlet pipe having an excessively large cross section.

This propeller also serves conveniently to form a supply means for compensating for the consumption of the developing liquid, since, as is typical concentrated developing liquid must be continuously supplied to the carrier liquid and of course the former must constantly be well mixed with the latter.

In still another arrangement according to the present invention, the cylinder is provided with external grooves for receiving comb teeth acting as copying paper separator means.

The invention will now be described by way of example with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view of a developing tank according to the present invention.

FIG. 2 is a cross-sectional view taken along line II—II of FIG. 1.

FIG. 3 is a cross-sectional view taken along line III—III of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A tank 1 is filled with developing liquid 2, which is supplied with carrier liquid through a pipe 3 and with concentrated developing liquid through a pipe 4, in accordance with the consumption of the developing liquid 2.

The lid 5 of the tank 1 is formed with two openings 6 and 7. Through the opening 6, a sheet member of paper 9 having an electrostatic latent image formed thereon is introduced by a pair of rollers 8. The sheet of paper 9 has the reverse (non-image bearing) side thereof sticking to a cylinder 10 as will be described, and then passes through the developing liquid 2, where the latent image on the sheet of paper is developed.

The paper leaves the developing liquid tank 1 through the opening 7 and moves to a drier or, if required, to a printer. The cylinder 10 is hollow and has an open axial end. Openings 12 are formed circumferentially in sections of the cylinder. A propeller 13 driven from a motor 14 is provided at the open end of the cylinder 10. The propeller 13 sucks liquid out of the cylinder and forces the liquid into a space surrounding the cylinder. Thus, the liquid passes through the openings 12 and again into the interior of the cylinder. The propeller 13 generates a relatively great negative pressure within the cylinder, whereby the sheet of paper 9 has its reverse side attracted to the cylinder. Thus, the paper can be passed through the liquid 2 relatively quickly.

The cylinder is shown to be provided with grooves 16 comprising cylinder sections of lesser diameter than the apertured cylinder sections, in which elongate comb teeth members 17 are fitted so as to separate the sheet of paper from the cylinder 10 and introduce it into the opening 7 after the paper has passed through the liquid.

The intense circulation of the liquid caused within the container 1 by the propeller 13 results in an advantage that when supplied through the pipe 4 the concentrated liquid is well mixed directly and immediately with the carrier liquid. The cylinder is journaled by

3

means of bearings 20 and 21. A packing ring 22 is provided to prevent the outflow of the liquid.

When the developing liquid tank is used with an electrophotographic apparatus utilizing the principle of electrostatic image formation, the cylinder is maintained at a constant potential or, if required, at zero potential, so that particles of developer, such as toner suspended in the liquid, may better and faster stick to the electrostatically charged surface area of the paper.

What is claimed is:

1. Apparatus for the liquid development of an electrostatic image-bearing sheet comprising:

- a. a tank containing developing liquid;
- b. a drum supported for rotation in said tank, the cylindrical surface of said drum including a first section providing for flow of said liquid between said tank and said drum and a second section of lesser diameter than said first section;
- c. means transporting said sheet through said tank in contacting relation with said drum surface including first means entering said sheet in said tank and second means providing reduced pressure within said drum thereby attracting said sheet to said drum surface and maintaining a contacting relation therebetween; and
- d. means removing said sheet from said drum surface including an elongate member having an end juxtaposed with said drum surface second section and engaging the leading edge of said sheet during rotation of said drum.

2. The apparatus claimed in claim 1 wherein said reduced pressure providing means comprises a propeller supported for rotation in said drum and propeller drive means.

3. Apparatus for the development of an electrostatic

4

image-bearing sheet comprising:

- a. a tank containing developing liquid;
- b. a drum supported for rotation in said tank, said drum having a hollow interior, the cylindrical surface of said drum having a first section incorporating apertures providing communication between said drum interior and said tank and a second section of lesser diameter than said first section;
- c. means transporting said sheet into said tank;
- d. means providing reduced pressure interiorly of said drum for drawing developing liquid through said drum surface first section and for providing contacting relation between said sheet and said drum surface; and
- e. means separating said sheet from said drum surface including an elongate member supported in said tank and having an end juxtaposed with said drum surface second section and engaging the leading edge of said sheet during rotation of said drum.

4. The apparatus claimed in claim 3 wherein said reduced pressure providing means comprises a propeller and a motor driving said propeller, said propeller being disposed interiorly of said drum.

5. The apparatus claimed in claim 3 wherein said drum surface comprises alternating ones of said first and second sections and wherein said sheet separating means comprises a plurality of said elongate members each extending intermediate a pair of said first sections.

6. The apparatus claimed in claim 3 wherein said drum surface is electrically conductive.

7. The apparatus claimed in claim 3 wherein said tank includes first and second intake ports respectively applying carrier solution and concentrated developing solution to said tank.

* * * * *

40

45

50

55

60

65

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,690,758 Dated September 12, 1972

Inventor(s) Wilhelm Josef Knechtel and Detlef Schaffer

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title page, item [72], after "Paulinen Str. 24," delete "Rodheim"; after "Kornmarkt 6," delete "Wetzlar".

Title page, insert--[73] Assignee: Canon Kabushiki Kaisha, Tokyo, Japan--

Column 1, line 6, after "relates" insert --to--.

Signed and sealed this 17th day of April 1973.

§
(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,690,758 Dated September 12, 1972

Inventor(s) Wilhelm Josef Knechtel and Detlef Schaffer

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Title page, item [72], after "Paulinen Str. 24," delete "Rodheim"; after "Kornmarkt 6," delete "Wetzlar".

Title page, insert--[73] Assignee: Canon Kabushiki Kaisha, Tokyo, Japan--

Column 1, line 6, after "relates" insert --to--.

Signed and sealed this 17th day of April 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents