

Komori et al.

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[54] **WET TYPE DEVELOPING APPARATUS**
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[58] **Field of Search**..... 95/89, 89 A, 89 L,
95/93, 94, 96; 355/10; 68/DIG. 5; 118/423,
426, 429, 418, 419

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Primary Examiner—John M. Horan

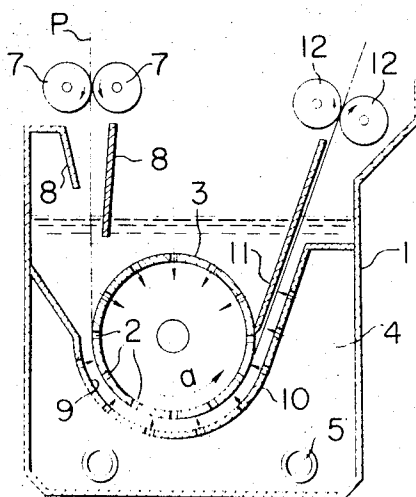
Assistant Examiner—Alan Mathews

Attorney—Joseph M. Fitzpatrick et al.

[57] **ABSTRACT**

An improved wet type developing apparatus which can accurately and positively develop a sheet or roll of copying paper at a high speed. The apparatus is provided with means for guiding the copying paper disposed within a reservoir for developer and adapted to attract and hold the copying paper thereto to thereby guide the same so that the copying paper may have the latent image thereon developed by a stream of sufficiently stirred developer providing a high developing effect. Subsequently, the copying paper held by the guide means can be readily released by the loss of attraction in the guide means or forcedly taken off the guide means by the developer flowing out of the guide means, whereby the discharge of the developed paper can be effected simply and positively without any undesirable deformation formed in the copying paper.

6 Claims, 6 Drawing Figures



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FIG. 3

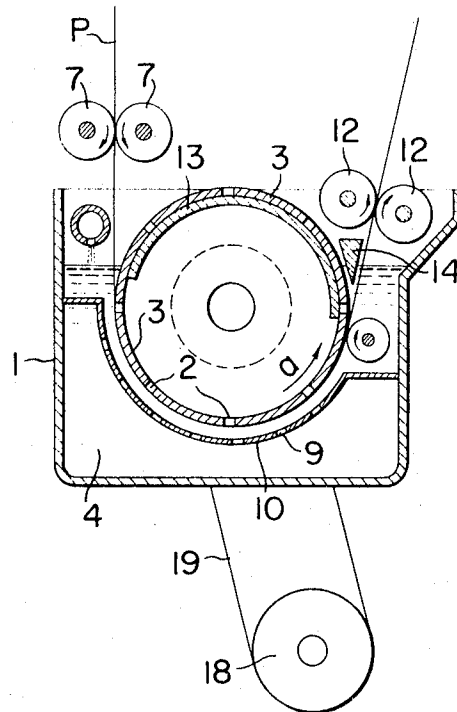


FIG. 4

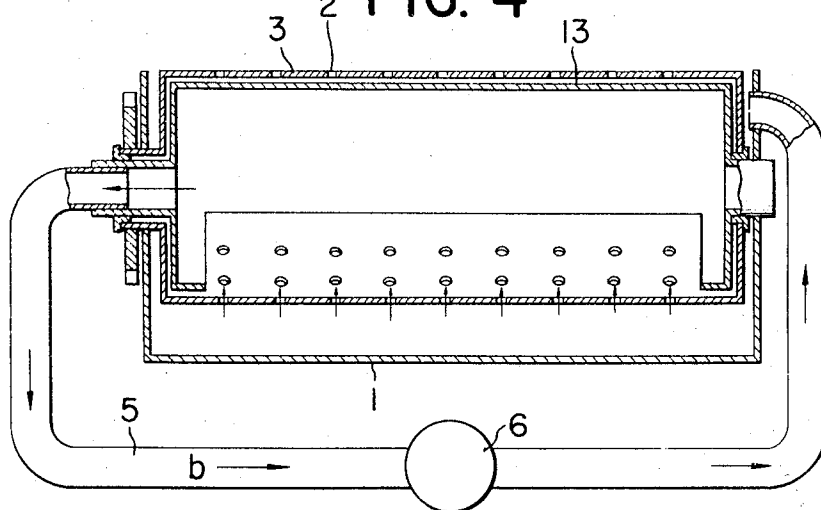


FIG. 5

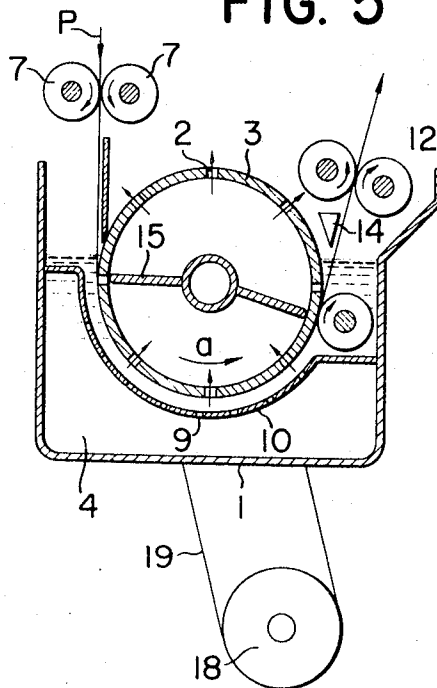
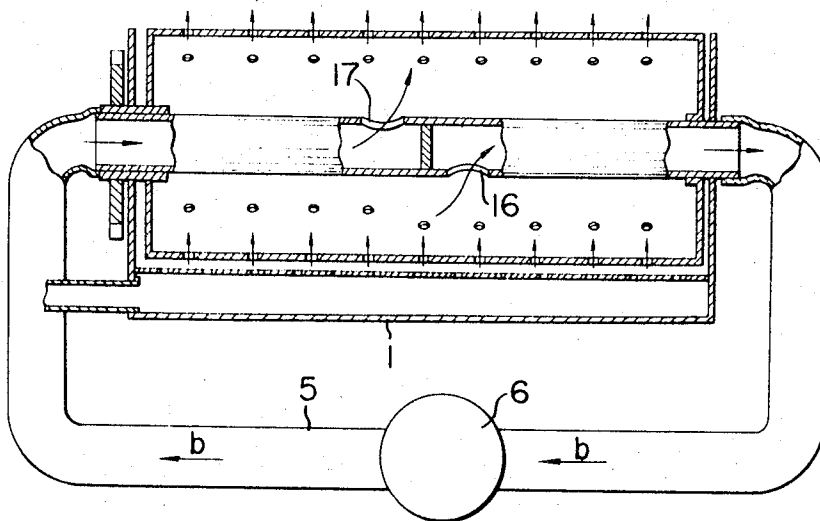


FIG. 6



WET TYPE DEVELOPING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to a developing apparatus, and more particularly to a wet type developing apparatus used with various types of copying machines.

2. Description of the Prior Art

In various types of copying machine such as electronic photocopying machine and diazo type copying machine, development is effected by the wet type process. The present invention consists in improvements relating particularly to the wet type developing apparatus for developing sheets of copying paper.

There are known various wet type developing apparatuses including those of bathing type, overflow type, roll type and so on. In the developing apparatus of bathing type or overflow type, if the developing solution is positively stirred to enhance the efficiency of development, a sheet of sensitive paper to be developed tends to be corrugated in the course of development process and engaged by the paper discharge means, thereby jamming up the interior of the developing apparatus. For this reason, the developing solution in such type of developing apparatus cannot be stirred beyond a certain degree. To compensate for such a limited degree of stirring, a sheet of sensitive paper must be bathed in the developing solution for a longer time, which in turn results not only in a lower speed of development but also in the inability to provide a compact structure of the developing apparatus. Insufficient stirring of the developing solution often results in the possibility of irregular or uneven development effect. In the known developing apparatus of roll type, a higher speed of development process has been achieved by the use of means for stirring the developing solution and as a result, the apparatus itself has been made compact to some degree, but the apparatus of this type has a disadvantage that the copying paper usable therewith is limited to that in the form of roll having a great length and no paper in sheet form cannot be used.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an improved wet type developing apparatus which can always ensure positive development process with a high efficiency and at a high speed.

It is a further object of the present invention to provide a wet type developing apparatus which is provided with means for positively holding and guiding copying paper in the form of sheet or roll disposed in a reservoir for developer, whereby the sheet or roll of copying paper can be developed positive at a high speed.

It is a still further object of the present invention to provide for a wet type developing apparatus which is provided with means for positively holding and guiding a sheet or roll of copying paper disposed in the reservoir for developer whereby the copying paper can be protected against any deformation resulting from stirred developer.

It is a still further object of the present invention to provide a wet type developing apparatus which is provided with guide means for attracting and holding a sheet or roll of copying paper thereto during the development process but losing the attraction upon completion of the development process to facilitate the release of the copying paper from the guide means.

It is a yet further object of the present invention to provide a wet type developing apparatus which is provided with means for attracting and holding a sheet or roll of paper thereto during development process but positively releasing or peeling the copying paper therefrom upon completion of the development.

According to the present invention, there is provided a wet type developing apparatus which can accurately and positively develop a sheet or roll of copying paper at a high speed. This can be accomplished by means for guiding the copying paper disposed within a reservoir for developing solution and adapted to attract and hold the copying paper with the aid of circulated developing solution thereby guiding the copying paper for development process. During the development process the copying paper attracted and held by the guide means can bring the surface thereof having a latent image thereof into contact with a stream of sufficiently stirred developer which provides a highly effective development. Upon completion of the development process, when it comes to discharge position, the copying paper so attracted to the guide means can be readily released by the guide means which now loses its own attraction or the paper is forced to be positively taken off the guide means by the developer flowing out of the guide means, whereby the copying paper can be discharged simply and positively from the developing apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal sectional view showing an example of the wet type developing apparatus provided according to the present invention;

FIG. 2 is a partly broken-away, transverse sectional view of the wet type developing apparatus shown in FIG. 1;

FIG. 3 is a longitudinal sectional view showing another example of the wet type developing apparatus provided according to the present invention;

FIG. 4 is a transverse sectional view of the wet type developing apparatus shown in FIG. 3;

FIG. 5 is a longitudinal sectional view showing a still another example of the wet type developing apparatus provided according to the present invention;

FIG. 6 is a transverse sectional view of the wet type developing apparatus shown in FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, a reservoir 1 containing therein a charge of developer includes a hollow cylindrical guide roll 3 for guiding a sheet or roll of copying paper P disposed therewithin. The hollow cylindrical guide roll 3 has one or more apertures 2 formed in the side wall thereof, and it is mounted for rotation in the direction as indicated by arrow *a* which is also the direction of movement of the copying paper P. The guide roll 3 is driven from a drive source 18 such as a motor through transmission means 19. A charge of developer 4 is circulated from the interior of the hollow cylinder forming the guide roll 3 through a developer circulating pipe 5 and a circulating pump 6 into the reservoir 1 and again into the interior of the guide roll 3, as shown by arrows *b* in FIG. 2. The copying paper P fed through a pair of feeding rolls 7 and paper guide plate 8 is attracted to the side wall of the guide roll 3 by the suction force provided by the developer flowing out through the apertures 2 formed in the side wall of the guide roll

fed through a pair of discharge rolls 12 into the subsequent fixing-drying process.

FIGS. 3 and 4 illustrate an improved modification of the above-described wet type developing apparatus. This embodiment includes a hollow cylinder forming a guide roll 3 provided within a reservoir 1 for guiding a sheet or roll of copying paper P. The guide roll 3 is formed with one or more apertures or channels 2 and mounted for rotation in the direction of arrow *a* which is also the direction of movement of the copying paper P. A charge of developer 4 is circulated from the interior of the hollow cylinder or guide roll 3 through a developer circulating pipe 5 and a circulating pump 6 into the reservoir 1 and again into the interior of the guide roll 3, as shown by arrows *b* in FIG. 4. The copying paper P is moved along the outer side wall of the guide roll 3 while being attracted thereto and subjected to development process. At this stage, the force attracting the copying paper P to the guide roll 3 is so great that the copying paper could not be separated for discharge from the outer wall surface of the guide roll 3 unless the take-off means is additionally provided as in the embodiment of FIGS. 1 and 2. To solve this problem, the embodiment of FIGS. 3 and 4 employs shield means covering the wall surface of the hollow guide roll 3 over a peripherally half portion thereof. In FIG. 3, such shield means is shown as a semicylindrical shield plate 13 closely attached to the inner wall surface of the hollow guide roll 3 over the peripherally half portion thereof. Thus, the copying paper subjected to the development process in the reservoir 1 can be readily released from the guide roll 3 without using any take-off means, and smoothly carried away along a discharge guide 14. At the same time the copying paper P can be transferred with such a good development effect maintained that the reproduced image thereon is marred in no way in the course of the transfer.

Description will now be made of a further embodiment of the present invention as shown in FIGS. 5 and 6. In the embodiment of FIGS. 3 and 4 described just above, one half of the side wall of the hollow guide roll 3 which is not covered by the shield means serves to attract and guide the copying paper for development while the other half of the side wall which is covered by the shield means acts to nullify the attraction with the

member. The communication openings 16 and 17 are located in diametrically opposite relationship with each other so as to communicate the two compartments of the tube with the lower and upper chambers of the hollow guide roll 3, respectively. The tube providing the aforementioned two compartments formed with communication openings 16 and 17 is connected at the opposite ends thereof to the circulating pipe 5 which is turn is connected to the circulating pump 6. Thus, the communication opening 16 provides an inlet and the other communication opening 17 provides an outlet, as shown in FIG. 6.

With this arrangement, the copying paper P fed into the developing apparatus is attracted and held closely by the lower half of the side wall of the rotating hollow guide roll 3 while being moved therewith, until it is released into separation from the guide roll 3 by the upper half of the side wall thereof. This separation of the paper sheet from the guide roll is accomplished because the developer in the upper chamber of the guide roll 3 is discharged into the reservoir 1 through the apertures 2 to provide a force to take off the paper. Thus, the copying paper P is now allowed to be positively transferred by discharge guide means 14 and rolls 12.

It will be readily appreciated from the foregoing description that the wet type developing apparatus of the present invention enables the copying paper fed into the reservoir to be positively attracted and held by the rotating guide roll while being guided therewith and subjected to development process, whereby the transfer of the copying paper can be effected smoothly without causing any jamming or undesirable deformation of the paper sheet which would result in unsatisfactory development effect or failure in the transfer of the paper sheet.

The force attracting the copying paper to the guide roll is so great that it is difficult for ordinary take-off means to take off the paper as it reaches the discharge portion in the reservoir, whereas according to the present invention the developer discharged out of the guide roll provides a sufficient force to readily and positively take off the paper as it comes to take-off position. Furthermore, the stream of the developer produced in the reservoir by the developer circulating means can be further stirred efficiently by the stirrer means provided

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in the reservoir, whereby the developing efficiency of the developer is highly enhanced. In addition, the stirrer means can also serve as an electrode which prevents the peripheral effect of the development. It will thus be apparent that the present invention results in great advantages such as highly enhanced efficiency of the development process and highly improved quality of image reproduction.

While the present invention has been shown and described in detail with respect to the illustrative embodiments thereof, it should be understood that the present invention is not limited thereto but that various changes and modifications in the details thereof may be possible without departing from the spirit and scope of the invention defined in the appended claims.

We claim:

1. A wet type developing apparatus for use in an electrophotographic copying device comprising reservoir means defining a reservoir containing liquid developer for visualizing a latent electrophotographic image, feed means for feeding a sheet of copying paper having a latent electrophotographic image defined thereon into said reservoir, a guide drum for guiding said copying paper through said developer, said guide drum being formed of a hollow cylinder having a plurality of through apertures, fixed partition means for dividing the interior of said hollow cylinder into upper and lower chambers, developer circulating means for circulating developer from said reservoir into said lower chamber through said apertures therein and further into said upper chamber through a developer communicating pipe and a developer pump so as to allow said developer to flow out of said upper chamber through said apertures whereby said copying paper is forced flat against the portion of said hollow cylinder adjacent said

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lower chamber and separated from said hollow cylinder adjacent said upper chamber, receiving means for receiving said copying paper separated from said upper chamber, and a drive source for driving said guide drum and said developer circulating means whereby said copying paper is passed through said reservoir without deformation.

2. A wet type developing apparatus for use in an electrophotography as defined in claim 1, wherein said hollow cylinder includes a shield means therein for blocking substantially half of the transverse holes provided in the peripheral wall of the hollow cylinder, one end of said shield means being located at the separating position of the copying paper for preventing suction of the developing liquid forced by the developer circulating means so that the copying paper is freed from being forced to contact on the peripheral surface of the hollow cylinder.

3. A wet type developing apparatus for use in an electrophotography as defined in claim 2, further comprising stirrer means for stirring the developer in said reservoir.

4. A wet type developing apparatus as defined in claim 1, wherein said take-off means comprises a take-off blade provided on the outer wall surface of said hollow cylinder.

5. A wet type developing apparatus as defined in claim 1, wherein said stirrer means also serves as an electrode for preventing peripheral effect arising during developing.

6. A wet type developing device as defined in claim 1, further comprising stirrer means for stirring the developer within said reservoir.

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